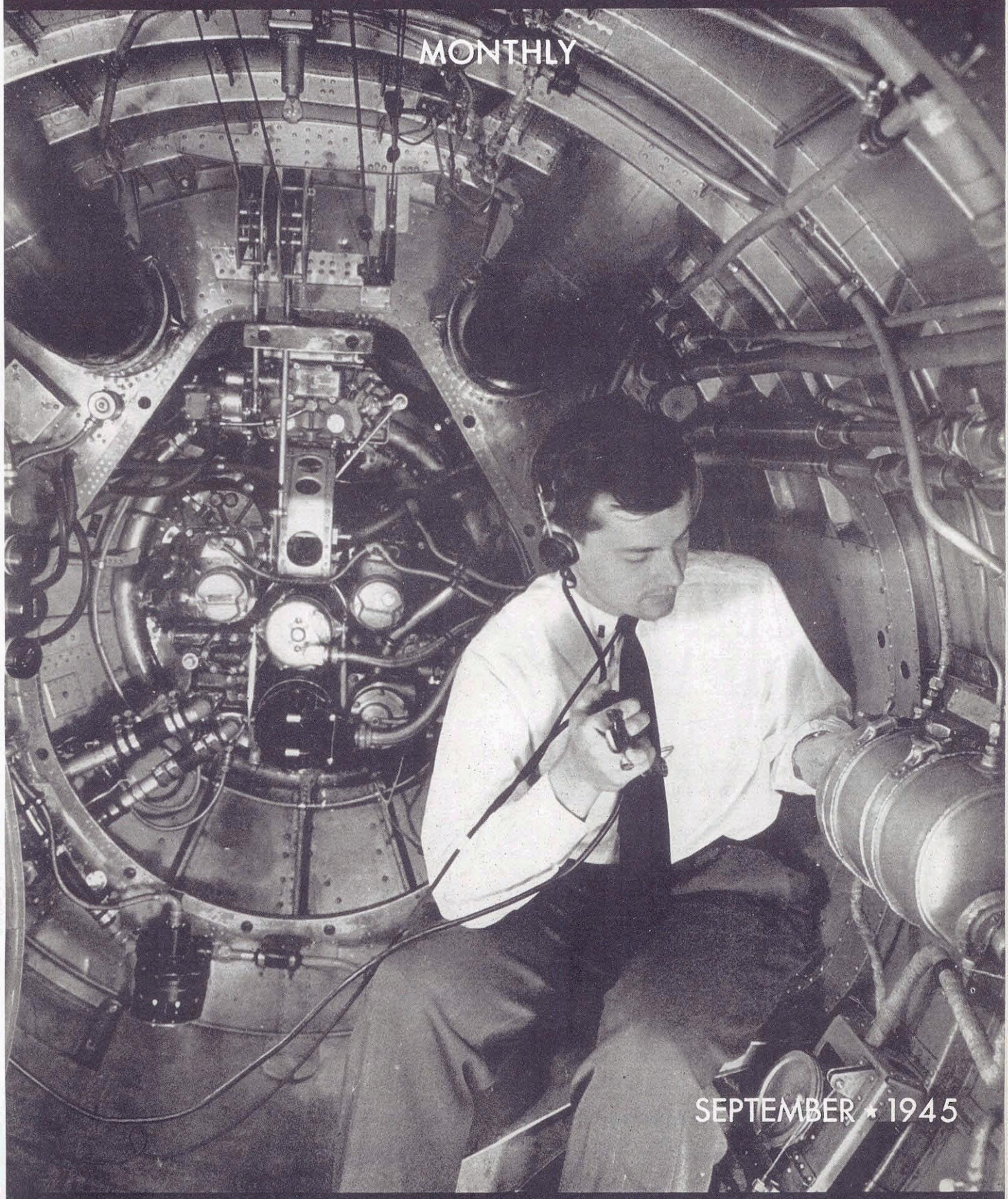
ENGINEERING AND SCIENCE

MONTHLY



SEPTEMBER • 1945

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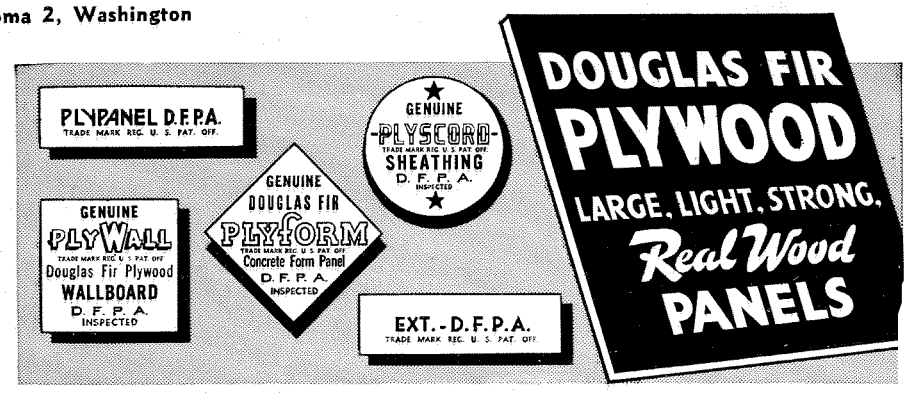

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BY-LINES

J. E. WALLACE STERLING

Dr. Sterling received his B.A. at the University of Toronto in 1927, M.A. at the University of Alberta, 1930, and Ph.D. at Stanford in 1938. Dr. Sterling is professor of modern history at the Institute and news analyst of the Columbia Broadcasting System. Prior to his work at the Institute, Dr. Sterling was on the research staff of the Hoover War Library, Stanford University, for five years.

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Walton A. Wickett attended California Institute of Technology from 1933 to 1935, transferring to Stanford where he received a B.A. degree in engineering. From 1941 to 1944 Mr. Wickett was associated with Pan American Airways; the latter year he served as assistant to the division engineer and operated the employees suggestion system. Since August, 1944, he has been with the University of California, engaged in physics research.

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RAY TEDRICK

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Caption for Cover Illustration: A flight engineer works inside No. 3 nacelle during flight operation, checking the prestone tank before reporting to the control deck via the interphone system. (See article, Turning Them Around, pages 7-11).

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ENGINEERING AND SCIENCE
Monthly
The Truth Shall Make You Free

CONTENTS FOR SEPTEMBER, 1945

ENGINEERING AND SCIENCE MONTHLY
Edited at California Institute of Technology

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ENGINEERING AND SCIENCE
Monthly

Vol. VIII, No. 9 September, 1945

The Month in Focus

TECHNICAL MANPOWER

AN EDITORIAL appeared in a June issue of the "Saturday Evening Post," pointing to a technological problem of a serious nature. This problem has to do with the effective creation of a shortage of technologists less than 30 years of age. Those who read these pages are undoubtedly cognizant of the scarcity of young engineers and scientists who should have been bringing into the field of technology the new life which is characteristic of youth.

In many cases, some of these younger men have been retained directly in the field of engineering or science for which they were trained by technological institutions. There is a large number, however, who have been required through selective service to enter the armed forces. One may argue that the armed forces as well as research and industrial organizations require the talent characteristic of men having engineering and scientific training. There would probably be somewhat less criticism of this policy of forcing a rather large number of individuals with this training into the armed forces if those individuals were given jobs commensurate with their training or in which their training could be fully utilized.

This country, being a democracy, may—and possibly rightfully so—take the attitude that professional standing should not place an individual in a special class which would be immune from regulations applied to all citizens of the country. All should be treated on an equal basis.

In the case of this war, we may ask has this been a rational approach to the solution of problems associated with a war which depends so much upon technological developments. During the past four years we have depleted the younger group of engineers and scientists. We find ourselves now, and shall find ourselves in the future, to have created a blank spot in our technological development. We may never replace the time lost. We will probably never know how much we may have slowed up scientific and engineering progress. One often hears that a war tends to accelerate technical developments. This is undoubtedly true, but will we have men who have been trained to carry on developments and to extend them over a period of several years following the end of the war?

The men of military age who have had scientific training have not been derelict in their duty or disinterested in joining the armed forces. It has been the older men who have recognized the situation and who have made every possible attempt to hold the young technically trained men in the field of engineering and science in order that that field might contribute its greatest effective and concerted action in technological development for the war effort. Let us hope that these older men have been able to retain a certain group of the younger men, and that the situation may not be as bad as it may appear to some. It is certainly a problem worth thinking about.

Now that the war has come to an end, young engineers and scientists will be needed for work on peacetime activities. Before many of these men can be utilized most effectively, they will require a certain amount of refreshing in their respective fields. None can tell precisely what the demands for trained technical men will be, but the demand probably will be high since very little successful recruiting has been done by industry in the past three or four years.

UNION PROBLEMS

In the past, engineers and scientists have not been particularly concerned or involved in labor union activities, except through their general interest as citizens of the country. Recently there have been efforts by some engineering groups to organize into what might be termed unions or professional organizations for the principal purpose of creating bargaining agencies. To many, it appears that the creation of such organizations has been made necessary for their own protection, by certain actions taken by existing labor unions.

One cannot help but note the attitude of some sections of the labor unions which comes very close to that of despotism. A union is supposed to be organized for the benefit of its members and to be controlled by the membership and to act in accordance with the wishes of that membership.

(Continued on Page 14)

The United Nations Conference

By J. E. WALLACE STERLING

THE United Nations Conference on International Organization opened in San Francisco on Wednesday, April 25, 1945. It was an historic moment. For the second time in a generation world statesmen had come together to organize as well as they could an international body which should operate to preserve peace and promote prosperity. As they met, Europe was still shaking from the bombs and shells of history's greatest war. The Allies had just begun their last great offensive against what was left of Hitler's arrogant Reich. In the Pacific the Allied blockade had been drawn so tight around Japan that she was being slowly strangled into military defeat. B-29's were demolishing her war factories; submarines, aircraft, and mines continued to take heavy toll of her diminishing shipping; and American troops on Okinawa were wresting from some of her finest troops the all-important advance base from which invasion of the Japanese home islands could be staged.

These stupendous events on the world's battlefronts, representing as they did the near culmination of five and one-half years of war, lent a particular urgency and seriousness to the task to which the San Francisco Conference addressed itself. Yet at the same time there was a touch of the unreal about the labors of men who strove early and late by the manipulation of words and phrases to insure the end of aggressive war. In essence the men at San Francisco were trying to make good an opportunity which had been won for them and the world by victorious Allied forces, millions of whom had died. That was the setting. San Francisco did what it could to make the beginning auspicious, for it braced the representatives with clear, crisp and sunny weather.

It is a matter of record that the decision to hold the United Nations Conference in San Francisco was made at the Yalta Conference early last February. It followed that because the United States thus became the host country, the State Department should have to make arrangements for the housing and staffing of this historical meeting. But pressure of work flowing from the Yalta decisions and the Conference in Mexico City delayed the detailed planning for the meeting in San Francisco. It was, in fact, late in March before much action was taken. Then State Department officials moved to San Francisco to make the necessary arrangements. In the Veterans War Memorial Building and the Opera House in San Francisco's Civic Center they found attractive and commodious facilities for the housing of the Conference proper. Committee meetings were held in the former, plenary sessions in the latter building. In the Veterans Building accommodations were also arranged for press and radio, post office, express and banking facilities, and a cigarette and candy counter which provided a well-patronized oasis in a desert of shortages.

