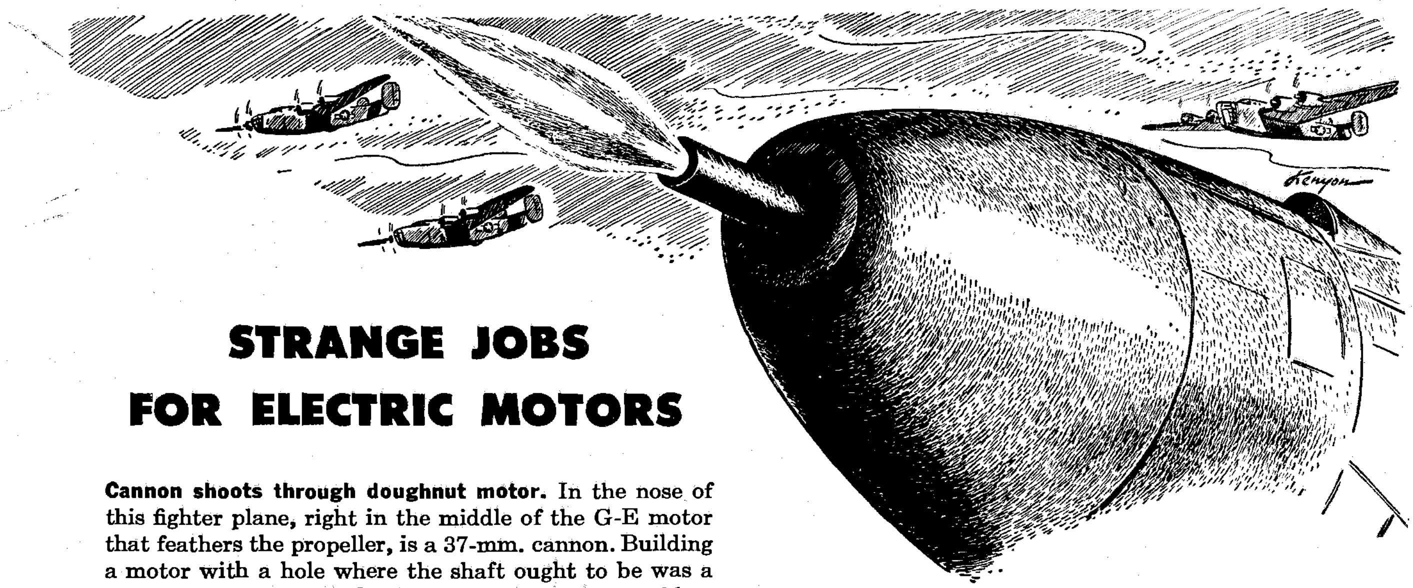
ENGINEERING AND SCIENCE

MONTHLY

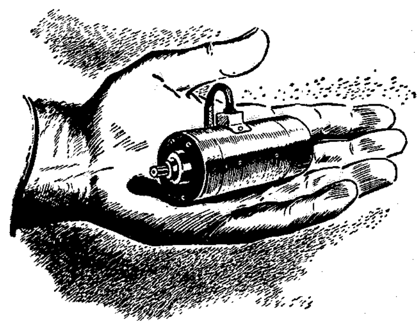
OCTOBER ★ 1944
VOL. VII NO. 9

PUBLISHED BY CALIFORNIA INSTITUTE OF TECHNOLOGY ALUMNI ASSOCIATION

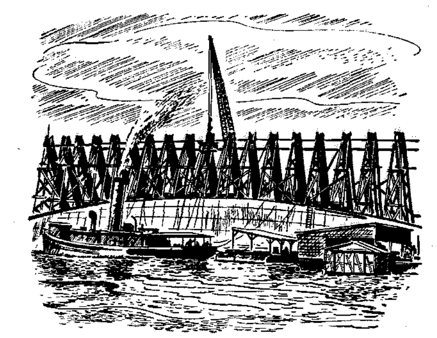


STRANGE JOBS FOR ELECTRIC MOTORS

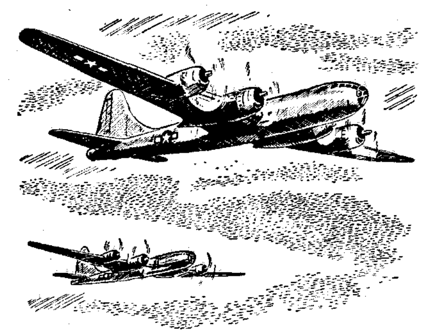
Cannon shoots through doughnut motor. In the nose of this fighter plane, right in the middle of the G-E motor that feathers the propeller, is a 37-mm. cannon. Building a motor with a hole where the shaft ought to be was a brain twister, but G-E engineers solved this problem with an electric motor shaped like a doughnut.



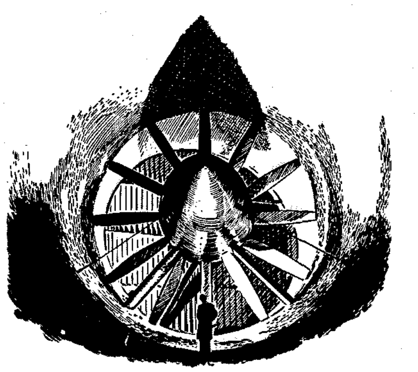
This Tom Thumb motor loads the guns on our bombers and fighters. Other electric motors raise and lower wheels, open bomb bay doors. War requires 40,000 different motor models, keeping G-E research and engineering men busy.



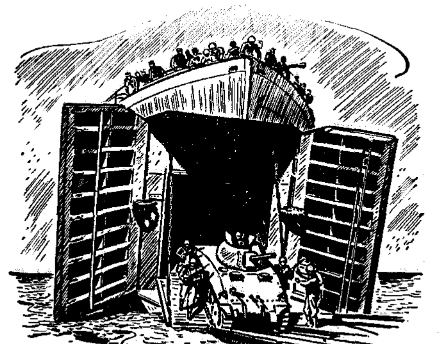
Turning a battleship over. 21 G-E motors teamed up for 21-thousand-ton pull to turn the capsized *Oklahoma* right side up at Pearl Harbor. Electric motors see action on every front, in weapons, and in tools to repair them in the field.



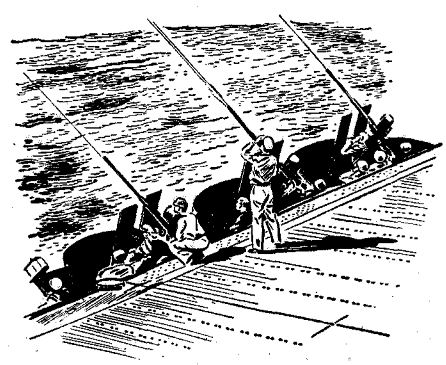
B-29 Superfortress. 150 electric motors act as muscles beneath the sleek exterior of the B-29. They power, among other things, the gun turrets in the G-E-designed fire-control system that arms the Superfort against attack.



Outblowing a hurricane. This twelve-bladed fan has 18,000 horsepower behind it, from one giant electric motor. In wind tunnels like this, G-E motors, sometimes totalling 30,000 hp., produce winds five times as strong as a hurricane.



Push-button doormen for LST's. Push a button, and out pops a tank. It's not quite that simple, but the doors and ramp on an LST are opened, at the push of a button, by electric motors. On an LST, there are 140 electric motors.



Cooling guns. Anti-aircraft guns are cooled by electrically driven pumps which circulate cooling fluid around their barrels. There are more than 900 electric motors on a battleship. *General Electric Company, Schenectady, N. Y.*

- *General Electric produced 7 million horsepower of electric motors in 1943.*
- *Over 2 million G-E electric motors will join the armed services this year.*

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BY-LINES

FLOYD R. WATSON

Dr. Watson received his B.S. degree in 1899 from the University of California and his Ph.D. from Cornell in 1902. He taught physics at the University of Illinois until his retirement as Professor in 1940. His research has been mainly in acoustics. He was editor of the Acoustical Journal and president of the Acoustical Society. His publications and scientific articles on sound and acoustics are well known.

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BRADLEY H. YOUNG

Bradley H. Young received his B.S. degree in 1935 followed by his M.S. degrees in 1936 and 1937 in mechanical and aeronautical engineering from California Institute of Technology. He has been engaged as a maintenance engineer for Pan American-Grace Airways in Lima, Peru, for the past seven years.

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EARLE A. BURT

Mr. Burt, chief deputy road commissioner, County of Los Angeles Road Department, received his B.S. degree from Throop College of Technology in 1915. He entered the service of the Los Angeles County Road Department in July, 1915, and has been continuously employed in various phases of road maintenance and construction since.

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Cover Photo: 75-foot glued laminated arches used in construction of the community center assembly room at Wilmington, California. Area of the structure is 75 feet by 156 feet. Ernest C. Hillman, engineer; Lewis Eugene Wilson, architect; Zoss Construction Company, contractor.

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ENGINEERING AND SCIENCE MONTHLY is published monthly on the 25th of each month by the Alumni Association, Inc., California Institute of Technology, 1201 East California Street, Pasadena, California. Annual subscription $2.50; single copies 35 cents. Entered as second class matter at the Post Office at Pasadena, California, on September 6, 1939, under the Act of March 3, 1879.

ENGINEERING AND SCIENCE

Monthly

The Truth Shall Make You Free

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ENGINEERING AND SCIENCE MONTHLY

Edited at California Institute of Technology

ENGINEERING AND SCIENCE
Monthly

Vol. VII, No. 9 October, 1944

The Month in Focus

Employment

LAST month Harry K. Farrar discussed some of the aspects of postwar research and the reconversion of production facilities to peacetime activities and civilian requirements. The utilization of many of the developments in science and engineering for purposes of war will require considerable effort on the part of the engineer in the adaptation of these developments for peaceful functions. Such activities will utilize the keenest thinking of which the engineers and scientists are capable. Most of the larger industrial concerns now concentrating on war production are actively engaged in planning for the day when they can return their production facilities to their normal products. There is, at present, considerable unrest among engineers and scientists employed in war activities. Many are looking for other employment which may have greater possibilities of permanency than the present. Transfer from one job to another is not easily accomplished. This is probably as it should be, for the war has not been won yet. This fact does not appear to deter men from wondering what is to become of them. Their problem is really not significantly different from that of the service men, although there is a feeling that service men will be given preference. The problem of readjustment in the employment field will not be simple, but all must remember that efficient engineering practices must continue on a high quality basis until military requirements are eased by a successful conclusion of the war on all fronts. The winning of the war in Europe may decrease many of the requirements, but certainly large quantities of supplies will be required for the early and final conclusion of war activities.

Inventory

A factor having a very important bearing on the employment situation is that of military inventory surplus. This subject is presented in the usual complete manner in the September issue of "Fortune." It has been estimated that the value of surplus goods which may possibly be of some use to civilians will amount to something over 14 billion dollars. The question arises as to how this material can be disposed of without upsetting the economy of the country. Every machine tool, truck, tractor, photographic supply and instrument sold to the public means less to be produced and thus less manpower required. On the other hand, it would seem to be extremely wasteful to destroy such material, making it in the true sense scrap. This is certainly a problem worth thinking about for it bears a direct relation to engineers. The design of new devices which utilize the developments made during the war will require the services of a large number of technically trained men, so the surplus inventory problem may not have as serious effect on engineering personnel as it could have on general labor.

Education

The colleges and universities have been most active in the training of men for the armed forces. Relatively few men have been in training for industry. Some of the educational institutions are now receiving veterans into their courses. It is probable that the return of men from the services to the technical institutions will be somewhat slower, except for those who had not entered college prior to entry into the services. For those whose education was impeded, delayed, interrupted or interfered with because of entry into the services. Public Law 346, more commonly referred to as the G.I. Bill, provides for resumption of their education. Furthermore, those who wish to take a refresher or retraining course may do so under this bill with certain restrictions. While attending courses under this law, tuition and other fees and subsistence will be paid by the government. It is probable that most engineers who entered the services have been given a certain amount of engineering duty. However, in many cases the type of engineering has been of a different character from what the individual would practice in industry. Three or more years away from the field of engineering or science may require a certain amount of refreshment. Whether these refresher courses should be of a special nature or consist of the regular upperclass or graduate courses normally given by the college is a matter for some discussion. Certainly the man returning to industry should be brought up to date on technical developments in his field. For a period there will be two classes of technical men to be dealt with: those who have not completed their undergraduate education and those who have graduated but who for some time have been out of touch with engineering and science.

ACOUSTICS OF BUILDINGS

With Applications in the Pentagon

By FLOYD R. WATSON

INTRODUCTION

ACOUSTICS of buildings is that part of the science of physics which deals with the control of sound in buildings. Since the purpose of this control is to create conditions by which people can hear with comfort, it is necessary to consider not only the principles of sound but to take into account also the phenomena of hearing.

SOUND AND ITS ACTION

Sound is similar to light in many of its actions; it is reflected, refracted, diffracted, etc., as light is, but it should be realized that it is entirely different fundamentally. Sound is a mechanical wave motion in a material medium, while light is an electro-magnetic phenomenon in the fictitious ether. Another difference which is important in the acoustics of buildings, is that the average wavelength of sound is about one million times greater than the average wavelength of light, so that objects that are optically "large" are acoustically "small." Thus, a rough plaster wall acts as a polished mirror for sounds of moderate frequency; a partly opened window diffracts sound in about the same proportion that the fine lines on a grating diffract light.

Sound originates when a vibrating body pushes and pulls on the air particles about it, thus generating compressions and rarefactions that travel out in the surrounding air with a large velocity of about 1100 feet per second. These waves enter the ear canal and push and pull on the ear drum, which transmits the motion through an effective arrangement of three small bones to the inner ear, where the mechanical energy is transformed into nervous energy and the person hears.

