

ENGINEERING AND SCIENCE



FEBRUARY, 1947

PUBLISHED BY CALIFORNIA INSTITUTE OF TECHNOLOGY ALUMNI ASSOCIATION

GOOD NEWS *from General Electric*

FOR CAR OWNERS

... a new lifetime finish



A finish that will retain its original brightness and gloss as long as your car lasts—that is the goal which General Electric chemists hope to reach with silicone resins, the new materials derived from sand.

They predict that the finish will be perfected within five years.

The paint is already under test. It has proved highly resistant to severe weather conditions, chemicals and heat. Immersed in acid and alkali solutions that would cause today's finishes to deteriorate, silicone-treated panels have remained unmarred.

FOR SMOKERS

... leakproof cigaret paper

A new G-E fault detector makes possible the production of a cigaret paper that is virtually leakproof—free of those pesky little holes that sometimes cause a cigaret to draw improperly.

Not only holes but minute imperfections in the paper are detected electronically by the instrument.

In addition to adding to smokers' pleasure, the new device will be used industrially for inspecting paper, sheet rubber, sheet mica, plastics and other materials.

FOR TRAVELERS

... peacetime radar

Radar is being used both on ships and planes to cut down the hazards of traveling in the dark, in fog, or in storms.

For planes, the General Electric Electronics Department will soon produce a radar unit weighing only about 100 pounds, designed to increase the efficiency of "all-weather" airline operations.

For ships there is the G-E "electronic navigator," which uses radar to detect the position of above-water obstacles.



FOR G-E EMPLOYEES

... life incomes after retirement

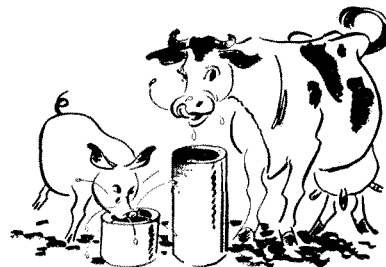
A steady life income after retirement is offered all G-E employees under provisions of a hundred-million-dollar pension plan recently announced by General Electric.

For the average employee this will mean a retirement income several times as large as the annuity he could ordinarily buy. Income at retirement, when added to Social Security payments, will amount to about 50% of average pay for the employee who has spent his working years with the Company.

Other G-E "job dividends," those extras that employees get in addition to wages, include insurance, vacations with pay, and achievement awards.

FOR FARMERS

... a stock drinking cup



One of the latest direct applications of electricity to the farm is an electrically heated automatic stock drinking cup. A clean, fresh, year-round, outdoor water supply for livestock is now possible with this drinking cup.

Designed for use in sub-zero weather, it consists of a Calrod-heated drinking cup, enclosed in a durable metal housing, and fed from the farm water supply system by an electrically heated water pipe. Livestock simply nose down a treadle in the base of the cup, causing water to flow automatically.

A thermostat automatically maintains the water in the cup and pipe at a temperature safely above freezing.

FOR HOMEMAKERS

... the Circline lamp

The Circline lamp is a circular fluorescent lamp. A 32-watt bulb of this type gives as much light as a 100-watt incandescent lamp.

These lamps, which set a new style in lighting, shed a soft, cool light from a diffused area instead of a single lighting point.

GENERAL ELECTRIC

BY-LINES

HARRY W. ANDERSON

Harry W. Anderson, vice president of General Motors in charge of personnel, was graduated from the Detroit College of Law in 1913. After working for the Union Title & Guarantee Company he served with the United States Air Force in World War I. In 1919 he joined the legal department of United Motors Service, a subsidiary of General Motors. Since that time he has had a variety of service with the Corporation, serving in its legal department and as an assistant to Mr. C. E. Wilson, then a vice president of the Corporation. Mr. Anderson was transferred to the labor relations staff of the department in 1934, assumed charge of the Personnel Staff in December of 1941, and has been vice president since January 5, 1942.



J. A. VAN DEN AKKER

Dr. J. A. Van den Akker graduated from the Institute with the class of '26 in physics and engineering. After finishing his doctoral work in 1930 he became instructor in physics at Washington University, St. Louis, where he carried on teaching and research activities until 1935. In that year he was appointed head of the physics department at The Institute of Paper Chemistry, Appleton, Wisconsin, where his work is graduate school teaching and research in applied physics. During the war, the activities of the physics department were confined largely to the physics of materials of interest to the Quartermaster Corps and the War Production Board.



COVER CAPTION

South entrance to the Charles Arms Laboratory of the Geological Sciences. Gift of the late Mr. and Mrs. Henry M. Robinson in memory of Mrs. Robinson's father, the building houses the geology museum and the main geology lecture hall. All of the laboratories and classrooms for invertebrate paleontology are in Arms, as well as laboratory facilities for mineralogy and petrology. Arms Laboratory was built in 1938 as one of two units for the study of geological sciences at the California Institute. The other building, the Seeley W. Mudd Laboratory, was constructed in the same year, and houses administrative offices, the entire meteorology department, and facilities for study and research in vertebrate paleontology.

ENGINEERING AND SCIENCE

Monthly



The Truth Shall Make You Free

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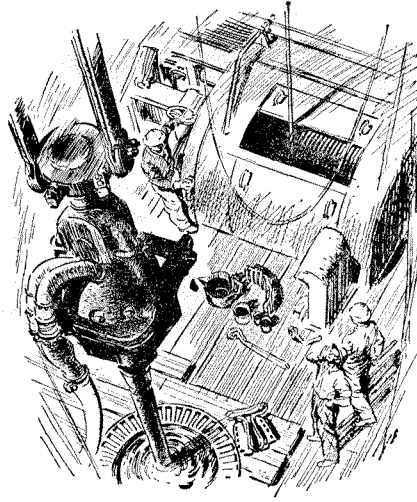
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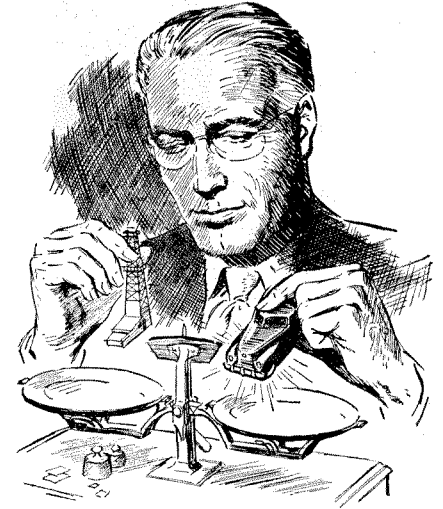
What is Profit?



1. Before people can have such things as shoes and gasoline and vacuum cleaners, at least two things are necessary. Someone has to provide the “tools” and raw materials you need to make those products. And someone has to perform the labor of turning them out.