These same State Department officials were likewise concerned to insure adequate hotel accommodations for the Conference delegates and their staffs. Some 50 hotels were made use of, and of these a dozen were the main centers. From these latter regular and free transportation service to the Civic Center was provided by Navy buses. Delegates and advisors were also transported hither and yon by special Army cars and a few limousines provided by interested San Franciscans.

While these arrangements were being made in San Francisco, the organization of the Conference was being planned in Washington. For this, the State Department had behind it the experience of the inter-war period during which many great international conferences were held; more recently, there were the conferences at Bretton Woods, Dumbarton Oaks, and Mexico City. And for the San Francisco Conference an agenda was already at hand in the Dumbarton Oaks Proposals.

CONFERENCE ORGANIZATION

Some knowledge of the organization of the San Francisco Conference is helpful to an understanding of how it operated. What might be called the sovereign body of the Conference was the plenary session where delegates of all states were represented and met on a basis of legal equality. Manifestly this body with up to 50 delegations represented was too large for the efficient conducting of business. Therefore, it was broken up into commissions and committees. There were four commissions. Commission 1 had to do with Principles and Purposes of the organization to be created, Commission 2 with matters concerning the General Assembly, Commission 3 with provisions concerning the Security Council, and Commission 4 with matters concerning the new World Court. Each of these commissions was in turn divided into technical committees of which there were 12 in all.

In addition to these technical committees there were others. There was a steering committee composed of the heads of all delegations. This was really the clearing-house of the Conference where items of procedure and thorny substantive matters were first threshed out. But even it was a large committee, so a smaller one, an Executive Committee of 14, was set up to give direction and energy to the proceedings. On this executive committee the Big Five Powers were represented and nine of the smaller nations were selected with an eye to geographical representation: three from Latin America, three from Europe, Canada and Australia respectively (from North America and the Southwest Pacific), and Iran (from the Middle East).

There was, too, a Credentials Committee whose task it was to make sure that all delegates were properly accredited and that the delegates who ultimately signed the Charter for their respective governments were fully empowered to do so. And every conference has to have its Coordination Committee in order that the work of all the technical committees may be fitted together into a complete and flawless whole.

An account of the Conference organization would be incomplete if it did not include something about the International Secretariate. There was, of course, a Secretary General of the Conference whose office did the chores for the Steering and Executive Committees. But the International Secretariate was exactly what its name implies. Its personnel was procured from many nations. Its responsibilities were to no particular country but to the Conference as a whole. It prepared the agenda for each meeting of every committee and commission. It kept the records of all these meetings and in the end prepared the final text of the Charter. The load of work carried by its staff was tremendous. The decision of the

Conference to have five official languages—English, French, Spanish, Russian and Chinese—meant that records had to be kept in all these tongues. The task of doing so and at the same time keeping abreast of Conference progress entailed work 24 hours a day, seven days a week. Some idea of the paperwork that all this involved may be gathered from the fact that in the nine weeks of the Conference the Documents Section of the International Secretariate used 30 million sheets or 100 tons of paper. An average day's work consumed about a half-million sheets; the record days' consumption was one million, six hundred thousand.

PERSONALITIES

All of this may seem a little drab, although the readers of this magazine should not be disinterested in machinery even though it does concern a Conference. The color was provided of course by dramatic episodes of the plenary sessions, but most particularly by the Conference personalities. In the early days of the Conference, the delegates who attracted most attention from an avidly curious public were the Saudi Arabians, Foreign Commissar Molotov, and Foreign Secretary Eden. About the Saudi Arabians there was an air of romance and adventure. On one occasion as some of them strolled through the crowded lobby of their hotel, a susceptible woman exclaimed: "What strange and handsome creatures," whereupon one of these creatures replied with a broad wink and in good English, "Really, Madam, you should see us on horseback." About Mr. Molotov there was an air of mystery. Many of those who came to gape did so as if to ascertain whether he was man or beast. Wherever he went he was proceeded, surrounded indeed, by a flying wedge of protectors reminiscent of football at the turn of the century and accompanied by his interpreter. About Mr. Eden there was an air of old world charm. He achieved sartorial distinction without effort and made friends and influenced people by a ready smile and an alert mind. There was no one in the United States delegation that could compete in romance, mystery, and glamour with these men from foreign lands, but in terms of ability and effectiveness Senator Vandenburg and Commander Stassen were in the front rank.

Perhaps some mention should be made of Dr. Herbert Evatt, Australian Minister of External Affairs. Stockily built, his large head resting almost directly on broad shoulders, his clothes looking very much as if he slept in them, which he may well have done, his hair closely cropped and rebellious to comb and brush, his ready speech in the Australian version of a Cockney accent—all these characteristics seemed to endear him to the public. And very soon it was recognized that his energy, boldness and ability were to make him one of the strong men of the Conference and the outstanding champion of the smaller nations.

There were distinguished personalities too among the representatives of radio and press: Walter Lippman, poised, confident, and well connected; Raymond Swing, intense, well informed, and displaying even at breakfast more of an appetite for news than for food; and Walter Winchell, brash, breezy, and sizing up San Francisco and its Conference through his accustomed keyhole. During the first 10 days of the Conference, when it passed through its exhibitionist stage, there were almost two thousand representatives of press and radio on the scene. But when the Conference in its second week got down to hard work not more than five hundred remained. Among those who left were many distinguished columnists and commentators like Lippman and Swing, but the general exodus was comprised of the sort of which Winchell and, I may add, Hedda Hopper and Gracie Allen were representative.

CHARTER DRAFTING

As already indicated the agenda for the San Francisco Conference was the Dumbarton Oaks Proposals. For six months these Proposals had been the subject of public discussion and examination. All the countries represented at San Francisco had had ample opportunity to study them and prepare amendments. The text of the Proposals can be set down in about eight pages. The amendments submitted at San Francisco filled about seven hundred pages. The initial task of the Conference committees, therefore, was to sift these recommendations for duplication and then to sort out those retained in such a way that each could find its way into the appropriate technical committee. When this had been done, the technical committees serving the four commissions as set forth above set to work to draft the Charter. All these committee meetings were closed. The public learned of what transpired therein through press conferences and through the time-honored practice of buttonholing committee members, some of whom saw fit to exchange "confidences" with friendly reporters.

THE VETO ISSUE

There is not space here to discuss in detail the provisions of the Charter which was finally signed on June 26. I may point out, however, a few of the most difficult problems that engaged Conference attention. The biggest of these concerned the veto power claimed by the Big Five. The attack on the veto was led by Dr. Evatt. Speaking for the smaller powers, he was willing to concede that the Big Five should have a veto over any enforcement action considered necessary to prevent or check aggressive war. He was not willing to concede, however, that the Big Five Powers should enjoy the right to veto the discussion of a dispute considered likely to result in war, or the right to veto a thorough investigation of such a dispute. In the end the smaller nations won their point with regard to freedom of discussion but they were obliged to accept the right of any of the Big Five, who was not party to the dispute in question, to veto the investigation of said dispute. The Great Powers felt that when a dispute had reached the stage where investigation was considered necessary, it had already reached a stage where enforcement action had to be seriously contemplated. It was on this basis that the problem of veto was tentatively solved. The smaller powers, even though they disliked the veto power, recognized that they had to accept it if there was to be a Charter at all.

Smaller powers made another gain along this same line. The Security Council of the new World Organization is to be made up of representatives of the Big Five nations plus representatives of nine of the smaller nations. Membership of the former is to be permanent; that of the latter non-permanent. The smaller nations succeeded in having written into the Charter the provision that the non-permanent members of the Council shall be elected by the General Assembly with "due regard being especially paid, in the first instance, to the contribution of Members of the United Nations to the maintenance of international peace and security and to the other purposes of the Organization, and also to equitable geographical distribution." This means that countries, sometimes called the Middle Powers, like Australia, Belgium, Canada, and the Netherlands who already have demonstrated a considerable war potential, shall have a greater

say in the Security Council than countries like Guatemala and Liberia, and that only after consideration has been given to the war potential of all countries shall the non-permanent members of the Security Council be elected with an eye to equitable geographical distribution. Further, the smaller powers, led by Canada and the Netherlands, insisted that whenever the Security Council considers the application of force against an aggressor, the nation whose troops are to be called into action shall have a voice in the deliberations of the Council whether or not it had at the moment representation thereon. This is in effect the principle of no military taxation without representation.

TRUSTEESHIP

The problem of trusteeship loomed large in San Francisco. Treatment of non-self-governing peoples had not been mentioned in the Dumbarton Oaks Proposals. It had been given preliminary consideration, however, by officials of several governments before the San Francisco Conference opened. Three categories of territory were brought under consideration: (1) Territories mandated at the end of the last war. (2) Territories to be detached from enemy powers at the conclusion of this war. (3) Dependent territories within existing empires. There is general agreement that the government which finds itself in charge of any of these territories has a prime responsibility to respect the culture of the peoples concerned, to protect them against abuses, and to lend them every assistance and encouragement in achieving eventual self-government. But it remains a matter for subsequent agreement as to which territories in the foregoing categories will be brought under the trusteeship system and upon what terms. This needs some further explanation.

Dependent territories at present within existing empires will not be placed under the trusteeship system except by voluntary acts of the imperial power. This would apply, for instance, to Kenya and French Indo-China, which would not be brought under the trusteeship system except by decision of the British and French governments respectively. As for territories within categories 1 and 2, presumably they will be placed under the trusteeship system in the very near future, that is to say as soon as the international organization becomes an established fact. It remains to be decided, however, what power will be assigned the task of administering these areas on behalf of the Trusteeship Council, an agency of the new International Organization. Some of these territories, such as Okinawa, or parts of them, will be designated as strategic areas. All functions of the United Nations relating to strategic areas are to be exercised by the Security Council and not by the General Assembly as in the case of non-strategic areas. This is important for it means that the Big Five will be in a position to determine what areas are to be strategic and how those strategic areas are to be developed. In this way, the trusteeship system, with its prime purpose of aiding the development of native peoples, becomes at the same time a part of the whole Security system.

REGIONALISM

The Conference also labored long and hard on the issue of regionalism. The Dumbarton Oaks Proposals had recommended that existing regional organizations, like the Pan-American Union, should be made use of within the general framework of an international body. The question was to determine what place such regional groups were to occupy. Quite early in the Conference the American delegation stated strongly its belief that the world organization should be paramount, that under no consideration should it be permitted to become a dog wagged by a regional tail. It was finally agreed that the settlement of local disputes through regional arrangements or agencies should be encouraged, but that enforcement action should be not taken by regional agencies without the authorization of the Security Council. Nothing in the Charter impairs, however, the inherent right of any state or group of states to defend itself until such time as the Security Council has taken measures necessary to insure security.

There is another aspect of this on which I might comment briefly. France and Russia have a 20-year alliance. Its purpose is to provide for combined force against possible future German aggression. These two countries were anxious to have their alliance become operative, should the occasion arise, without the necessity of gaining authorization from the Security Council. They feared that the delay which such authorization might entail would prove fatal. Accordingly the Charter provides that any regional arrangements directed specifically against enemy states of this war may become operative without prior authorization from the Security Council.