Sounds in a building are of two kinds: those that are wanted and those that are objectionable (noise). The unwanted sounds should be eliminated as far as possible, while the wanted sounds should be adjusted for comfortable hearing. Sound is a form of energy, and energy cannot be destroyed. To eliminate sound, therefore, requires a transformation to some other form of energy, ultimately heat. Thus, sound waves impinging on a porous structure are absorbed when they set up a friction between thin layers of air and the adjacent solid material to which the layer adheres, with a consequent creation of heat. Sound energy is also used up when it generates vibrations in windows, doors, partitions, etc. The amount of energy in sound is small, an average voice having only about one-millionth of the energy needed to operate an ordinary electric lamp, which means that but little heat is generated when sound is absorbed.

HEARING

The limits of sound that can be perceived by the normal ear are shown by the diagram in *Fig. 1*. The lower heavy line (threshold of hearing) shows the faintest sounds that can be perceived, while the upper curve locates the loudest sounds that can be endured without harmful effects. Ordinary speech sounds lie between the frequencies of 100 and 8000 cycles per second, but musical sounds cover a greater range. The intensity range that can be tolerated lies between zero decibels (threshold) and 120 decibels, the latter sound being very loud, as explained later.

Many people are hard-of-hearing, a fact that must be remembered in adjusting the acoustical conditions in rooms. For a hard-of-hearing person, the threshold of hearing curve lies above the one shown in *Fig. 1*, indicating that the fainter sounds, including some of the sounds of speech and music, cannot be heard by the person, and that some sort of hearing aid may be needed.

APPLICATIONS IN ACOUSTICS OF BUILDINGS

The procedure followed by acoustical engineers in designing acoustical treatment is, first, to anticipate the possibilities of noise before a building is started and to make provision to reduce the disturbances. The second procedure is to adjust conditions so that the wanted sound will be loud enough and undistorted.

A detailed account of acoustical treatment is not possible in a brief article, but some general principles may be discussed. Consider the disturbances set up by a typewriter in an office. It generates a "click" when a type

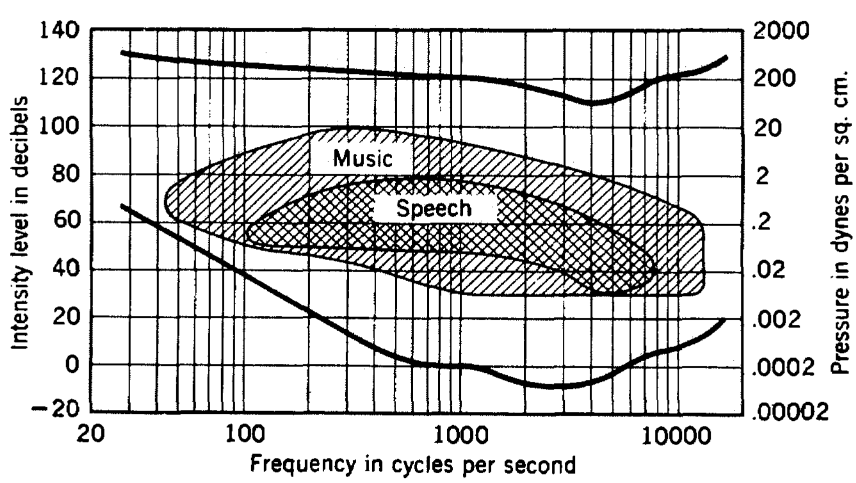
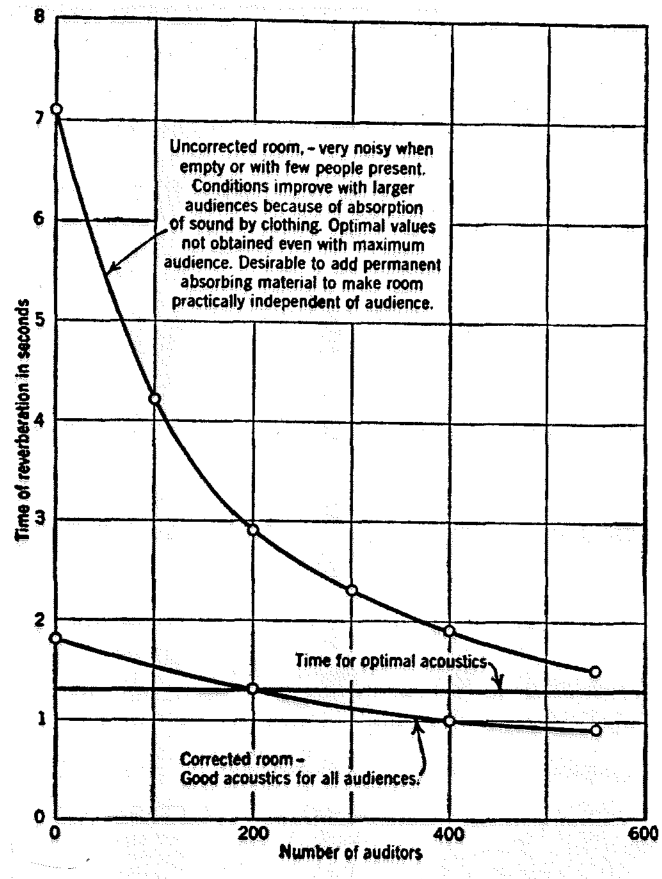


FIG. 1. (Left) Limit of sound that can be perceived by the normal ear.

FIG. 2. (Right) Reverberation time for auditorium as a function of the size of the audience.



hits the paper and a "thump" when the carriage is stopped abruptly after each click. The click sound is effectively stopped (reflected) when it meets a solid boundary of the room, and if this boundary is lined with sound-absorbing material, much of the click sound disappears. The thump creates a vibration that is communicated to the table, then through the table legs to the floor, where it spreads out through the solid structure of the building and may be heard, usually in the room below. An elastic felt cushion under the machine presents an effective reduction in the transmission of the disturbance. This same procedure applies also to other machines, such as calculating machines, motors, etc., but more drastic action must be taken for these more intense disturbances. Grouping noisy machines in separate rooms allows a better control of the sound by mounting each machine on an elastic support and by installing sound-absorbing material on sound-proof walls.

The theory and practice of insulating machines is a large subject in itself. The resonance frequency of the elastic support is an important factor compared with the frequency of the machine that is supported. If the two frequencies are the same, a resulting motion is set up with a large amplitude that may result in damage. Gen-

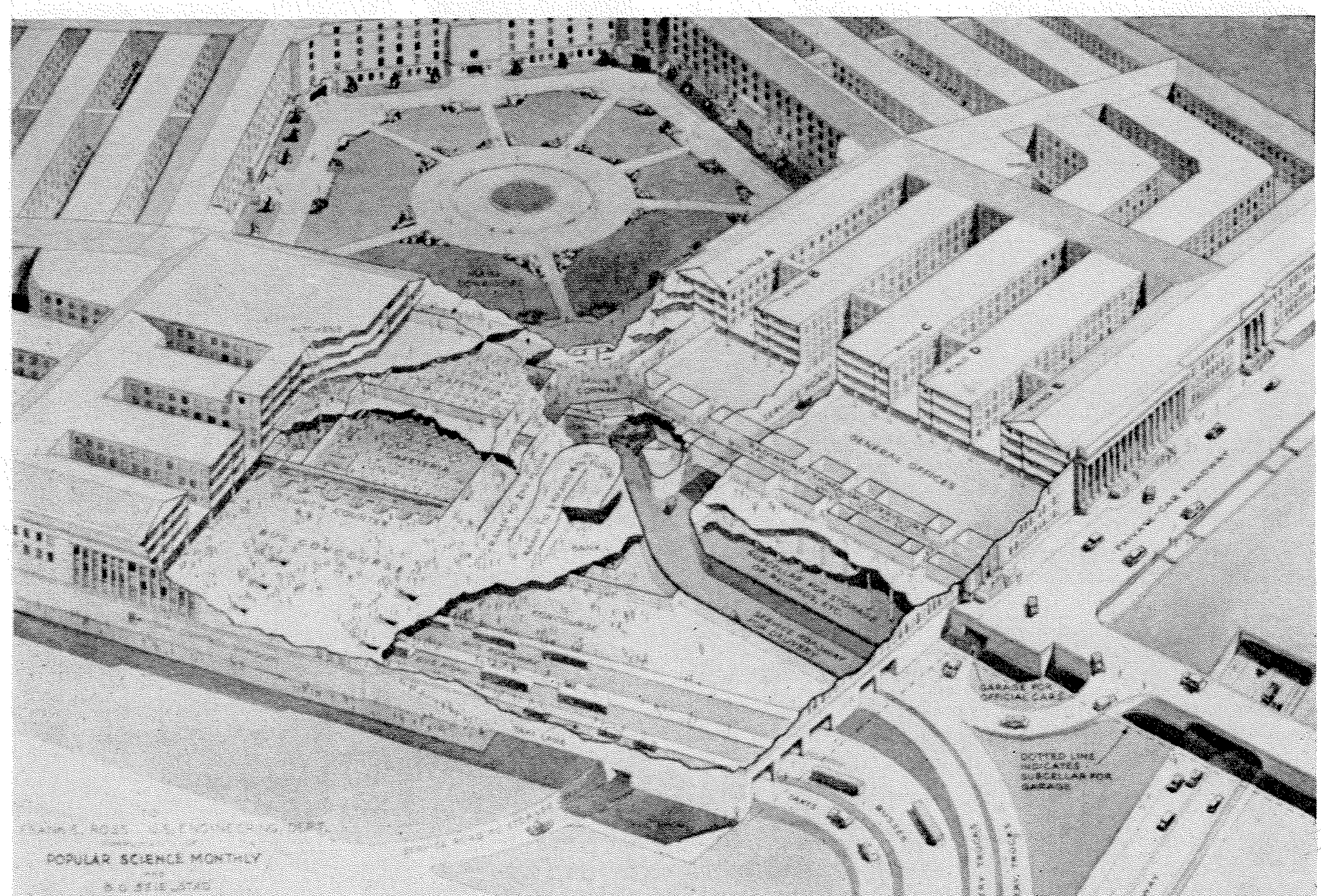


FIG. 3. Pentagon Building.

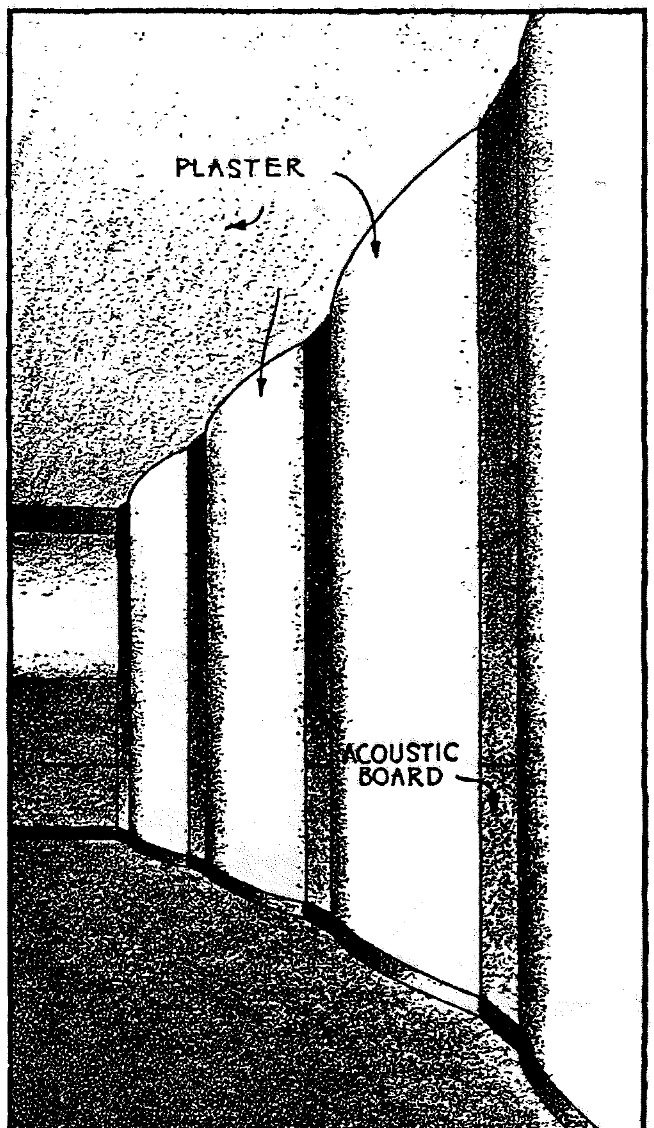


FIG. 4. Acoustic treatment of walls with convex panels—Pentagon Building.

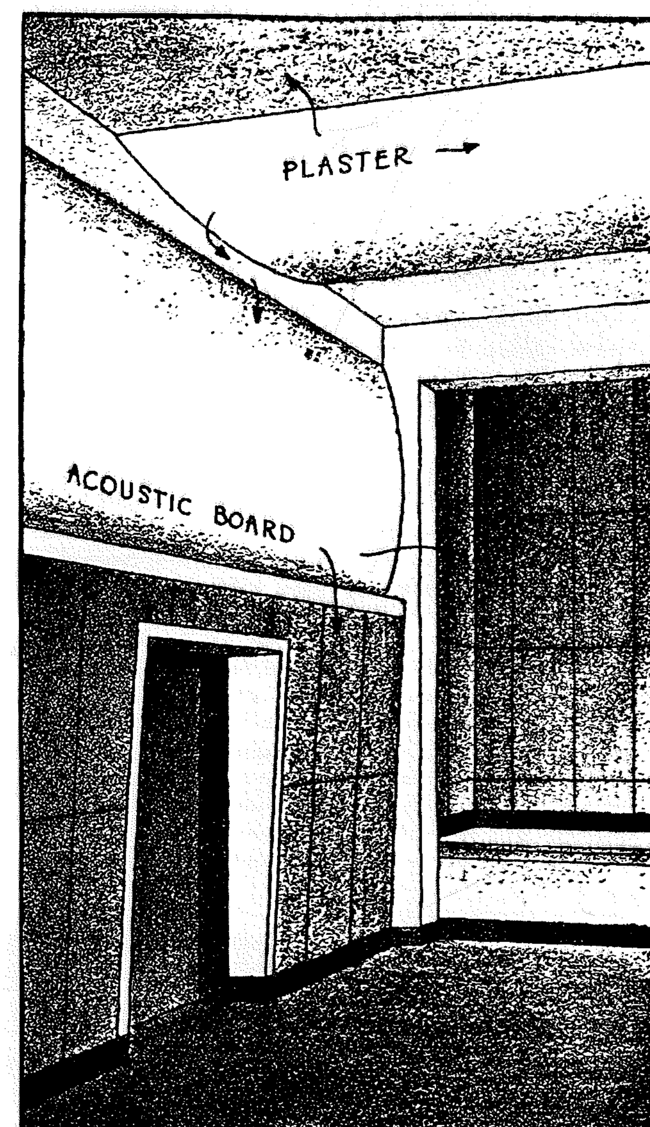


FIG. 5. Acoustic treatment of ceiling with convex panels—Pentagon Building.

erally, high-frequency machine vibrations require an elastic mounting of low frequency and without friction, but low frequency or impulsive vibrations should have an elastic mounting *with* damping. (See *Mechanical Vibrations,* by J. P. den Hartog, and other texts.)