2. Now if you're going to ask a man to put all his labor into the production of gasoline and petroleum products for other people—instead of expending it on things for his family and himself—you obviously have to compensate him in some way. Under our American economic system we do this with wages.



3. By the same token, if you're going to ask a man to put his money into “tools” and raw materials that will produce gasoline for other people—instead of spending it on things for his family and himself—you have to compensate him in some way. So we offer the “tool-provider” a chance to make a profit.



4. At Union Oil, for example, 34,970 individual Americans have put up varying amounts of money to provide the refineries, drilling rigs, service stations, etc., that we need to make and distribute petroleum products. If the company makes a profit these people—called shareholders—are rewarded with cash dividends.



5. As a rule, about half the profits are plowed back into more “tools” and half are paid out in cash dividends. But the total profits each year are much smaller than most people think. In 1945, for example, they amounted to only 5.9% on the capital invested in the company—less than 6¼¢ out of each dollar the company took in.



6. It seems to us that this is certainly not an unfair reward for the contribution these “tool-providing” people have made to the company. And without this profit incentive we Americans could never have achieved the high productivity and efficiency that have made this country great.

UNION OIL COMPANY
OF CALIFORNIA

This series, sponsored by the people of Union Oil Company, is dedicated to a discussion of how and why American business functions. We hope you'll feel free to send in any suggestions or criticisms you have to offer. Write: The President, Union Oil Company, Union Oil Bldg., Los Angeles 14, Calif.

AMERICA'S FIFTH FREEDOM IS FREE ENTERPRISE

ENGINEERING AND SCIENCE

Monthly



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February, 1947

Management's Responsibility for Discipline

By H. W. ANDERSON

The accompanying address was presented by H. W. Anderson, Vice President in Charge, Personnel Staff, General Motors Corporation, Detroit, Michigan, on January 27, 1947, at a dinner-discussion meeting held in the Music Room of the Biltmore Hotel, Los Angeles, under the auspices of the Industrial Relations Section.

Reprints of this article are available from the Industrial Relations Section of the California Institute of Technology.

THIS analysis of "Management's Responsibility for Discipline" covers the experience of General Motors over a period of many years in more than 100 plants, employing a large number of people, varying from 150,000 to half a million, supervised by some 20,000 foremen and supervisors. In view of this scope, I will limit my discussion of some of the experiences we have had to the fundamental principles of our disciplinary policies, with a few case illustrations.

It has become quite customary to pose the general subject of discipline and then talk about its rougher and rather minor manifestations. The subject is, of course, broader than such treatment would indicate. Discipline is a fundamental which makes it possible for folks to work together. Unless a group recognizes and observes the adjustments requisite for unity of purpose, the enterprise cannot succeed.

First, I want to discuss the usual everyday plant disciplinary problems, and later I will go into a special problem involved in dealing with wildcat strikes in violation of agreement terms.

SHOP DISCIPLINE

Much has been said and written about discipline in the shop. Unfortunately, the word "discipline" has for most persons a harsh connotation which is not justified by the actual application of the term to shop disciplinary situations.

Shop discipline in General Motors does not mean strict observance of rigid rules and regulations. On the contrary, it means working, cooperating, and be-

having in a normal way as anyone would expect an employee to do. For example, "discipline" means:

- Reporting for work regularly, on time, and without unnecessary absences;
- Doing a fair day's work;
- Respecting the prestige and authority of supervision;
- Obedying reasonable orders and carrying out job assignments;
- Cooperating with others; and, in general, Conducting oneself in a reasonable and orderly manner.

The maintenance of discipline in a plant is a Management responsibility. We in General Motors do not consider discipline to be a matter of Management's inalienable right or prerogative—it is a responsibility—it is a primary part of the job of managing the business. All of our labor agreements specifically provide that the matter of discharge and discipline for cause, and the maintenance of discipline and efficiency are the sole responsibility of Management. When Management yields this responsibility or agrees to share it with others, it has failed in its duty to manage.

I think this concept of the matter of responsibility for discipline was very well stated by Dr. George W. Taylor, who enjoyed an enormous experience with the problem as impartial umpire and as Vice Chairman and Chairman of the National War Labor Board:

Discipline as a Duty

Instead of considering only the right to discharge, perhaps we should ponder briefly why management must undertake discipline at times as a duty. Management's job is to run a plant efficiently. Instead of viewing discipline and discharge as an unchallengeable right, I should like to suggest that it be conceived as a heavy responsibility that frequently cannot be avoided if the interests of the workforce and of the company are to be protected. Every progressive executive will recog-

nize that the discipline function is not a license to be tough or capricious but a phase of maintaining an efficient working force. It is closely related to the selection of employees. Excessive use of disciplinary measures is often a symptom of a poor selection or assignment or of an inadequate training program.

When, however, an employee cannot make the grade despite management's assistance, and when his continued employment hinders the productive possibilities of other employees, management may have the disagreeable responsibility of discharging him. Considering discipline from this point of view, as a function of management, lends emphasis to management's usefulness and essentiality rather than to its inherent rights, which can be abused.

If management retains not so much the right but the duty to discipline when the effective operation of the working force requires it, one need have no fears about the reviewability of disciplinary action through collective bargaining. Such reviewability is a necessary protection to employees. Admittedly, this approach is harder going, but it emphasizes the professional competence of management. It is through collective bargaining that management must preserve its responsibility for exercising, in a professional way, such discipline as is necessary to operate efficiently.

In the earlier days of collective bargaining, some of the less experienced union leaders insisted upon negotiating shop rules and penalties with us. We resisted the demand on the grounds that such a sharing of Management's responsibility would be unsound from Management's point of view and equally unsound from the Union's standpoint.

We pointed out that the Union could not retain its proper function of representing the employee and protecting his interest if it assumed any part of Management's function of setting disciplinary penalties. If the Union should agree with Management as to what a proper penalty should be in a case, it would thereby foreclose its right to protest the penalty. The Union should be in a position to protest any disciplinary action taken by Management on the grounds that the discipline is unfair, unjust, discriminatory, lacks cause, or is too severe. Any procedure which forecloses the right of an employee to have his case appealed to the highest authority in the grievance procedure is basically unsound. This has been our position every time a union insisted on negotiating rules and penalties. We believe the wiser heads of the Union realize that our position is sound and realistic, because we have not heard anything about this subject from the experienced Union leaders for some time.

In General Motors, Management establishes the rules and it disciplines for violations. The Union is free to challenge the application of any rule in a given situation and it can "walk the last mile" with a disciplined employee without embarrassment.

Several basic principles govern our application of shop rules. Some of these were hammered out the hard way!

1. The employee is entitled to know the rules.

In every plant of General Motors the shop rules are posted in conspicuous places throughout the plant. Most plants also include the rules in handbooks given to employees. The rules are written in simple language which can be understood by all.

