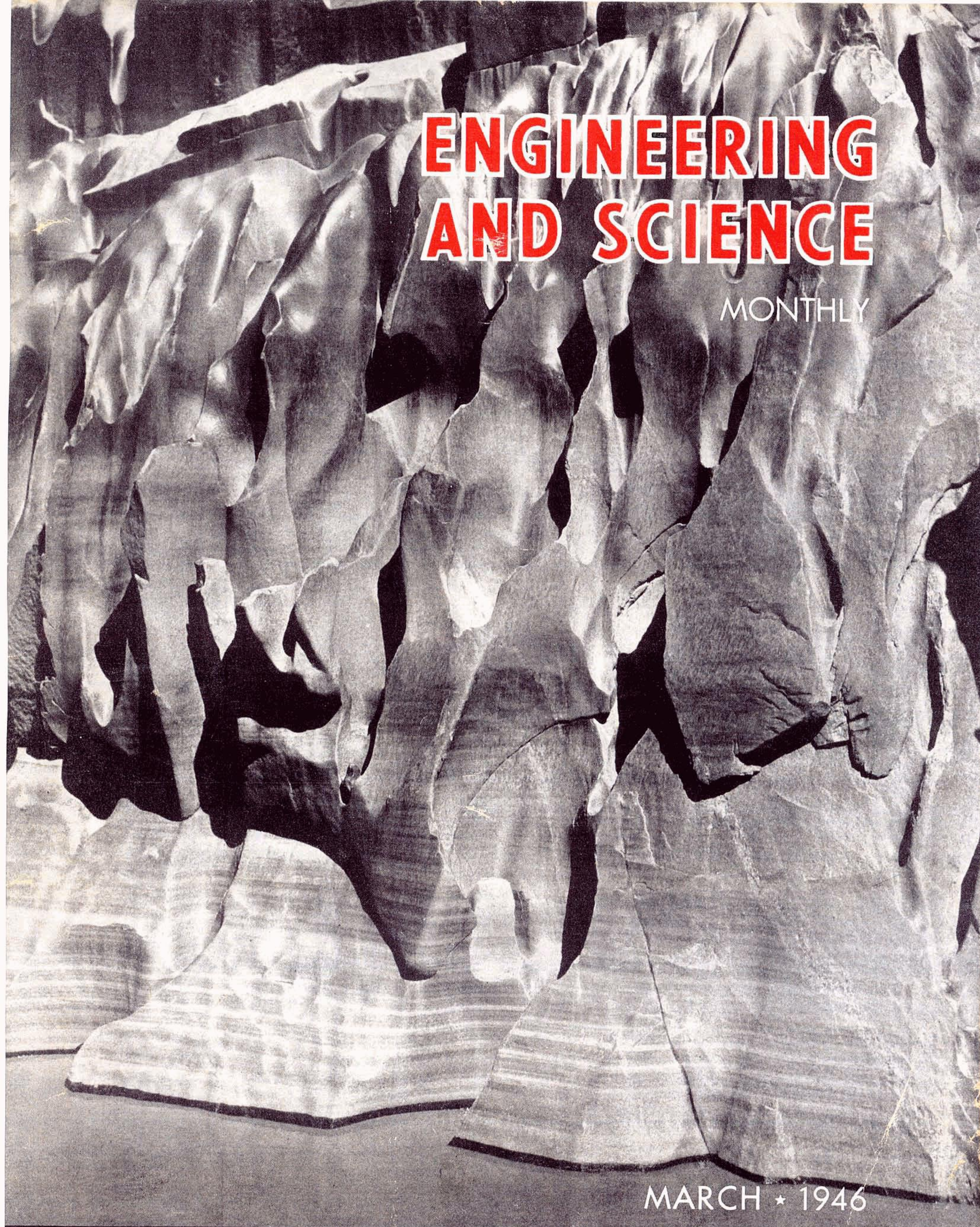
# ENGINEERING AND SCIENCE

MONTHLY



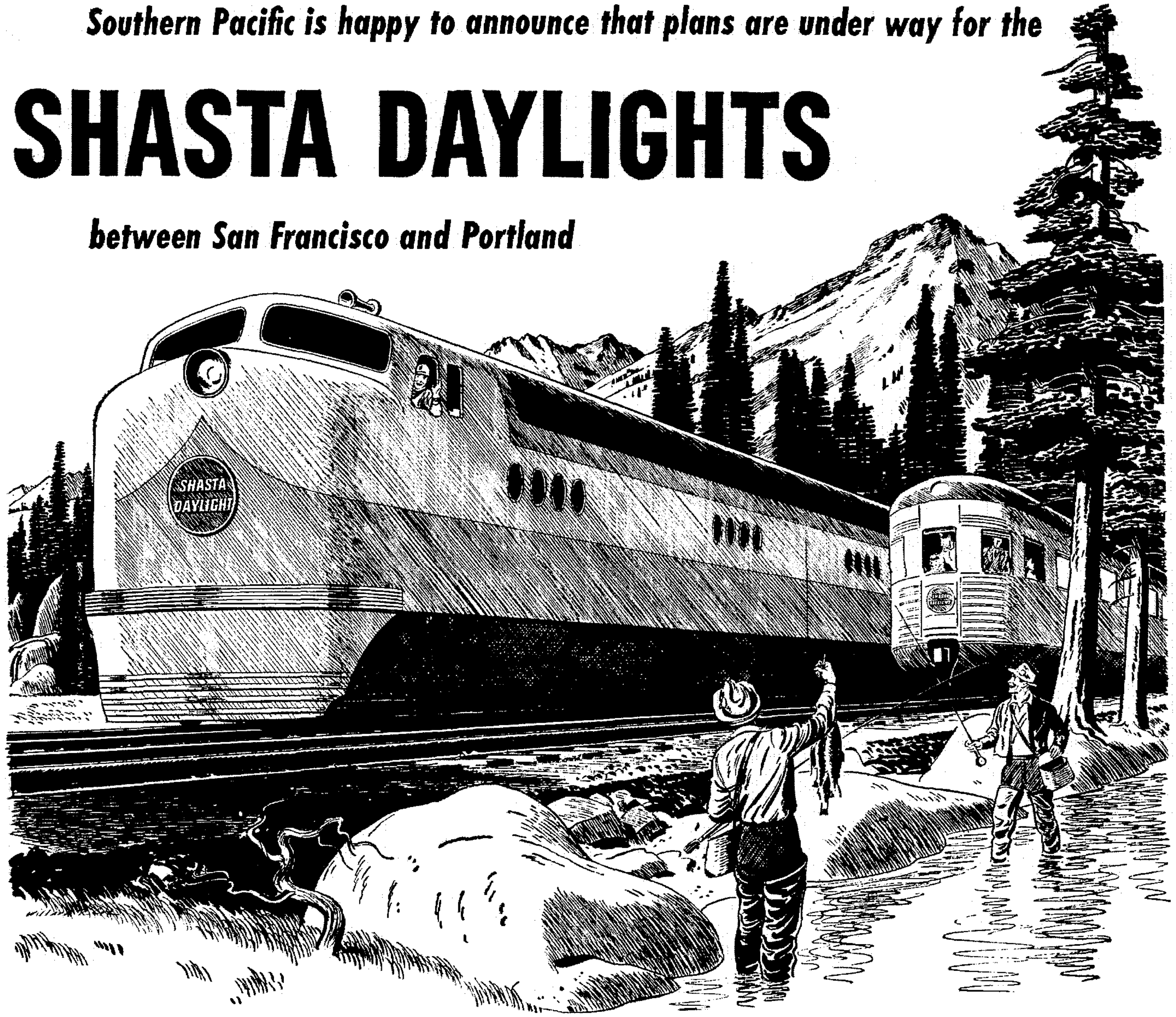
MARCH ★ 1946

PUBLISHED BY CALIFORNIA INSTITUTE OF TECHNOLOGY ALUMNI ASSOCIATION

***Southern Pacific is happy to announce that plans are under way for the***

# SHASTA DAYLIGHTS

***between San Francisco and Portland***




We are happy to tell you that plans are under way for the first streamliners in Southern Pacific's postwar program—the *Shasta Daylights.* We promise you that we will spare no expense to make these the finest and most luxurious streamlined coach trains ever constructed.

Leaving San Francisco-Oakland and Portland in the morning and arriving in the late evening, the diesel-powered *Shasta Daylights* will speed daily in each direction over Southern Pacific's famous Shasta Route— certainly one of the most magnificent scenic trips in all the world.

Each seat on the *Shasta Daylights* will have its own individual window, and these windows will be of unique design—much taller than the windows on any other train. Through these enormous windows you will see the Sacramento Valley, Lassen Peak, Mt. Shasta and the vast lake behind Shasta Dam, the Cascade Mountains, Odell Lake, the lovely Willamette Valley.

We have given our ideas to the designers of the car building companies, who are now working out the details and technical specifications. As soon as bids are received, we will place orders for actual construction of the *Shasta Daylights* for delivery, we expect, before the end of the year.

### *A faster streamlined CASCADE*

Our plans include streamlining the *Cascade,* making it a de luxe overnight sleeping car train between San Francisco and Portland. Based on designs now being worked out, orders will be placed for triple unit articulated cars for the *Cascade* similar to the ones on our *Lark* between Los Angeles and San Francisco. (Each unit consists of a lounge car, a dining car and a kitchen car.)

As fast as the manufacturers can deliver new streamlined sleeping cars they will be placed in service on the *Cascade.* This, we hope, will be early in 1947. The *Cascade,* as well as other trains, will be speeded up as soon as the present heavy traffic load eases, and before we receive the new equipment.

**S•P** ***The friendly Southern Pacific***

# BY-LINES

**JOHN H. MAXSON**

Dr. John H. Maxson was graduated from California Institute of Technology in 1927, receiving his Ph.D. from the Institute in 1931. From 1933 to 1939, he was a research associate of the Carnegie Institution of Washington, and in 1938 he became Assistant Professor of Geology at Caltech. While on military leave of absence from 1941 to October 15, 1945, Dr. Maxson served in the capacity of class director and director of instruction, Army Air Forces Air Intelligence School, Harrisburg, Pa., and as chief, training section, Air Staff Intelligence, Washington, D. C. In addition, Dr. Maxson spent fourteen months of his military service in the European-North African theatre. He completed his military service as lieutenant-colonel.

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## ENGINEERING AND SCIENCE MONTHLY

***Edited at California Institute of Technology***





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# The Month in Focus

By DONALD S. CLARK

## PLACEMENT OF VETERANS

THE "Month in Focus" which appeared in the August, 1945, issue of *Engineering and Science* discussed briefly the matter of technical employment, particularly the placement of engineers returning from service and transferring from wartime work to peacetime work. It seems advisable to review the situation as it stands at present.

The general demand appears to be for younger men who have had little or no experience and who are willing to start in subordinate positions in the engineering field. This demand has created a serious situation for a number of men returning from military service. In many cases, men were commissioned directly after completing their formal engineering education. In some instances, these men have not pursued technical duties in the armed forces, but have spent from two to four years away from the technical field. Such men, now between the ages of twenty-four and twenty-six years, lack technical experience. Many have taken on the responsibility of a family. Some have attained advanced rank in the armed services, with attendant satisfactory salary. What happens when a man in this situation applies to an industrial concern for an engineering position? In most cases, the company recognizes that this individual is more mature now than when he left college. However, from the strictly engineering point of view, he is only slightly more desirable than a green college graduate. He cannot be placed in an advanced position with the company, nor can he be placed in a subordinate position at a salary commensurate with that which he has been receiving, because such an arrangement would be unjust to men who have been with the company for some time. It may seem unjust to a man who has sacrificed from two to four years of his life for the benefit of the people who stayed at home and were advanced in their industrial positions, to be placed back at the bottom just as though he were a green college graduate. In such a situation, it is necessary to try to see all phases of the matter.