Air openings between rooms, such as ventilators, transoms, cracks under and around doors, etc., allow easy transfer of sound. Doors and windows transmit more sound than the adjacent thicker and more massive walls. Unless these defects are corrected, it will be a waste of effort to construct sound-proof walls. Ventilators can be equipped with baffles and lined with sound-absorbing materials; doors and windows can be made tight-fitting. When effective insulation is wanted, double doors and windows should be installed. Generally, the objective is to make all the boundaries of the room equal in stopping sound.

Noise is measured in units called decibels. The intensities of sounds that the ear can tolerate range from a threshold sound—one that can barely be perceived—to that of a very loud sound, such as a nearby airplane, that may be as much as 1,000,000,000,000 times greater than the threshold. Such large numbers were found to be awkward to use in practice, so that smaller numbers were obtained by taking logarithms of the intensities. The decibel difference between two sounds of intensities I_1 and I_2 is given by the equation:

$$db = 10 \times \log_{10} (I_2/I_1)$$

where *db* is the usual abbreviation of decibel. For example, if I_1 and I_2 represent respectively the intensities of one musical instrument and 10 similar instruments, the *db* difference between them is: $db = 10 \times \log (10/1) = 10 \times 1 = 10$ *db*. It might be remarked further that the 10 instruments would appear to be only about *twice as loud* as one instrument.[1]

ACOUSTICAL ADJUSTMENT OF ROOMS

A sound in a room proceeds rapidly outward in spherical waves with but little absorption until a surface is reached. Here the sound suffers some absorption and is reflected to another surface for more absorption and reflection, and so on until it becomes inaudible. For example, in a room with a volume of 100,000 cubic feet, bounded by 20,000 square feet of hard plaster walls and wooden floor that absorb an average of three per cent of

[1]Fletcher and Munson, *Jour. Acous. Soc. Amer.*, 9, 1, 1937.

the sound at each reflection, calculations show that while the sound is decreasing in energy to one-millionth of its initial value it will be reflected 461 times and will travel a distance of 9,220 feet in a "time of reverberation" of 8.22 seconds.[2] Under these conditions, the acoustics will be very unsatisfactory. Before one word of a speech dies out, several later words will have been uttered and will have been mixed with the earlier ones, thus producing a confusion that makes it almost hopeless for an auditor to understand what is being said. The obvious improvement is to make the sounds die out quicker by making the room more absorptive.

The correction is brought about by installing sound-absorbing materials on the boundaries of the room. The amount of absorption needed is calculated from the simplified form of the general reverberation equation:

$$t = 0.05V/a$$

where t is the time taken for a sound to decrease to one-millionth of its initial value, V is the volume of the room in cubic feet, and a is the total amount of sound absorption. For satisfactory acoustics the time should be reduced to about two seconds for a large auditorium of 1,000,000 cubic feet, with greater reductions for smaller rooms. Details of calculation may be found in texts on the subject.[3] *Fig. 2* illustrates graphically how a reverberant school room may be corrected.

RESONANCES

The action of sound in a room as just described is modified by what are called normal modes of vibration. That is, sound proceeding in certain directions is amplified when successively reflections cause the waves to unite so as to make these particular sounds louder. This result is noticeable in a bath room which has highly reflecting surfaces whereby sounds of appropriate frequency are increased in volume. The equation for the frequencies, f, of these "normal modes," as they are called, is as follows:

$$f = \frac{c}{2}\left[\left(\frac{p}{l}\right)^2 + \left(\frac{q}{w}\right)^2 + \left(\frac{r}{h}\right)^2\right]^{\frac{1}{2}}$$

where p, q, and r are numbers, 0, 1, 2, 3, etc., for different modes; l, w, and h are respectively the length, width, and height of the room; and c is the velocity of sound. As an example, if $q = 0$, $r = 0$, then $f = cp/(2l)$, which gives the normal vibrations parallel to the length of the room. If the length of the room is 10 feet, the velocity of sound 1,120 feet per second, and $p = 1$, then $f = 1{,}120/(2\text{x}10) = 56$ cycles per second. For $p = 2$, $f = 112$ cycles per second, etc. Similar vibrations can be set up parallel to the width and height of the room. Diagonal vibrations can also take place as for example, when $p = 1$, $q = 1$, and $r = 0$.

Resonances are objectionable because they amplify some frequencies more than others, thus interfering with a uniform distribution of sound in a room. What is desired are conditions that will allow all auditors wherever they may be located to get satisfactory hearing. One method for correcting the difficulty is to modify the walls and ceiling by convex panels which diverge the reflected waves, thus reducing the possibilities of resonance and increasing the uniform distribution sound. Sound-absorbing materials installed between the convex panels serve to control the reverberation and also to reduce the noise level in the room.

PUBLIC ADDRESS SYSTEMS

A very important new development in the acoustics of rooms has been brought about by the use of public address systems, which might be designated more appropriately as sound-amplifying systems. These consist of a microphone that "picks up" the sound of speech or music and converts the sound energy into an electric current, which is amplified and reconverted back into a louder sound that is emitted from an electric loud-speaker directly to the audience. Thus, instead of the comparatively weak sound of the speaker's voice that spreads out in spherical waves to all parts of a room, the loud-speaker emits a powerful beam of sound that is sent directly to the area occupied by the audience. This arrangement is comparable to the action of an automobile headlight on a foggy day that serves to reveal the presence of the automobile to oncoming cars. The loud-speaker may be regarded as an acoustic headlight that pierces the "fog" or reverberant sound in the room and "shines" on the auditor, thus allowing him to "see" (hear) the sound. A satisfactory sound-amplifying system allows all the auditors in the room to get sufficient sound, those in the rear seats getting just as loud sounds as those in the front seats near the speaker. The system also raises the sound level, which tends to hold the attention of listeners more effectively than the usual weaker sounds of speaking—a feature that is welcomed particularly by the hard-of-hearing.

IN THE PENTAGON BUILDING

An opportunity for the application of the acoustical procedures just described was given in The Pentagon. First of all, a noise survey was conducted in various public buildings in Washington to obtain information about the disturbances to be expected in The Pentagon Building, which was then in the process of construction. Sound-level readings were taken of the noises of calculating machine rooms, elevators, air-conditioning machinery, cafeterias and the Union Depot. An investigation was also made to get information about available sound-absorbing materials. Large samples of these materials were mounted for inspection, and detailed data were collected concerning the qualities of the products and the cost of installation.

Fig. 3 gives a perspective of The Pentagon. It reveals a large variety of rooms and spaces, starting with the bus terminal on the ground floor, the large concourse over it, cafeterias, lunch rooms, a multitude of offices, miles of corridors, etc. The perspective shows five concentric pentagonal buildings about the central court, connected by radiating corridors. The building covers 32 acres, including the 6-acre court, and is expected to accommodate as many as 40,000 people.

The chief features of the acoustical treatment are given as follows: Machinery for the air-conditioning system and for other purposes was placed on the top floor, remote from the main activities of the building, in rooms that were sound-deadened and that were equipped with sound-proof walls when they were adjacent to offices. The machines selected were chosen from the "quiet-running" types and were mounted on elastic supports. On the ground floor, the bus terminal ceiling was covered with a material (metal-clad rockwool) that was highly absorptive, fireproof, and could be cleaned or painted without acoustic loss. In the hundreds of office rooms, the ceilings were deadened with various types of materials. The noise of the Lamson tube system was reduced by a special device for minimizing the explosive sound when packets left the tubes, and by deadening material in the central control room and in the outlets in different parts of the building. A small auditorium and several review rooms received special study. Convex panels in the walls and ceiling were used to promote uniform dis-

(Continued on Page 18)

[2] F. R. Watson, *Acoustics of Buildings,* 31.
[3] V. O. Knudsen, *Architectural Acoustics;* P. E. Sabine, *Acoustics and Architecture;* F. R. Watson, *Acoustics of Buildings.*

View of mile-high Andean peaks, taken from Panagra airliner, already at an altitude of more than two miles.

RHUMBA RUN

By BRADLEY YOUNG

EDITORIAL NOTE: The October issue presents the second instalment of Rhumba Run, by Bradley Young. The first instalment was printed in the previous issue of Engineering and Science.

TROUBLE

The impetus gained in the Chaco carried the company on up until 1936. It was at this time that trouble began to develop, not only in *Lab* but in other South American concerns with large German elements. Pro-Nazi and anti-Nazi began pulling and hauling against each other. These people were pure German colonists and not refugees, for the influx of the latter had not yet started. In La Paz and other Bolivian towns the German concerns were about equally divided with a predominance if any of anti-Nazi feeling. In Cochabamba, the German Club was split with the majority anti-Nazi. *Lab*, with the exception of Schroth, was the same way. Schroth, not interested in Nazi politics, was pro-Schroth to the complete exclusion of everything else.

By 1938 the Nazi plan for the South American airlines in their control began to become quite clear. Lines that had been started in the various countries as isolated organizations were to be linked into a great network covering the continent. It was to be possible to go from Cartagena to Santiago, from Lima to Rio on the German lines. *Lab*, Condor in Brazil, *Sedta* in Ecuador, *Scadta*, and the new Lufthansa in Peru were all to have their part. In Peruvian Lufthansa, the last German airline to be formed in South America, the Nazis even abandoned their former pretext of giving the company a Latin name. The planes flew openly with swastikas painted on their sides. Now, with the weather permitting, a person could leave Lima on Tuesday morning and arrive in Frankfort-am-Main the following Sunday, following a route that included La Paz, Rio, Natal, and the South Atlantic. The Nazis were just about to carry out the final linking-up of their network in early 1940 when the going got tough.

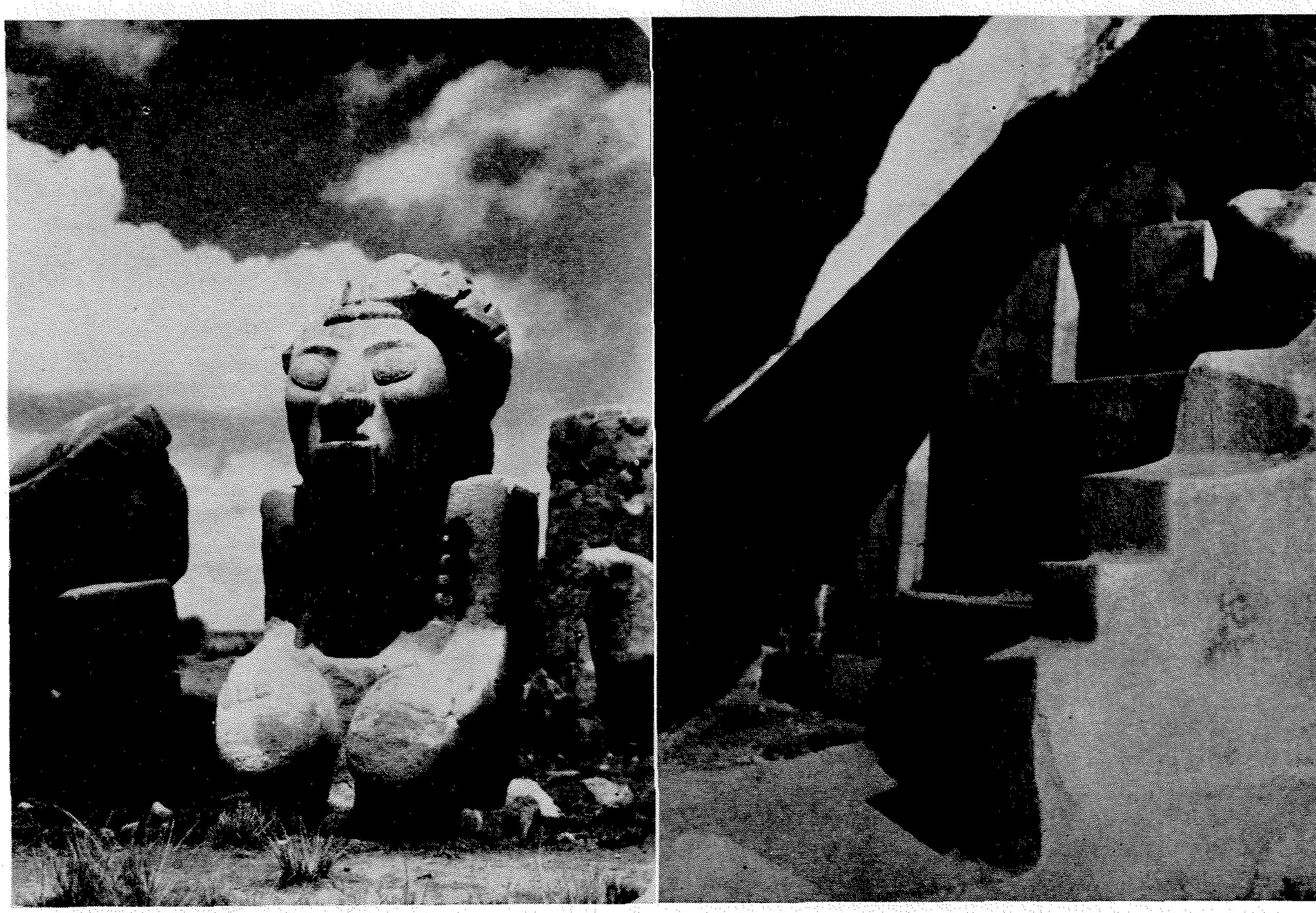
Most of their South American flying was being done with the Junkers JU-52, the tri-motor that operated so successfully as a paratroop carrier in Norway, Greece, Holland, and other invasion spots. This was and still is a real airplane, an efficient and sturdy aerial work horse turned out by the Germans in greater numbers than any other plane ever built. No airplane, however, is any better than the supply of spare parts necessary for its upkeep. Even if the German High Command were willing to release these parts, as they no doubt were, their shipment to South America was becoming a virtual impossibility. *Lab* was in a better position than most with regard to airplane spares, having large overstocks that Schroth had purchased to get his usual commission. Engine spares were another story. Schroth, with a technical education that enabled him to judge good machinery from bad and a pilot's respect for his own neck, had consistently refused to use German engines. He chose instead those good old New England Pratt and Whitney Wasps and Hornets. These motors to all external appearances had exact duplicates in the engines put out under Pratt and Whitney License by the Benz Motorwerke. Appearance was the only point in common. Material, manufacturing precision, and the resulting reliability of the German copies were poor. All the time it was becoming more difficult to obtain United States export permits on needed engine parts. Obtaining aviation fuel became another nightmare. South American, Canadian, and United States firms were not so willing to release large quantities of high octane gasoline and the aircraft engines would not operate successfully on anything less. This was one of the things that caused *Sedta* to suspend their Ecuadorean services early in 1941 after some sad experiences in attempting to use automotive gasoline. Air France had ceased operating between Buenos Aires and Santiago, Chile, after the French armistice a year earlier. German control of *Scadta* in Colombia had been done away with some time before. By the time the South American Fall season came around in May of 1941 things really began to happen. The Bolivian Government in carrying out an investigation of *Lab* found the company had not lived up to their managerial agreement. They terminated the company's contract and appointed a governmental committee to take over. Schroth was called to the carpet at La Paz. It was found that commissions received on parts ordered by himself were not the only advantage he had taken of his position and the company. There was a little matter of hardwood hauled in free by plane from Santa Cruz, and the use of company labor and trucks on a house building job.