2. Management accepts the full responsibility for assessing discipline.

It is the foreman's job to maintain discipline in his department. It is his job to assess penalties for infractions. He may consult his superiors for advice in some cases, but the final responsibility is his. He may discharge on the spot for very serious infractions. He often suspends the employee, pending a complete investigation. We have learned that a case which appears to be simple can become very complex and involved by the time it goes through the various steps of the grievance procedure. It pays to have all the facts before the discipline is set.

We have no mechanical formula for establishing disciplinary penalties. It cannot be done with a slide rule. We do have a penalty spread for violation of each posted rule. This specifies a minimum and a maximum within which the penalties are set. In arriving at the proper discipline within the spread, the foreman takes into consideration four factors:

1. Seriousness of the offense
 2. Past record of the employee
 3. Circumstances surrounding the particular case
 4. Plant practice in similar cases
3. Management is willing to have its disciplinary actions reviewed, after the fact, by an impartial Umpire to determine in an impartial way whether the action was for cause and fair in the light of all the facts and circumstances.

Our labor agreements provide for an impartial Umpire as the terminal step of the grievance procedure. Under these agreements, Management delegates to the Umpire full discretion in the case of shop rule violations. Any employee who is disciplined can file a grievance, and the Union has the right to process the case through the grievance procedure up to the Umpire. The Umpire, after a full hearing of the facts and circumstances, can decide whether Management's action was proper. He has the power to revoke the penalty and award reinstatement and full back pay for time lost, or he may modify the penalty and award appropriate redress.

We make no claim that this method of handling disciplinary problems is perfect. But it does work pretty well; we continually learn as we go along. The Umpire machinery under our agreement with the UAW has been functioning for more than five years. During this period, more than 500 disciplinary cases have been decided by the Umpire. These decisions deal with a wide variety of disciplinary situations and they stake out the guide posts for handling similar cases. This backlog of decisions forms a kind of common law which is used by both Management and the Union in appraising cases. We print more than 10,000 copies of the Umpire decisions and circulate them throughout our entire supervisory organization. The Union distributes copies to the Local Union officials. Needless to say, these decisions are of great value as educational material in the plants.

Our discipline is for the purpose of correcting improper conduct and obtaining compliance with shop rules. It is not punitive in nature.

Discharge is resorted to in two types of situations:

1. Where the offense is of such a serious nature as to make any other form of discipline inadvisable. For example:

- Assault on a member of supervision
- Leadership and direction of a strike in violation of the agreement
- Theft
- Sabotage

2. In cases of repeated violations where other efforts to bring about correction have failed.

This is what the Umpires call "corrective discipline." It requires that some corrective action be taken in violations before the violations accumulate. It is definitely contrary to good practice to overlook violations until they pile up and then to discharge the offender as the first disciplinary effort.

I hope that this discussion will not leave you with the impression that all we do in General Motors is to hand out discharges and disciplinary layoffs. On the contrary, our experience shows that a policy of firm, even-handed discipline creates respect and actually lessens the disciplinary problem. Fortunately, in shop operations the vast majority of personal adjustments are, because of the innate sense of fairness of the American workman, self-imposed and self-administered. If this were not so, we could not operate a single day. Employees prefer to work in a well-disciplined plant. The majority of employees want to do a good day's work and never get into trouble. It is the few in any large group who try to beat the rules of the game.

In a group of more than 200,000 employees, there will naturally be a considerable number of situations which require discipline and over a period of a year there will be a sizeable number of discharges. One might think that cases of this kind would overload an Umpire procedure. As a matter of fact, however, in more than 90 plants covered by the GM-UAW agreement, only 30 employees appeared before the Umpire protesting disciplinary action against them in the year 1946—and only nine of these were discharge cases.

The Union has knowledge of all the disciplinary cases, as the foreman informs the district committee-man of disciplinary actions within 24 hours after the action is taken. The disciplined employee has three days in which to file any grievance he may have as a result of the discipline.

It seems a fair conclusion that our supervisory organization is doing a good job of handling shop rule disciplinary cases.

STRIKES IN VIOLATION OF AGREEMENTS

Strikes in violation of agreements present unusual disciplinary problems and require unusual treatment. Whenever we have a strike or stoppage in a local plant, it ceases to be a local matter—we treat it as a strike against the Corporation. We immediately telegraph the top officers of the Union, demanding that the strikers be ordered back to work. We believe that it is the responsibility of the Union to live up to its agreements, but we do not leave it up to the Union alone. Our agreements specifically pro-

vide that Management may discipline any employee for violation of the no-strike section of the agreement.

During the war, there was considerable comment in the public press about the fact that General Motors had a much better strike record than the other automobile companies or the war production industries as a whole. There was some difference of opinion as to the exact reason for this. One of the obvious reasons for the small number of strikes was the existence of a comprehensive grievance procedure which included a full-time Umpire to settle disputes. We believe, however, that the long-established policy of General Motors of dealing promptly and rather severely with leaders of strikes in violation of agreements was an important factor in this record.

Our experience with this problem began immediately after the first agreement was signed by the UAW ten years ago. At that time, the Union leaders were new at the business and they had no concept of their responsibilities under a labor agreement. The local Union leaders were inexperienced and many of them felt no particular responsibility to the International Union. Consequently, the first few months of operating under an agreement with the UAW were hectic indeed.

Daily wildcat strikes and quickie sit-downs were the usual thing. We decided then that the Union and its members must learn to respect the agreement. So, in April, 1937, General Motors notified the UAW that unless wildcat strikes were controlled there might as well be no agreement. The Union's demands for revision of agreement terms were met by a refusal to enter into negotiations until the International Union took steps to get its own house in order. In September of that year, after the impasse had continued for three months, the Union took a public stand against wildcat strikes and acknowledged that it was Management's right to discharge or otherwise discipline any employee guilty of violating the no-strike clause in the agreement.

From the outset, Management disciplined the leaders of unauthorized strikes. For example, on March 31, 1937, a group of employees stopped work and manhandled an employee who refused to join the Union. Seven employees were disciplined, and this became our first Umpire case.

Progress in controlling wildcat strikes during the early days was slow and it is difficult to point to any particular situation which could be said to have been a turning point; however, two cases at the Fisher Body plant in Flint, Michigan, are particularly significant:

In September, 1940, a group of employees left their work and proceeded to another floor of the plant, where they attempted to physically eject a worker who was a leader of a rival Union group. This demonstration naturally caused a stoppage of work. The Union at this plant had been through a bitter factional split and, although the group affiliated with the C.I.O. won a majority vote in an N.L.R.B. election, there was still a considerable group who followed the UAW-AFL leaders. This was the plant where the 44-day sit-in strike occurred in 1937, and the local Union leaders were particularly recalcitrant and scornful of orderly agreement procedure. The demonstrators demanded immediate dismissal of the

rival unionists. Management refused to become involved in the factional fight and discharged 17 employees who were active in leading the demonstration. After a short strike, operations were resumed without the 17 leaders of the demonstration. The case of the 17 was appealed through the grievance procedure and out of it came a long strongly-worded statement by the International Union, denouncing unauthorized strikes. Incidentally, some of the 17 men were later given employment as new employees.