One of the great improvements of the new Charter over the League Covenant has to do with economic and social matters. As Field Marshal Smuts repeatedly emphasized in San Francisco the men who made the peace at the end of the last war were concerned mainly with political matters. The experience of the intervening years has served to underline the importance of removing social and economic inequalities and abuses, for it is in these that the roots of war are nourished. To the end, then, that a more determined effort should be made to remove the causes of war, an Economic and Social Council is to be established under the auspices of the General Assembly. Its assignment is comprehensive and, being couched in broad terms, a little vague. But under the inspiration and direction of determined and forward-looking men the studies it initiates on economic and social matters and the recommendations it makes on the basis of these studies may yet prove to be among the most effective advances made by mankind in its long crusade against war.

APPRAISAL

The statesmen of from 44 to 50 nations spent nine weeks drafting the Charter. I have spent but a few pages touching, but lightly, on a few of the more interesting and stubborn problems with which they were confronted. There is much in the Charter worthy of further study. As it stands it is an imperfect document. Much of its strength comes from the realization that it is imperfect. Indeed, the tenor of every speech made at the closing sessions of the Conference, whether on behalf of a great or a small power, admitted these imperfections. Every speech then made also expressed recognition of the fact that it was the best Charter that could be drawn at this period of world history. Every speech expressed also a determination to apply steady effort to eliminate the imperfections and improve the Charter through the passing years.

The responsibility for making the Charter work rests heavily on the Big Five Nations. As theirs is the power, so theirs is the responsibility. If they fall out among themselves, the predictable result is another world war. If they stick together in applying the principles of the Charter the world is truly on the threshold of a new era of peace and prosperity. Among these great powers

(Continued on Page 16)

Part of Pan American Airways' Pacific fleet.

TURNING THEM AROUND

By WALTON A. WICKETT, R. A. TEDRICK, AND STANLEY MOY*

THE AIR AGE

ACCORDING to current literature, we are now in the Air Age. Certainly there are few people today whose personal lives are not in some way affected, directly or indirectly, by air transportation. Furthermore, one need but read the newspaper headlines and thumb through the aviation magazines to become aware that our dependence on this form of travel is steadily increasing.

Significant, too, are manifold new developments and technical improvements. Thirty-five-hundred-horsepower engines, commercial airplanes that will weigh 300,000 pounds or more and fly in excess of 300 miles per hour at an elevation of 30,000 feet, luxury airliners capable of carrying 200 or more passengers in super-charged cabins wider than a Pullman (three seats on each side of the aisle instead of two), with berths and staterooms, as desired, at a cost of four cents or less per passenger mile—all of these the manufacturers are now not only designing but have started producing in some cases, and all are typical of the equipment U. S. airlines will utilize with the advent of peace. Every detail from now-secret radio-navigation aids to windows made of two thicknesses of polaroid glass that will never fog and can be adjusted to admit just the right amount of light will be provided. Plans for cargo carriers are just as elaborate.

Concurrently, to serve their own interests as well as to keep in step with the activities of manufacturers, operating organizations have been equally busy. Already the Civil Aeronautics Board has before it several hundred applications to increase the domestic route mileage of United States airlines from a present approximate total of 60,000 miles to more than 500,000 miles. The majority of these applications, intended to provide air transportation service to every city in the nation with a population of 25,000 or more, have been submitted by existing airlines and established surface carriers, such as the Greyhound Corporation, which applied to fly some 50,000 miles of helicopter feeder routes, supplementing its bus service and tying in with the major airlines. However, other interests, including the private citizen, also have made applications.

*This article appears jointly in ENGINEERING AND SCIENCE MONTHLY and STANFORD ALUMNI REVIEW by request of the authors.

THE COMMERCIAL AIRLINE

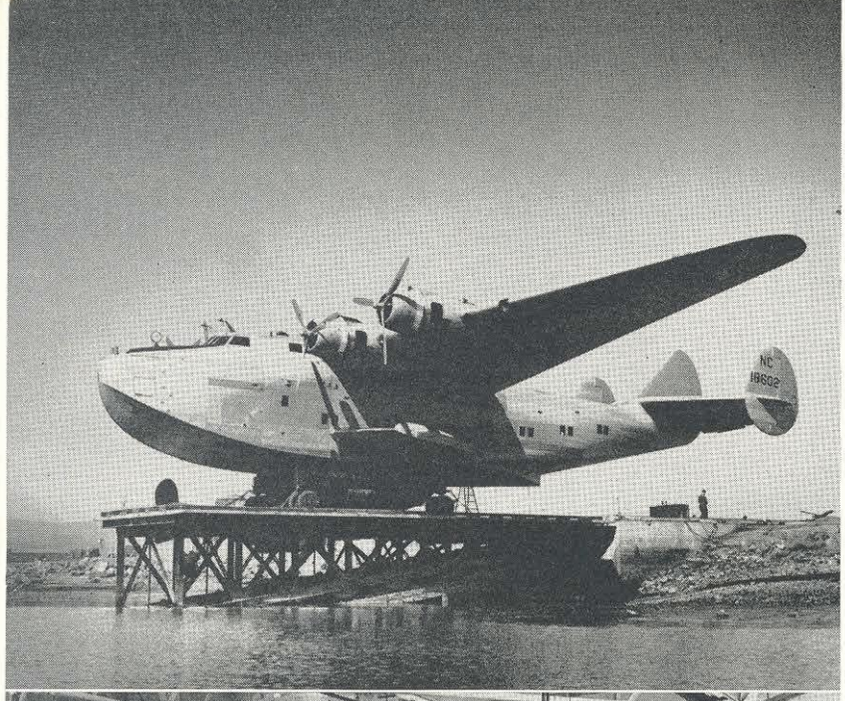
At the present time, successful commercial air carrier operation is a very complex activity. So that the reader may gain some idea of this complexity, let us consider a few of the problems facing an individual or group of individuals desiring to establish and operate an airline as a practical business venture. For the sake of brevity, we shall assume that our would-be airline operator already has obtained the necessary capital, qualified personnel, certificated air-borne equipment, and adequate ground equipment and facilities. Also that he has been granted a route certificate and, if his case is a good one, a mail contract by the Civil Aeronautics Board. Now the operator must make the airline, figuratively and realistically speaking, fly. To accomplish this, he must resolve such general problems as administration, accounting, purchasing, public and industrial relations, all more or less characteristic of any business, plus four special considerations:

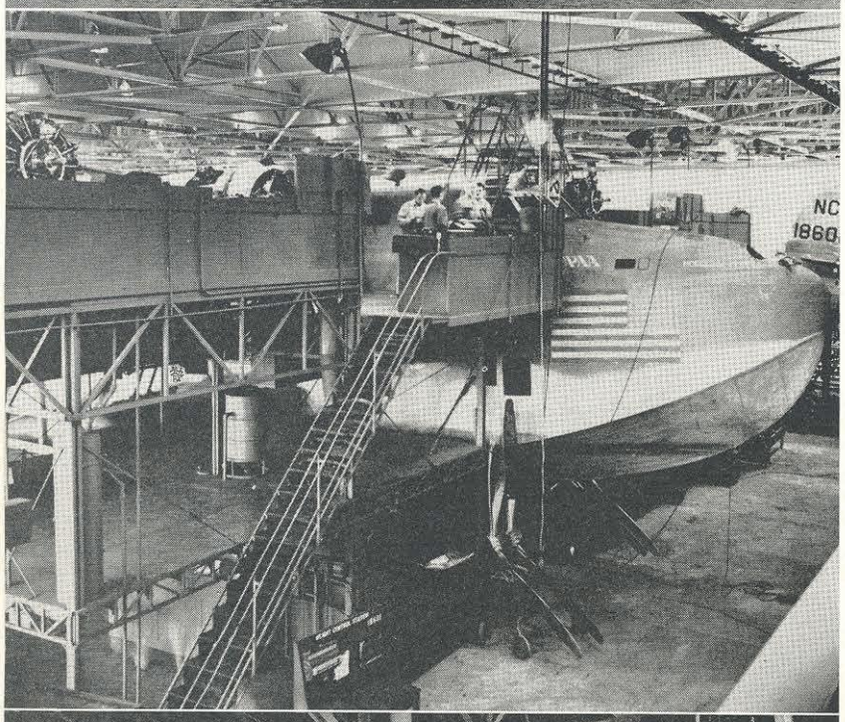
1. Operation of the aircraft.
2. Maintenance of the aircraft.
3. Communications and meteorology.
4. Traffic and passenger service.

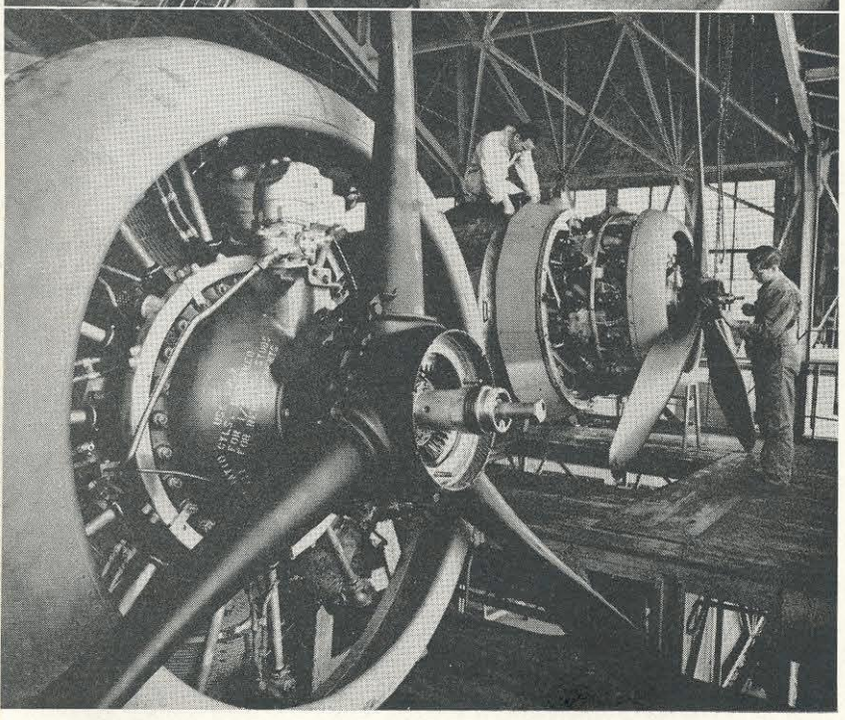
Since the authors are primarily concerned with aircraft maintenance, it is their intention, with no thought of detracting from the importance of other phases of airline operation, to confine this discussion to the subject of keeping large airplanes in first-rate flying condition. At this point, then, in order fully to appreciate the emphasis placed on thorough and efficient aircraft upkeep, or maintenance, the reader must realize that utilization, and that is average flying hours per airplane per day, determines available ton-miles and passenger-miles, which are the commodities an airline has to sell.

AIRCRAFT MAINTENANCE IN GENERAL

"Turning Them Around" refers specifically to major service and overhaul of airline aircraft at the main base.







Years ago most airline maintenance methods were far different from those of today and from those contemplated for postwar operation. Likewise, a utilization of six to eight hours per day was once considered normal and 10 hours per day exceptional; but now 10 hours per day is normal and we hear that 15 to 18 hours per day can be expected in the future. Obviously, then, maintenance and overhaul procedures have been and will continue to be revolutionized.