About the time of the Bolivian investigations the United States Congress passed bill number HR 4674. This broadened the powers of the Federal Loan Administration to the point where they could financially aid South American republics seeking to nationalize their Axis-controlled airlines. The Bolivian Government promptly took advantage of this, and in June a three-way agreement was made between the Government, *Lab*, and the Federal Loan Administration. Among other things this agreement made it possible for *Lab* to obtain a considerable amount of badly needed working capital and some modern transport planes of United States design. *Lab* also secured the services of Pan American-Grace Airways in an advisory capacity. *Panagra* was granted the authority to extend its line from La Paz on to Corumbá, joining *Panair do Brasil* at that point. This was the Rhumba Run.

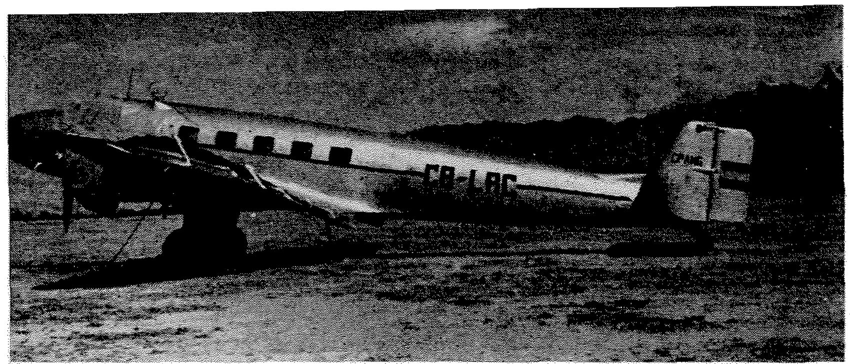
In July Axis boats were sunk and burned by their crews in ports throughout the Americas. In Peru two were scuttled at Callao. To the north in Paita one was burned. On the same day that these three boats went to Davy Jones' locker, various German diplomatic envoys to Peru took off in a Lufthansa Junkers from Lima and were gone all day. Whether they were scouting Peruvian cruisers, directing Nazi submarines or just up for the ride no one knew. At any rate the flight was an unscheduled one over proscribed territory and certainly not in the realm of commercial air transportation. To the Peruvians this was the last straw. Lufthansa was promptly grounded, its planes taken into custody, and its buildings vacated, and placed under armed guard. In Ecuador the spasmodically operated *Sedta* closed completely. The next few months saw the total eclipse of Axis airlines in South America.

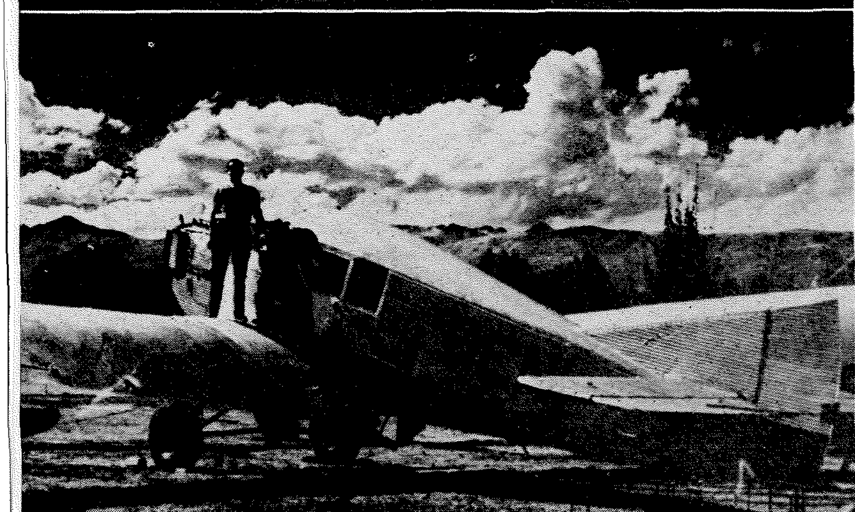
FUTURE POSSIBILITIES

This first big step, nationalization of the airlines and ousting Nazi control, is only the beginning of the problem. Nowhere is this more true than in Bolivia. Here air transportation has opened and can continue to open new ground. In order to do this and survive, the airline must continually seek new commodities to haul and new



Rhumba Run passes over the ruins of Tiahuanaco, birthplace of western civilization.





AT LEFT:

UPPER: Junkers 88 at Cochabamba. CENTER: Loading for take-off at airport of Lloyd Aero Boliviano. LOWER: The Beni Junkers 13.

markets to haul them to. Surely the possibilities are interesting enough. Fresh meat in Cochabamba is 10 Bolivianos a kilo, approximately 10 cents a pound. In Trinidad a scant 200 miles away the price is three cents a pound. Such a price is no great incentive for the Trinidad farmer to raise many cattle. With a large market he would raise more. This would mean more money to buy the hundred things he wants available only in La Paz and Cochabamba.

The Bolivian likes his beer. The bottle he buys in La Paz for four Bolivianos 30 costs 20 Bolivianos in Cobija. About half the weight of a three-pound bottle of beer lies in the bottle itself. This doesn't make for economical air transportation. As a consequence, any bottle that goes into Cobija stays there. A curb of beer bottles surrounding a house is a mark of distinction. This is rightfully so, for any person who can afford to drink enough beer at 20 Bolivianos a bottle to surround himself with the empty glassware is a person of no little wealth and prestige. A solution here would seem to be the shipment of beer in cans or other cheap lightweight containers. The revenue traffic need not be all one way. Now, as never before, the Allied Nations need rubber. The grade known as hard fine Pará that brings 45 cents a pound in New York from those lucky persons with a high enough priority to buy it, sells for 30 cents a pound in Cobija.

SUPPLY PROBLEMS

These opportunities that make an airline so desirable to Bolivia exist in part due to the geographical barriers that hinder surface transportation. As such, the opportunities bring their own difficulties. Lack of surface transportation for very heavy goods is the purchasing agent's nightmare. Consider the little matter of gasoline. High octane gas for the western part of Bolivia is made in refineries at Talara, a Pacific port on the north coast of Peru. From Talara south to Mollendo it is carried by boat, then trans-shipped by rail to the high shores of Lake Titicaca. Here it is put on a steamer for the lake crossing to Guaqui on the Bolivian side. From Guaqui the gasoline rides the rails again to La Paz, Oruro, Cochabamba, and other Altiplano way points.

For eastern Bolivia gasoline moves out of Montevideo on the Atlantic, up the River Plate past Buenos Aires, and into the Paraná. It is a long pull up the Paraná to Corrientes where the smaller Paraguay branches off. This is not the last lap though, for the fuel must be pushed 600 miles further upstream to Corumbá. At Corumbá trucks drive hub deep into the waters of the Paraguay, unloading the gas drums from river boats grounded on the mud. Corumbá is the jumping-off place for wagons that haul the fuel across the Brazilian border and into the Bolivian interior. It sounds, and is difficult.

The problem of moving gasoline into the eastern and western sections of the country is trifling compared to the problem of supplying northern Bolivia. Moving gas to Trinidad serves as a good example. The scant 200 miles that separate Trinidad from Cochabamba and the fuel brought in from Peru might as well be 10,000. Fuel destined for Trinidad is loaded on board ship at New York harbor docks. The 3400 mile haul between New York and Pará at the mouth of the Amazon is the easiest part of the trip. Loaded on the decks of river steamers the gasoline starts up the Amazon and finally arrives at Manáos. This famous town of the old World War I rubber days is as far as the large boats go. Here the gasoline is transferred to smaller craft. After coming back down the Amazon 75 miles the boats turn south into the Madeira. From the mouth of the Madeira to Porto Velho is a tortuous 800 miles further into the jungle. This last point is the head of the most fantastic set of tracks any engineer ever had the nerve to lay and call a railroad. There is a sad claim made that it cost the life of a man for every tie. This probably comes closer to being a statement of bald conservative fact than anyone would care to admit. From Porto Velho the fuel goes over these tracks to Guajará-Mirim and then back again to the decks of other still smaller river boats that ply the Rio Mamoré. Their cargoes are an odd assortment of merchandise. Piles of Brazil nuts are loaded on board with coal scoops from mounds along the river bank. They ride next to crates of graniteware washbasins from Chicago. Next to the washbasins are stowed cases of black Brazilian cigars and machetes from Collinsville, Connecticut. The abilities of the crews are as diversified as the goods they handle. The captain of one of the boats is a grinning Brazilian who worked at Hog Island in 1918. He loves to spread his English. It is a Portuguese-modulated Brooklynese slang of 20 years back and funny as hell.

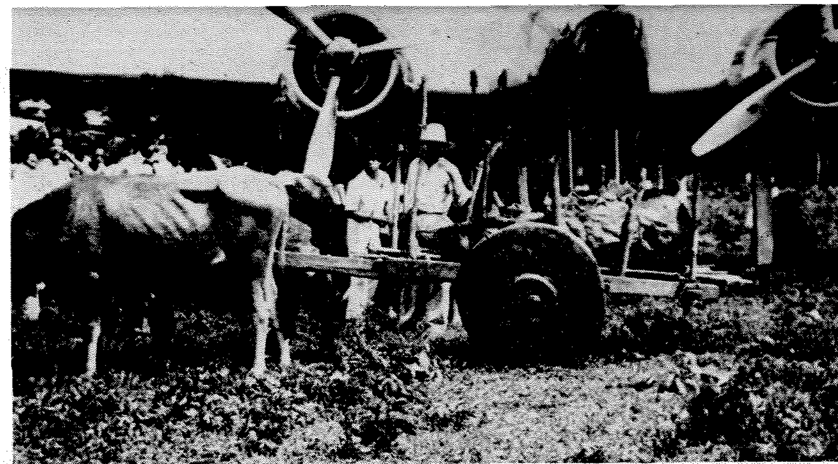
The trip of the now well-battered drums upstream on the Mamoré is a slow one. The river winds in great coiling loops, nearly doubling upon itself in countless places. At these spots it is frequently possible to cross on foot in 20 minutes a neck of land separating two sections of the river that are four hours apart by boat. One of the most unfortunate features of the entire route is the fact that Trinidad does not lie directly on the Mamoré. The fuel is off-loaded from the boats at La Loma or Puerto Almacen. From here the last haul must be made in ox-carts. Gasoline arrives in Trinidad 6000 miles and six months away from New York's East River piers.

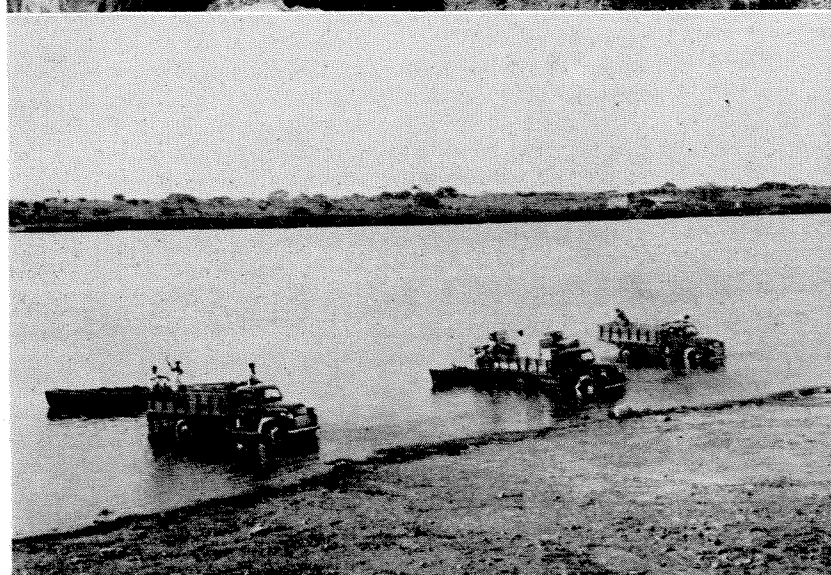
The final needle is this: with due allowance for delays due to torpedoed freighters, customs red tape, river boats aground, and just plain delays, the shipments must be scheduled to arrive at their last stage during three specific months of the year. These months comprise Trinidad's alleged dry season. Missing them may mean a fuel shortage for the remaining nine months of the year until the trail dries up again. The consequences of such a shortage are too sad even to think about.