## CHANGING POSITIONS

Sometimes older men who have been in service do not wish to return to their former employers. These men may overlook the fact that because of their extensive experience with a particular company they have gained a certain understanding of that company that only time and experience can create with another company. Moreover, these men have accumulated certain rights and privileges which most companies lean over backwards to grant their employees. These are the accrued benefits of service with one company. A man in these circumstances who feels that he would like to work for another company with possible betterment, and who expects to secure a position yielding almost equivalent compensation with greater opportunities for advancement, will not have an easy time of it.

Industrial concerns are, in general, reticent about filling positions of responsibility and advanced status with new men, for it is necessary that they retain positions for their former employees who entered the armed services. It is natural, too, that the company's own veterans should come first in its personnel policy, in so far as re-hiring is concerned, for these individuals are familiar with the general policies of the company. Those who are on leave from companies and who intend to return to their former employers will definitely recognize this situation and the problems involved.

With younger men, the situation is somewhat different. Some of the young engineers worked for companies for one or, at most, two years after receiving their degrees from college, and prior to entering the armed services. In some cases, these men have found that the company by which they were formerly employed is not the type of company, or does not present the particular opportunities, which they had hoped for. It is necessary, however, for these men to recognize that in changing from one company to another they will probably have to take a cut and start in a position of less responsibility than they may have had with their former employer.

The majority of men returning from the armed forces are well aware of these problems, and they are not asking for special considerations, or for special positions. Primarily, they are looking for an opportunity to go ahead with a concern that believes in engineering. However, these men must take stock and evaluate their qualifications: technical skills may have deteriorated to

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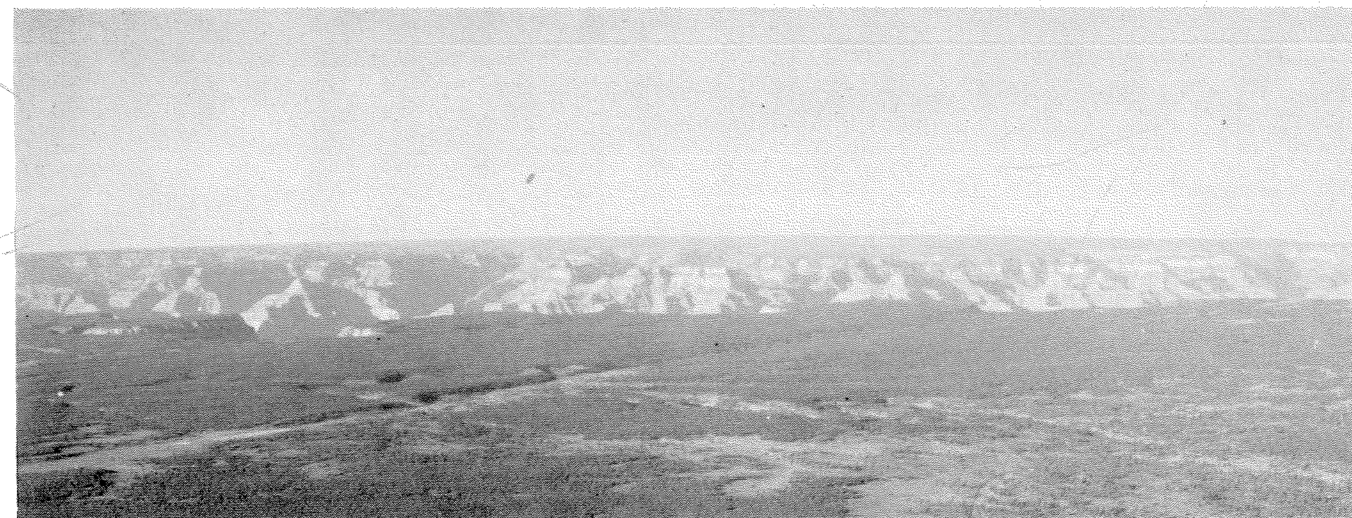

FIG. 1—General setting of the Grand Canyon. View looking northward over the Colorado Plateau in Grand Canyon National Park. The plateau to the north of the canyon is known as the Kaibab Plateau, and that to the south, as the Coconino Plateau.

# RELATIONSHIP OF SCENERY TO GEOLOGY IN THE GRAND CANYON

By JOHN H. MAXSON

THE great canyon cut by the Colorado River for a distance of over 200 miles across the Colorado Plateau is one of the great sights of the world. It is a narrow, V-shaped stream valley with precipitous, stepped, side walls. Although it is relatively deep in proportion to its breadth, being nearly a mile deep near the village of Grand Canyon and only thirteen miles wide, there are other valleys in the world which are relatively more steeply walled, although not so deep. There are other valleys that are just as deep, although broader.

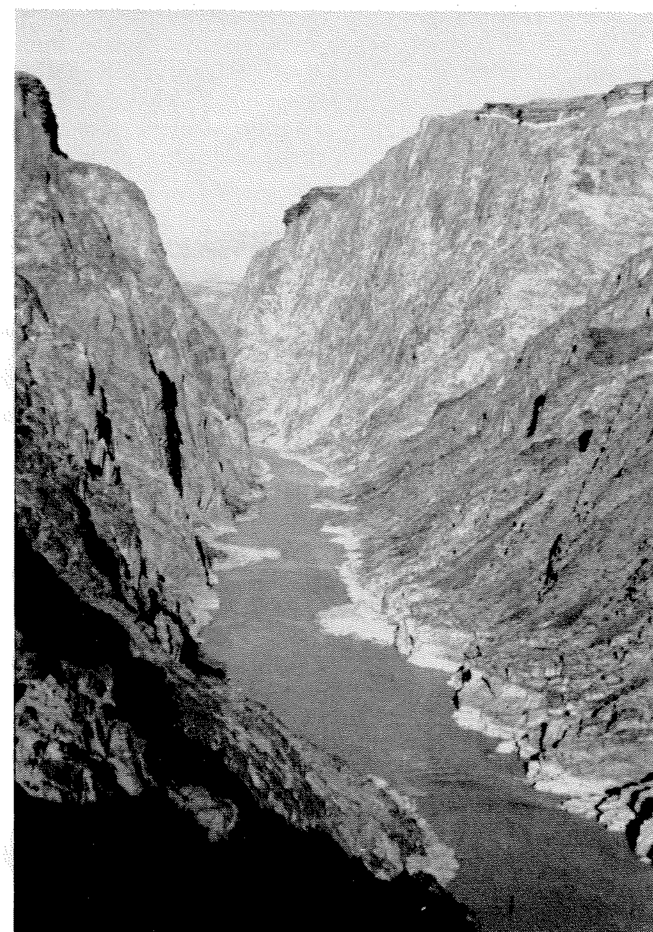

FIG. 2—Looking westerly down the deepest part of the Inner Gorge below the mouth of Zoroaster Creek.

What causes the Grand Canyon to have greater fascination for the human eye than other valleys and canyons? It is the fact that its geologic structure, faithfully revealed by processes of erosion, is on a large scale and produces interesting lineaments both vertical and horizontal. The regularity of the great and continuous cliffs with their subjacent benches is elaborated in plan into an apparent confusion of spired promontories and deep alcoves. To these lineaments is given a vivid and contrasting coloration by the geologic constitution of the rocks themselves. Since geologic circumstances are responsible for the peculiar attraction of Grand Canyon scenery, an analysis of the geologic and erosional history will contribute to the enjoyment of a visit by any scientifically minded person.

The Canyon has attracted many visitors, scientists and non-scientists alike, during the long period of time that has elapsed since its discovery by the Spaniard, Cardenas, in 1540. The first 200 years after discovery were ones of continued solitude so far as the historic records are concerned. During the later part of the eighteenth century the Canyon was visited by Spanish priests, and during the early part of the nineteenth century it was occasionally seen by pioneer herdsmen, hunters, and trappers. Through all these years of occasional visits, the depths of the Grand Canyon of the Colorado remained a mystery.

## EXPLORATION OF THE GRAND CANYON

In 1869, the geologist, Major John Wesley Powell, a one-armed Civil War veteran, started down the river from Green River, Utah. He began the journey with nine men and four boats, and concluded it three months later a thousand miles down the stream after losing two boats on the river. Three men left the expedition en route at Separation Canyon. They thought that this canyon offered access to the north rim and were tired of the constant wettings and other hardships which the river trip entailed. Since no one had ever made the trip before, no one could be sure that even greater rapids than those through which they had managed to pass did not lie ahead. But the abandoning of the main party proved a mistake, for the three men were murdered by Indians when they reached the north rim, and the remainder of the party a short time later successfully passed the remaining rapids. Powell found the Grand Canyon to be replete with spectacular geological phenomena, and did not abandon his explorations after his first dangerous and difficult trip. In 1873, he again led an expedition down the Colorado River.

In considerable measure, because of the losses and difficulties experienced by the Powell expeditions, the Colorado River in the Grand Canyon district gained the reputation of being no place for a pleasure boat trip. However, many parties have passed through subsequently, and, when suitably equipped, the parties have suffered no losses. Some people have made the trip to obtain photographs, some to study botany, and some to study geology (including the California Institute of Technology--Carnegie Institution Expedition of 1937), and many have gone through just for the sake of adventure. Most people, however, will doubtless continue to visit the points on the rim where the mighty features may be viewed with ensemble effect. During good tourist years over 300,000 people visit Grand Canyon National Park. The Government, through the National Park Service, is attempting to provide visitors to all of our parks not only with recreation, but also to some degree with education. At the Grand Canyon this education is in large measure geologic.

## EXPLANATORY DESCRIPTION OF LAND FORMS

The general explanation of land forms of the Grand Canyon is by no means complicated. Land forms are usually described genetically in terms of three factors: structure, process, and stage. Structure refers to the geologic structure of the materials constituting a given land form or region of land forms. It includes such things as stratification or non-stratification of the rocks, and their relative hardness, as well as the physical relations of rock masses to each other brought about by folding or faulting. Structure, in its geomorphic sense, is the major topic of discussion in this article. The other two factors will be briefly disposed of.

Process means the type of erosion actively operating on the given land form or in its vicinity. In the case of the Grand Canyon the only perennial streams are the Colorado River itself and a few major tributaries. Elsewhere in the valley the processes of erosion are those characteristic of an arid climate and they include weathering, which is mainly mechanical, leading to fracturing and disintegration of massive rocks, and, to a lesser extent, chemical decomposition. Occasional rains assist in transportation of debris down temporary stream courses and pick up calcium carbonate from the soluble limestones. As might be expected in a precipitous terrain, mass movement of rock fragments under the influence of gravity assists in the removal of the products

**Cover Illustration**

**FIG. 3—Fluting and potholing of granitized schist in the Colorado River channel in the lower part of the Grand Canyon. (Photo by E. T. Schenk, U. S. National Park Service.)**

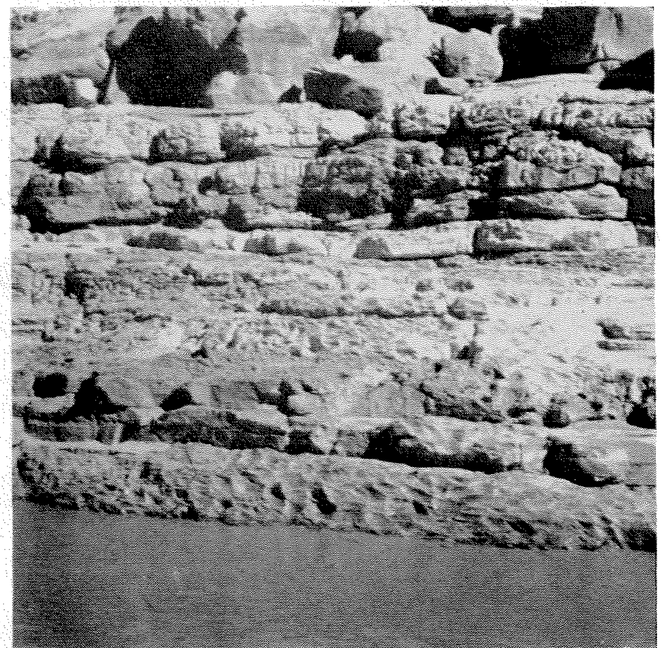

FIG. 4—Fluting developed on limestone strata of the Colorado River channel in Marble Canyon.