For example, consider the case of a major transoceanic airline in the late 1930's when the public was not yet "sold" on flying and a 2,400-mile overnight trip to Honolulu was regarded as a pioneering venture. With but a few airplanes (all flying boats) in scheduled operation, it was not practical to establish mass production-line types of shop layout, work scheduling, and production control. In addition, the airplanes, engines, and propellers, as well as numerous instruments, accessories, and "gadgets," were the first of their type ever used in commercial airline operation. Therefore, until the new equipment had been proved in service and all the "bugs" eliminated, practically full time was devoted to detailed inspection and service of almost every part of the airplane—the system used being analogous to that of a professional auto-racing driver who is mechanic for his own racing machine.

Today both inspection and service of the aircraft are no less thorough; they are, in fact, more comprehensive. However, methods and procedures have been streamlined. Specialized testing machines have been developed, portable hoists have been obtained, so that now when a propeller, engine, or other heavy part must be removed, the hoist is brought to the airplane instead of the airplane to the hoist—the industrial analogue of pushing the piano stool to the piano instead of vice versa. Many parts that once were returned to the manufacturers for servicing, repair, and overhaul now receive complete overhauls at the base.

Besides, there are three other important developments: The first springs from the fact that nowadays when an airplane becomes useless, the reason is just as frequently depreciation as obsolescence. Perhaps the outstanding illustration of this point is the Douglas DC-3. For over 10 years the DC-3 has been the outstanding commercial air transport in all parts of the world. Indeed, it was

AT LEFT:

UPPER: Coming ashore or being launched, Boeing 314 on marine railway in the up position. At this point, the airplane may be towed onto the apron and thence into the hangar or may be lowered into the water via inclined tracks (upper portion of which are visible) and cast afloat. Note wheeled cradle supporting the plane as described in the text.

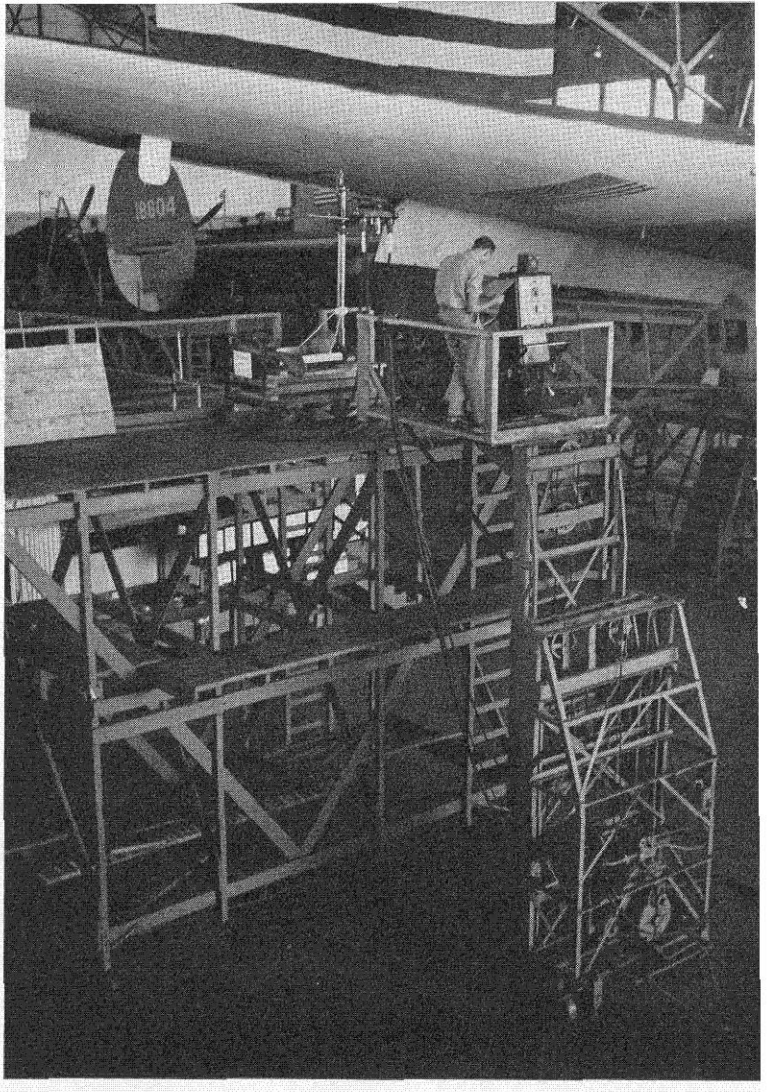
CENTER: Honolulu Clipper gets the works. With workstands in place, the service proceeds. Propellers have been removed for checking and await reinstallation. Note stile-like arrangement for access to either workstand over top of plane, tracks for overhead hoist, and weight control station in lower foreground. Also, portion of a second airplane's tail assembly visible in right background.

LOWER: Engines and propellers rate meticulous attention. View from top workstand platform shows mechanics at work on No. 1 engine and propeller. In the foreground a portion of the hydraulically operated propeller blade pitch-changing mechanism may be seen.

not until September, 1944, that the last commercial airplane of this general model was built; and now plans seem to indicate that production will be resumed. Hence, the DC-3 is not yet out of date, although any given one may wear out—a process that takes a lot of time if good maintenance practices are observed.

Second, the service life of various aircraft components has been greatly extended. Some certificated airplane engines are now overhauled after as much as 800 hours of flying time, and many parts no longer show any appreciable wear. Airplane propellers no longer have specified retirement time limits, but may be operated indefinitely by replacement of worn parts.

Third, airframe and engine manufacturers have come to realize that building an airplane is not merely a matter of putting together a structure which, once assembled, requires a welding torch to pull apart. Engines, accessories, controls, functioning systems, etc., should all be readily accessible. If something goes wrong with a magneto, for example, the mechanic should not have to spend hours in a superhuman struggle, cutting safety wire, loosening sequestered bolts, unsoldering connections, and doing acrobatics to reach the failing unit. Hence, we now sometimes find these vital accessories mounted on the nose section of the engine, where not only better cooling is obtained but immediate repairs can be effected. Electrical connections are made by quick disconnects, separable in seconds. Fuel, oil, prestone, and other fluid lines are "broken" with a half turn of a nut, and on being broken are automatically sealed. One reads of "packages" of one sort or another, particularly "power packages." The modern trend is to develop the various functioning devices as complete units. Suppose an airplane comes in with a defective engine cylinder. Mechanics, instead of sweating over the removal and replacement of the faulty part, could remove a few supporting bolts and detach the entire engine assembly. A new unit, already run up on the test stand, could be quickly installed and the airplane dispatched on schedule. Later, on a convenient workstand at floor level, the mechanics, with leisure, safety, and a vastly improved disposition, would make whatever changes are necessary to recondition the original engine.



A special inspection of internal wing structure is made. The illustration shows a typical setup of X-ray equipment used to inspect parts of the main wing spars. The particular aluminum alloy tubes used to fabricate these spars are subject to stress-corrosion cracking under certain conditions; and the illustrated X-ray inspection procedure is used to examine critical areas in search of possible hidden defects.

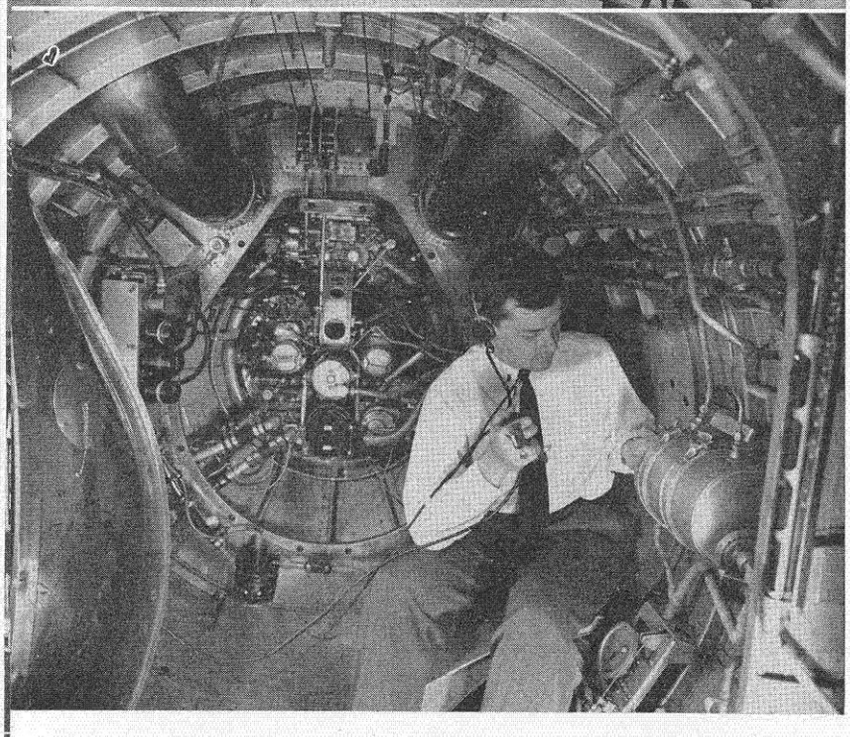
A FUNCTIONING MAINTENANCE ORGANIZATION

So that the reader may obtain a truly vivid picture of a modern airline's maintenance procedures, we shall suppose that a Pan American Airways Boeing Clipper, due for a periodic hangar service, is just coming in from across the Pacific, and we shall follow it from its landing, through the shops, up until the time it is released for its next scheduled flight.

As the airplane lands in San Francisco Bay, 16 hours out of Honolulu, various members of the 10-man crew not actually engaged in operation of the 42-ton flying boat are making final entries in their logs, noting any irregularities, indicating what repairs and corrections must be made before the next flight. Serious troubles, if any, already have been radioed in to the base, thus enabling the Maintenance Planning Group to set up schedules for their handling.

No sooner is the airplane secured at a dock than mechanics swarm through it, crawling through the leading edge of the wing into the nacelles and out through doors just back of the engines, from which access to still-warm cylinders and spark plugs is gained. The latter are immediately removed, taking advantage of their relative looseness while hot. Meanwhile, after the passengers have disembarked and the cargo and mail have been carried off by the loading crew, the airplane is towed to the marine railway, on which it is lifted from the water to the apron on shore. This is made possible by sliding a wheeled cradle underneath the hull while still in the water, to support and permit easy handling of the great weight on dry land. Here the salt water, whose effects on the aluminum skin are devastating over a long period of time, is washed off with fresh water. Then the airplane goes into the hangar. Continuing their work on the hull, cleaners scrape off any scum that may have accumulated. In this connection, it may be of interest to note that but a few days after December 7, 1941, an eastbound Clipper arrived, showing not only its battle scars—shrapnel gashes and bullet holes sustained as it escaped from Wake Island—but also carrying the first direct proof of what had happened at Pearl Harbor. Its bottom was stained with oil, a condition which prevailed for months on other airplanes as well until the harbor was at last cleaned up.

To facilitate work on the airplane, three-story work stands are utilized. These are simply de luxe portable scaffoldings of dimensions suitable for working on an airplane whose wing span is some 150 feet. The lowest workstand platforms are slightly above floor level and are equipped with cleaning fluid tanks and outlets, junction boxes for connection to hangar electrical and compressed air outlets, and desks for the filling out of work



UPPER: The empennage gets its share of attention. Control surfaces and mechanisms are extremely important parts of an airplane and must be checked and serviced as carefully as the engines or propellers. To facilitate such work, stands of convenient height are utilized as shown. Note openings to permit inspection of and access to control cables, pulleys, etc., inside the tail assembly structure.