PILOTS' HEADACHES

The purchasing agent isn't the only one with troubles. The pilot has his too, mostly made by the Andes, the jungle, and the weather. Last September, Sam Park, veteran United States pilot, ferried *Lab's* second Lockheed Lodestar obtained under the reorganization plan from the States to Bolivia. A month later he again flew down over the same route with another Lodestar. With him came Ernie Gann, pilot on leave from Eastern Airlines. Gann, naturally curious about the ground he was to fly over, asked Park beforehand what the route was like. Sam promptly informed him that the land was indescribable, that he would have to wait and see. Upon their arrival in Cochabamba Ernie remarked: "Well, we're here—I've seen it—but I still don't believe it. We flew over Lost Horizons without the Shangri La." This reaction is always a surprise to the local *Lab* pilots who have never flown anywhere else.

One of these boys is Luis Torres, a tall, Latin, young Bolivian of unfailing good nature and excellent natural





AT RIGHT:

VIEW 1: The airport stationwagon at Riberalta waits to serve passengers from a South American plane. VIEW 2: Way-point passengers on the Rhumba Run may reach their ultimate destination by a llama train on the Altiplano. VIEWS 3 AND 4: Gasoline is more precious than diamonds on the Rhumba Run. Aviation gasoline must be high octane, which for the eastern part of Bolivia is made on the north coast of Peru, from whence it is carried by boat and trans-shipped by rail to the high shores of Lake Titicaca. Here it is put on steamer for the lake crossing to Guaqui on the Bolivian side. From Guaqui the gasoline again rides the rails to La Paz, Cochabamba, and other Altiplano way points.

flying ability. One day in the course of a rather rambling conversation the author happened to mention that United States domestic airline pilots didn't generally consider terrain runs as being among their easier flying assignments. Luis questioned the unfamiliar use of the word "terrain," and was informed that it applied to a route spanning rough or mountainous country. Still somewhat mystified he remarked that he had always thought of the United States as being nearly flat and therefore probably a very dull place to fly over. When pressed further, the author finally had to admit that a route over the Appalachians of not more than 7,000 feet might be classed as terrain. The ensuing laughter was certainly prodigious. Luis has lived most of his life at an altitude above 8,000 feet. He spends a great part of his flying time over country much higher and more rugged than the Appalachians. Typical of this mountain country is the terrain around the *Nudo* of Apolobamba. The *Nudo* is a great confused knot of lofty intersecting spur ranges and deep *quebradas* or canyons that lie along the line between La Paz and Apolo. In this area are at least 50 peaks topping Mount Whitney, highest in the United States. It would be possible to sweep the entire Alps into the *quebradas* of this region like so much dirt into a floor crack, and with scarcely more remaining evidence once the job were completed. The weather around the *Nudo* is something to contend with, too. During the winter season it is a region filled with what the airman terms hard center clouds. A hard center cloud is any cloud with a mountain peak deceptively wrapped up and hidden within it.

Even if the western section of Bolivia were as level as a billiard table, its altitude would still have a vital effect on *Lab's* planes. An airplane depends upon the density of the air for its support; the power of its engines is strongly affected by this same factor. At an airport such as La Paz on a warm day the air density will drop to only 70 per cent of what it is at sea level. An airplane that jumps from a sea level airport like a frightened flea may not be able to more than stagger off the ground at La Paz. A few years back one wise-guy pilot tried to fly from Arica to La Paz and return in a small light plane inadequate for the purpose. The trip going up was fine. He rode back in a chair car, his plane loaded on a coal gondola behind.

Not long ago the same Luis Torres previously mentioned made what was without doubt one of the most difficult take-offs ever attempted from a location considerably higher than the La Paz airport which lies at 13,400 feet. The place was the Pampa of Chilligua, 15,000 tapeline feet above sea level. With the high air temperature involved the "density" altitude topped 19,000 feet, higher than most airplanes ever fly. To make the problem doubly difficult, the plane was a Grumman amphibian. The comparatively unstreamlined amphibian, having both a hull seaworthy enough to withstand the shock of water landings and a retractable undercarriage to permit land operations, is an airplane of definite and obvious advantages for certain types of service. These advantages are inexorably paid for by a slower climbing ability, lower payload, and inferior take-off performance as compared to a single purpose airplane of the same size. Mr. Grumman's amphibian as turned out in his Long Island plant is a very nice airplane. It is a safe bet though that he never planned it for take-offs at 19,000 feet. Nobody ever designed any airplane, amphibian or otherwise, to meet that kind of requirement. Standing by the Grumman at Chilligua, the air so thin that breathing alone was a real effort, the author could not help but think of a remark he once heard an airplane pilot make at Albuquerque, New Mexico. The pilot was preparing to lift his DC-3 transport from more than a mile of surfaced runway. He said he never liked to take off from Albuquerque, it was too high. Albuquerque is a bare 8,000 feet above sea level. Torres plowed up three miles of soft sand before he boot-strapped the Grumman into the air at Chilligua. His take-off run took so long it could almost have been timed with an alarm clock.

JUNGLE TROUBLES

On the Altiplano the airport runways have to be long. Most of these, built on salt flats or other dry level ground, are relatively easy to construct. It is a good thing that all Bolivian airports don't take quite so much room, particularly in the northern and eastern sections. Whacking an airport out of low and swampy jungle country isn't a particularly easy or joyful job. Getting dump trucks, graders, and the big caterpillars to pull them in on the airport sites is a tough piece of work in the first place. It is nothing, though, compared to the task of keeping them going in the sticky red mire that must be cleared, leveled, and drained to make a decent field. The Nazis, during their regime, didn't do much more than the absolute minimum required to accommodate the slow flying and short landing characteristics of "Die gute Tante Ju." Even then they had more than a normal quota of nosed up landings, marcelled propeller tips, and the grief that an airport too short on one end can bring. The advent of heavier modern planes with faster landing speeds such as the Lockheed Lodestar and Douglas DC-3 made field extensions mandatory.

A number of survey flights were made on the Rhumba Run with the new equipment before starting regular service, and prior to the extension of the airports. After one of these, Frank Achilles, a *Panagra* pilot, came back to Lima firmly declaring he had found the only sure way of getting a DC-3 into the field at San Jose. His formula ran as follows: "Get the flaps and gear down, then try to take the top off of the Mission tower. If you miss the tower, aim the wheels at the runway fence. But mister, if you miss that fence pour on the coal and come around again, because you've overshot."

Sometimes the American concerns that furnish equipment and materials for the airport extension work aren't any too understanding of the problems involved. At Concepción some trouble was met in clearing out nests made by driver ants. These ants, which at times travel in armies a hundred yards wide and many times as long, are extremely vicious. In the space of a few hours they can take the hide and flesh of a full grown wild ox down to bare polished bones. Their nests are three-foot mounds of clay laboriously deposited pellet upon pellet. Something in the secretion used by the ants to moisten their building clay makes these pillars almost rock hard. They could as easily rip a wheel from a landing airplane as could a concrete post. In looking for something to destroy the ants it was decided to try a certain disinfectant company, a United States concern advertising themselves as one of the oldest, largest, and most experienced makers of insecticides in the business. One afternoon some three months later a crew flew into Concepción with the anxiously awaited remedy on board. After the usual scramble for the mail, this package was opened. Its contents consisted of a dozen small squat glass jars of ant paste, fitted with covers perforated like a salt shaker. No self-respecting driver ant could even get a mandible through

(Continued on Page 15)



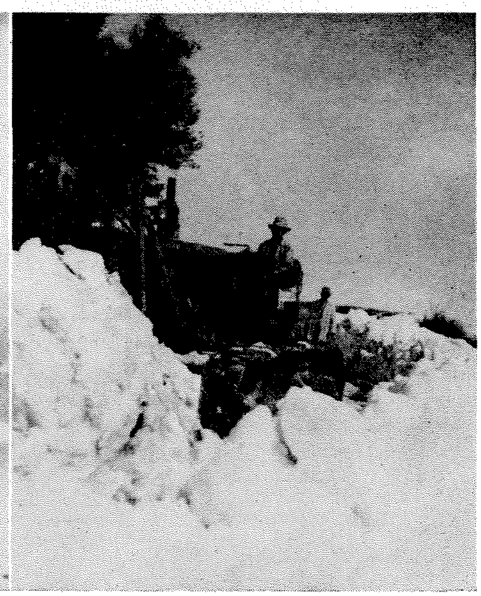


FIG. 1. (Left) Rotary snow plow in action—Big Pines Road. FIG. 2. (Center) Another view of the rotary snow plow in action—Big Pines Road. FIG. 3. (Right) Bulldozer on Mt. Wilson, March, 1944.

Snow Removal

By EARLE A. BURT

THE PROBLEM

ASSOCIATING thoughts of snow and those of a warm climate is not uncommon and, offhand, one might conclude that the removal of snow from the highways of this area could be accomplished by allowing the same invariable natural laws to operate as, in our imagination, dispose of the proverbial "snowball" and the "paraffine dog." Such a conclusion, however, fails to take into account many of the elements of the problem and consequently it may be of interest to consider a few of them. In giving this consideration, it may be well to bear in mind that extensive variation occurs in other parts of the country and that this particular analysis relates only to southern California. Many of the ideas expressed are the result of practical solutions of an interesting problem.

A number of miles of important highways in this area traverse districts where elevations of from three to seven thousand feet are common. From November to March, these districts are subject to snowfalls of from a few inches to seven or eight feet. If no attempt at cleaning is made, important establishments, such as weather bureau stations, scientific observatories, and other inhabited establishments, are isolated for several months and main arteries, such as the Ridge Route and Angeles Forest Highway, are closed. Invariably, also, visitors in the forest area are snowed in and prevented from returning to important duties in the nearby cities. In addition, it should be noted that utilization to the fullest extent of the recreational area provided by our nearby forests can be accomplished, especially in peacetime, only by making them accessible for snow sports.

OPERATIONS

With this brief summary of the situation in mind, some of the practical features of snow removal may be considered. Probably the most difficult part of the problem arises from the extreme variations in the volume to be handled. In many locations there is no snowfall at all for periods of several years; then the really unusual weather occurs and there is a fall of several feet and, as might be expected, no adequate equipment is available, not even a good snow shovel. In many locations, falls of less than a foot occur for many years and then a record of five or six feet is noted. Operations also are complicated by the fact that many of the roads involved are rather narrow on side hill locations, and have many curves. Often, the section requiring attention is remote from sources of qualified operators and equipment.

Probably the most universally accepted rule in snow removal is to start clearing when it starts snowing. This practice, however, in our mountainous areas does not result in a perfect record, although nearly so. It is unbelievable how quickly, on a few occasions, that lovely blanket of fluff can settle down and stop the most powerful equipment. In addition, the development of snow slides during a heavy fall is a source of considerable hazard to men and equipment. To follow the practice of prompt starting of the work, requires trained men on the job with proper equipment. Incidentally, it is of considerable importance that the business end of the equipment be headed out. The operator who stores his plow otherwise, and finds three or four feet to be shoveled by hand before the plow can be backed out, will not soon forget it. It may or may not be true, but it appears that most of the snow falls during the night. After men have the experience of getting out during the night, time after time, and then finding that a fall of a few inches could just as well have been swept off in the morning, it becomes more and more difficult to keep them convinced of the necessity of prompt action.

Some very important steps can be taken during the summer months. They consist of: placing snow stakes six or eight feet high to indicate the location of the roadway and the location of drainage structures, such as culverts, ditches and outlets; careful clearance of rocks and other debris, which is a wrecker of rotary plow equipment; provision of adequate drainage channels because of the runoff which occurs under the snow; and, of great importance, the preparation of equipment for the fight to come.

To start promptly in storms that begin during the daylight hours presents no particular problem, but the important feature is to enlist the services of someone who works nights, to inform the gang of the first flake that falls. With this help, a light blade plow can be under way within an hour of the beginning of the storm. Our interest is inclined to center on the spectacular rotary plow, and this is important, but the blower without the blade is seriously handicapped. Conditions vary, but in general accepted procedure consists of starting early with a blade attached to the forward end of a comparatively light truck and pushing the snow to the outer edge of the roadway. On side hill locations only, the outer edge can be used, thus developing the necessity of a reversible blade. In the event that the storm continues during this preliminary operation, the blade plow is gradually restricted in its width of operation, and the rotary plow must be placed in operation to blow the accumulated windrow of snow away from the roadway or over the bank. Both the blade type and the rotary type of plow are seriously affected in their operation by the condition of the snow. During periods of low temperature, when snow remains granular, the operation proceeds with little difficulty, but as alternate melting and freezing take place, it is often found that expert technique on the part of the operator is required to make reasonable progress. In many cases, it is found desirable to stop operations until a change in temperature has altered the consistency of the snow, and thereby to increase the rapidity with which it can be removed.

EQUIPMENT

Considerable study has been made by manufacturers of equipment to perfect the various types of snow plows, one of the simplest designs being the reversible plow for attachment to the forward end of a one-and-a-half ton truck. An effort is made to keep the equipment as light as possible in order to relieve the load on the front axle of the truck. The blade is mounted on a center pin, and can be rotated manually to plow in either direction. Considerable care is given to the curvature of the blade, as this feature has an important effect in throwing the snow clear off the roadway if the truck is able to travel at speeds of 20 or 25 *m.p.h.* In general, the forward frame is supported by arms extending to the rear end of the truck, and the whole mechanism can be raised and lowered by a small hydraulically-operated ram.

The rotary-type plow consists essentially of a simple power drive rotary fan individually driven by a separate gasoline motor. Methods devised to feed the snow to the rotor consist of various blade arrangements or a series of screw conveyors. It is found very desirable to have the rotor arrangement as simple as possible in order to facilitate repairs, because, in spite of the best care possible, rocks will be delivered, and may damage the fan blades. Rotary type plows are, in general, mounted on very powerful four-wheel drive trucks. Careful attention must be given to balance the power and capacity of the rotor with the power and speed of the truck. This is necessary in order that the amount of snow fed into the rotor may not overload it. This feed is controlled by the truck speed. Some of the trucks are able to move at speeds of less than one half mile per hour with motor at full governed speed, thus developing a powerful thrust but at a speed best suited to the rotor capacity.