FIG. 5—California Institute-Carnegie Institution expedition of 1937 passing through the Inner Gorge.

of weathering. The third factor, stage, represents the point reached in the cycle of erosion. It is the degree to which the original high-lying area has been reduced to a land surface of low relief. In the vicinity of the Grand Canyon it is obvious that very little progress has been made, and that extensive, nearly flat highlands form the adjacent Colorado Plateau. The Grand Canyon, then, is a youthful geomorphic feature. Just how youthful we cannot say in terms of years, but it is likely that the canyon has been cut during the Pleistocene Epoch—that is, during the course of the last million years, more or less.

## STRUCTURE AND GEOLOGIC HISTORY

The detailed shapes of the land forms are controlled by structure which we can subdivide into two categories. First, is the structure which controls cross profile, and this may be termed vertical control. The second type is structure which controls distribution of feature in plan,


**FIG. 6—This view shows the Wedge Series of Bright Angel Canyon sloping northward (to the right) and lying on a remarkably flat erosion surface cut on schist. The series is truncated, giving it wedge form, and overlain by the nearly horizontal Tapeats sandstone (basal member of the Horizontal Series) with angular unconformity.**

and this may be termed horizontal control. The vertical control is dependent upon the sequence of rock types existing from the bottom of the Grand Canyon upwards to the rim. The horizontal control consists of the inherited direction of flow of the master stream, the Colorado River, and the direction of fault zones, shatter zones, and joint systems in the rock mass as a whole. The geologic history which offers the key to vertical control was simply described by the late Professor-Emeritus William Morris Davis, of Harvard, who was Professor of Physiographic Geology at the California Institute, 1930-1934, somewhat as follows: There are three major groups of rocks in the walls of the Grand Canyon: the Vertical Series of hard rocks at the bottom, the Wedge Series of tilted rocks at intermediate levels, and the Horizontal Series, consisting of alternating hard and soft, stratified, nearly flat-lying beds in the upper and outer canyon.

The Vertical Series is along the bottom where the Colorado River is cutting the Inner Gorge. It consists predominantly of vertically standing schists and pegmatite dikes. The sedimentary parts of this series were laid down as a part of the earliest geological record on the earth, in Archean times, possibly as much as a billion and a half years ago. Originally, they were sands and shales deposited in a broad and shallow sea. There came a period of crustal deformation and intrusion, believed to be a part of the Laurentian Revolution, which affected the whole earth. The sediments were

## FACING PAGE:

**FIG. 7—Looking westerly over Grand Canyon and Coconino Plateau from over vicinity of Trinity Creek. This view illustrates vertical control and topographic subdivisions within the canyon. 1. Vertical Archean schist; 2. Tapeats sandstone, lying on flat erosion surface and forming cliff separating Inner Gorge from Outer Canyon; 3. Bright Angel shale, eroding back to form prominent Tonto Platform; 4. Muav limestone, forming cliffs and slopes, the formation that is sapped from beneath the Redwall cliffs; 5. Redwall limestone, the major cliff-forming member of the Horizontal Series; 6. Supai formation, consisting of red sandstones and sandy shales; 7. Hermit shale, uppermost member of Supai formation is fine-grained, red shale, forming low slope or bench. Farther to the west the Esplanade (see FIG. 9) is cut as this level; 8. Coconino sandstone, prominent white, cliff-forming stratum of cross-bedded, wind-lain sandstone; 9. Toroweap formation of impure limestones and limey shales forms steep slope; 10. Kaibab formation of thick limestone strata forms cliff.**

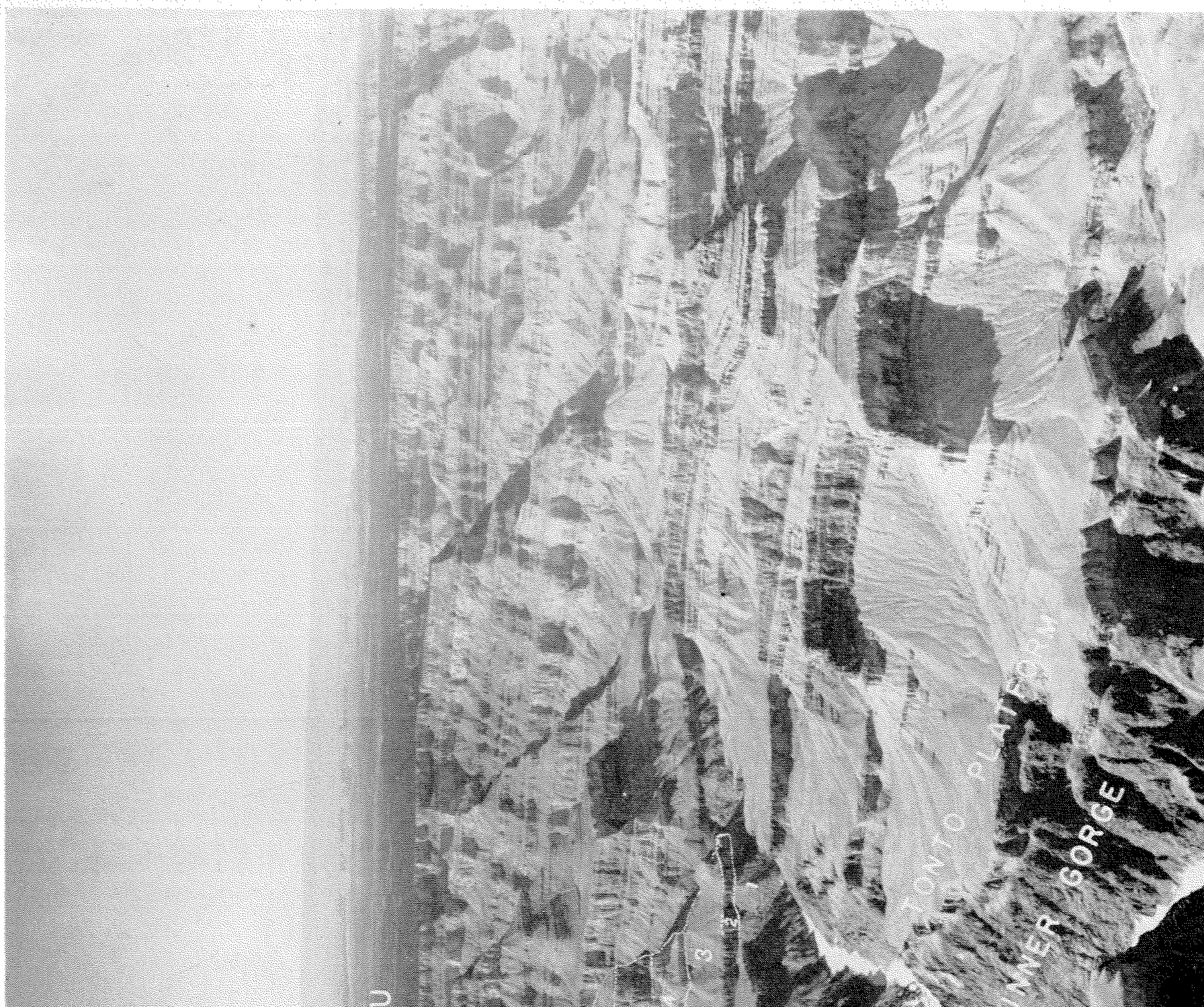


FIGURE 7

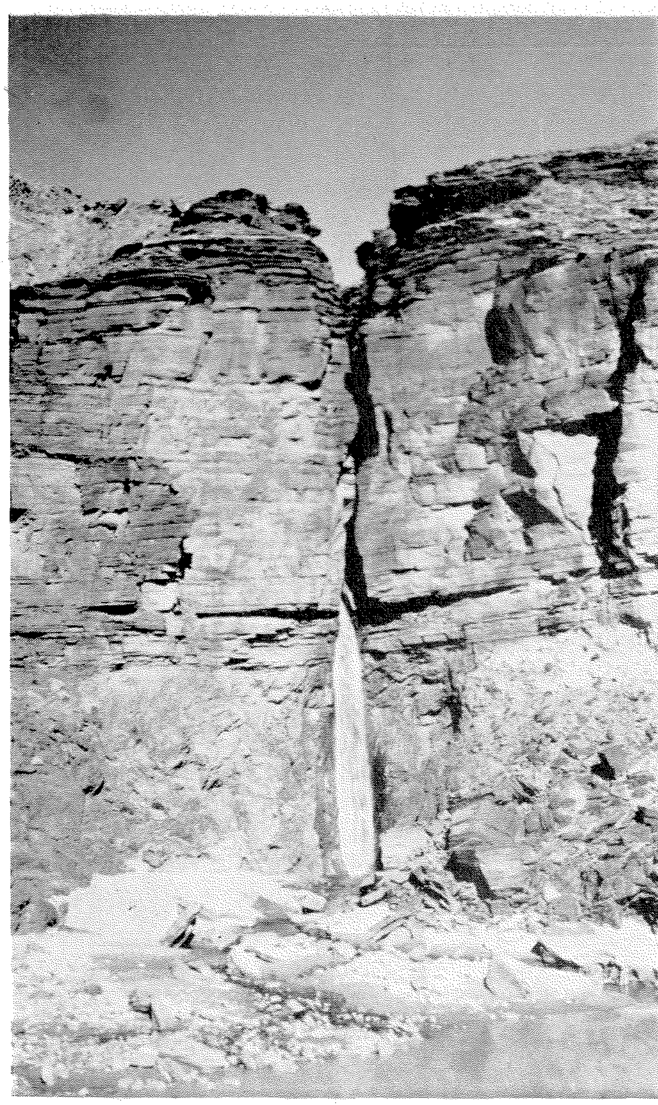

FIG. 8—Deer Creek Falls. Downcutting in Colorado River channel is so rapid that, although narrow slot has been cut in Tapeats sandstone cliff, Deer Creek has not been able to reach an accordant junction with the master stream. It constitutes one of the exceptions to Playfair's Law of Accordant Junctions.

compressed, and a great mountain system was built. The sediments were subjected to heat and pressure, and were metamorphosed into schists and quartzites. Juices from a deep-lying granite batholith worked their way up along the planes of foliation of the metamorphic rocks. Then followed a long period of erosion. The mountains were worn completely away, and an almost perfectly level surface was cut across the steeply dipping schists. From the cross sections of this erosion surface exposed in the walls of the Grand Canyon it had practically no relief whatever and therefore was more advanced than a peneplain. It was, in fact, a true erosional plain. No true erosional plain of such large extent is now known on the surface of the earth.

This plain was submerged beneath the sea and a great thickness of sandstones and shales accumulated. During the last phases of the accumulation of this series there was volcanic activity; basaltic lavas were erupted on the surface and injected as sills in the earlier strata. There followed another period of crustal deformation and erosion. This time, instead of being folded, the region was broken into blocks and faulted. Various blocks were tilted. Erosion led to beveling of these strata, and they may therefore be termed the Wedge Series. They are of Algonkian Age and may have been deposited between 500,000,000 and 1,000,000,000 years ago.