Five months later, at the same plant, an employee was sent home for one day for "horse-play" in violation of safety rules. The other 82 men in the department refused to work, demanding the cancellation of the one-day penalty. The group crowded around the Superintendent's office, demanding action. Management discharged the entire group—the whole department. This action was severe enough to finally impress upon the local Union leaders the necessity for ending wildcat strikes as a means of attempting to force settlement of Union disputes. The plant resumed operation with a new crew in the department. Management later put most of the 82 men back to work in other parts of the plant as probationary employees. Only one minor stoppage has occurred in that plant since.

I am not suggesting that this is the easy way to curb wildcat strikes. It definitely is not the approach for the timid, for once you discipline for strike leadership, you must be prepared and willing to see it through. An experience we had in one of our key plants during the summer of 1945 will illustrate the point. The plant was covered by agreement with the UE-CIO. On V-J Day this plant had all of its war contracts cancelled. The post-war program was put into effect immediately and, although the conversion problem was considerable, the unemployment which resulted was limited to a temporary layoff of 295 women employees. The situation was fully explained to all of them and they understood the problem. Not one of them complained. Most of them said they were glad to get a couple of weeks off.

Nevertheless, the Union filed a grievance, charging violation of the seniority agreement. Before the grievance could be answered by Management, the Union planned a meeting of the employees during working hours to discuss the matter. This device had been tried out before by the Union in some other plants not in General Motors.

Management warned the local Union leaders that a stoppage to attend a Union meeting would be a violation of the agreement and would be treated as such. We notified the International Union officers of the situation and put them on notice that if the plan went through we would treat it as a strike.

At the appointed hour, the local Union officials began a demonstration and attempted to lead the employees out of the plant to the Union hall. About 15 per cent of the people went along—the others continued to work. After the Union meeting, Management was served with an ultimatum to immediately reinstate the employees who were on temporary layoff; otherwise the Union would take further action.

This was a challenge which could not be overlooked. The alleged violation of the seniority agreement was a matter on which the Umpire under the agreement was fully empowered to rule. If Manage-

ment was wrong, he could make it right. The ultimatum was a challenge not only to Management but also to the whole concept of peaceful relationships under a collective bargaining agreement.

The five Union leaders who were responsible for the stoppage were notified of their discharge for violation of the agreement. As would be expected, the discharged leaders promptly organized picket lines and closed the plant.

Management's position from the start was: (1) Return to the agreement, (2) go back to work, and (3) submit to the Umpire the seniority question and also the disciplinary cases. The top officials of the Union conceded the soundness of this approach to settling the strike, but they could not sell the idea to the local leaders.

The strike continued for seven weeks. This plant was a key supplier of all the car plants as well as many important customers outside General Motors. Naturally, there was great pressure on the Management to yield and get back to work. From Management's point of view, the issue was simply whether disputes were to be settled under the orderly procedure of the agreement or by a show of force. On this issue, there was no room for compromise.

Finally at the end of the seventh week, the Union agreed to return to work (except for the discharged employees) and to submit the matter to the Umpire. Incidentally, the Umpire later ruled that there was no violation of the seniority agreement; the disciplined employees were reinstated by the Umpire because of a highly technical loophole in this agreement. The Union found a way legally to authorize the strike retroactively. We have not had any further trouble in that plant.

The so-called "company security" plans have received sensational publicity during the last year or so. Some of these plans called for joint disciplining of strike leaders. No matter how attractive such proposals may appear to be, we believe they are basically unsound. We had an experience in a case which may illustrate the point.

At our Diesel Plant in Grand Rapids, three members of the Shop Committee organized a walkout one morning in March, 1944, in protest against the suspension of a girl who refused to operate her drill press unless she were permitted to wear canvas gloves—a dangerous practice which could not be permitted. It later developed that the strike plan was all set and the glove incident just happened to be the first one, which could be used as an excuse to walk out. The strikers set up picket lines and kept the plant closed for several days. The three members of the local Shop Committee were openly active in leading and directing the strike. They were promptly discharged.

The International Union conceded we had an open-and-shut case against the three who were discharged; however, the Union argued that the real planner and instigator of the strike had remained behind the scenes and had escaped discipline. The Union offered to deliver to us a signed confession from the hidden leader. This offer sounded interesting, but closer examination revealed dangerous implications. It was an open secret that the real cause of the strike was a factional struggle for control of the local Union. Moreover, the Union's offer had a string on it. The

three discharges would have to be reduced to long penalty layoffs. We offered to consider any evidence the Union was willing to deliver, but we refused to make any commitments regarding the three discharges, nor would we make any "horse-trade" of one strike leader for another. We stuck to our policy of disciplining those whose guilt could be established by our own evidence, and the three stayed fired. The official who offered to deliver the secret leader, later admitted he was unable to obtain any signed confession.

You have heard, no doubt, the argument that the Union should discipline its own members for strikes in violation of agreements. We tried that idea a few times but it did not work.

One of our earliest experiments with this approach occurred in one of our Pontiac plants in November, 1937, shortly after the sit-down episodes. In that period of Union development, the local leadership was not particularly noteworthy for deliberation or conservative action. Curtailed schedules necessitated the layoff of some employees in accordance with the seniority provisions of the agreement; but the Shop Committee succeeded in inducing the employees to pull a strike, unauthorized by the Union, demanding a restoration of full production, including the transfer of operations from our Linden plant to provide full schedules. The strike resulted in a full-scale seizure with all the sit-down trimmings, which was terminated after five days by persuasion of higher Union officials.

For organizing the incident, the Management discharged some 20 men and the Union requested permission to identify the ringleaders and participate in the setting of penalties. To this the Management agreed, but in a series of nine meetings over a period of several months the Union failed to agree upon or produce a single guilty member, and settlement was finally made on the basis of Management's action. It was impossible in a political organization such as the Union to fix the blame—and perhaps unreasonable to expect any such result.

The Union usually defends those we discipline for violation of the agreement. It does so on the grounds that the complainant is innocent or that the discipline is too severe. This is a proper function of the Union. On the other hand, the Union benefits directly from our policy. It assists the Union in maintaining some semblance of discipline over the local Unions. In many cases, the wildcat leaders who defy the agreement also defy the International Union. In reducing the frequency of wildcat strikes, our policy builds the Union's reputation for contract observance. We have reason to believe the top leaders of the Union fully appreciate this fact.