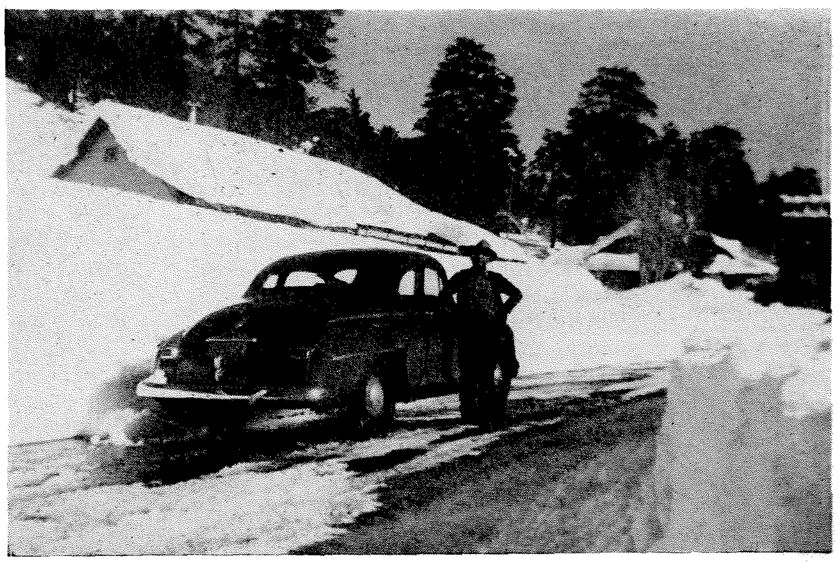
Many other types of equipment, in addition to specialized snow plows, have been found effective as an expedient, or for some specialized purpose. In general, however, such equipment as the bulldozer, the motor grader and the tractor loader is limited in its usefulness in heavy snow by its inability to dispose of accumulations. In addition, the track-laying type of equipment often injures existing road surfaces to a rather serious extent. During the more serious type of storm, conditions involving snow slides, mixed with debris, eliminate the possibility of using plowing equipment, and dictate the use of bulldozers or, in some cases, power shovels. The use of bulldozers, in combination with industrial type loaders, often proves very satisfactory. With this combination, the snow is piled and then shoveled over the side with the loader. One of the serious deficiencies of this type of equipment is the lack of adequate shelter and heating provisions for protection of operators.

BATTLE TO THE END

In many respects, the operation is a real battle against the elements. As a consequence, it cannot be performed on an eight-hour basis. When this job is started, it must be fought through until the storm is ended and the road is clear, or it is lost. This often means continuous operation for 48 hours or more. Equipment must be repaired and supplied with fuel, in many cases, over damaged

AT RIGHT:

FIG. 4. Big Pines Road, 1944.



and partly blocked roads. Operators must be relieved, rested and fed. To accomplish these things, supply stations must be maintained and stocked with essential supplies and materials. Minor repairs, such as replacement of damaged motor blades, are ordinarily made where they happen, but when more extensive repairs are called for, a heated building is required. It is disagreeable enough to make repairs, but when the patient is encased in several inches of frozen snow and ice, it is a discouraging prospect.

Well-constructed, heated, operating compartments on equipment are not only desirable but essential for effective work. In some cases, they constitute the minimum of safety for personnel. In the heavier types of work, at least two men should be assigned to each operation, and, in general, should not separate during the period of storm. There have been cases where near fatalities occurred because one member of a crew attempted to "walk out" when equipment stalled.

The need for well trained, energetic men in snow removal operations is of primary importance. The entire operation appears simple while the sun shines and the ground is bare, but when the fight is on, an inexperienced operator soon becomes a liability, and, in addition to being a hazard to himself and fellow-employees, may cause actual physical damage to the road structure. A case to illustrate this fact was brought about by the plowing of a single roadway in mountainous country during a three foot fall, which created a sluice-way, down which melted snow, water and ice rushed to form an ice jam, which, in turn, diverted the flow over an embankment, and resulted in several thousand dollars' damage which might have been prevented if precautions had been taken.

Snow is an asset to this warm, desirable climate if, like most assets, it is handled with care and understanding. From the viewpoint of purely physical enjoyment, what is more pleasing and invigorating than a drive through the frosty, snow-covered mountains into the summery climate of the valleys below? There are many who have experienced this pleasure and there are many who look forward to it when peace comes again. If you enjoy the ride, just remember that someone has probably toiled through the chilly night to make it possible.

Rhumba Run

(Continued from Page 12)

one of these holes, much less crawl through and eat his fill. The engineer in charge, a man whose temper has been shortened by 20 years of such trials in South America's out sections, took just one look. With an acrid Spanish oath he ripped the cover from a single can. A driver ant, too long to go in any other way, was curled up and deposited inside. This can with the cover replaced was air-expressed back to the manufacturer by the same plane it arrived on.

Much of the airport work is done by Indians. They vary in type and appearance as much as Bolivia's geography. All along the Cordillera are the copper-skinned Quechuas and Ayamarás. An almost pure race, these people still speak no Spanish, only the tongue of their Pre-Incaic forebears. Heavy boned, with enormous chest development and apparently no feeling of cold, they are well adapted to their high environment. The Indians in the low regions are much more primitive. Printed across one jungle portion of the excellent map compiled by the Bolivian Cartographic Commission are the words *Gentios Salvajes*. This means Savage People. Whether these people are really savage or not is a common conversational topic. The consensus is generally with the "nots." But at least they have the equipment for making any unwanted visitor exceedingly unhappy should they choose to do so. No archer from Robin Hood to Ralph Hoogerhyde ever dreamed up a siege gun of the sort these boys use. The author has in his possession a number of *Gentio Salvaje* arrows and a bow. The arrows are 11 feet long, longer than an Olympic Games javelin and somewhat more vicious, being sharply barbed over the first 15 inches of the business end. The bow is a section of dense black-palm only a little less stiff than a piano leg. It is strung with a raw-hide thong as thick as a piece of sash cord. The bowman sits on the ground, places this little number across both feet, and hauls back the bow string with both hands.

Fortunately the chances of a Rhumba Run passenger ever finding out first hand if these people are savage or not is very remote. In the first place the route does not cross the area that is their usual habitat. In the second place the people setting up the methods of operation have been more conservative than a bunch of Coolidge era Republicans. All the planes are multi-motored craft capable of flying with one engine dead. They carry a separate radio operator which permits the taking of constant position checks by radio bearings and gives the first officer more time to spend on straight navigation. Gasoline loads are high. On the Rhumba Run enough fuel is carried not only to permit the pilot to reach an alternate airport in bad weather, but to return to his point of departure should he so desire. As additional trouble insurance in the event of a forced landing at some place in the wilds, the planes carry a bewildering assortment of equipment never seen on more domestic airlines. A list of these items looks like the inventory of an Army-Navy department store. They range from a shotgun and machete to a two-quart pot for cooking beans. Fish hooks, bait, and a Boy Scout knife are only three more items in a list of 50. A separate medical kit contains everything from benzedrine to a bottle of Haig and Haig. There probably never will be a foolproof airplane so long as human beings build and fly them. Anyhow, it doesn't hurt to push the chance for trouble right out to the last limit of probability.

In spite of all obstacles such as hard center clouds, altitude airports, ants, and an ox-cart fuel supply in places, the Bolivians have a goal worth the long haul their airline development will take. One day the natural resources tapped and the new areas opened will prove it. Long before this happens *Lab* and the Rhumba Run may mean a great deal to many people who will never see Bolivia. The cargoes moving in and out of Latin American airports are now peaceful ones of salt, meat, sewing machines, and plowshares. When the time comes that these must be replaced by swords, soldiers, and bombs, the Americas, both North and South, will prove that they can do this, too.

FOOTBALL SCORES

The following, are the season's football scores:

Sept. 15	CIT—67	Univ. of Redlands..........0
Sept. 22	CIT—39	Univ. of Redlands..........0
Sept. 30	CIT—20	USC Jr. Varsity..........0
Oct. 6	CIT—33	UCLA Jr. Varsity..........0

ALUMNI NEWS

ALUMNUS AL

RECENTLY a short questionnaire was sent to a representative group of alumni in the hope that their response thereto would assist in the preparation of next year's program. Replies were received in sufficient number to provide an adequate basis for this purpose; moreover, information became available regarding the character and habit of the composite grad, known hereinafter as Alumnus Al. In the interest of your own personal scrutiny and evaluation, Al's quiddity is herewith mathematically sketched.

Al belongs to the Class of '29.3. Only about 12 per cent of him is interested in Alumni Association affairs, the remainder being either very busy or phlegmatic. He would like to attend three times as many meetings as were arranged last year, two-thirds of them in the evening. His taste runs 65 per cent to technical subjects. The usual meeting place suits Al fairly well (43 per cent satisfied, 36 per cent indifferent) since only 5 per cent of him says the food, frankly, is lousy, and only 7 per cent maintains that the price is exorbitant.

The Annual Dance appeals to 78 per cent of A.A., but in his circumspect manner he would reject the proposed increases in the admission price by a 19 to 1 veto. He might (55 per cent) like a dinner dance instead, but no matter what Mrs. Al says, he won't (72 per cent) put on the soup-and-fish.

The agonized supplication of the social chairman for an assistant falls on ears only 3 per cent attentive.

Grice Axtman, '41, Social Chairman

GUERRANT ACCEPTS WASHINGTON POSITION

Dr. Edward O. Guerrant, instructor in history and economics at the Institute since 1942, and author of several articles on Latin American subjects in *Alumni Review* and *Engineering and Science Monthly*, has received a leave of absence from Caltech. He left for Washington, D. C., the latter part of June to accept a position as political analyst in the Office of the Coordinator of Inter-American Affairs.

Dr. Guerrant received his B.A. degree from Davidson College in North Carolina, and his M.A. and Ph.D. degrees from the University of Southern California. During August he was married to Miss Charlotte Tompkins of Pasadena who has been assistant secretary of the Alumni Association and associate and news editor of *Engineering and Science Monthly*.

TENTATIVE SCHEDULE ALUMNI ASSOCIATION MEETINGS

November 16, evening—Clark Hotel, Carl A. Hienze, consulting electrical engineer, speaker.

December 14, noon—Clark Hotel, H. L. Harvill, Harvill Manufacturing Company, speaker.

January 18, evening—Clark Hotel, Bob Bawbell is presenting a meeting by the Disney Studio.

February 15—Annual Dance in charge of Carl Friend.

March 15, noon—Plans incomplete.

April—Annual Seminar.

May—Field Day.

June—Annual Meeting.

16,000th CALTECH WAR-TRAINING CERTIFICATE TO OFFICER'S WIFE

Professor H. N. Tyson, of Caltech's engineering department, at a brief ceremony held on the campus in June, presented to Mrs. Robert M. White the 16,000th certificate given out by the California Institute of Technology War Training Program. Mrs. White, whose husband is a naval officer on active duty, was one of a group of 30 young women employed at Lockheed's engineering department who had completed a Caltech course in aircraft engineering design fundamentals. The course covered a period of a year and was given at Caltech's training center at Pasadena Junior College.

EXECUTIVE PROGRAM — CHICAGO UNIVERSITY

THE University of Chicago has recently announced initiation of a graduate program of executive training, leading to the degree of Master of Business Administration. This program is designed for potential senior executives and is to be presented from the point of view of business management. The objectives of this program are as follows:

1. To provide an over-view of business and economic institutions and processes.
2. To offer basic training in the use of tools of management, economics, accounting, and statistics in preparation for advanced study of methods and problems in management.
3. To develop an appreciation of the growing importance of public relations in business and to provide a basis for an understanding of governmental policy.
4. To provide training in the solutions of problems of business organization and policy in the various fields of business management, such as production, personnel, marketing and finance.
5. To provide advanced specialized training in a selective field of management, personnel, marketing, accounting, production, statistics, or finance. Here each student selects his field of specialization.
6. To develop the habit of orderly thinking and effective reporting of conclusions, both orally and in writing.

The course is intended for college graduates who have had substantial business experience at a supervisory or executive level. Admission to this program is on the basis of individual application, supported where possible by a recommendation from the employer. Time required for completion of this course will be two nights a week for two years, excluding summer months. Those who reside in the Chicago district and who may be interested in this restricted program may obtain further information by directing their inquiries to Willard J. Graham, School of Business at the University of Chicago, Ill.

CALTECH MEN IN SERVICE

(Corrected to July 20, 1944)

The following is a list of men in service whose names were not published in the March issue of *Engineering and Science Monthly* or whose rank or location are known to have changed since that time. Corrections and additions are desired; all communications should be addressed to the Alumni Association, 1201 East California Street, Pasadena 4, California.