The erosion surface which was developed after the tilting of the Wedge Series was one of very low relief. Some fault block hills rising 500 feet above the general level remained, and it may therefore be termed a peneplain. This peneplain was submerged beneath the sea, and a sandstone accumulated in the seaways between the archipelago-like fault block islands. Later, shale was deposited on top of the sandstone and this accumulated to such thickness that the islands were buried. These and succeeding formations of the Paleozoic Era are almost flat-lying, having but a gentle slope to the south. This series may therefore be called the Horizontal Series.

Of the three components, the Vertical Series and the Horizontal Series have had the greatest influence on the topography because they are generally present throughout the Grand Canyon, whereas the Wedge Series occurs only in isolated localities.

## LAND FORMS IN THE VERTICAL SERIES

The Vertical Series are, in a broad sense, geomorphically homogeneous—that is, the various rocks in the series have about equal resistance to stream erosion. They are compact and hard. Since the river is cutting downward in its channel rapidly in proportion to the erosion of the side walls, the valley is very steep-walled. From its position this chasm has received the name Inner Gorge. It is sometimes called the Granite Gorge, but this is a misnomer, since only a few relatively short stretches are cut in more or less homogeneous granite. The Inner Gorge is the scene of the most active stream erosion. The Colorado River can do an enormous amount of work during flood stages. During flood the discharge may total 125,000 sec. ft. in a single day, and

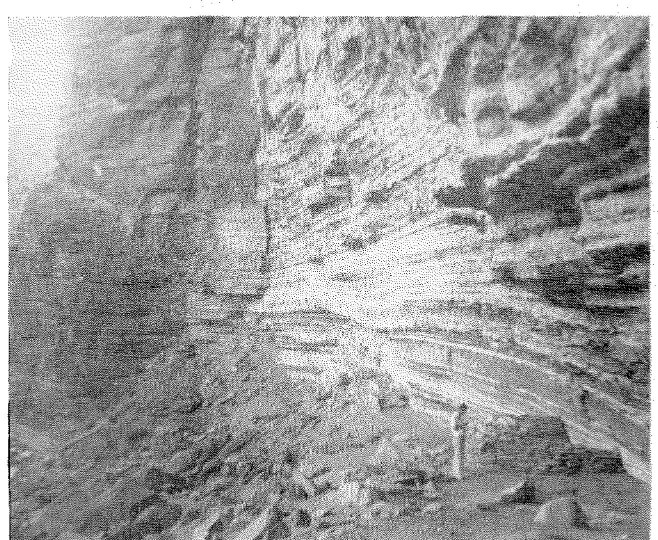

FIG. 9—Detail of Tapeats sandstone cliff showing accumulation of rubble by fall of joint blocks. Under overhanging ledge is ruin of an Indian shelter. Remains of Indian shelters and food caches are found in some of the most inaccessible parts of the canyon.


FIG. 10—Looking westerly down the Grand Canyon from above the vicinity of Havasu Creek. The origin of the meanders of the Colorado River shown by the dashed line is one of the geomorphic problems of the Canyon. They are believed to have been superposed from a surface higher than any in the photograph. The Esplanade itself is not a stream terrace, but originated by retreat of the Coconino cliffs through sapping of the relatively soft Hermit shale. The stripped surface is on thick-bedded sandstone of the upper Supai formation.

during such discharges the mean velocity in the total cross section of the river is about 10 ft/sec. In the upper part of its course, through Wyoming and Utah, the Colorado River picks up a great amount of sediment. During flood stage in the Grand Canyon as much as 27,600,000 tons of suspended matter has been recorded passing a gaging station in a single day. This does not include the bed load of the stream, which is carried along or near the bottom of the channel, although some estimates place this bed load as constituting 20 per cent of the total load. The endless barrage of silt particles, borne by turbulent high velocity stream currents, operates as a sand blast, actively abrading the channel walls and boulders in the channel. Soft rocks like limestone are fluted in accordance with the turbulence pattern. If it were not for the extremely effective reduction of boulders, the Colorado channel would be choked by huge deltas at the mouths of steep gradient tributaries. As conditions are, large boulder deltas accumulate, which produce the rapids forming the hazard to boat navigation.

The Inner Gorge is a dark and somber place, for the rocks are brownish-black, and the walls cut out much of

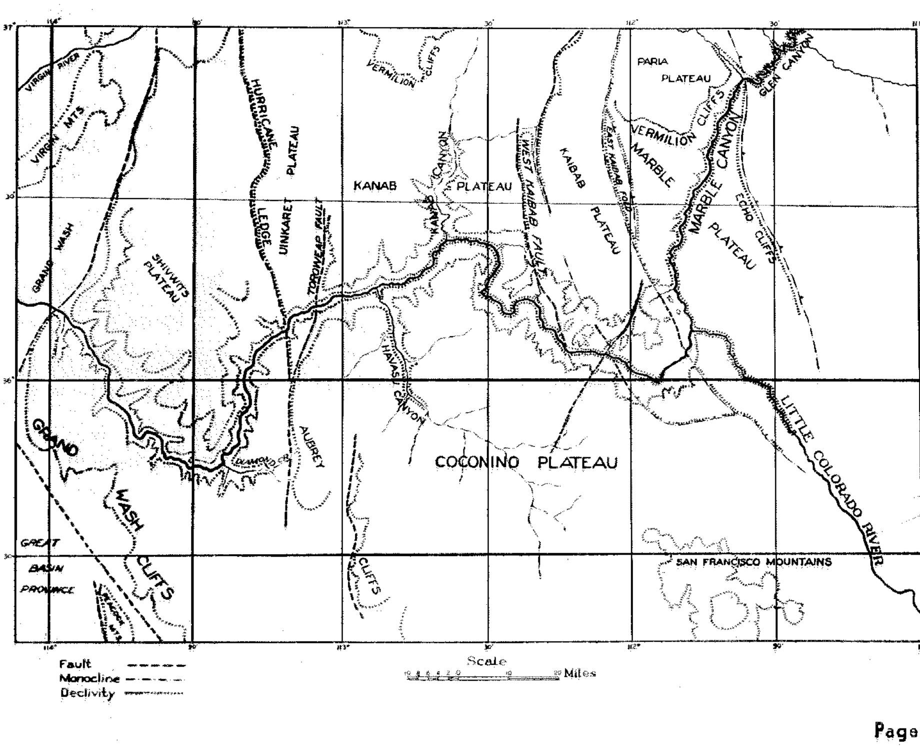


FIG. 11—Major structural lineaments in the Grand Canyon district.

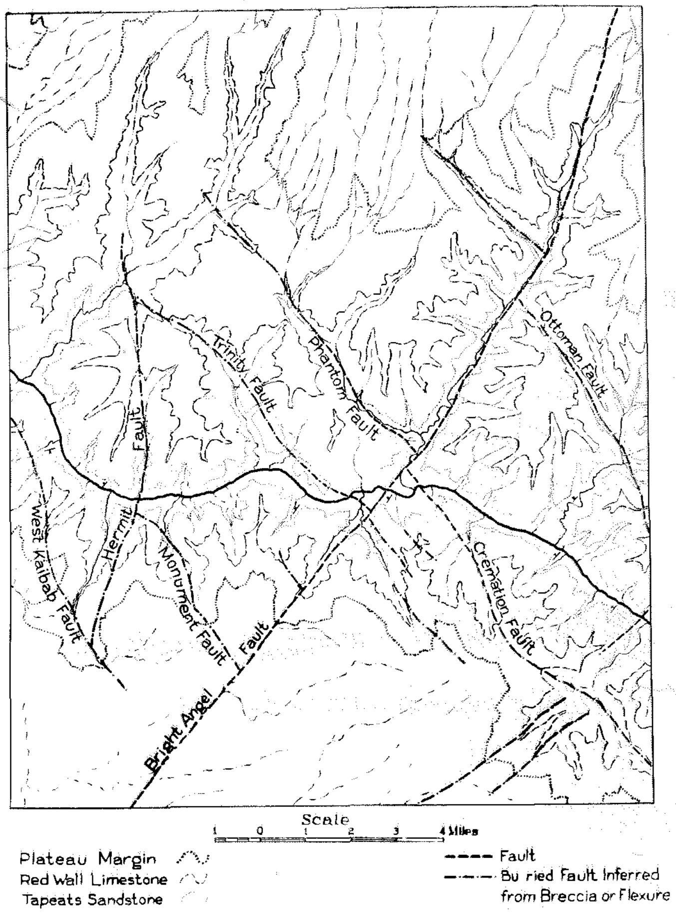


**FIG. 12—Plan relationship of topographic features of the Bright Angel quadrangle to structural pattern.**

the sunlight. Except at midday, the shadows are long and continuous. In the vicinity of the deltas the great rapids make a constant roar that reverberates through adjacent parts of the Inner Gorge.

## VERTICAL CONTROL IN THE WEDGE SERIES

In some places a thin conglomerate (Hotauta) lies over the flat erosion surface cut on the Archean schists and granites. Elsewhere, this surface is overlain by a brown limestone (Bass) which forms a step-like series of low cliffs. This limestone is overlain in turn by a thick shale deposit (Hakatai) which is relatively easily eroded to form a bench, although small cliffs are formed by the more resistant sandy members. This shale is overlain by a very thick quartzite formation (Shinumo) which forms high cliffs wherever found. The quartzite is overlain by a very thick series of sandstones (Dox), some of which form cliffs, others of which form benches. This lower part of the Wedge Series (Unkar) may be seen in the headwaters area of Bright Angel Creek on the north side of the Grand Canyon opposite the village. Overlying this group is the upper Wedge Series (Chuar), which contains limestones and shales and erodes into cliff-bench topography. This series is found only in the upper end of the Grand Canyon and it can be seen to the northeast of Grandview.

Diabase dikes, sills, and flows are found at various places in the Wedge Series and generally form steep, but not vertical, cliffs. During the erosion period which followed tilting of the Wedge Series, fault block ridges capped by resistant Shinumo quartzite formed monadnocks.

## VERTICAL CONTROL IN THE HORIZONTAL SERIES

The land forms in the Horizontal Series can best be understood by referring to *Fig. 7* in connection with the following discussion. The lowest and oldest formation of the Horizontal Series is a sandstone (Tapeats), which overlies the old erosion surface cut across the Archean metamorphics and the Wedge Series, and everywhere forms a precipitous cliff. This cliff marks the outer boundary of the Inner Gorge and the lower boundary of the Outer Canyon. It weathers to a dark brown in color. Overlying the sandstone is a shale formation (Bright Angel) which is everywhere bench-forming. The broad bench which has been formed by erosion back of the Bright Angel shales is one of the characteristic features of the Outer Canyon in the Bright Angel district, and to it is given the name Tonto Platform. An old Indian trail follows for many miles along the Tonto Platform on the south side of the river. Overlying the shale is a series of impure limestones (Muav), which in their upper portion form cliffs, in