LOWER: Nacelle and engine are checked in flight. A flight engineer works inside No. 3 nacelle during flight operation. Illustration shows engineer officer checking the prestone tank before reporting to the control deck via the interphone system.

sheets and inspection write-ups. The middle platforms are at the passenger deck entrance level of the airplane, and the highest ones are just below the level of the engines. These last are furnished with work benches, engine and propeller wells, safety wire, mineral spirits hoses, and everything else needed to service the engines.

A tractor is used to position these work stands, locating them deftly within an inch of each side of the plane. While this is being done, mechanics are converging upon the aircraft; ship's equipment men and women, instrument technicians, engine experts and their helpers, sheet metal crews, and others skilled in the maintenance and repair of particular parts of the airplane. The engine cowling is removed by giving a half turn to Dzus fasteners, a clip with a flush screw head that secures the cowling to the engine frame. Parts-control "runners" take the individual sections to the proper benches for cleaning, sheet metal repair, painting, and storage until such time as the engine is ready to be "buttoned up." The propellers are removed and checked, or, if their time is up, sent into their proper shop for complete disassembly, thorough cleaning and inspection, etching, buffing down, balancing, and refinishing.

Should any portion of the metal structure be found defective for any reason (usually corrosion or accidental physical damage), sheet metal mechanics either repair the damage in such a manner as to restore the original strength or simply replace the weakened member with heavier new material. Plane-service men crawl into the bilges, ventilated by a powerful blower, to check for leaks and to make sure that the main fuel pumps and plumbing system are in good condition. Plane-service mechanics also open inspection doors and remove cover plates throughout the plane, thus enabling experienced inspectors to make certain that every part of the aircraft is in an airworthy condition.

THE AIRLINE ENGINEER

Engineers also are mixed up in what to an outsider may appear to be a general melee. The flight engineer's logs may show that an engine has been running rough, overheating, using excess oil, or otherwise performing in a not altogether accountable manner. Now, a power plant engineer is making an investigation to discover definitely what is wrong and will continue his study to its logical conclusion—determination of what can be done to prevent recurrence of the trouble.

Suppose a report has come in that a thermostat in the hot water system is out of order and, rather than repair of the present one, a job that the mechanic and the inspector could adequately handle, some modification is desired. In this case the instrument engineer would be on the airplane, working out the details of such modification. And while there, he might pause to note the progress on a new installation, such as a fire detection system for the engines. Some weeks ago he planned how this installation was to be made, arranged for preparation of a drawing, complete with exploded and pictorial views, and drew up a set of written instructions. This material then filtered down to the shop, and now the installation is in process.

The aircraft engineer is primarily a structural man. It may be that the flight stewards have requested some change in the galley. Incidentally, before the Boeing Clippers went into service few people would have dreamed that a four-course meal with filet mignon as the entree could be served to more than 50 people from a galley five feet long, four feet wide, and slightly over six feet high. Nevertheless, the Boeing Clipper galley can produce just such a meal; but here have had to be all sorts of additions and improvements, for no original designer could anticipate all the problems in so new a development. The engineering for these changes is handled by the aircraft engineer. Likewise, that connected with structural mounts for new radio equipment, design of a compartment for fragile express, modification of the water tank support to strengthen it against high landing loads, rework of the flap operating mecha-

nism, and so on. The water tank problem, by the way, is one that soon may exist no longer; for in tomorrow's planes it is highly probable that the drinking water supply will be obtained by condensation and purification of the exhaust products of the engine fuel, the device for accomplishing this feat weighing considerably less than the present tank with its load of tap water.

Then, in addition to those mentioned above, there are other engineers who are specialists with regard to some aspect of the aircraft or its operating characteristics, among them the weight-control and equipment engineer, an authority on aircraft interiors and on emergency equipment, such as oxygen masks, life rafts, special rations, signaling devices, etc. He also guards the weight of the airplane with as much care as a fond mother watches over the weight of her child. All these men can be classed as aircraft maintenance engineers and certainly there is great variety in their duties. Primarily, though, they are concerned with changes in the aircraft and/or changes which must be standardized on every plane, which require C.A.A. approval, call for calculations relative to stress limits, and are connected with airplane engine operating characteristics or other technical matters with which the mechanic would not be expected to be familiar. The successful aircraft maintenance engineer understands every detail of his particular section or function of the airplane, has the know-how when it comes to designing all manner of gadgets within his bailiwick, and is able to prepare clear, written instructions for the mechanics and equally clear reports for management and various governmental agencies. He should keep up with current aircraft literature and must be agreeable to working at all times of the day or night—such is the nature of the transportation business. Finally, he possesses the ability to get on with others, the all-essential attribute without which he could not hope to accomplish his manifold duties.

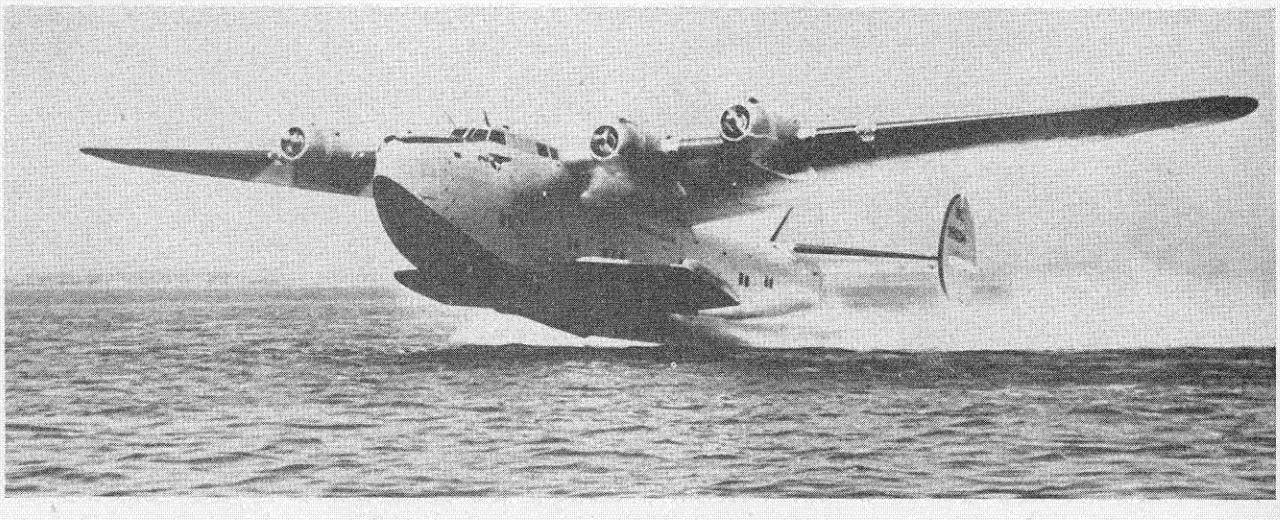
The close interweaving of effort which initially may have caused the airplane to look like something of a shambles—certain services require that even sections of the wings and tail be taken off, although doing this is not so difficult as it may sound—now begins to put it back in shape. The mechanics have signed off most of the items on their work sheets. These are subsequently initialed by the foreman and lastly must be accepted by the inspectors. Engineers have moved on to other newer projects—all but two of them, the weight-control engineer and the performance engineer. Now, as completion of the service draws near, it is the responsibility of the former to list all changes made to the aircraft involving an alteration in weight and a possible shift in the center of gravity. Every pound of weight added to the aircraft weight empty means one pound less of payload carried, for the allowable gross weight cannot be exceeded. And even though for the Boeing Clipper this gross weight is in the neighborhood of 42 tons, compared to which a pound of payload more or less seems insignificant, each decrease of one pound in the weight-empty figure means an increased revenue amounting to more than one hundred dollars per airplane per year. Hence, it becomes vitally important for the weight control engineer to keep a careful record of weight changes, so that the airplane will always depart at full gross weight and no more or less. It also behooves him, both by personal contact and through more formal channels, to impress upon every employee the importance of keeping the weight of the airplane as low as possible. Toward this end, substantial awards are made by the "suggestion committee" to those employees who submit practical ideas for weight reduction.

With respect to the center of gravity, anyone who has piloted a plane or anyone, for that matter, who can project himself from a childhood seesaw to an imaginary pilot's seat, knows that the location of the center of gravity has a very great effect on the performance of the airplane, especially upon its take-off and landing characteristics. The weight engineer calculates the center of gravity, using a specially constructed slide rule; then, working with Operations, he determines how the passengers shall be seated and the cargo loaded so that its final position will be the optimum one.

AIRLINE PRODUCTION ENGINEERING

Naturally, this last arrangement is made after the airplane has been released from the hangar and announced ready for flight—and here we may consider who does the releasing. This is done by the "maintenance planning group," which is the king pin in the entire maintenance routine. Back in the days when both airplanes and personnel were few, the division engineer and the shop superintendent personally watched over the servicing and release of the aircraft. Today, a division engineer, responsible for all maintenance work performed by the vastly expanded group of personnel under his direction, not only at the home base but also at distant island and foreign stations, has such a multitude of

(Continued on Page 13)



REPRODUCTIONS OF PRINTS, DRAWINGS AND PAINTINGS OF INTEREST IN THE HISTORY OF SCIENCE AND ENGINEERING

4. Richard Trevithick and the First Railway Locomotive.

By E. C. WATSON

"It has been claimed that the steam locomotive, in conjunction with the railway, has done more to promote the progress of the human race than any other single product of man's ingenuity."[1]

THE originator of the steam locomotive was, without question, Richard Trevithick, (1771-1833), *Fig. 1*, who pioneered the high-pressure non-condensing steam engine. On Christmas Eve, 1801, on Beacon Hill at Camborne in Cornwall a road locomotive, designed and built by Trevithick, carried the first load of passengers ever conveyed by steam and in 1803 another steam vehicle made by him was run in the streets of London without, strange as it now seems, attracting enough attention to lead to a single press notice. A modification of this engine was used successfully in 1804 to haul trucks on the tramway running from the Penydarran Iron Works, near Merthyr Tydvil, Wales, to Abercynon, a distance of nine miles. This was the first railway locomotive. Unfortunately its exact construction is uncertain and no authentic illustration of it exists. It is known, however, that it weighed about five tons and had a cylinder 8.25 inches in diameter by 54 inches stroke. It also discharged the exhaust steam into the chimney. When first tried on February 21, 1804, a date forever memorable in the history of the locomotive, it hauled a load of about 20 tons at a speed of five miles an hour. The performance was described by Trevithick in a letter to Davies Giddy dated Penydarran, 1804, February 22, which reads as follows:[2]

> "Yesterday we proceeded on our journey with the engine; we carry'd ten tons of Iron, five waggons, and 70 Men riding on them the whole of the journey. Its above 9 miles which we perform'd in 4 hours & 5 Mints, but we had to cut down some trees and remove some Large rocks out of the road. The engine, while working, went nearly 5 miles pr hour; there was no water put into the boiler from the time we started untill we arriv'd at our journey's end. The coal consumed was 2 Hund.d On our return home, abt 4 miles from the shipping place of the Iron, one of the small bolts that fastened the axel to the boiler broak, and let all of the water out of the boiler, which prevented the engine returning untill this evening. The Gentleman that bet five Hund.d Guineas against it, rid the whole of the journey with us and is satisfyde that he have lost the bet. We shall continue to work on the road, and shall take forty tons the next journey. The publick untill now call'd mee a scheming fellow but now their tone is much alter'd."