One indication of this appreciation was shown by Walter Reuther in his testimony before the Meade Committee of the United States Senate. You may recall that the Meade Committee came out to Detroit to learn why certain plants were not producing war material. One of our competitors bore the brunt of investigation; however, the Unions were invited to testify and they blasted everybody in general, hoping the noise would divert attention from strikes as a major cause of the lag in production.

Mr. Reuther in his testimony was asked about General Motors. We consider his reply to be a fine, although perhaps unintentional, compliment. He said:

"General Motors is tough. We don't agree with everything they do, but at least they have policies and they know where they are going."

It seems appropriate to quote from a speech made by the late Justice Brandeis in Boston at the conclusion of a long and bitter strike more than forty years ago. In speaking of what we now call collective bargaining, he said:

Men fail at times to see the right; and, indeed, what is right is often in doubt. For such cases arbitration affords frequently an appropriate remedy. This remedy deserves to take its place among the honorable means of settling those questions to which it properly applies. Questions arise, however, which may not be arbitrated. Differences are sometimes fundamental. Demands may be made which the employer, after the fullest consideration, believes would, if yielded to, destroy the business. Such differences cannot be submitted to the decision of others. Again, the action of the union may appear to have been lawless or arbitrary, a substitution of force for law or for reason.

You may compromise a matter of wages, you may compromise a matter of hours—if the margin of profit will permit. No man can say with certainty that his opinion is the right one on such a question. But you may not compromise on a question of morals, or where there is lawlessness or even arbitrariness. Industrial liberty, like civil liberty, must rest upon the solid foundation of law. Disregard the law in either, however good your motives, and you have anarchy. The plea of trade unions for immunity, be it from injunction or from liability for damages, is as fallacious as the plea of the lynchers. If lawless methods are pursued by trade unions, whether it be by violence, by intimidation, or by the more peaceful infringement of legal rights, that lawlessness must be put down at once and at any cost.

If labor unions are arbitrary or lawless, it is largely because employers have ignominiously submitted to arbitrariness or lawlessness as a temporizing policy or under a mistaken belief as to their own immediate interests.

As I said, Justice Brandeis made that statement over forty years ago.

In conclusion, I would summarize our experiences as follows:

I. We believe our experiences show beyond a doubt that discipline is necessary for efficiency. For without discipline, efficient production is not possible. By discipline, I do not mean the ironclad discipline of military rule, but rather the smooth-running discipline of teamwork and cooperation.

II. Disciplining is a responsibility and duty of Management which cannot be dodged or shared with others. It is a task of Management which must not be shirked.

III. Voluntary arbitration, under rules and procedures agreed to in advance by the parties, is a fair and workable means of settling disputes arising under agreement terms. Our experience with the Umpire machinery in our labor agreements shows that impartial review of Management's action in disciplinary situations protects employees from errors or unfair treatment and provides a fair and peaceful means of settling such disputes.

IV. We in industry must continue to improve discipline and efficiency to produce more and better things for more people at lower costs and at a profit. This is the only road to prosperity and the fuller life in America.

FORTIFIED PAPER

By J. A. VAN DEN AKKER

PAPER in its ordinary forms is so commonplace and has been with us for so long that one is apt to overlook its very great importance in all phases of our economy. During the desperate days after Pearl Harbor, when industry was mobilized for total war, the pulp and paper industry was almost neglected. However, the men of the industry, aware of the rapidly developing shortages of steel and wood, and sanguine of the possibilities of cellulosic fiber reinforced with modern resins, reacted to the emergency with a combination of zeal and ingenuity that proved to be remarkably prolific. During 1942 and '43, pulp and paper were considered "reasonably available," and many articles needed in the war effort and in the maintenance of civilian life were fabricated with various forms of "fortified paper," thus releasing large tonnages of steel and other critical materials to war industry.

The growing substitution of paper for other materials, together with inadequate allotment of manpower to the paper industry and to the cutting of pulpwood, eventually resulted in the paper shortage, which is still with us. The normal uses of paper accounted for huge tonnages. Some of the data are illuminating. During the later months of the war, 90 per cent of the 700,000 articles necessary for the maintenance of our troops overseas were packaged or protected by paper, and a majority of those articles included paper as an integral part. Thirty tons of blueprint paper are required in the construction and fitting of one battleship. Four billion more tabulating cards were used in 1943 than in the preceding year.

A description of the normal uses of paper would require a "five-foot shelf" of books. The importance of a material is not, of course, always measured in terms of volume of production. The electrical industry requires various classes of dielectric and insulating papers ranging from dense condenser paper of thickness less than 0.0003 in. in certain grades (the decimal point is in the right place!) to heavy, porous high-voltage cable paper and vulcanized or impregnated fiberboard. Although the total tonnage of electrical papers is not inconsiderable, the technical value of such papers is far out of proportion with their listing in a tabulation of business statistics of the whole paper industry. One is prone to think of paper as something on which to write or print—there is very little publicity on the industrial applications

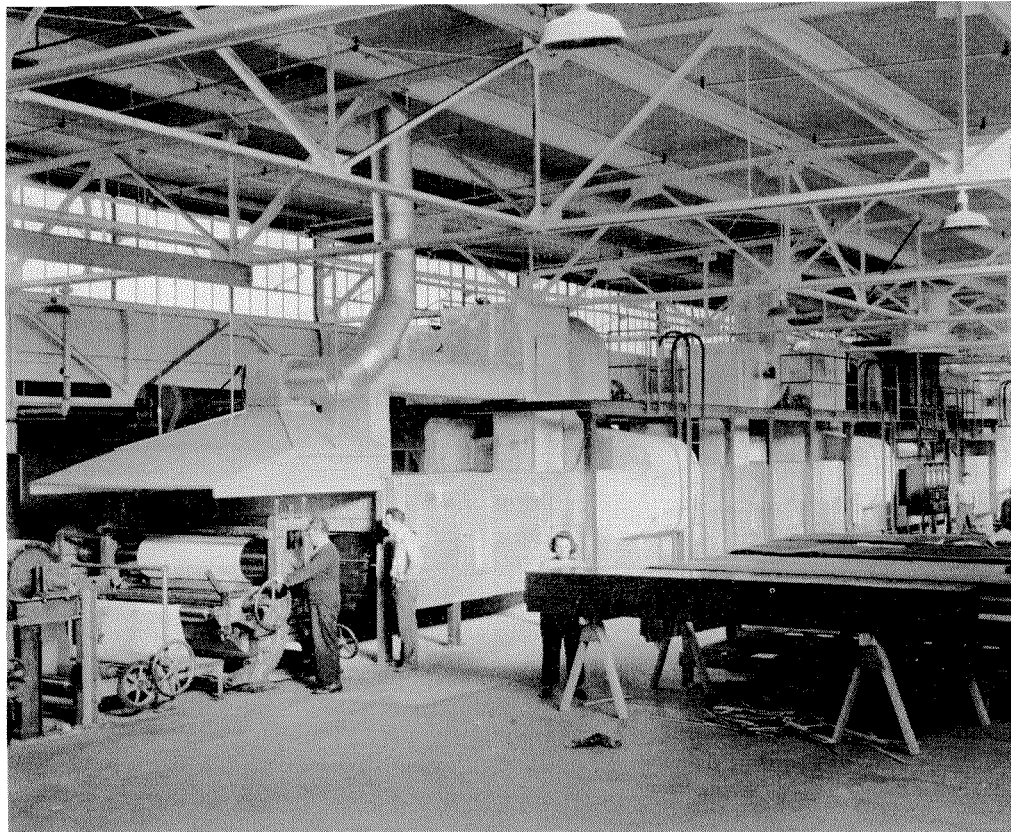
of the many grades of paper designed for specific applications. The technical reader may find interest, during the coming months, in making mental note of special applications which have hitherto escaped his attention.