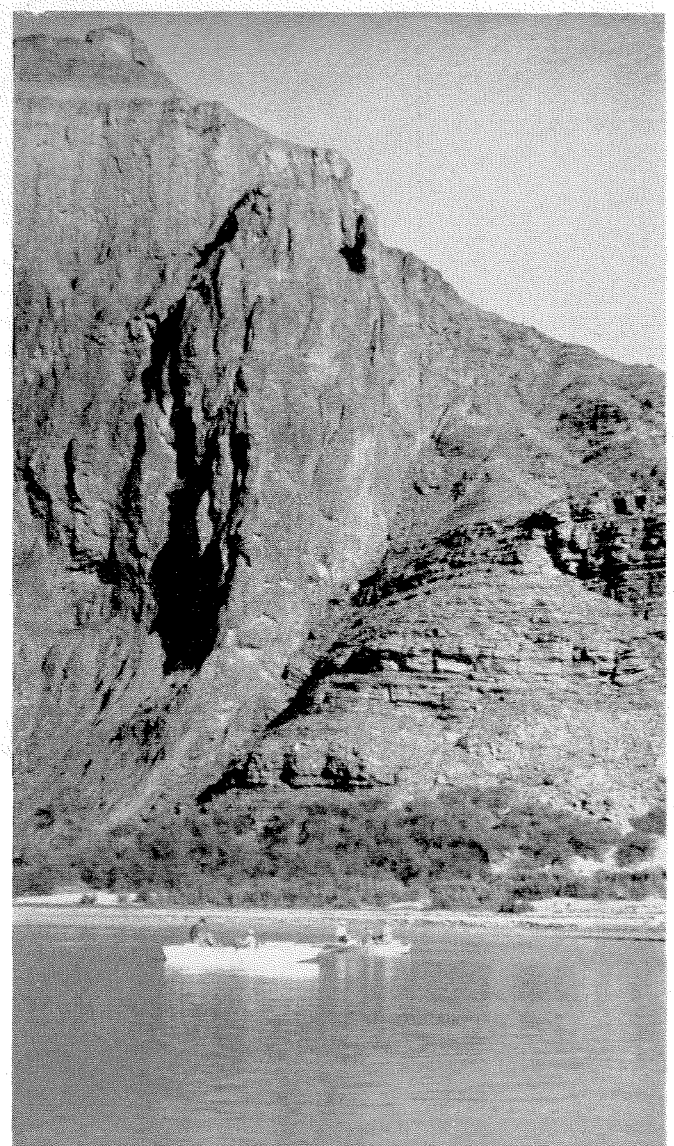

**FIG. 13—West branch of Butte fault. During first epoch of movement left side is believed to have gone down. During last movement left side went up and flexed the overlying strata as shown in FIG. 15.**

the middle portion form steep slopes, and in the lower portion form cliffs. The Muav limestone and Bright Angel shales have weathered to a pale yellowish green.

Overlying the Muav limestone in the eastern part of the Grand Canyon is the Redwall limestone which is everywhere cliff-forming, and which forms one of the most prominent topographic breaks in the Outer Canyon. The Redwall limestone is actually a compact grayish-white limestone whose outer surface has been stained reddish by iron oxide washed down from the overlying red Supai Formation. This latter formation consists of alternating sandstones and shale beds which form respectively cliffs and benches. The upper part of the Supai consists of red shale (Hermit), which overlies a rather thick red sandstone. The Hermit shale is a bench-forming member and in the western part of the Grand Canyon has been eroded back on the top of the heavy sandstone, forming a broad bench, known as the Esplanade. Overlying the Hermit shale is a thick, white, wind-laid sandstone (Coconino), which everywhere forms a prominent cliff. This in turn is overlain by a series of impure limestones and shales (Toroweap), which forms a steep slope resulting from alternating cliffs and benches. Resting on the Toroweap and forming the plateau surface to the north and south of the Grand Canyon is the Kaibab limestone, which forms prominent grayish-white cliffs.

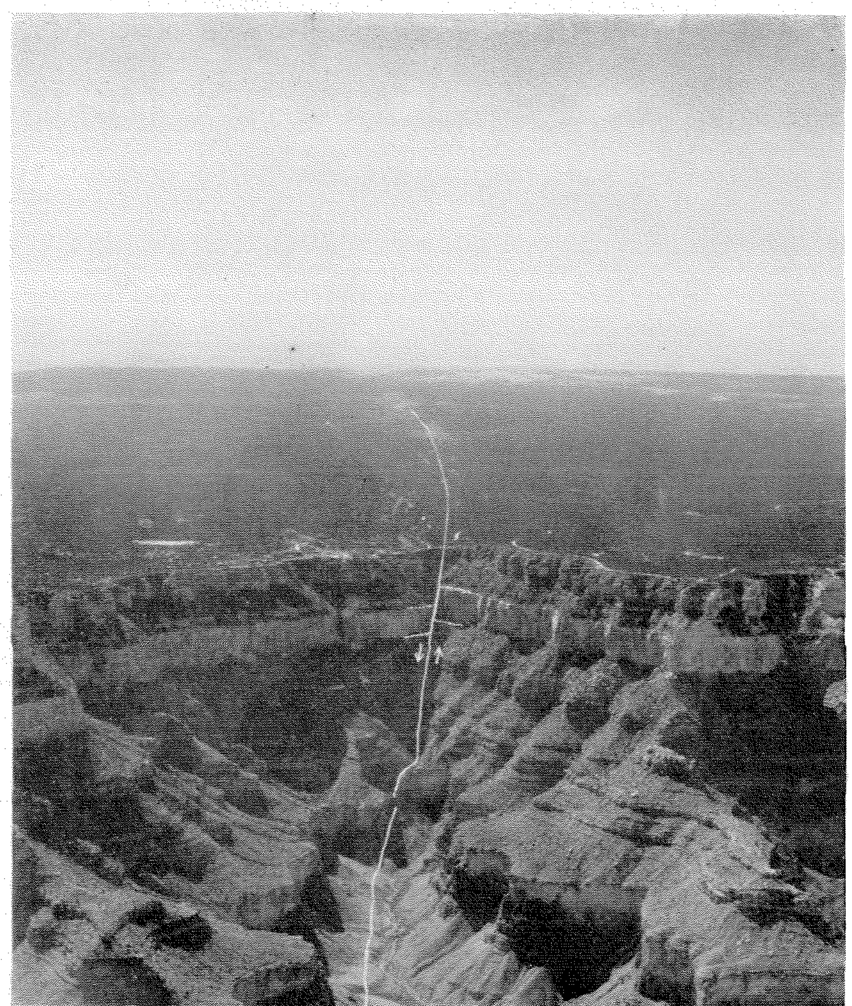

**FIG. 14—Looking south along Bright Angel fault trace in Outer Canyon and on Coconino plateau. A post-Paleozoic normal fault of 180 feet displacement, it nearly overlies a post-Algonkian reverse fault of opposite directions of displacement. It illustrates V-shaped re-entrant in canyon walls where erosion has been facilitated by rock brecciation along the fault.**

The stepped topography of the outer part of the Grand Canyon, which is so important to cross profile form, is due to the fortuitous alternation of beds having widely different resistance to erosion. Also, by chance, there is an alternation of light-colored beds and dark-colored beds, with the striking red beds in intermediate position, which gives an effective color combination when seen from a distance.

## HORIZONTAL CONTROL

In plan, as shown in *Fig. 12*, the remarkable alignment of tributary valleys may be seen. These tributary valleys determine the principal amphitheaters in the Outer Canyon. One important system has a northeast-southwest trend parallel to the Bright Angel fault. This northeast-southwest trend is also possessed by the foliation of the underlying metamorphic rocks. A northwest-southeast trending series of faults also determines a tributary system with its group of amphitheaters. This fault system tends to be parallel to the major joint system in the underlying metamorphic rocks.

So, in plan, the basic control is inherited from very ancient structures. We may picture the underlying metamorphic basement as consisting of immense polyhedrons (in some cases roughly rhombohedrons) measuring several miles on a side. As compared with the mile of horizontal strata lying over them, they possess unlimited strength. Therefore, stresses within the crust have been adjusted by movement of the underlying blocks, accompanied by faulting and flexing of the weak overlying veneer, in cases of considerable movement, or just by shattering of the overlying veneer above the old faults, in cases of small displacement.

Crustal stresses developed in separated periods of geologic time in the Grand Canyon district and operated in different directions on two occasions. During the first period of stress, with which we are concerned, the northeast trending series of fractures were developed as reverse faults by compression acting in a direction normal to them—namely, southeast-northwest. The north and northwest striking faults were normal faults resulting from tension or lack of compression. The movement occurred at the end of Algonkian time, perhaps on breaks developed earlier at the end of Archean time.

Sometime after the Paleozoic series forming the Outer Canyon walls had been deposited, stresses were again applied to the underlying blocks, but in the opposite directions. Now the north and northwest striking faults were subjected to compression, and movement on them was reversed, forming thrust faults, and monoclinal structures in the overlying sediments. The Cremation fault is an example of this group. *Fig. 13* shows the

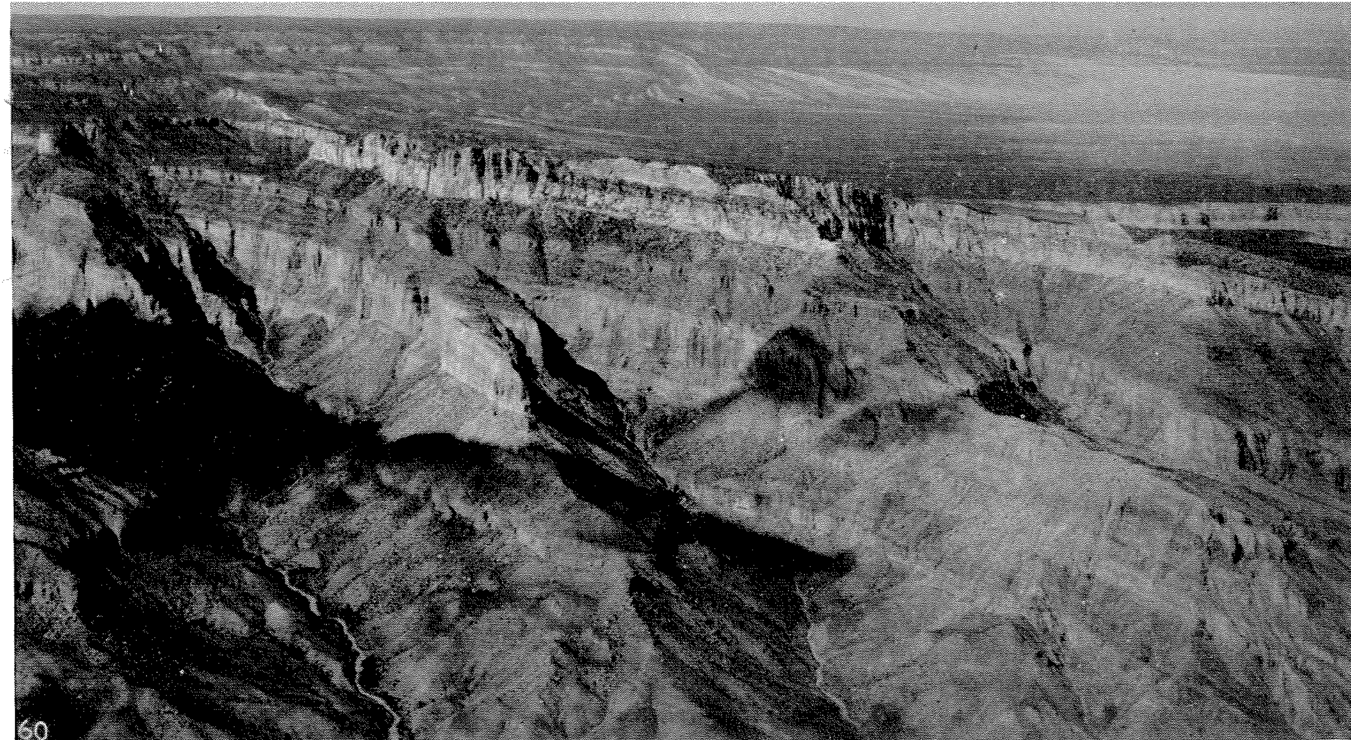

FIG. 15—East Kaibab monocline, a flexure in the strata of the Horizontal Series reflecting movement on underlying fault blocks.

north-northwest striking Butte fault, and *Fig. 15* shows the monoclinal folding of the Paleozoic strata overlying this fault. On the other hand, the northeast striking faults were relieved of compression and normal faults developed. In the case of the fault traversing Bright Angel Canyon, the plane of the late normal fault is close to, but not everywhere coincident with, the earlier thrust fault.