A similar engine was supplied to the Wylam colliery at Newcastle in 1805, but apparently it was not used, possibly because its weight was too great for the wooden rails upon which it was to run. Drawings of this locomotive have, however, been preserved and are now in the Science Museum in London. They are reproduced in *Fig. 2*. This locomotive is believed to be almost identical with the Penydarran one and is the lineal ancestor of the Wylam and early Stephenson locomotives.

Several accounts of Trevithick's romantic career are available. The *Life of Richard Trevithick, with an Account of his Inventions*, written by his son Francis Trevithick (London, 1872, 2 vols.) is the source of nearly all that is known about him, but it is uncritical, tedious and repetitious. A more critical, readable, and up-to-date life has been provided by W. H. Dickinson and Arthur Titley in their memorial volume, *Richard Trevithick, the Engineer and the Man* (Cambridge, 1934). This excellent work contains a very complete four-page bibliography. A still more recent short account will be found in *Great Engineers* by C. Matschoss (London, 1939, pp. 154-171).

[1] Handbook of the Science Museum, *Land Transport. III. Railway Locomotives and Rolling Stock. Part I—Historical Review* (H.M. Stationery Office, London, 1931). The writer is greatly indebted to the Science Museum and its excellent handbooks.

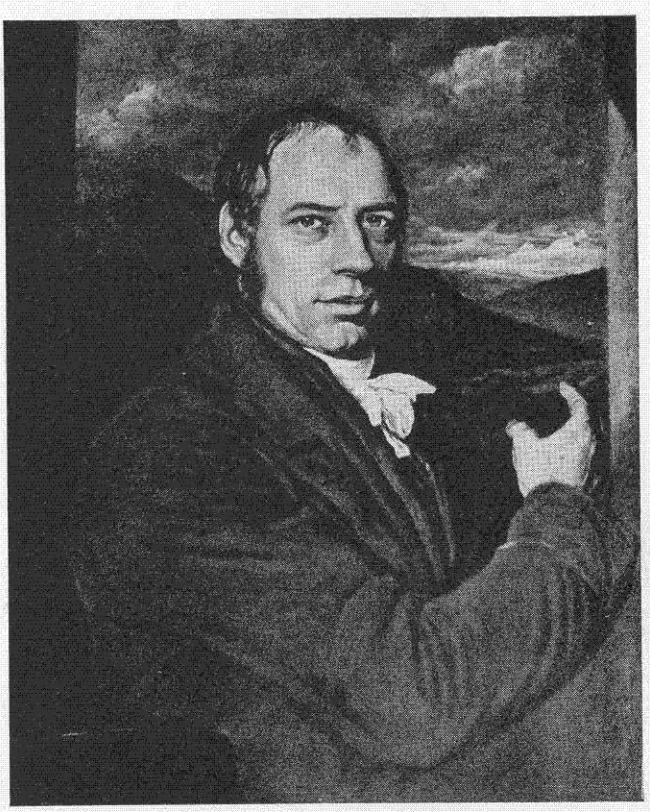


FIG. 1. Richard Trevithick (from portrait painted in 1816 by John Linnell, now in the Science Museum, London).

[2] From the Trevithick—Giddy correspondence preserved by the Enys family at Enys and now in the possession of the Royal Institution of Cornwall at Truro, Cornwall.

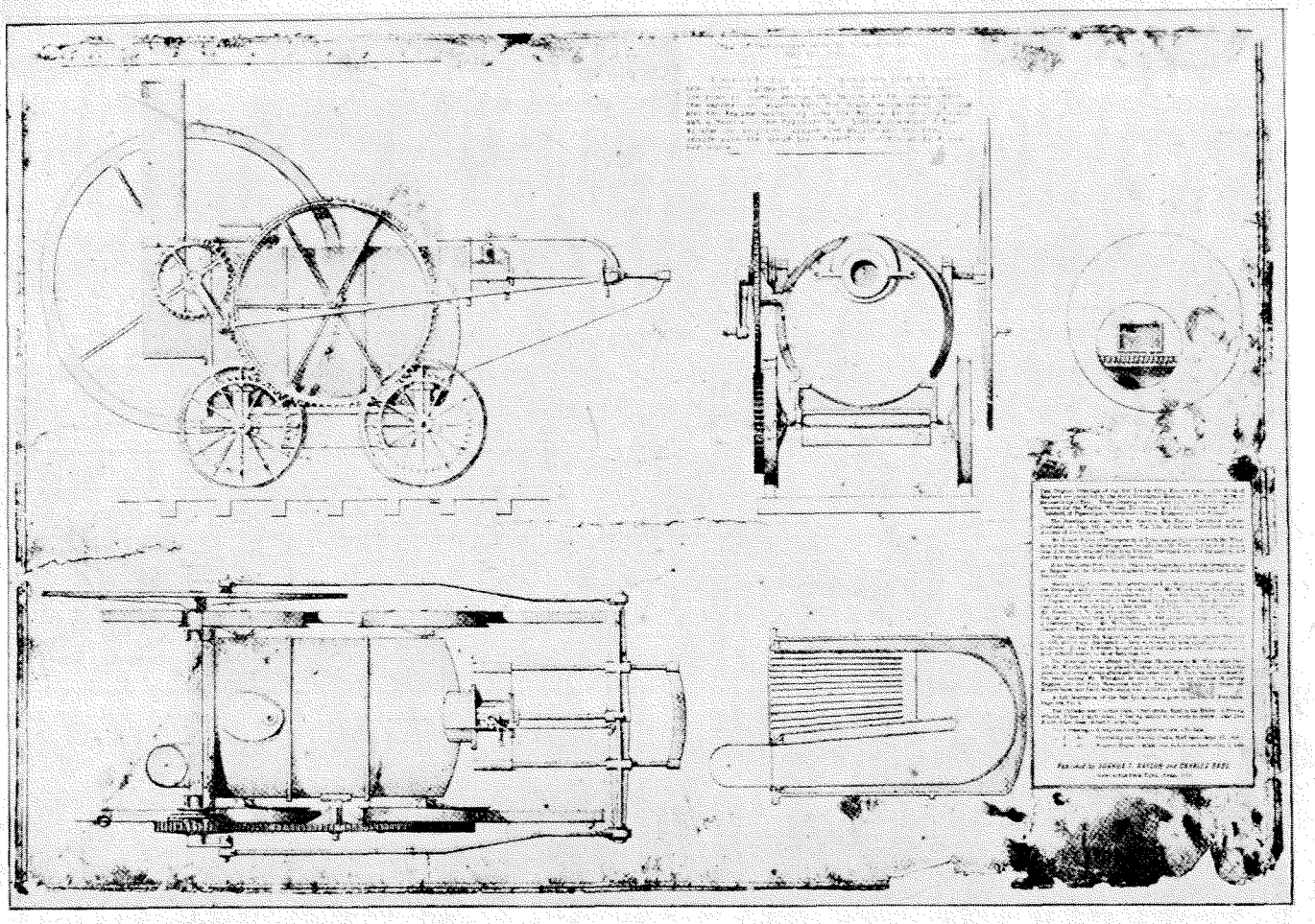


FIG. 2. Trevithick's Newcastle locomotive, 1805. (From the original drawing in the Science Museum, London).

Turning Them Around

(Continued from Page 11)

problems to cope with that he can no longer concern himself with the details of servicing individual airplanes. Similarly, the shop superintendent, charged with the responsibility of supervising more than 20 different shops and crews which may number as much as 1,000 men, finds his time occupied to a large degree by personnel matters whose ramifications can be and sometimes are quite complex. He, too, therefore, must restrict his activities to those dealing with the over-all picture.

Hence, the creation of a work-scheduling and planning organization. It is the planning supervisor, assisted by his staff, who schedules the many aircraft maintenance projects requested by various individuals or groups within the airline organization, plans all jobs within the shops, coordinates with the purchasing department in the procurement of supplies, keeps detailed records on engine, instrument, and accessory times, sees that job orders are issued when cost accumulation on a particular undertaking is desired, and develops work analyses leading to job simplification and standardization. Finally, it is the planning group that releases the aircraft to the operations department for scheduled operation.

THE END IN SIGHT

This release is accomplished in two steps. There is first the test flight. Although new installations on the aircraft may have a previous shop test—propellers and engines on a run-up stand, instruments inside pressure chambers and on wobbling mounts that simulate all types of flight conditions—there is always a test flight to make certain that items which functioned separately satisfactorily will perform just as correctly on the airplane. The plane goes into the water; its engines are run up and thoroughly checked by qualified mechanics; and inspectors commence a survey of the ship which lasts for the duration of the flight. Next the flight crew comes aboard and makes a second check of the entire airplane before the actual flight test begins. When all is in readiness, engines are started, the ship is taxied to the take-off area, and a carefully controlled and observed take-off is made. The flight test is under way.

During the test flight, each functioning system of the aircraft is carefully checked for proper operation. If any irregularities are noted, they are recorded and must be corrected before scheduled flight operation is resumed. In addition to routine checks, there may also be special engineering tests or investigations to he made. For example, engine tests may be run, not only for the purpose of testing the particular airplane involved, but to obtain data that may be useful to the entire aircraft industry, or an instrument calibration of some nature may be required. Normally, it is here that the performance engineer steps into the limelight, gathering his data for subsequent reduction and application toward more efficient or safer flight operation of the aircraft. On some occasions, where a number of diverse tests and checks are being made simultaneously, the inside of the plane resembles the main intersection of a metropolitan community, such is the bustle of engineers, flight per-

sonnel, mechanics, and inspectors, each independently carrying out his individual assignment. There is even activity in the wings, their unusual thickness permitting access to the engine nacelles in flight. As the airplane makes its circuit about San Francisco Bay, men crawl into the nacelles five feet in back of the propeller to make sure that everything there is in tip-top running shape. Should it be necessary to communicate with the pilot, the radio operator, or the flight engineer, push of a button will connect them via the interphone system with any of these men.

The test flight ends—it may be the middle of the night. Back on the ground, Inspection tells Planning what loose ends must be tied together and this information is passed on to those who will accomplish the necessary work involved with maximum speed. If calibration tests have been required, the performance engineer finishes the reduction and plotting of data obtained during the test flight and his conclusions are posted within the airplane for the use of the departing flight crew. Planning, estimating accurately how much time will be required to accomplish these finishing touches, has already called Operations, announcing just when the plane will be ready. The traffic department has notified the passengers and the loading crew is standing by.

BACK ON SCHEDULE AGAIN

At the time agreed upon, the airplane is released to Operations; and except for the beaching crew that does the casting off and the line crew mechanics and inspector who again warm up the engines, the maintenance department has already turned its attention to another airplane. The passengers' going aboard, the thundering taxi run, the ultimate take-off—features which still thrill the bystander—are now accepted as routine. That is the difference which numerous departures a day have made. If one were to desire additional evidence, he should note the passengers going aboard. Before the war began, it was orchids, dress clothes, cameras, flashlight bulbs, plus innumerable friends and relations. Now it is a group of military personnel, commissioned and enlisted, some of them in shirtsleeves, their luggage merely a khaki bag under their arm, their departure unheralded and unattended.