BONDING IN TYPICAL PAPERS

It is an age-old fact that a strong sheet of paper cannot be formed unless the cellulosic fibers of which it is composed have been subjected, in the presence of water, to a mechanical beating action. The beater causes a partial disruption of the fibers, as manifested by the formation of microscopic and sub-microscopic fibrils (electron micrographs reveal that some of the finer filaments released from the fiber are of diameter less than 100 Angstroms), and, although the entwining of fibrils resulting from the beating contributes to the strength of the paper, it is erroneous to think of the papermaking process as essentially a felting together of the fibers. The important result of beating is believed to be a bonding together of the fibers at points of contact during the drying operation. During the last stages of drying, contacting fibers are pulled together by large localized pressures of capillary origin, and, according to one theory, the hydroxyl groups of the cellulose molecular chains (exposed by the beating action) are brought sufficiently close together for their force fields to be effective; this cohesive bonding is aided by the adhesive effect of a colloidal dispersion of cellulose and of the hemicelluloses formed during the beating process.

In view of the fact that the strength of the fiber-to-fiber bonds is greatly inferior to the tensile strength of the fibers, the strength of paper is determined by (among other things) the number and nature of the bonds. The dry strength of paper, in the vast majority of uses, is more than adequate. However, the nature of cellulosic bonding is such that water produces a great weakening; the wet strength of untreated paper is a minute fraction of the dry strength. This unhappy but intrinsic weakness of untreated papers is well known through such common vexations as the paper towel which disintegrates while one dries his hands, the paper bag which fails in its job of carrying home a precious lot of eggs because one egg happens to break and leak, and the newspaper, left in the rain a moment too long, which falls apart if its reader

Impregnating machine for the treatment of paper to be used in phenolic paper-base laminates. Courtesy of the Consolidated Water Power and Paper Company.



is imprudent enough to fling it open before the paper dries.

For many years, a number of kinds of paper have been made with sizing agents (such as rosin and wax) added to the beater. Such papers resist penetration by water and, hence, display a measure of wet strength if not placed in contact with water for a long period of time. There is a surprisingly large number of uses of paper in which strength is required over short periods of contact with water or aqueous media and, in consequence, the generally employed sizing techniques have been fairly successful.

It is obvious, however, that wet strength of paper towels and other absorbing papers cannot be achieved through the use of agents which act through imparting water resistance to the paper. During the decade before the war, the technology of adding low percentages of polymerizing resins was developed. The resin (usually urea- or melamine-formaldehyde) is added to the fiber in a water soluble form (monomer or low degree of polymerization) and is subsequently cured on the driers of the paper machine. Paper fabricated by this process can be made both absorbent and adequately strong when wet. The better paper towels, in which the fibers are bonded together with a polymerized resin, can be used as wash cloths, and may be re-used a number of times.

WARTIME DEVELOPMENTS

Some of our earliest shipments of supplies to the South Pacific in domestic-type paperboard containers suffered tragic losses. In many instances the conditions of battle were such that cargoes could not be transferred in normal manner to lighters or docks. It was necessary for our supply ships to speed to a supply point, drop their cargoes into the sea, and make a hopeful dash for safety. Subsequently, our men on shore fished the supplies from the water. Containers of the domestic type simply disintegrated. It appeared that wooden boxes and crates would be required for all overseas shipping; however, analysis of the lumber supply showed that there would not be

sufficient lumber to satisfy the needs of global shipping.

The industry met the challenge of producing paperboard boxes of strength, rigidity, and durability at least the equal of nailed or wirebound wooden boxes in the so-called "V-board" boxes. The "solid-fiber" kraft board (so named to distinguish it from corrugated board) was comprised of laminations bonded together with waterproof glues such as the rather remarkable combination of urea-formaldehyde resin and starch. V-board, of thickness of about 0.1 in., was manufactured to a specification of more than 750 lb/in.² dry bursting strength (pressure differential over a circular orifice of one square inch area) and more than 500 lb/in.² after a 24-hour immersion in water. It was conservatively estimated in 1943 that the V box program was equivalent to conserving 1500 carloads of lumber per month. Improvements were made in the V boxes and, eventually, it was found that a number of classes of supplies could be shipped more satisfactorily in them than in wooden boxes.

The conservation of steel during the war by substitution of paper products is noteworthy. The steel grommets employed for the handling and protection of bombs were replaced by laminated chipboard rings which, except for a thin outer band of steel, were made from waste paper; it has been estimated that the metal conserved by the paper rings was more than 50,000 tons per year. Cylindrical paper containers for oil and paint conserved about 90,000 tons; a variety of new folding and set-up boxes replaced about 125,000 tons of metal per year, and large tonnages of pliofilm, rubber, and cellophane were also conserved. The molded fiber industry employed phenolics in the production of such items as flash-light cases, alarm-clock cases, walky-talky battery cases, special

cannisters, and instrument cases. Huge tonnages of steel (in the form of drums) and of burlap, cotton, and wood were released through the successful development of the multiwall paper bag, which has been used for the shipment of many commodities formerly shipped in drums or slack wood barrels, such as calcium chloride, soda ash, bicarbonate of soda, ammonium nitrate, and rosin. These bags are used by the hundreds of millions for the shipment of chemical fertilizer, and a larger number is consumed by the cement industry. The complete list of wartime substitutions of paper for critical materials is impressive. One of the most interesting exhibits in Washington during the war years was that prepared by the Pulp and Paper Division of WPB's War Products Development Section, to which credit is due for an effective job in serving as a clearing house for the armed forces and industry and in co-ordinating the efforts of the paper industry.

Great improvements had to be made in paper itself. Battles cannot be won if the maps and other vital papers carried by the troops fail to withstand repeated wetting by rain, mud, and swims in jungle streams or ocean water. It is necessary that such papers withstand, without danger of failure, the wiping off of mud, blood, or grease. Papers for maps, charts, and manuals having amazing wet strength and durability were fortified with resins which were polymerized on the paper machines in a manner similar to that previously mentioned. Only small percentages of resins (just sufficient to produce strong, water-resistant bonds between the cellulosic fibers) were employed, so that the paper retained its essential physical and structural properties.