The intricate system of amphitheaters in the Outer Grand Canyon has been developed by headward erosion of streams along shatter zones or fault zones in the Paleozoic veneer, and by accompanying cliff retreat, influenced by joint zones, away from the stream channels. In the case of many tributaries, the brecciated zones have exercised predominant pattern control. In others, developed at right angles to the Colorado River where

TABLE SUMMARIZING GEOMORPHIC CHARACTERISTICS OF GRAND CANYON FORMATIONS

| | | | | |
|---|---|---|---|---|
| PALEOZOIC | Permian | Kaibab Limestone | 400 ft | Cliff forming |
| | | Toroweap Formation | 250 ft | Cliff-bench |
| | | Coconino Sandstone | 300 ft | Cliff forming |
| | | Supai Formation | 1440 ft | Cliff-bench |
| | Mississippian | Redwall Limestone | 600 ft | Cliff forming |
| | Devonian | Temple Butte Limestone | 0-1000 ft | Cliff-bench |
| | Cambrian | Muav Limestone | 450 ft | Cliff forming |
| | | Bright Angel Shale | 25-375 ft | Bench forming |
| | | Tapeats Sandstone | 0-300 ft | Cliff forming |
| ALGONKIAN | | Chuar Series | 9000 ft | Cliff-bench |
| | | Unkar Series | | |
| | | Dox Sandstone | 2000 + ft | |
| | | Shinumo Quartzite | 1000 + ft | |
| | | Hakatai Shale | 600 ft | |
| | | Bass Limestone | 350 ft | |
| ARCHEAN | | Phantom Pegmatite | | Hard basement, |
| | | Zoroaster Granite | | inner gorge-forming |
| | | Alarcon Amphibolites | 3000 + ft | |
| | | Vishnu Paraschist | 25000 ± ft | |

it is oblique to major structures, jointing has influenced the detailed pattern. The tributary valleys of the Outer Canyon on the north side of the river are longer than those on the south because the south-sloping Kaibab Plateau collects rainfall and feeds streams and springs from the north. The streams on the south have relatively small collecting basins because the drainage divide is on or near the edge of the south-sloping Coconino Plateau. As first pointed out by Professor Davis, the cliffs of tributary valleys meet headward in acute-angled re-entrants because the channel in the cliffed re-entrant is the site of most effective stream erosion and transportation.

On the spurs between the tributaries there is very little rainfall, so that streams are developed at rare intervals. Reduction of these spurs proceeds through the sapping of the various cliff-forming members. The breaking and dropping of joint blocks proceeds in such a way as to form a rounded re-entrant. The larger the amount of water that flows over the cliffs, and the narrower the zone of streamlet channels, the greater is the curvature of this re-entrant. *Fig. 16* illustrates this point, the cirque at the right having greater curvature and more stream development than the cirque on the left. The more rapid enlargement of the cirque on the right might ultimately result in its cutting through the spur end and forming a butte. Where there is no concentration of streamlets the cirque enlarges concentrically, as illustrated by the left example in *Fig. 16*. An advanced stage in the development of cirques is shown in the Tower of Set in the lower right portion of *Fig. 7*. A cirque of large radius of curvature faces in the direction of the river. Other cirques expanding away from the tributary valleys meet in sharp cusps at the outer end of long narrow tongues of Redwall limestone. To the right of the Supai pinnacle, forming the Tower of Set, is a saddle caused by the reduction of the cliff-bench forming members above Redwall cirques on the two sides of the ridge which are approaching each other in their retreat.

In summary, as illustrated in *Fig. 12*, the general plan of the Grand Canyon in the Bright Angel quadrangle is one of long tributary valleys on the north and short tributary valleys on the south. The cliffs of these valleys meet headward in acute-angled re-entrants. Some of the tributary valleys are developed approximately at right angles to the Colorado master course; others are developed along the northeast trending and northwest trending shatter zones and fault zones. Where the systems intersect, amphitheaters on a large scale are developed, such as the Hindu and Ottoman amphitheaters on the north and the Cremation and Grapevine amphitheaters on the south. The detailed plan of the inter-tributary spurs, controlled by concentrically expanding cirques of cliff retreat, resembles dough from which cookies have been punched. Dependent upon the intersection or approaching intersection of circles of cliff retreat are the various stepped buttes and step-spired temples of the Outer Canyon.

The geologic story of the Grand Canyon is told by the landscape so plainly that any visitor can understand it. Its separate chapters and paragraphs are coherent and succinct. It is colorful and fascinating. It is rich, not only as a source of scientific facts, but also in features elucidating them. The Grand Canyon is certainly one of the great heritages of the American people.

**FIG. 16—Vertical view of cliff-bench topography near Indian Gardens. Heavy shadows are caused by Redwall limestone cliff which is controlling factor, virtually a temporary base-level, in the recession of cliffs in the overlying Supai sandstones. Note their parallelism with the Redwall cliff. Where there is no continuous drainage from above, sapping operates with equal effectiveness about the periphery of a re-entrant, and it is expanded in sub-circular outline to form a cirque or amphitheater.**

# C.I.T. NEWS

## ATHLETICS

By H. Z. MUSSELMAN
Director of Physical Education

WITH four wins out of eight starts, Coach Carl Shy's basketball squad finished third in the Conference Championship race. Redlands topped the Conference with six victories; Occidental was in second spot with five wins. The Conference race was close, as more than half of the contests were won by only a few points. None of Tech's league defeats was by more than five points.

Highlight of the Caltech season was the 43-41 non-league victory over the Pepperdine Waves, the strongest college team in the west. The Waves, runner-up in the 1945 Intercollegiate basketball tournament at Kansas City, were behind 20-12 at the half, but quickly assumed the lead at the start of the second period. Baskets by Paul Nurre and Tom Martin, forwards, and by Paul Saltman, center, tied the score in the closing minute, with guard Jerry Schneider sinking the winning basket from mid-court as the gun sounded.

As predicted early in the season, Coach Shy's big problem was the development of a scoring punch, a handicap which persisted throughout the season. The team developed slowly, and did not reach its peak until the closing weeks of the season. Dick Jackson, forward, a V-5 trainee, topped the scorers with an average of 9.75 points per game, and center Paul Saltman, the only civilian member of the squad, averaged 7 points. Captain Stuart Bates, playing his third year on the team, won high recognition for his excellent defensive work at guard.

### THE SEASON'S SCORES

| | | | |
|---|---|---|---|
| *Caltech | 30 | Whittier | 29 |
| *Caltech | 37 | Occidental | 35 |
| U.S.C. | 33 | Caltech | 25 |
| *Redlands | 51 | Caltech | 47 |
| March Field | 49 | Caltech | 35 |
| U.C.L.A. | 33 | Caltech | 9 |
| *Whittier | 43 | Caltech | 38 |
| *Redlands | 43 | Caltech | 39 |
| Pepperdine | 41 | Caltech | 32 |
| March Field | 61 | Caltech | 47 |
| *Caltech | 46 | Pomona | 31 |
| *Occidental | 41 | Caltech | 38 |
| Caltech | 43 | Pepperdine | 41 |
| *Caltech | 50 | Pomona | 41 |
| San Diego Naval Training Center | 46 | Caltech | 38 |

Normal schedules have been arranged for Caltech teams in track, baseball, tennis, and swimming. With only forty Navy trainees remaining in school, the teams for the first time in three years will depend largely on civilian student support.

All squads will be quite inexperienced, as there are only five Spring sport lettermen in school and only a few others who have competed on Tech teams. However, with a large Freshman class entering this semester, and the return from service of many former students, much new material will no doubt be uncovered.

Bob Merrick, '42, who coached the Water Polo team last fall to such a successful season, will coach the swimming team this spring, and John Lamb, former tennis coach at Stanford University, has been appointed Tennis Coach.

*Conference Games

## SCHEDULES

### TRACK

March 22—Interhouse Meet
" 30—San Diego Invitational
April 6—College Relays at Occidental
" 13—Pomona-Redlands-Whittier at Caltech
" 20—Caltech at Occidental
" 27—Pepperdine at Caltech
May 4—Caltech at U.C.L.A.
" 11—Conference Meet at Pomona
" 18—Fresno Relays
" 25—Coliseum Relays at Coliseum
" 31—Pasadena Games at Rose Bowl
June 7—S.P.A.A.U. Championship at Compton

### BASEBALL

March 30—Loyola at Caltech
April 6—Caltech at Redlands
" 13—Whittier at Caltech
" 20—Caltech at Loyola
" 27—Pepperdine at Caltech
May 4—Caltech at Whittier
" 11—Caltech at Occidental
" 18—Caltech at Pepperdine
" 25—Redlands at Caltech
June 1—Occidental at Caltech

### TENNIS

March 30—Caltech at U.C.L.A.
April 6—Pepperdine at Caltech
" 10—Caltech at Pomona
" 13—Occidental at Caltech
" 16—U.S.C. at Caltech
" 20—Caltech at Redlands
" 27—Caltech at Pepperdine
May 1—Pomona at Caltech
" 4—Redlands at Caltech
" 8—Caltech at U.S.C.
" 11—Caltech at Occidental
" 17—Conference Tournament at Caltech
" 18—Conference Tournament at Caltech

### SWIMMING

March 29—Compton JC at Caltech
April 5—Caltech at Occidental
" 11—Caltech at Compton JC
" 16—Pomona at Caltech
" 19—Caltech at U.C.L.A.
" 26—Occidental at Caltech
May 1—Caltech at Pomona
" 4—Conference Meet at Occidental
" 8—U.C.L.A. at Caltech

## NEW FACULTY MEMBERS

CALIFORNIA Institute of Technology announces the addition of two noted geologists to its teaching staff in the division of geological sciences. Dr. J. Wyatt Durham, authority on oil deposits, will join the Caltech faculty as an Associate Professor of Invertebrate Paleontology next August. Dr. Richard H. Jahns, metallurgist for the United States Government during the war, comes to the Institute in March as an Assistant Professor of Geology.

A native of Okanogan, Washington, Dr. Durham received his B.S. from the University of Washington in 1933, his M.S. and Ph.D. from the University of California in '36 and '41. Formerly a geologist for the Standard Oil Company of California, he is currently employed by the Tropical Oil Company in Venezuela.

A Caltech graduate of 1935, Dr. Jahns was noted here both as an honor student and an athlete. He took his master's degree at Northwestern University in '37, then returned to Caltech for his Ph.D. in '43. Associated with the United States Geological Survey in studies of strategic minerals during the war, he developed an important source of domestic tantalum ore, and aided in development of an unusual deposit of beryllium in New Mexico.

## MAJOR M. M. BOWER '27

MAJOR M. M. BOWER has resumed work with Bell Telephone Laboratories in New York City after serving three and one-half years with the Signal Corps. For the first two months he was Officer-in-Charge of Military and Civilian Personnel, General Development Branch of the O.C.S.O. He was next assigned as Officer-in-Charge of the carrier telephone and telegraph and the wire and cable sub-sections of the Ground Signal Equipment Branch. During this time he went to Africa with 6,000 tons of this material and assisted in the introduction of carrier telephone and telegraph cable and rapid pole line.

In November, 1943, he transferred to the Signal Corps Engineering Laboratory, Bradley Beach, New Jersey, and was Control Officer of the Eatontown Signal Laboratory for one month.

Major Bower organized the Systems Engineering Branch at the Evans Signal Laboratory, endeavoring to compile information on communications systems engineering to coordinate developments within the Signal Corps. From May until his release, he was chief of the Radio Direction Finding Branch of the Evans Signal Laboratory.