To summarize, it may be stated that for Pan American Airways' Pacific-Alaska Division, the net results and benefits derived from improved products and streamlined maintenance methods over a 10-year period have included a 250 per cent increase in utilization and a 30 per cent decrease in elapsed service times required. Such an increase in utilization is tantamount to almost tripling the size of the fleet on the basis of seat-miles and ton-miles made available. Finally, since the actual number of units operated has increased even more than this, it is evident that operations have been stepped up tremendously.

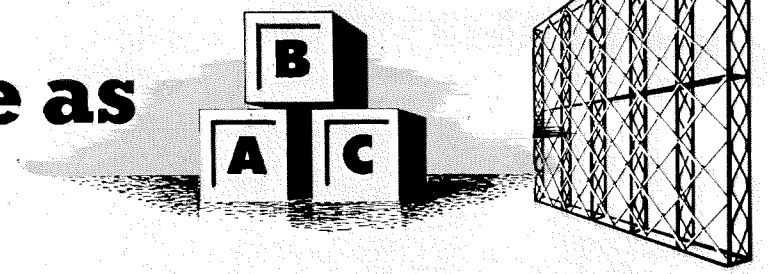
In this light, then, "Turning Them Around," while still retaining its adventurous side, is today a mature business.

Month in Focus

(Continued from Page 3)

Recently, and probably in the past as well—at least more obviously now—several cases have been observed in which the membership of a union organization have

Simple as



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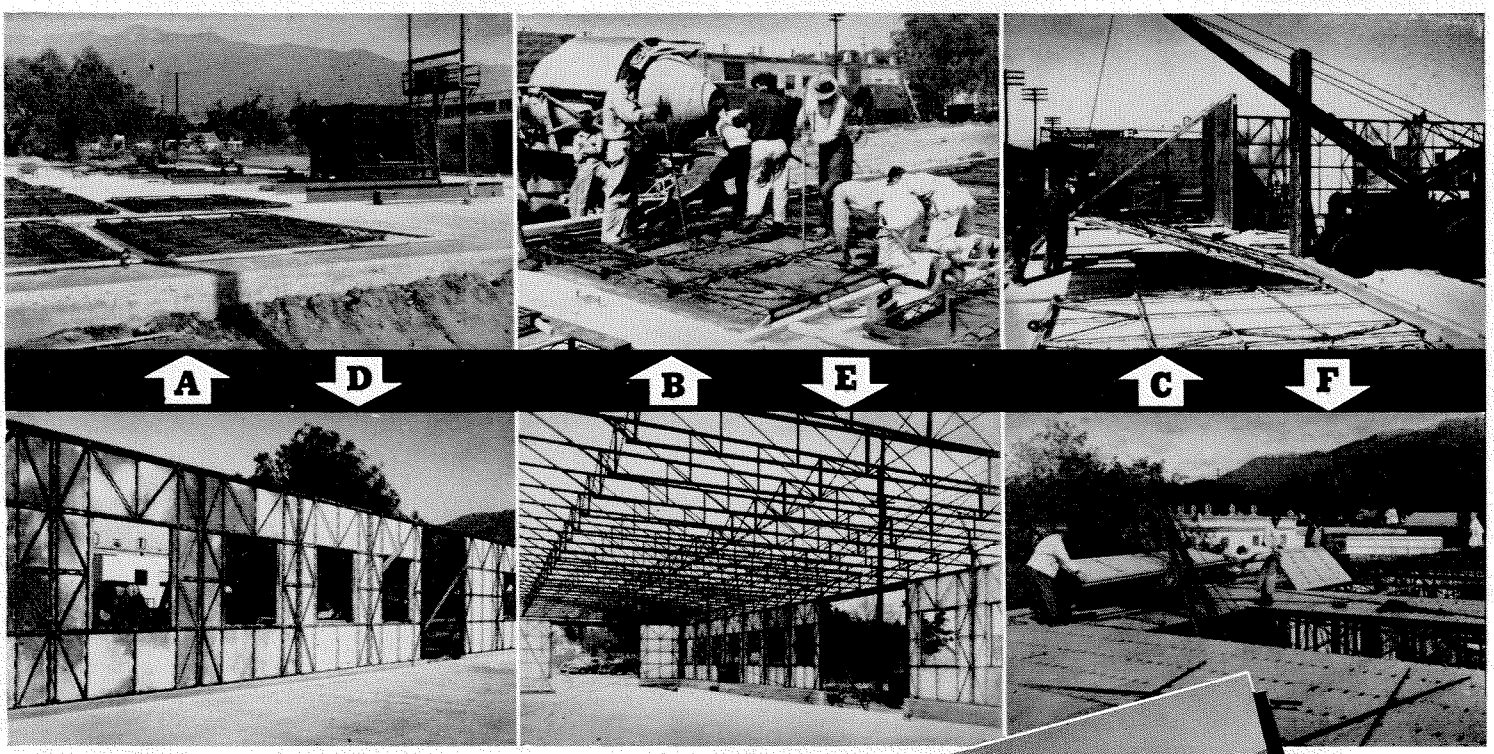

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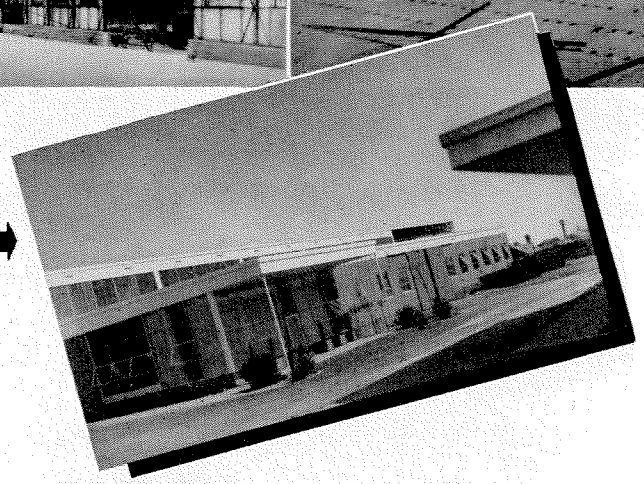

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voted not to act in a certain direction. This action has not met with favor by some of the administering group who constitute a minority. The minority have attempted or threatened to cancel memberships.

Certainly unions can be of benefit to their members and to society as a whole, but they must be run on a democratic basis and not on that of dictatorship. When it gets to the point where no man can work where he chooses, vote as he chooses, financially support or not support political groups as he chooses, life in these United States ceases to be free. May we hope that the conditions which seem to be prevailing at present in connection with certain organizations will improve. Improvement can only come through the exercise of the democratic rights of each citizen. If these rights are not exercised, through laziness or disinterest, those rights will naturally be lost.

A few lines taken from "Autumn Leaves" by P. W. Litchfield seem appropriate:

> "While there is one untrodden track
> For intellect or will,
> And men are free to think and act,
> Life is worth living still."

Let us hope that we shall remain free to think and act and that the professional group will maintain themselves on a high democratic plane.

The United Nations Conference

(Continued from Page 6)

the greatest strength, now and in the foreseeable future, resides in Russia and the United States. Both of these powers are comparatively new to leadership in world affairs. It is to be expected that comparative inexperience in their new roles will make at first for some awkwardness. Understanding between them will remain more difficult because of the differences of their political heritage and their present economic and political systems. But neither country can lightly consider the alternative to successful cooperation.

C.I.T. NEWS

FOOTBALL

By HAL MUSSELMAN,
Director of Physical Education

BUCKLING down to work in mid-summer heat, the 1945 football squad of 45 men opened practice the middle of August in preparation for a six-game season. Games have been scheduled on consecutive weeks with Redlands, Occidental, Cal Poly, U.C.L.A. Junior Varsity, San Diego State, with a return game with Occidental concluding the season.

The new coach, Pete Brown, who has an enviable record both as a player and assistant coach at Colorado State, appears quite optimistic over the 1945 Tech team. However, it would be asking almost too much to expect the squad to duplicate the phenomenal record of the 1944 squad.

An entire new line-up will be in starting positions this year, as all of last year's regulars have finished. Building the team around three returning lettermen: Milt Strauss, guard, Bill Libbey, tackle, and Jerry Wozniak, half, Coach Brown has rapidly molded a fast but clever ball-handling outfit. Wozniak and Mort Powell, halves, *together with Stan Mendes, a terrific driving 148-pound* fullback, will supply the Tech backfield with plenty of punch.

The squad as a whole does not boast of as much weight and experience as the 1944 squad, but may make up for this deficiency through speed and deception. The reserves especially lack experience, but if injuries and ineligibility do not take too many key men, the squad should come through with a fine season.

TO ALL ALUMNI:

WITH the cessation of war activities many alumni will be concerned with the procurement of a new position. For this purpose the Alumni Placement Service jointly operated by the Alumni Association and the Institute is organized to give all possible assistance. Men in the armed forces will be released over a period of a year or 18 months. Those who have been employed on special research projects also will be free to secure regular peacetime employment. If each man who wants assistance will advise the placement office as far in advance as possible every possible assistance will be given to arranging proper connections. Those who have been away from engineering or science for a considerable period may find it advantageous to review some of their technical training. While this training may be in progress *certain contacts may be made which may lead to* later employment. It is our duty to assist these men to get back into normal industrial and scientific pursuits.

ASSISTANCE WANTED

THIS is a personal note to each alumnus. Many are known personally to the Editor while others are not. A large number of you have been receiving *Engineering and Science* since it replaced the *Alumni Review.* In some ways it is disturbing to the Editor that he has received no adverse criticism. Some have taken the pains to write in expressing definite approval of the magazine and sincere appreciation is expressed to them. It is realized that these have been busy times and there has been little opportunity to give us your comments. Now it may be possible for you to give the Editorial Board the benefit of your constructive criticism and help. Articles of general technical nature are believed to be most appropriate for *Engineering and Science.* You may not think that your story is important or of interest to the readers, but why not suggest a topic on which you could write an article with good illustrations and write the Editor. He will give you a frank opinion on the suggested topic. Please help by at least writing the Editor on your views; the magazine will be as good as you want to make it. If you are in the vicinity of the *Institute don't hesitate to stop in at the office.*

ALUMNI OFFICERS 1945-46

President	Charles Varney '22
Vice-President	Allen Laws '26
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Treasurer	Karl Hegardt '32
New York Chapter President	Clyde Keith '22
San Francisco Chapter President	Marshall Baldwin '27

PERSONALS

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

—Editor.

1918

NOEL PIKE, employed in Mexico for several years, has returned to the United States to accept a position with the Imperial Irrigation District at Imperial, Calif.

JOSEPH HARTLEY passed away on Wednesday, July 18, after a prolonged illness. Death was due to heart trouble.

Ex. '18

CAPTAIN FREDERIC A. MILLERD was recently made commanding officer of the 34th Bombardment Group and is stationed in East Anglia, England.

1922

HAROLD R. HARRIS (A.A.F.) recently received the rank of brigadier general. Prior to the war, General Harris was head of Pan-American Grace Airlines in South America and came back during the war to be commissioned in the Air Transport Command.

LINNE C. LARSON is a captain in the corps of engineers stationed in Los Angeles with the district engineers, U. S. Engineer Department.

1925

LAWRENCE P. HENDERSON is sales engineer for Lincoln Electric Co., which supplied welding equipment and materials for use in the war. Lawrence lives in Berkeley, Calif., and is the father of six children.

ALBERT FERKEL is in charge of operation of a plant of the Atlantic Refining Co. producing 100 octane gasoline. Albert is unmarried and lives in Port Arthur, Tex.