Some people like to think of paper as a skeletal web, the voids of which may be filled with an opacifying agent such as clay, titanium dioxide, or other "filler," and the surfaces of which may be coated with the conventional "coating color" (essentially an aqueous slurry of casein and clay) to improve the printing quality—or the surfaces may be sealed with a continuous film of wax, asphalt, or moisture-impervious plastic to yield a moistureproof sheet. During the

war the manufacturers of rag-content map paper developed the technology of filling the voids of the paper with fluorescent pigments. The fluorescent map papers so produced were of considerable value in night military operations; by the use of small ultraviolet lamps equipped with filters which eliminate the visible radiation, the deleterious effect of map reading on the dark adaptation of the observer's eyes was mitigated, and the chance of attracting the enemy's attention was rendered negligible. When printed with two or more inks containing fluorescent pigments displaying different colors, fluorescent maps are beautiful to behold. (Needless to say, the choice of colors and pigments was such that the maps could be employed in ordinary light!)

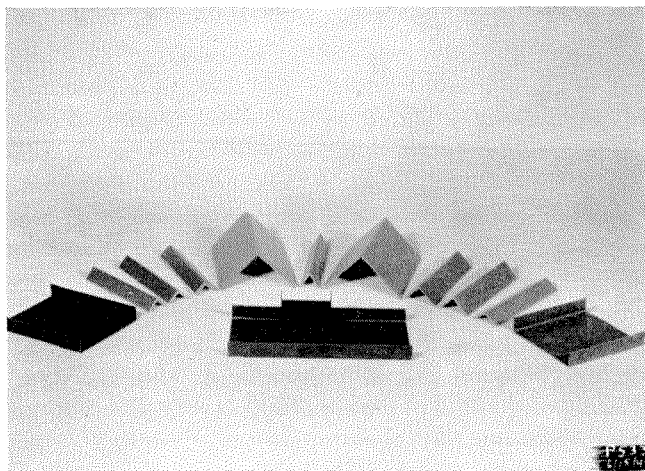
Lens paper was one of the tremendous trifles of the war. The pre-war rate of production of lens paper was, of course, completely inadequate for the job of cleaning the large number of optical devices and instruments used by the Navy and Army. Moreover, lens paper was composed of Mitsumata fiber, the supply of which was cut off by hostilities in the Pacific. A number of experts must have shuddered at the thought of wiping fine optical parts with tissues prepared from domestic fibers. However, one of the large tissue mills produced satisfactory, grit-free lens paper by the carload on huge, high-speed equipment.

Paper has long been employed as a base for Bakelite and other plastics. During the war a considerable amount of developmental research was done on resin-impregnated paper which, in the form of many layers, could be cured at **low pressure** to produce a dense, hard, and strong plastic laminate*. Used on a limited scale by war industries, the new paper-base plastics were not sufficiently well developed early in the war for widespread use in aircraft, marine craft, and materiel. However, their mechanical and physical properties, some of which are presented later, indicate numerous, interesting peacetime applications.

"LOW-PRESSURE" PAPER-BASE LAMINATES

In a general way, it was expected that the strength of a laminate would depend upon the elastic constants

*Designated "papreg" by the Forest Products Laboratories; concurrently, that organization, located in Madison, Wisconsin, the Consolidated Water Power and Paper Company of Wisconsin Rapids, Wisconsin, the McDonnell Aircraft Corporation of St. Louis, and the Institute of Paper Chemistry of Appleton, Wisconsin carried out intensive research on the development and application of low-pressure laminates.



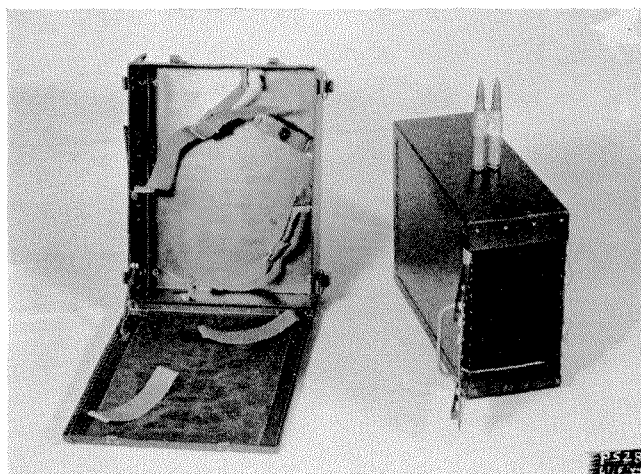
Angle and channel pieces fabricated with "Consoweld." Courtesy of the Consolidated Water Power and Paper Company.

of both the resin and fiber (but not on the strength characteristics of the unimpregnated paper), and that the moduli of elasticity of the resin should be comparable with those of the fiber. The fiber-resin system is not amenable to mathematical analysis and, therefore, the successful development of papreg involved numerous experiments of the typical "experiment station" variety. At length, optimum factors relative to sheet composition and characteristics were found. Research on resins was, of course, vitally concomitant with the work on papreg.

In the manufacture of papreg, a continuous web of suitable paper is impregnated with resin (usually phenol- or urea-formaldehyde) in soluble or depolymerized form. After passage through the impregnating bath and squeeze rolls, most of the solvent is driven from the web in a drying operation. The product obtained—now ready for any one of a variety of hot pressing operations—contains a substantial percentage (usually 30 to 40 per cent) of incompletely polymerized resin; it is fairly hard and is not tacky or sticky, so that it may be shipped and stored in rolls or in the form of packages of cut sheets.

In the production of flat stock, a number of sheets of the resin-impregnated paper are placed between the platens of a hydraulic press, and the pressure and temperature are elevated in accordance with a definite schedule. During the initial stages the resin is thermoplastic and the sheets, then quite flexible, become intimately bonded together. The pressure employed depends, of course, on the type of product employed, but is relatively low, being less than 250 lb/in.² and, in certain types, less than 100 lb/in.² In a short time the molecules of the resin polymerize (as a result of the elevated temperature) to produce the desired hardness and mechanical properties in the papreg; the material, no longer thermoplastic, may then be removed from the press without cooling. As in the production of resin-bonded plywood, the only limitation on the thickness of flat stock obtainable with steam-heated platens is that associated with the conduction of heat to the central plane. Without doubt slabs of considerable thickness could be produced with presses equipped for dielectric heating.