## POSTHUMOUS AWARD

THE SILVER STAR has been awarded posthumously to Captain Herbert V. Ingersoll '26, Corps of Engineers, with the following citation:

SILVER STAR

"For gallantry in action near Alangan River, Luzon, Philippine Island, on 8 April 1942. During the early phases of the war, Captain Ingersoll assumed command of the 803rd Engineer Battalion and, by his coolness under fire, decisive action, and sound judgment, maintained the confidence and high morale of his inexperienced troops during a critical period of operations. When flanking units withdrew under cover of darkness leaving the battalion in a front base sector with unprotected flanks and rear and with no communications, Captain Ingersoll placed himself in an exposed position at the head of his men and, with utter disregard of personal danger from enemy patrols, led an orderly withdrawal without loss. By his inspiring courage and intrepid leadership in moving his unit to safety in darkness and under artillery fire over unfamiliar terrain, Captain Ingersoll rendered invaluable aid to our forces at a critical time and proved himself worthy of the highest traditions of the United States Army."

## CONSOLIDATED VULTEE FELLOWSHIPS

ACCORDING to a recent announcement received by Dr. Clark B. Millikan, one new scholarship and five new fellowships have been established by Consolidated Vultee Aircraft Company (Convair) for students at California Institute of Technology.

The scholarship provides for a grant of $500 a year and is open to highly recommended students in Engineering (civil, electrical, mechanical or aeronautical) who have completed their junior year, while the fellowships carry with them grants of $750 a year and are open to graduate students in engineering, metallurgy, chemistry, physics or mathematics. The scholarship is for a one year period; the fellowships cover the time required for the student to obtain the degree approved by the Institute and Convair.

The scholar, at the time of acceptance of the scholarship, agrees (the agreement is between the student and Convair) to work at Convair for a total period of thirty-two weeks. The work may be done during the summer vacation in his senior year and the remainder after graduation. The fellow agrees to work for Convair for a total period of thirty-seven weeks during summer vacation and after receiving his degree. At the conclusion of scholastic work and the training period, the student will be offered an employment contract at the discretion of Convair. Students are under no obligation to accept this offer.

The scholarships and fellowships are open to men who are in school and wish to continue work in their chosen field. Such men are selected by the Institute and approved by Convair. Men who are Convair employees are also eligible, but in applying for admission to the Institute, these men go through the regular channels.

For graduate students, a research problem will be mutually agreed upon by the student, Convair, and the Institute. After deduction of tuition, the remainder of the scholarship or fellowship funds may be distributed at the discretion of the California Institute of Technology. Funds not spent in any one year may be held over until the next year.

## DR. EDWIN F. GAY

DR. EDWIN FRANCIS GAY, Associate in Economic History at the California Institute of Technology, and chairman of the Research Group at the Henry E. Huntington Library and Art Gallery, died of pneumonia February 7, 1946, in Pasadena. He was seventy-eight years old.

Dr. Gay came to Pasadena in the autumn of 1936 from Harvard University; he exercised his option at that time of retiring as Professor Emeritus in order to join the Research Group at the Huntington Library. The Library was so rich in source material on economic history that Dr. Gay's work there was mutually profitable. At the Institute, Dr. Gay gave a graduate course in Economic History which was offered as a Humanities elective.

At Harvard University Dr. Gay will be remembered professionally for at least two reasons; the large group of students he trained and inspired in the field of economic history, and the leadership he gave the Harvard Graduate School of Business Administration beginning in 1908 when President Eliot appointed him its first Dean. In the first regard, it is probable that Dr. Gay played a unique part in advancing teaching and research in economic history; his students are carrying on in that field on a broad front as teachers and as members of research groups. In the second undertaking, as Dean of the Harvard Business School, he laid the groundwork for professional training for business. World War I interrupted this work; Dr. Gay was called to Washington to assist with the administration of several parts of the war economy. In November, 1919, he accepted an invitation to become president of the New York Evening Post. In January, 1924, this paper was purchased by the Curtis Publishing Company and Dr. Gay returned to Harvard University.

Throughout his life, Dr. Gay laid particular emphasis on research. His only early research in the field of economic history, carried on principally in Great Britain and in Germany from 1890 to 1902, was the basis for the particular distinction he enjoyed in England as an economist. He initiated the extensive program of business research at the Harvard Business School. He served as director of Research for the National Bureau of Economic Research from 1924 to 1933, and he was active in sponsoring the valuable statistical work undertaken by the Bureau on national income. He was an advisor to the California Institute of Technology authorities in connection with the establishment of the Industrial Relations section. A few months before his death he gave counsel and encouragement to his associates at the Institute as to the conduct of industrial research.

Dr. Gay was one of the leading figures in the Council on Foreign Relations during its first years. In 1921 he was its first secretary-treasurer, and from 1921 to 1945 he served as a director. The purpose of the Council was to promote an understanding of international affairs. It sponsored study groups in foreign relations in various cities. The quarterly publication of the Council, "Foreign Affairs", is the leading magazine in its field. Dr. Gay was a member of its editorial advisory board until his death.

Surviving Dr. Gay are his son, Edward R. Gay, of New York, and his daughter, Mrs. Godfrey Davies, of Pasadena, California.

## WILBUR C. THOMAS, TELEPHONE PLANNING ENGINEER, PASSES

STRICKEN suddenly, Wilbur C. Thomas, Toll Plant extension engineer of the Southern California Telephone Company, died at his home, 1270 Lorain Road, San Marino, California, on February 27.

Mr. Thomas was born in Georgetown, Colorado, May 8, 1897, where he spent his early years. At college age he won two Princeton University scholarships, but his college career was interrupted by World War I. In 1918 he was graduated from California Institute of Technology and subsequently employed by Standard Oil Company as an overseas representative in China.

From the beginning of his association with the Southern California Telephone Company in 1921, Mr. Thomas was instrumental in applying constantly improving developments to the expanding phases of this industry in the southern California area. In his recent post, he was largely responsible for the toll program which has provided facilities for the tremendously increased volume of long distance traffic developed during the war period and continuing into the postwar period.

Mr. Thomas was an active member of Tau Beta Pi, American Institute of Electrical Engineers, San Marino American Legion, Los Angeles Athletic Club, and Telephone Pioneers of America.

He leaves his mother, Mrs. Quinnie Thomas Owen, of Venice, California, his wife, Mrs. Grace Thomas, and daughter, Miss Grace Lorraine, of San Marino, California.

## NINTH ANNUAL SEMINAR

FIRST major postwar assembly of C.I.T. Alumni will be the Ninth Annual Seminar, scheduled to convene Sunday, April 28, on the Institute Campus.

Subjects for discussion will deal with up-to-the-minute developments in the fields of radar, electronics, and jet propulsion, as well as topics of the day concerning international affairs, and current economic and industrial problems.

According to Ken Belknap, '27, and Nick D'Arcy, '28, chairman and vice-chairman, respectively, of the Seminar committee, the program will be an "all-out" affair with the following tentative schedule of speakers, subjects, and events:

8:15 A.M. —Registration—Throop Hall.

9:00 A.M. to 9:25 A.M.—Chapel—Throop Hall.

9:30 A.M. to 10:20 A.M.—Professor Frederick Lindvall—201 Bridge Laboratory. Subject: "A New Type Electro-Mechanical Brain".

9:30 A.M. to 10:20 A.M.—Professor William Pickering—155 Arms Laboratory. Subject: "Radar, Its Postwar Possibilities".

(Since Dr. Lindvall's and Dr. Pickering's talks include laboratory demonstrations, the audience will divide into two groups for the above events.)

10:25 A.M. to 11:15 A.M.—Professor Wallace Sterling—Culbertson Hall. Subject (Dependent on national and international developments.)

11:20 A.M. to 12:10 P.M.—Doctors Lindvall and Pickering will give repeat performances for the alternate groups.

12:20 P.M. to 1:00 P.M.—Luncheon, cafeteria style, at student houses.

2:05 P.M. to 2:55 P.M.—Professor Robert D. Gray—Culbertson Hall. Subject: "Industrial Relations".

3:00 P.M. to 3:30 P.M.—James R. Page—Culbertson Hall. Subject: "The Institute and the Alumni".

The Seminar, a stag affair, will be open to all paid members of the Alumni Association, and guests. The registration fee, which includes the price of the luncheon, will be $2.50 per person. Since an overflow attendance is expected, reservations will be on a "first come, first served" basis. Alumni will receive announcements and reservation cards in early April.

## ALUMNI DINNER DANCE

SOFT lights, sweet music, and the renewal of old fellowships featured the Tenth Annual Caltech Alumni dance held at the Oakmont Club in Glendale on February 2. The sweet music was provided by Bob Mohr and his orchestra, and by Elsie Bear, her organ and accordian. The fellowship was contributed by 420 Tech graduates and their wives and guests, aided and abetted by the able ministration of the staff of the Oakmont Club's bar and grill.

Dinner at eight was followed by dancing which continued until exhaustion threatened the orchestra. The Alumni showed no signs of weakening. So great, in fact, was the response to, and the enthusiasm for, this gayer aspect of Alumni activity that your Social Chairman, Carl Friend, would like to have an expression of opinion as to your desire for another function of the same kind. If you want it, Carl has volunteered to shoulder the load and to arrange for another dance, tentatively suggested for October. Let us hear from you, and we will pass the word on to Carl.

## NAVY BASE IN MINIATURE

A 14,000 square foot model of a 60-square-mile naval base to be built at an undisclosed place in the Pacific will be used in studying effects of waves, currents and "other hydro-dynamic phenomena or ocean behavior", according to Dr. Robert T. Knapp of California Institute of Technology's Department of Mechanical Engineering, who will supervise construction of the model.

To be located in Azusa, California, the model will be built at a scale of 1 to 360 and will be based on exact topographic and hydrographic surveys including complete moles, breakwaters and lagoons. "Whatever the actual cost of this experiment", said Dr. Knapp, "it will be relatively small, perhaps as low as one per cent of the possible millions saved in correcting mistakes before they happen, thereby avoiding storm damage to costly harbor installations." In charge of the project at the site in Azusa will be Warren O. Wagner, Ph.D. '45, also of the California Institute of Technology.

## Month in Focus

*(Continued from Page 3)*

such an extent that they demand refreshing; experience in the technical field may be completely lacking because of duties of a different kind pursued since graduation from college.

### SHIFT TO THE WEST

A large number of men who left the Pacific Coast either many years ago, or within the past five years, were effectively frozen in their positions in the eastern part of the country during the war. It is surprising to see how many of these men are now trying to secure employment on the Pacific Coast. Men who have attained positions of considerable responsibility are seeking employment in the "industrially expanding west". The expansion that is talked about does not come as quickly as some would have it; before it arrives a reasonable period of development will be required. If one considers the problems associated with such a development from an engineering point of view, it becomes obvious that such a tremendous task cannot take place in any very short time.

### ELECTRONICS

The armed forces have trained large numbers of men in the field of electronics, radio, communications, etc., and a majority of these individuals are desirous of remaining in that field on returning to civilian life. The greater proportion of these men are seeking electronic employment on the Pacific Coast where developments in electronics are not of the greatest industrial importance at present, rather than in the east where these activities are firmly established.

### LOOKING AHEAD

Most industrial concerns tend to go a little easy on new technical hiring; they are waiting to see how many of their technical employees return to them from the service. Under these conditions, employment of newcomers is not now unusually active. Nevertheless, the longer-term outlook is bright. This is particularly true for those who return to their old employers, or who promptly recapture and improve their scientific skill by taking refresher, or graduate, work.

During the past three years, the universities have graduated relatively few technical men, and another four years will lapse before there is any regular class of B.S. to Ph.D. men. The general opinion prevails that it will take from ten to fifteen years to catch up to the normal availability and need of scientific men. Meantime, most companies are expanding their technical forces (especially along research lines) as rapidly as their own men return, or as other really good prospects become available. The long-term prospects are definitely conducive to optimism for those who are able and willing to qualify themselves fully for professional work.