Name	Class	Rank	Service	Location
Ackerman, J. B.	'38	Colonel	U.S.A.	Washington, D.C.
Ahuja, V. B.	'44	Lt.	Army of Mexico	Mexico

Name	Class	Rank	Service	Location
Albach, W. H.	'37	Lt.	U.S.N.	*
Alford, J. L.	'42	Lt. (j.g.)	U.S.N.	San Diego, Calif.
Allingham, R. E.	'44	*	U.S.N.R.	*
Allyne, A. B.	'42	Ensign	U.S.A	Maryland
Anderson, D. W.	'32	Lt. Cmdr.	U.S.N.R.	New York
Anderson, R. E.	'42	Ensign	U.S.N.R.	*
Armstrong, R. C.	'28	Capt.	U.S.A	Colorado
Arnold, D. R.	'43	Ensign	U.S.N.R.	Mare Island, Calif.
Arnold, H. A.	'39	Lt.	U.S.A	Massachusetts
Arnold, M. W.	'37	Capt.	U.S.A	Washington, D.C.
Bacon, J. W., Jr.	'43	2nd. Lt.	U.S.A	*
Bair, W. P.	'44	*	U.S.N.R.	*
Baird, R. C.	'40	Major	U.S.A	*
Baker, J. R.	'38	Ensign	U.S.N.R.	*
Ballard, W. O. B.	'44	Lt.	U.S.N.R.	*
Bard, R. T.	'35	*	U.S.A.	Overseas
Barfield, H. P.	'44	Lt.	U.S.A.	*
Barnes, D. P.	'30	Lt. Col.	U.S.A.	Overseas
Barnes, Frank A.	'44	*	U.S.N.R.	*
Barnes, S. U.	'36	1st Lt.	U.S.A.	Overseas
Baronowski, John J.	'44	Lt. Cmdr.	U.S.N.	*
Barriga, F. D.	'44	*	Army of Mexico	Mexico
Bartlett, E. R., Jr.	'42	Lt. (j.g.)	U.S.N.R.	New York
Bashor, R. H.	'43	Ensign	U.S.N.R.	Overseas
Baskin, A. C.	'37	Lt.	U.S.N.	*
Beakley, W. M.	'35	Lt.	U.S.N.	San Diego, Calif.
Beanfield, B. F.	'39	Lt.	U.S.N.R.	Philadelphia, Pa.
Beardsley, George F.	'39	*	U.S.N.	Overseas
Beckstead, M. W.	'43	Ensign	U.S.N.R.	*
Beck, B. B.	'44	*	U.S.N.R.	*
Belzer, T. R.	'37	Major	U.S.M.C.	Overseas
Benioff, B.	'22	Lt. Col.	U.S.A.	Utah
Bennett, R. L.	'44	Ensign	U.S.N.R.	Washington, D.C.
Benson, G. L., Jr.	'44	*	U.S.N.R.	*
Bergren, Wm. R.	'32	Capt.	U.S.A.	Overseas
Berry, W. L.	'29	Lt. Col.	U.S.N.R.	Overseas
Bewley, J. W.	'43	Ensign	U.S.N.R.	Florida
Biot, M. A.	'32	Lt.	U.S.N.R.	*
Blayney, J. A.	'43	Lt.	U.S.A.	Colorado
Blue, J. H.	'37	Major	U.S.M.C.	Overseas
Bogert, R. C.	'44	Lt.	U.S.A.	*
Bond, W. H.	'44	*	U.S.N.R.	*
Booth, F. O., Jr.	'44	Midshp.	U.S.N.R.	New York
Boothe, R. H.	'36	Lt. (j.g.)	U.S.N.R.	Overseas
Boyd, J.	'27	Colonel	U.S.A.	Washington, D.C.
Bradburn, J. R.	'32	Capt.	U.S.A.	*
Broadwell, J. E.	'44	*	U.S.A.	*
Brossy, F. A.	'26	Lt.	U.S.N.R.	*
Brown, W. H.	'43	Ensign	U.S.N.R.	Washington, D.C.
Buchanan, R. A.	'44	*	U.S.N.R.	*
Buettell, Theo. D.	'43	*	U.S.N.R.	Illinois
Bungay, R. H.	'30	Major	U.S.A.	*
Bussard, W. A.	'44	Ensign	U.S.N.R.	Key West, Fla.
Cabral, H. J.	'44	*	U.S.N.R.	*
Campbell, D. C.	'41	Lt.	U.S.N.R.	Washington, D.C.
Campbell, R. S.	'37	Lt.	U.S.N.R.	Overseas
Carter, C. L.	'43	Lt.	U.S.A.	*
Chambers, L. S.	'44	Cmdr.	U.S.N.	*
Chesson, G. H.	'33	Lt. (j.g.)	U.S.N.R.	*
Clapp, G. W.	'26	Lt. (j.g.)	U.S.A.	Overseas
Clingan, F. M.	'42	Ensign	U.S.N.R.	Overseas
Coates, L. D.	'39	Lt.	U.S.N.R.	*
Cogen, W. M.	'31	Lt.	U.S.A.	*
Collings, W. T.	'44	*	U.S.N.R.	Rhode Island
Colodny, M. D.	'33	*	U.S.N.R.	*
Craig, C.	'34	Lt. (j.g.)	U.S.N.R.	Washington, D.C.
Craig, P. H.	'33	Lt.	U.S.N.R.	Overseas
Creal, A.	'36	Lt. Col.	U.S.A.	Washington, D.C.
Crosher, K. R.	'28	Lt. Col.	U.S.A.	*
Daams, G.	'41	Capt.	U.S.A.	Virginia
Debevoise, J. M.	'44	Lt.	U.S.A.	*
Deremer, K. R.	'44	*	U.S.N.R.	*
Desmond, J. M.	'34	Lt.	U.S.A.	Virginia
Detmers, Fred	'33	Sgt.	U.S.A.	*
Dickey, W. L.	'31	Lt. Cmdr.	U.S.N.R.	San Francisco, Calif.
Dixon, H. H.	'44	Flt. Of.	U.S.A.	*
Doll, R. E.	'44	Cmdr.	U.S.N.R.	*
Doolittle, R. C.	'40	Lt. (j.g.)	U.S.N.R.	Anacostia, D.C.
Drake, J. A.	'42	2nd Lt.	U.S.A.	Nebraska
Dunn, A. W.	'29	Lt. Col.	U.S.A.	North Carolina
Dunn, W. C.	'34	Lt. Col.	U.S.N.	Rhode Island
Durfee, P. T.	'28	Lt. Col.	U.S.A.	Alaska
Edwards, G. L.	'41	Lt. (j.g.)	U.S.N.R.	Overseas
Elliott, T. D.	'42	Ensign	U.S.N.R.	Overseas
Ely, F. B.	'44	*	U.S.N.R.	*
Ely, R. L.	'44	Lt.	U.S.A.	*

Name	Class	Rank	Service	Location
Engelder, A. E.	'35	Capt.	U.S.A.	Camp Roberts, Calif.
Engelder, Paul O.	'39	Major	U.S.M.C.	Washington, D.C.
Eusey, M. V., Jr.	'41	Lt. (j.g.)	U.S.N.R.	Overseas
Fahy, T. R.	'45	*	U.S.N.R.	*
Fleck, F. A.	'42	Lt.	U.S.A.	Selman Field, La.
Fleisher, E. P.	'43	*	U.S.N.R.	*
Fleming, M. K., Jr.	'36	Lt.	U.S.N.	Washington, D.C.
Frank-Jones, Glyn	'41	Lt.	U.S.N.R.	Overseas
Franzini, Joseph B.	'42	Ensign	U.S.N.	Tucson, Ariz.
Fuller, W. P., Jr.	'42	*	U.S.N.R.	San Diego, Calif.
Furer, A. B.	'44	Lt. Cmdr.	U.S.N.	*
Galbreath, A. M.	'44	*	U.S.N.R.	*
Galeski, R. B.	'41	*	U.S.N.R.	*
Garner, H. K.	'43	*	A.A.F.	*
Gazin, C. L.	'27	Capt.	U.S.A.	*
George, J. W.	'37	Sgt.	U.S.A.	Colorado
Giacomazzi, W. F.	'43	Lt.	U.S.A.	California
Gibbons, R. M.	'42	Cmdr.	U.S.N.	Rhode Island
Gillette, W.	'42	Lt. (j.g.)	U.S.N.R.	Overseas
Gillings, J. W.	'41	1st Lt.	U.S.A.	*
Givens, F. I.	'42	*	U.S.A.	*
Goldsmith, E. A.	'44	*	U.S.N.R.	*
Graham, H. K.	'43	*	U.S.A.	*
Gramatky, F. G.	'28	Major	U.S.A.	Overseas
Graner, J. B.	'43	Ensign	U.S.N.R.	*
Gray, J. B.	'44	Lt.	U.S.N.R.	*
Green, W. M.	'39	Capt.	A.A.F.	Dayton, Ohio
Griffin, R. H.	'31	*	U.S.A.	Minnesota
Griffith, G. D.	'43	Ensign	U.S.N.R.	Texas
Griffith, J. R.	'39	*	U.S.N.R.	*
Hale, F. S.	'27	Capt.	U.S.A.	Overseas
Hall, W. A.	'42	Ensign	U.S.N.R.	Vallejo, Calif.
Hall, W. L.	'24	Lt. Col.	U.S.A.	California
Halpenny, W. H.	'43	Ensign	U.S.N.R.	Annapolis, Md.
Hanchett, H. K.	'43	2nd Lt.	U.S.A.	*
Harrell, DeWitt	'44	Lt. Cmdr.	U.S.N.	*
Harshberger, J. D.	'34	Lt.	U.S.M.C.	Virginia
Hasert, C. N.	'44	Lt.	U.S.A.	*
Haupt, L.	ex-'42	Ensign	U.S.N.R.	Massachusetts
Haymond, C. D.	'43	*	U.S.A.	New Jersey
Hedrick, L.	ex-'42	2nd Lt.	U.S.A.	*
Hight, C. T.	'41	Capt.	U.S.A.	Overseas
Hite, J. E., Jr.	'40	1st Lt.	U.S.A.	Overseas
Hoch, W. C.	'31	Lt.	U.S.N.R.	Washington, D.C.
Hoff, F. C.	'39	Lt.	U.S.N.R.	Nebraska
Horne, O.	'42	Lt.	U.S.A.	Nebraska
Howenstein, J. B.	ex-'42	*	U.S.N.R.	*
Hughes, W. H.	'44	*	U.S.N.R.	New York
Hunt, C.	'42	Lt. (j.g.)	U.S.N.R.	Overseas
Ingersoll, W. L.	'42	Ensign	U.S.N.R.	*
Jackson, W. G., Jr.	'44	Cmdr.	U.S.N.	*
Jaeger, V. P.	ex-'23	*	U.S.A.	Overseas
Johnsem, E. G.	'43	Lt.	U.S.A.	Overseas
Johnson, K. W.	'43	*	U.S.A.	*
Johnston, W. C.	'42	Lt.	U.S.A.	Lowrey Field, Colo
Jones, R. P.	'35	Lt. (j.g.)	U.S.N.R.	New York
Jones, W. P.	'43	Ensign	U.S.N.R.	Overseas
Jordon, J. T.	'41	Carp. Mate 1st class	U.S.N.R.	Overseas
Kane, R. F.	'43	Lt. Cmdr.	U.S.N.	Oregon
Keating, D. A.	'44	*	U.S.N.R.	*
Keech, D. W.	'26	Lt.	U.S.N.R.	San Diego, Calif.
Keller, S. H.	'38	Lt. (j.g.)	U.S.N.R.	Overseas
Kendall, J. W.	ex-'19	*	U.S.A.	Virginia
Kennedy, E. R.	'33	Capt.	U.S.A.	Overseas
Kidd, R. E.	'34	Lt.	U.S.N.R.	Washington, D. C.
Kingsbury, W. S., Jr.	'26	Major	U.S.A.	Overseas
Kinsler, L. E.	'31	Lt. Cmdr.	U.S.N.	Annapolis, Md.
Klein, D. J.	'43	Ensign	U.S.N.R.	Massachusetts
Knudson, A. G., Jr.	'44	*	U.S.N.R.	*
Labory, R. F.	'31	Lt.	U.S.N.R.	Virginia
Landau, A.	'42	2nd Lt.	U.S.A.	Overseas
Larabee, O. S.	'25	Lt. Col.	U.S.A.	Washington, D. C.
Larson, E. R.	'42	Lt. (j.g.)	U.S.N.R.	Overseas
Larson, W. R.	'40	Capt.	U.S.A.	Tennessee
Lavagnino, E.	ex-'10	*	A.A.F.	*
Lawrence, B. E.	'41	Lt. (j.g.)	U.S.N.R.	*
Lawson, W. G.	'39	Lt. (j.g.)	U.S.N.R.	Mare Island, Calif.
Leeper, L. D.	'31	2nd Lt.	U.S.A.	Louisiana
Leggett, J. R.	'38	Ensign	U.S.N.R.	Overseas
Lehan, F. W.	'44	*	U.S.A.	Missouri
Lester, R. W.	'44	*	U.S.N.R.	New Jersey
Levenson, B. D.	'41	Lt.	U.S.A.	Overseas
Levet, M. N.	'39	Lt.	U.S.A.	Overseas
Lewis, C. F.	'28	Capt.	U.S.A.	Overseas
Lind, G. W., Jr.	'42	Ensign	U.S.N.R.	Arizona
Lingle, H. C.	'43	Lt.	U.S.A.	Lowrey Field., Colo.