CARYL KROUSER is a newspaper publisher—publishing the "Barstow Printer Review." In 1941, he was a major in the Army, stationed at Ford Ord.

ALLYN W. BLUNT who is on leave of absence from his position with the Los Angeles County Flood Control District, is a Lieutenant-Commander in the Navy now serving in the Pacific area.

NEAL D. SMITH is city manager of the City of Ontario, Calif.

JAMES E. MOORE is manager of the economic research department of the United Air Lines, Inc., at Flossmoor, Ill. In 1942, Mr. Moore served as expert consultant on air transportation services and supply, U. S. Army, Washington, D. C.

GEORGE C. SPELMAN is general superintendent, New Orleans division, of the Standard Dredging Corp., New Orleans, La.

PAUL C. RIVINIUS is a public accountant for Price, Waterhouse & Co., of Los Angeles, Calif.

1927

LIEUTENANT-COLONEL ARTHUR H. WARNER, head of the technical section of the air defense S.H.A.E.F., received the Legion of Merit. Lieutenant-Colonel Warner, an associate professor of physics, is on leave from the Los Angeles campus of the University of California.

1930

J. R. LESTER BOYLE, city engineer of Laguna Beach, Calif., for the last six years, has resigned. Mr. Boyle intends to open an office in Santa Ana as consulting engineer.

RALPH L. LUPHER is professor of geology at Washington State College, Pullman, Wash. He has added some courses in military work to his regular curriculum and has been spending his summers on strategic mineral work in the State of Washington.

1932

THOMAS CLEMENTS is professor of geology and head of the department at the University of Southern California, Los Angeles.

ALEX CLARK is division geologist for the Shell Oil Co. at Ventura, Calif.

E. N. HARSHMAN and Mrs. Harshman were liberated internees from Los Banos

camp in the Philippines in late February. They are in good health, considering the meager diet of small portions of daily rice and some few vegetables grown on the internment grounds.

J. W. PATTERSON moved his consulting work from El Paso a year or two ago in order to help develop the black sand deposits on the Oregon coast. At present, he is working for the Joshua Hendy Iron Works at Sunnyvale, Calif.

FRED B. PHLEGER, JR., is continuing as professor of geology at Amherst College, Amherst, Mass., but on a part-time basis and is spending the rest of his time in cooperative work with the Navy through the Woods Hole Oceanographic Institute.

B. HENRY POWNALL, since May first, was promoted to chief industrial application engineer of the York Corporation at York, Pa. Mr. Pownall is also owner of a chain of locker plants.

1937

CAPTAIN LUIS E. KEMNITZER gave up his consulting practice as a petroleum geologist in Los Angeles in order to accept a commission as a Civil Affairs officer in the Army. After completing training in Michigan and graduate work at Stanford, Captain Kemnitzer went overseas about a year ago and at present is reported to be about ready to take over the administration of some portion of Germany.

JOHN P. KLOCKSIEM announces the birth of a daughter, Bonnie Ann, on May 19.

W. C. PUTNAM is on leave from his position as assistant professor of geology at University of California, Los Angeles, to serve with the military geology unit of the U.S.G.S. He acted as consultant for the Mindoro invasion, recommending the placing of air strips and routes for the landing beaches. For the success of this work, Dr. Putnam won special commendation from Major General William Dunckel, commander of the Mindoro task force.

DR. ROBERT W. WEBB, of the geology department of the University of California, Los Angeles, has been in charge of A.S.T.P. courses at that institution.

1938

PHILIP IVES is a research associate in the biology department of Amherst College, Amherst, Mass.

JAMES R. BALSLEY, after dividing his time for several seasons between the Alaskan branch of the U.S.G.S. and the Carnegie Geophysical laboratory, is now on full time with the section of Military Geology of the Geological Survey, Wash.

GARN A. RYNEARSON, whose business address is Grants Pass, Ore., is working on lead-zinc of Oregon and Siskiyou County, Calif., for the U.S.G.S.

1939

JOHN A. BATTLE is forecasting weather for the U.S.A.A.F. and Pan American Airways at Guatemala City, Guatemala, C. A.

DELOS FLINT recently has been commissioned second lieutenant following his graduation from the Field Artillery Officer Candidate School at Fort Sill, Okla. Delos spent part of his academic leave in July visiting friends at the Institute and then returned to Fort Sill to receive an overseas assignment.

1941

LIEUTENANT STANLEY J. MITCHELL, Air Forces, is at present stationed at Scott Field, Ill. Prior to entering service, he was designer-engineer for Westinghouse, then in charge of a laboratory at Wright Field. Lieutenant Mitchell was recently home in Southern California on a 30-day furlough. Late in the fall, he expects to receive an overseas assignment where he will be in charge of communications.

THOMAS HASSARD, R.A.F., is a leading aircraftsman (ground crew) stationed in India, near the border of Iran.

1942

CHIEF RADIO OPERATOR HENRY ROESE, U.S.M.S., took advantage of his 30-day furlough at home to work out a number of times with the Caltech baseball squad.

LIEUTENANT ROBERT ANDERSON, U.S.N.R., after 30 months active duty in the South Pacific, returned to Washington, D.C., for several months before returning to the Pacific.

LIEUTENANT (j.g.) WILLARD P. FULLER, U.S.N.R., resigned from Basic Magnesium, Inc., in the spring of 1944 to enter the Navy and is now in the Pacific theater of operations.

BENJAMIN HOWELL completed his work with the Navy Radio and Sound Laboratory in San Diego in December, 1944, and is now with United Geophysical Corp. in Pasadena. Ben has a daughter, Barbara Carolyn, 15 months of age.

LIEUTENANT H. W. MENARD, U. S. N.R., has seen action on many fronts. In the early stage of the war, he was in the Southwest Pacific area, then assigned to the European theater; recalled to Wash-

ington for a few months and then reassigned to the Pacific. The nature of his work is photo interpretation.

WALTER TOVELL is associated with the Standard Oil Company in Alberta, Canada. In October of last year, Mr. and Mrs. Tovell announced the birth of a daughter, Marianne.

GORDON K. WOODS is chief marine engineer for Kaiser Company, Inc., at Richmond, Calif.

1943

LOUIS J. REGAN, JR., is with the Texas Co. and alternates between work in the Northwest in the summer and the Los Angeles area in the winter. He is the proud father of three children and dares anyone in his class to match his record.

RICHARD H. JAHNS has been with the pegmatite section of the U.S.G.S. for the past two years or more, working first in New Mexico and more recently in North Carolina where he is in charge of exploration for mica.

ROBERT GREENWOOD is a geologist with the British Colonial Geological Service, working in Nigeria. In a letter, Bob describes the plateau as comparable to Western Texas. He is hoping, after his 18 months assignment, to be able to return to the States and acquire a Ph.D.

1944

STEPHEN W. DANA accepted a position with Standard Oil Company of California as a combination geologist-geophysicist in February of this year. Mr. Dana's home is in Everett, Wash.

ENSIGNS BOB FREEMAN, PHIL ADAMS, EARL FISCHER AND CARL COULSON attended communications school at Harvard. Freeman, Adams and Fischer were transferred to San Diego prior to duty overseas.

AHMED CEBECI, after receiving his Master's degree from the Institute in June, 1944, has returned to Turkey where he is working for his government.

MARTIN J. STEWART, after completing midshipman school at Columbia University and specialized work at Miami, is now overseas in the Pacific area, serving as an ensign on a destroyer escort. Martin states that the heat of the Mojave Desert is nothing compared to some places he has been.

FERNANDO NIERI expects to return to his home in Lima, Peru, sometime during this summer, taking home his bride, formerly Anita Sievert, whom he married on March 11.

THOMAS E. HUDSON has been given a medical discharge from the Navy. Tom was in midshipman school at Columbia University where he received his commission as ensign. On departure for overseas duty, he became ill and was sent to the U. S. Naval Hospital at Oakland, Calif., for three and one-half months. Tom plans to come back to the Institute to study for his Master's degree.

RICHARD H. LOCKETT is a test engineer for General Electric Co., Schenectady, N. Y.

Ex. '44

JAMES F. DRAKE left the Institute in May, 1943, to enter the Army Air Forces, and is now a first lieutenant, stationed on Tinian in the Marianas. Jim is a squadron flight engineer and has completed 17 missions over Japan.

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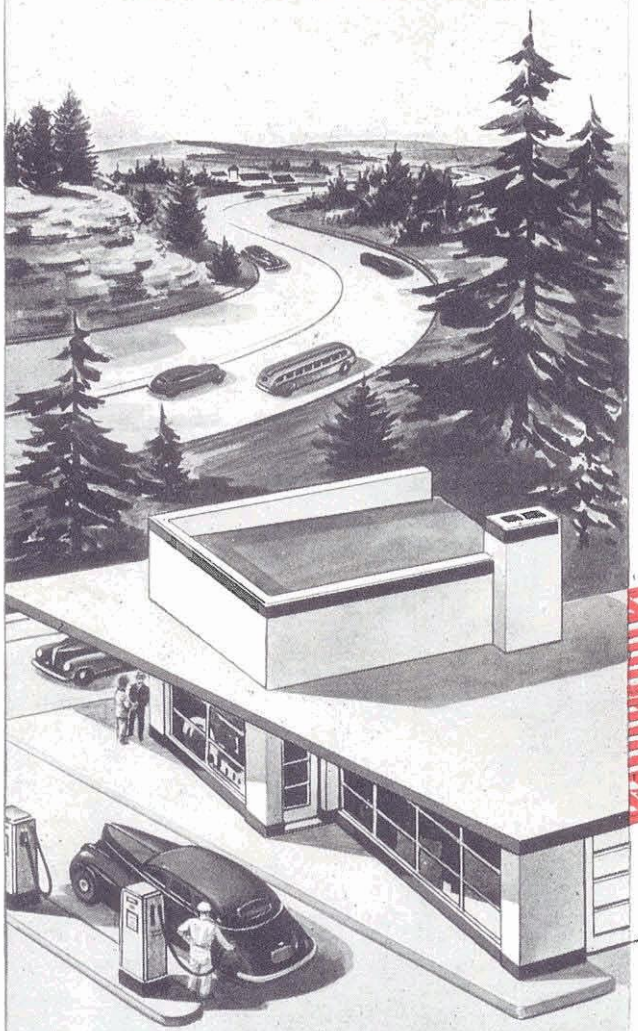

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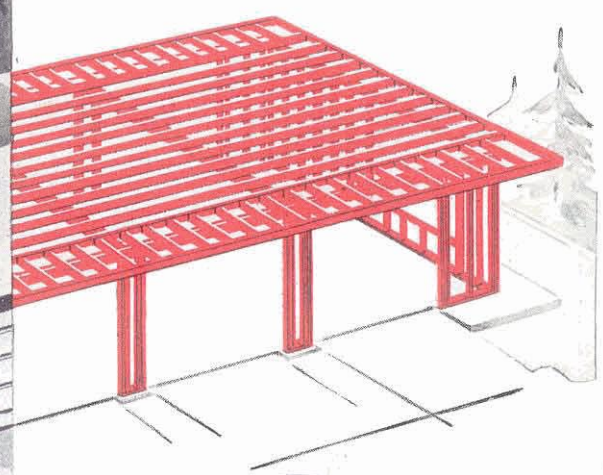

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