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## PERSONALS

### 1920

ROSCOE R. ROCKAFIELD has been promoted from chief draftsman to engineer-in-charge of the crushing, cement, and mining section at the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin.

### 1925

Dr. SAMUEL L. DIACK has returned to Portland, Oregon, from military service with the Army Medical Corps in North Africa, France, and Germany, where he is re-entering medical practice at the Portland Clinic, Portland, Oregon.

MICHAEL C. BRUNNER, formerly a colonel in the Army and now on inactive status, has returned to the Shell Oil Company, Houston, Texas, as assistant to the vice-president who is in charge of exploration work east of the Rocky Mountains. Mr. Brunner's family, who has been living in southern California, is now returning to Texas. Michael Stuart, however, is remaining at the Southwest Military Academy, San Marino. While in service, Mr. Brunner was awarded the Legion of Merit.

### 1926

COLONEL JOSEPH MATSON, JR., AUS, chief construction division office of the engineer, headquarters, MidPac, returned to civilian life November 1. After a month's vacation he resumed his post as civil engineer for the Waialua Agricultural Company, a position he held for two years prior to the war. Before his discharge, he was awarded the Legion of Merit.

J. E. VOELKER, formerly major in chemical warfare, has been released from military service and is now employed by the Riverside Cement Company as chemical engineer.

IVAN FARMAN has just been appointed brigadier general. He is moving from Asheville, North Carolina, to Langley Field, Virginia. The Farmans have one son.

### 1927

WM. A. MINKLER has been transferred from the former Westinghouse Air Conditioning and Refrigeration headquarters in Jersey City, New Jersey, to Hyde Park, Boston. Westinghouse Electric Corp. has purchased the B. F. Sturtevant Company, with factory and headquarters at Hyde Park. Mr. Minkler has been manager of application engineering and continues in this capacity in the new location.

LAYTON STANTON is now division geologist, Union Oil Company of California, Oregon and Washington division, with headquarters at Olympia, Washington.

TED C. COMBS, formerly lieutenant-colonel of the Army Service Forces, has accepted a position with Timber Structures, Inc., San Francisco, California.

FRANK A. NICKELL is in the employ of the Government of India (Punjab and United Provinces) for T.V.A. He is under contract for a year to supervise construction of five dams, the size of Boulder Dam. The construction is under the direction of the United States Board of Reclamation.

**1929**

W. W. BAUSTIAN, will be chief engineer in charge of construction of a new giant telescope for Lick Observatory, Hamilton, California. Mr. Baustain's appointment to head the University of California project, which includes plans for a 120-inch reflector telescope, became effective January 14.

MAJOR J. W. DUNHAM, who served three and one-half years in foreign service in the Corps of Engineers, has returned to the States and his former position with the United States Engineers.

**1931**

COMMANDER THOMAS V. TARBET is now on inactive duty having returned recently from the Pelay Islands Group. Commander Tarbet is the father of one son, five, and a daughter, two, years of age.

**1932**

COLONEL W. R. SHULER has been transferred from Ft. Lewis, Washington, to Washington, D. C. He is working on the atomic bomb project. His address is P. O. Box 2610, Washington, D. C. Bill has one son—a "chip off the old block".

**1933**

LIEUTENANT-COMMANDER DICK A. PLANK visited the campus in January while on terminal leave. Dick served in southeast China on a special S.A.C.O. mission for thirteen months. Dick has two children: a son seven years of age and a daughter, two. The family are now living in Torrance, California.

ED HAYES returned to his former position at the Howard Hughes Company from General Electric. Ed is in charge of the installation of television equipment.

WILLIAM W. MOORE presented a paper before the San Francisco Section, American Society of Civil Engineers which was held at the Engineers' Club in San Francisco on December 18. The subject of his paper was, "Experiences with Predetermining Pile Lengths".

MADISON T. DAVIS was recently advanced to the position of assistant production manager of the Dicalite Division of the Great Lakes Carbon Corporation.

LIEUTENANT R. L. RUSSELL, U.S. N.R., is on terminal leave from service and expects to locate in southern California. Lieutenant Russell spent thirteen months on Attu as an Underwater Defense Officer and sixteen months in Washington, D. C., working in the office of the Chief of Naval Operations.

LOUIS GOSS has recently been appointed city engineer of Brawley, California. Prior to his appointment, Mr. Goss was an associate engineer in the United States Engineers office in Los Angeles. In addition to his engineering duties at Brawley, Mr. Goss is acting head of all service departments, including water, sewer, and street departments.

**1934**

NORMAN S. JOHNSON returned from Honolulu where he has been serving as Project Engineer, District Public Works 14th Naval District for the past four and one-half years. Norm is going into the contracting business and will live in Fullerton, California. The Johnsons have two sons, age three years, and eight months respectively, both born in Hawaii. Norm regretfully states: "My sons will never become Presidents!"

HOWARD E. GULICK is back in civilian life and has returned to his prewar job as mechanical engineer with the public service department of the city of Glendale, California.

LEONARD (GENE) E. ROOT, chief aerodynamicist at Douglas Aircraft, was chosen by the Junior Chamber of Commerce as one of ten outstanding young men in the U. S. A.

ROBERT P. SHARP, formerly a captain in the Army and now a civilian, has assumed his position on the faculty of the University of Minnesota.

**1936**

FRANK W. DAVIS was recently advanced to the position of assistant chief engineer of the Vultee Division of Consolidated-Vultee at Downey, California.

**1937**

HARRY H. MILLER was still in Naples at Christmastime with the Medical Division of the last squadron of the 62nd Troop Carrier Group. Mrs. Miller and Harry, Jr., are in Spokane, Washington.

**1938**

JAMES BALSLEY is still with the U.S. G.S. He and Mrs. Balsley and Christopher (age seven months) are living in Arlington, Virginia.

LIEUTENANT BLAINE A. DIXON, U.S.N.R., visited the Institute in January while on terminal leave. Lieutenant Dixon was stationed in the Pacific area on a sub tender. He was married last July and is now living in Hollywood.

LIEUTENANT SAM H. KELLER visited the Campus while on terminal leave in January. Sam was in service three and one-half years, having been stationed the last nine months on Leyte and Samar Islands with the 104th Seabees, where he was engaged in building a Naval operating base on Leyte.

HENRY K. EVANS was discharged from the Army in December. He has returned to the National Conservation Bureau in New York City.

**1939**

JOHN A. BATTLE announces the arrival of a son, John A., Jr., born September 21 at Guatemala City, C. A. John is employed by Pan American Airways of that city.

MAJOR MELVIN LEVET, who has been in the Philippines, visited the Campus in January on terminal leave. Major Levet was overseas twenty-eight months serving as Staff Weather Officer, 13th Air Force. His home is in Monterey Park, California.

JOHN E. OSBORN, formerly a lieutenant in the Navy, is back in civilian life, with Osborn Company, grading and paving contractors. John is living in Pasadena with Mrs. Osborn and their five months' old son.

EDWIN F. SULLIVAN, associate engineer, U. S. Bureau of Reclamation, Sacramento, has just been elected president of the Speakers Club, Sacramento Section, A.S.C.E. Ed has also been re-elected secretary-treasurer of the Sacramento Section.

**1940**

FRED STOLTZ has accepted a position

with the Holly Heating Company of South Pasadena, California.

DR. VICTOR WOUK, formerly with Westinghouse Electric Corporation, recently joined the Engineering Laboratories staff of North American Philips Company, Inc. at Dobbs Ferry, N. Y.

HERBERT SARGENT, formerly in the Chemistry Department of the Institute, has accepted a position with U. S. Rubber Company, Passaic, New Jersey.

### 1941

LIEUTENANT NEWELL BALLREICH, U.S.N.R., is now on a civilian status and is making his home in Inglewood, California. Newell was commanding officer on an L. S. M., serving both in the Atlantic and Pacific areas. He returned to the States from Japan.

### 1942

G. R. MAKEPEACE has been working at Menasco Manufacturing Company since graduation. Gerry is married and has a son three years of age. Recently he purchased additional property adjoining his Pasadena home for the cultivation of orchids, which is his hobby.

LEIGHTON TRUE, formerly stationed for twenty months at the Bureau of Ordnance,, Representatives Office, Western Electric Company at Kearney, is on terminal leave until the end of March.

LIEUTENANT PAUL ALLEN, JR., U.S.N.R., Inspector of Naval Material, Los Angeles District, since 1942, is now on inactive status. Paul is living in South Pasadena with Mrs. Allen, their son, Paul 3rd, and the new daughter who arrived the latter part of January.



SAM MADLEY visited the Institute in January on his way to Washington, D. C., where he was to be stationed one month, prior to his terminal leave. Sam served two years at the Naval Supply Depot, Clearfield, Utah.

LIEUTENANT (j.g.) WILLARD FULLER, JR., visited the Campus in January. Willard has been stationed on Saipan and expected to go back to the Pacific area. When released from military service, which will probably be in the spring, Willard intends to engage in mining activities.

LIEUTENANT (j.g.) MELVIN J. SKINNER CEC, who has been stationed on Manus Island in the South Pacific with a construction battalion, is now enjoying terminal leave. Melvin has a son one year of age.

CAROL M. VERONDA, formerly with the Naval Research Laboratory, has accepted a position with North American Philips Company, as assistant engineer, Microwave Section.

ROGER BRANDT is now employed as a design engineer for Barkley & Dexter, Boston, Massachusetts.

SECOND LIEUTENANT KENNETH URBACH, formerly stationed at the Holabird Signal Depot (Surplus Property Disposal), Baltimore, was discharged some time last fall.

JACK ALFORD, now on inactive status from the Navy, has accepted a teaching appointment at the Institute, effective in March. Last September a son, Christopher John, arrived at the Alford home.

### 1943

DOCTOR JOHN OTVOS has accepted a position with Shell Development Co. at Emeryville, California.

LIEUTENANT (j.g.) KENNETH POWLESLAND is stationed at Norfolk Navy Yard, engaged in repair of ships.

T/4 M. C. SMITH, U.S.A. was discharged from service in December. He plans to resume study at the Institute in March.

T/4 WILLIAM SNYDER, U.S.A., is now stationed at Holabird Signal Depot in Baltimore where he is engaged in radio propagation work. William is coming back to school when discharged.

CORPORAL WILLIAM J. RUSSELL is working for a radio propagation unit, Noise Station of Bureau of Standards, at Sterling, Virginia. William served overseas duty in Puerto Rico. He hopes to continue schooling when discharged.

### 1944

WESLEY SANDELL is entering Harvard Business School in February.

LIEUTENANT FRED B. ELY, U.S.N.R., having served nine months overseas in the vicinity of Iwo Jima, is now stationed at Terminal Island aboard A.P.B. 50, U.S.S. *Cameron*. Fred expects his terminal leave soon, probably in April.

DAVID GOLDING, formerly in the Chemistry Department of the Institute, is now working at Du Pont in Washington, D. C.

ENSIGN F. A. BEHRENS, JR., has assumed command of the U.S.S. YMS-407 in the western Pacific area.

### EX. '44

FIRST LIEUTENANT JAMES WIGGS, now on terminal leave, was a navigator in the 15th Air Force in Italy for eight months. Jim was married in 1943 and is living in Venice, California.

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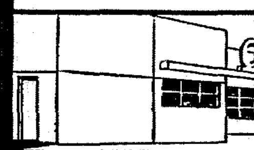

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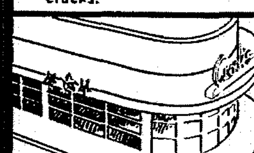

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