Name	Class	Rank	Service	Location
Llewellyn, F. E.	'38	Lt. (j.g.)	U.S.N.R.	Washington, D. C.
Loeffler, D. E.	'40	*	U.S.A.	California
Losey, R. M.	'35	*	U.S.A.	Killed in Norway, 1940
Lownes, E. D.	'24	Lt.	U.S.A.	Canada
Macartney, E. J.	'43	Ensign	U.S.N.R.	Connecticut
MacDonald, J. H.	'30	Lt.	U.S.N.R.	*
MacDonald, R. G.	'33	Capt.	U.S.A.	Overseas
MacKenzie, D. C.	'22	Lt. Col.	U.S.A.	Georgia
Maier, M. P.	'44	Lt.	U.S.A.	*
Maloney, F. V.	'35	Lt. (j.g.)	U.S.N.R.	Overseas
Manchee, V.	ex-'24	Capt.	U.S.A.	Alabama
Marshall, R. W., Jr.	'44	*	U.S.N.R.	*
Martin, J. S.	'44	*	U.S.N.R.	*
Maurer, F. A.	'22	Lt.	U.S.A.	Ohio
Mayer, A.	'42	*	U.S.A.	Illinois
McClung, R. M.	'39	2nd Lt.	U.S.A.	Illinois
McDougall, C. H.	ex-'43	Ensign	U.S.N.R.	North Carolina
McKillip, J. C. S.	'36	Lt.	U.S.N.	New York
McNaughton, J. B.	'44	Lt.	U.S.N.R.	*
Mercereau, J. T.	'24	Lt. Col.	U.S.A.	Fort Belvoir, Va.
Meyer, G. F.	'42	Lt. (j.g.)	U.S.N.R.	Overseas
Mitchel, T. S.	'33	Lt. (j.g.)	U.S.N.R.	Florida
Mitchell, G. S.	ex-'30	Major	U.S.A.	Overseas
Mitchell, R. K.	'44	*	U.S.N.R.	*
Mohr, W. H.	'29	Lt. Col.	U.S.A.	Mississippi
Monning, J. C., Jr.	'33	Lt. Col.	U.S.A.	Overseas
Moore, C. K.	'37	*	U.S.A.	Dayton, Ohio
Morris, L. P.	'34	Lt. Cmdr.	U.S.N.R.	California
Morse, C.	'36	Capt.	U.S.A.	Overseas
Munk, W. H.	'40	*	U.S.A.	Washington
Murphy, J. N.	'37	Lt.	U.S.N.R.	San Pedro, Calif.
Nestler, W. W.	'36	Capt.	U.S.A.	Florida
Nevis, A. H.	'36	Lt.	U.S.N.	Hawaii
Newby, C. T.	'41	Lt.	U.S.N.R.	Virginia
Nichols, R. M.	'36	*	U.S.A.	Overseas
Olson, C. W.	'44	*	U.S.N.R.	*
Osborn, J. E.	'39	Ensign	U.S.N.R.	Overseas
Osborne, J. B.	ex-'31	Sgt.	U.S.A.	Missouri
Osborne, L. S.	'44	*	U.S.N.R.	*
Ours, S. R.	'44	Comdr.	U.S.N.	*
Parker, J. E.	'38	Lt.	U.S.A.	*
Parker, R. G.	ex-'37	Major	U.S.M.C.	Overseas
Parker, T. B.	'44	Lt.	U.S.A.	*
Pearce, R. B., Jr.	'44	Lt.	U.S.A.	*
Pearne, J. F.	'34	Lt. (j.g.)	U.S.N.R.	*
Philleo, R. A.	'27	Major	U.S.A.	California
Pilorz, B. H.	'44	*	U.S.N.R.	*
Potter, W. T.	'35	Ensign	U.S.N.R.	*
Powlesland, K. L.	'43	Ensign	U.S.N.R.	Virginia
Proctor, H., Jr.	'44	*	U.S.N.R.	*
Putt, D. L.	'38	Lt.	U.S.A.	*
Radford, J. C.	'34	Lt. Cmdr.	U.S.N.R.	Washington, D. C.
Rambo, L.	'43	Ensign	U.S.N.R.	New Jersey
Ramey, R. C.	ex-'26	Lt. (j.g.)	U.S.N.R.	Overseas
Rattray, M., Jr.	'44	*	U.S.N.R.	*
Reid, D. C.	'43	Ensign	U.S.N.R.	Overseas
Reimers, G. I.	'41	Ensign	U.S.N.R.	Washington, D. C.
Rempel, J. R.	'44	*	U.S.N.R.	*
Reynolds, R. W.	'27	*	U.S.A.	*
Rhoades, R.	'43	Ensign	U.S.N.R.	New Jersey
Richards, R. T.	'17	Lt. Col.	U.S.A.	Overseas
Richardson, O. B.	'30	Lt. Cmdr.	U.S.N.R.	California
Ridenour, C. H.	'18	Brig. Gen.	U.S.A.	New York
Riggs, E. H.	'27	Major	U.S.A.	California
Ritter, J.	'35	Lt.	U.S.N.R.	Overseas
Roese, H. V.	'42	*	U.S.M.C.	*
Rogers, W. V.	'27	Major	U.S.A.	*
Rupert, C. S., Jr.	'41	Lt. (j.g.)	U.S.N.R.	Washington, D.C.
Schneider, A.	'43	Cadet	U.S.N.R.	*
Schneider, C. L.	'34	Capt.	U.S.A.	*
Schrader, C. G.	'40	*	U.S.N.R.	Washington, D.C.
Schroder, L. D.	'32	*	U.S.A.	Fort Douglas, Utah
Schubert, Wm.	'41	Lt. (j.g.)	U.S.N.R.	Annapolis, Md.
Schultz, W. F.	'32	Capt.	U.S.A.	Overseas
Scott, W. R., Jr.	'44	*	U.S.N.R.	*
Scribner, O.	'42	Lt.	U.S.A.	Overseas
Seed, R. W.	'44	*	U.S.N.R.	*
Seekins, C. W.	'42	*	U.S.N.R.	Annapolis, Md.
Seiler, D. D.	'44	Lt.	U.S.N.	*
Seymour, S.	'26	Lt. Col.	U.S.A.	California
Shalecky, F. H.	'40	Ensign	U.S.N.R.	Overseas
Sharp, R. P.	'34	Capt.	U.S.A.	New York
Shields, J. E.	'22	Major	U.S.A.	Missouri
Shor, G., Jr.	'44	Ensign	U.S.N.R.	New York, N.Y.
Sigworth, H. W.	ex-'44	Ensign	U.S.N.R.	Overseas
Silberstein, R. F.	'41	Sgt.	U.S.A.	Overseas
Sinclair, C.	ex-'45	Cpl.	U.S.A.	Georgia
Skinner, M. J.	'42	*	U.S.N.R.	San Pedro, Calif.
Slawsky, M. M.	'35	*	U.S.N.R.	Washington, D.C.
Small, J. G.	'41	*	U.S.M.C.	*
Smith, F., Jr.	'44	*	U.S.N.R.	*
Smith, J. C.	'42	*	U.S.N.R.	Maryland
Smith, R. C.	'20	Major	U.S.A.	Denver, Colo.
Smith, W. H.	ex-'36	Lt.	U.S.N.R.	Massachusetts
Snyder, W. M.	'39	Cadet	U.S.N.R.	Texas
Soike, R. J.	'44	*	U.S.N.R.	*
Southwick, T. S.	'29	Capt.	U.S.A.	Virginia
Spaulding, A. T., Jr.	'44	*	U.S.N.R.	*
Sperling, M. H.	'29	*	U.S.N.R.	*
Spooner, W. A.	'40	Ensign	U.S.N.R.	Overseas
Staatz, D. S.	'40	Lt.	U.S.A.	*
Strickland, C. P., Jr.	'43	Ensign	U.S.N.R.	Overseas
Stroud, S. G.	'41	*	U.S.N.R.	Ft. Schuyler, N. Y.
Sutton, R. A.	'43	Ensign	U.S.N.R.	Overseas
Swift, F. T.	'30	Lt.	U.S.N.R.	Overseas
Taylor, R. M.	'39	*	U.S.N.R.	*
Tenney, F. H.	'43	Ensign	U.S.N.R.	*
Thayer, E. M.	'33	*	U.S.N.R.	*
Thompson, F. W.	'29	Lt.	U.S.N.R.	*
Thompson, W. C., Jr.	'43	Cpl.	U.S.A.	Florida
Tickner, A. J.	'32	*	U.S.A.	Washington, D.C.
Tiemann, C. F.	'41	*	U.S.A.	*
Titzler, H. N.	'44	Lt.	U.S.A.	*
Tuedio, J.	'44	*	U.S.N.R.	*
Tyler, R. M.	'39	Lt.	U.S.N.R.	Overseas
Urgin, N.	'34	Lt. (j.g.)	U.S.N.R.	*
Van Dyke, G. R.	'40	Capt.	U.S.A.	Montana
Van Dusen, C. A.	ex-'37	Lt.	U.S.N.R.	Florida
Van Reed, M.	'35	Capt.	U.S.A.	Ft. Belvoir, Va.
Veronda, C. M.	'42	Ensign	U.S.N.R.	Massachusetts
Wadsworth, J. F., Jr.	'44	Capt.	U.S.A.	*
Walkowicz, T. F.	'44	Capt.	U.S.A.	*
Warfel, J. S.	'33	Lt. Cmdr.	U.S.N.R.	Washington, D.C.
Wayne, J. C.	'44	Capt.	U.S.A.	*
Weaver, F. E.	'44	*	U.S.N.R.	Rhode Island
Webster, G. M.	'22	Major	U.S.A.	Oregon
Wheeler, F. A.	'29	Lt. Cmdr.	U.S.N.R.	Overseas
Widdoes, L. C.	'41	Lt.	U.S.N.R.	Washington
Williams, R. S.	'44	Capt.	U.S.A.	*
Wilson, J. H.	'44	*	U.S.N.R.	*
Winchell, Robert	'44	Major	U.S.A.	Florida
Winter, P. H.	'44	Ensign	U.S.N.R.	Rhode Island
Wolf, P. L.	'44	*	U.S.N.R.	*
Wolfe, S.	'41	*	U.S.A.	*
Wood, F. W.	'42	Lt.	U.S.A.	Idaho
Woodard, G. E.	'34	Ensign	U.S.N.R.	*
Wychoff, P. H.	'37	Major	U.S.A.	Ohio
Zipser, S.	'30	Lt.	U.S.A.	Overseas
Zivic, J. A.	'44	Lt.	U.S.N.R.	*

Acoustics of Buildings

(Continued from Page 7)

tribution of sound, while absorbing material was installed in selected locations to reduce the reverberation and noise. *Figs. 4* and *5* give sketches of the constructions used.

CONCLUSION

The decision to provide acoustical treatment for the entire Pentagon Building is in accord with the modern trend of adjustment of large buildings. Statistics show that office workers are more efficient under quiet conditions; they are not so nervous, they get more work done, and absences are reduced. The Pentagon has the reputation of being the world's largest and best equipped office building, a reputation which is based in part on the quiet conditions.

PERSONALS

1924

R. C. (DUKE) HASTINGS is superintendent of the Solvay Process Company plant at Kings Mountain, N. C.

FRANK W. PINE has a machine shop in Los Angeles where certain oil well tools are machined. He has a daughter, 12, and another 6 months old.

MAURICE ROSS is now principal of the Sherman Elementary School, one of the San Diego city schools.

V. A. KALICHEVSKY has moved from Woodbury, N. J., to Beaumont, Tex., where he is employed by the Magnolia Petroleum Company.

BILL HOLLADAY has returned to the refrigeration engineering business in Oakland for the Army and Navy, after having spent two years with Montgomery Ward in Oakland.

1926

MANLEY W. EDWARDS has been transferred to Fort Monmouth where he will attend the Eastern Signal Corps School to learn to handle large fixed radio stations.

1928

MAJOR GUNNER GRAMATKY is Plans and Operations Officer with a Combat Engineer Battalion in the South Pacific.

CAPTAIN GUY CHILDBERG, after the completion of his training at the C.G.S.S. at Leavenworth, will be stationed at Camp Evans Signal Laboratory at Belmar, N. J.

CAPTAIN RICHARD C. ARMSTRONG is stationed at the Station Hospital, Peterson Field, Colorado Springs, Colo.

1929

MAJOR TOM EVANS is in the training division of the Office of Chief of Engineers at Washington, D. C.

LIEUTENANT COLONEL LARRY LYNN is the commanding officer of the Candidates Regiment at Fort Belvoir.

A. J. LARRECQ is now a consulting engineer, with headquarters at 52 Vanderbilt Avenue, New York.

1933

J. GIBSON PLEASANTS is western division superintendent of the manufacturing department of Procter and Gamble Co. His news of 1944 to date is the addition of a second child, a daughter, Peggy, and the purchase of a new home in Cincinnati.

JOHN RANDALL is project engineer for the Austin Company, general contractors constructing new warehouse, office, and cafeteria facilities for North American Aviation, Inc., at Inglewood.

LIEUTENANT COMMANDER E. G. CRAWFORD is executive officer of a naval construction battalion stationed in the Pacific.

1934

WILLIS F. JAYNES is chief engineer of the Western Industrial Engineering Company which received on May 15 the U. S. Maritime "M" Award for production, the only "M" ever given to a company of this type. The award was the 13th in California and the 171st in the nation.

LIEUTENANT COLONEL J. W. McCREA is now at the Camp Evans Signal Laboratory at Belmar, N. J.

1936

LIEUTENANT COLONEL AL CREAL, U.S.M.C., who has been in the Southwest Pacific for two years, is now on duty with the Marine Corps Headquarters in Washington, D. C.

1939

MAJOR R. W. WINCHELL is stationed in Orlando, Fla., in meteorological service.

WALT LARSON is with the Army Air Force stationed at Smyrna, Ga.

HAROLD FISCHER is now with the Douglas Aircraft Company's engineering department as aerodynamicist.

LAWRENCE G. BORGESON is at the Pearl Harbor Navy Yard, employed by R.C.A. He expects to return to the mainland in the fall.

LIEUTENANT MELVIN LEVET is an Army Station weather officer in the Southwest Pacific.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

of ENGINEERING AND SCIENCE MONTHLY, California Institute of Technology, published monthly at Pasadena, California, for October, 1944.

State of California,
County of Los Angeles, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared the editor of the ENGINEERING AND SCIENCE MONTHLY, California Institute of Technology, DONALD S. CLARK, who having been duly sworn according to law, deposes and says that he is the editor of the ENGINEERING AND SCIENCE MONTHLY, California Institute of Technology, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation) etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Alumni Association, Inc., 1201 E. California St., Pasadena, California; Editor, Donald S. Clark, 1201 E. California St., Pasadena, California; Managing Editor, R. C. Colling, 124 West Fourth Street, Los Angeles, California; Business Management, Colling Publishing Co., 124 West Fourth St., Los Angeles, California.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Alumni Association, Inc., California Institute of Technology, 1201 East California St., Pasadena, California; no stock, a non-profit corporation.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is . . . . (This information is required from daily publications only.)

DONALD S. CLARK, Editor.

Sworn to and subscribed before me this 3rd day of October, 1944.
(Seal) Janet Cristy.
(My commission expires November 4, 1945.)

A WELCOME HAND TO BELL SYSTEM WAR VETERANS

Some day we shall have the pleasure of welcoming back to the Bell System the men and women who are now in the armed forces. They number more than 55,000. Some 3500 released from service are already back with us. We shall have a warm welcome for the rest as they join us again. Not only shall we be glad to see them personally but we shall be glad of their skill and energy for the big tasks which face the Bell System in the future.

BELL TELEPHONE SYSTEM