A most important advantage of the new plastic laminates is the fact that they can be formed with bag-molding operations like the Vidal and Duramold processes, using low-pressure equipment. As is well known, bag-molding of plastic laminates eliminates the need, in many operations, of employing large and excessively expensive dies. Large, curved bodies of complex shape



(such as the hull of a rowboat) are formed in an autoclave. Although there are several bag-molding techniques, the general principle may be illustrated by two methods. In one procedure, the sheets of resin-impregnated paper are laid over a wooden die (the process of cutting and laying on is something of an art), the whole is enclosed in a rubber bag and placed in an autoclave, and steam of the desired pressure and temperature is admitted to the autoclave. The other method utilizes a semi-cylindrical autoclave resembling a Quonset hut. In this case, the bottom surface of the wooden die is flat and is placed in contact with the floor of the autoclave. A rubber bag occupying the space between the die and the inner surface of the autoclave is then inflated with steam, thus being made to exert pressure against the laminations. In these operations the small thickness of the resin-impregnated paper permits the latter to be bent around sharply curved surfaces.

In a qualitative manner a phenolic laminate may be described as being hard, stiff, strong, wear-resistant (in the presence of water as well as when dry); its color, usually light brown, is dependent upon the color of the resin and fiber and may be adjusted, through the use of dyestuffs, in an appreciable area of chromaticity; its density is about twice that of ordinary paper, but only half the density of aluminum. It is not ductile and cannot be formed in dies, but it can be machined. The brittle nature of phenolic resins is offset by the toughening action of the cellulosic fibers and, although the impact resistance of phenolic laminates (Charpy or Izod) leaves something to be desired, ruptures are not readily propagated by cracks. The material is anisotropic, exhibiting different mechanical properties in the three principal directions if not cross-banded (the fact that the fibers in a paper sheet are not randomly oriented accounts for a "grain" effect); however, in building up a laminate, the individual sheets may be cross-banded, as in the fabrication of plywood, to yield equality of mechanical properties in the two principal directions parallel with the laminations.

Some of the important characteristics of phenolic



"Kimpreg" surfaced plywood tables in the "Quonseteria."
Courtesy of the Kimberly-Clark Corporation.

paper-base laminates are presented in Table I. The values given are not exact, but are intended only to give the reader the orders of magnitude of the properties.

Of special interest is the high ratio of strength to weight of papreg. To be comparable on this basis, a light-metal alloy having twice the density of papreg should have a tensile strength in the range of 50,000 - 70,000 lb/in.². The stiffness of bar or plate of papreg is especially noteworthy. It is well known that the flexural rigidity of a plate or curved member increases with the cube of its thickness; that is to say, for the same weight, the stiffness of members of different materials should be compared on the basis of the ratio of the modulus of elasticity to the cube of the density. As an illustration, a light-metal alloy of density twice that of papreg would not be comparable on this basis unless its modulus of elasticity were of the order of 20,000,000 lb/in.². This underscores the value of paper-base laminates in stressed-skin and monocoque structures where weight is an important consideration, as exemplified by prefabricated houses, mobile craft of all sorts, household and business articles, concrete forms, etc. This advantage is recognized in plywood, which was used extensively in the production of high-speed aircraft in England during the war. Announcement is made, at

the time of writing, of the commercial construction in Milwaukee of a 19-ft cabin cruiser in which the hull, cabin, decking, flooring, and many other parts are fabricated from paper-base laminate. It is said that the weight of the finished cruiser, 900 lb, is more than 50 per cent less than that of a conventional wooden cruiser of the same size. An advantage claimed in the announcement is the avoidance of caulking through the use of the new water-proof resin glues. The company making the announcement states that a number of row, sail, and outboard boats have been built with the

TABLE I
Some Properties of Phenolic Paper-Base Laminate

	Parallel Laminated	Cross Laminated
Molding Conditions		
Pressure, lb/in. ²	75	75
Temperature, °F	325	325
Time (1/8 in. thick), min	12	12
Specific gravity	1.4	1.4
Tension, lb/in.²		
Ultimate, with grain	36,000	25,000
Ultimate, across grain	18,000	
Modulus of elasticity, with grain	3,000,000	2,200,000
Modulus of elasticity, across grain	1,500,000	
Compression, lb/in.²		
Ultimate, flatwise	40,000	40,000
Ultimate, edgewise with grain	19,000	18,000
Ultimate, edgewise across grain	17,000	
Flexure, lb/in.²		
Modulus of rupture, with grain	32,000	26,000
Modulus of rupture, across grain	20,000	
Modulus of elasticity, with grain	3,000,000	2,000,000
Modulus of elasticity, across grain	1,500,000	
Shear, Johnson double, lb/in.²		
Edgewise, across grain	15,000	14,000
Edgewise, with grain	13,000	
Flatwise, across grain	15,000	14,000
Flatwise, with grain	13,000	
Impact, Izod, ft lb/in. notch		
Flatwise, with grain	5.0	4.0
Flatwise, across grain	2.0	
Hardness, Rockwell	M100	M100
Water absorption, per cent		
1/8 in. x 2 in. x 2 in. specimen, 24 hr	3	3

plastic laminate, and that "high reports on their durability under severe usage" have been received.

Another advantage of papreg lies in its internal friction or damping capacity, which is high, relative to that of metals of the types employed in structures. Vibrations originating in engines, for example, are readily transmitted throughout metal structures, and stresses may rise to perhaps dangerously high values where a condition of resonance or near-resonance exists. These undesirable phenomena are greatly reduced in plastic structures. Of course, a structural element which is directly linked with a strongly oscillating member, and is thereby subjected to intensive vibrational stress, should be of a metal alloy having high fatigue endurance—a property ordinarily associated with low internal friction.

Plywood surfaced with paper-base laminate is attractive in both appearance and technical properties. In the production of this interesting material, the plywood is sandwiched between layers of the partially cured resin-impregnated paper, and the combination is bonded together between the heated platens of a hydraulic press. In the case of woods (like Douglas fir) used in the manufacture of plywood having excellent strength properties but poor appearance, the surfacing with the paper-base laminate greatly extends the range of application. In all cases, however, surface layers of the strong laminate (applied in optimum thickness) greatly increase the flexural strength of the material—the laminate is applied at the greatest possible distance from the neutral plane of the combination, where it can do the most good. Recalling our considerations of density, we note that we are here dealing with a material having a core of quite low density and, hence, for a given weight, great stiffness.

Plywood surfaced with paper-base laminates is available from a number of plywood manufacturers, and is finding wide application in such diversified fields as aircraft, automotive vehicles, boats, boxes, trunks, building construction (including a variety of farm structures), furniture, freight and passenger cars, and refrigerators. It is greatly superior to ordinary plywood in the follow-

ing properties: water absorption (very low), abrasion resistance, resistance to weathering, water-vapor permeability (considerably lower than that of asphalt-laminated building paper), hardness, strength, chemical stability, resistance to termites, fungus, etc., and appearance.

It is sometimes helpful, in appraising a new development, to obtain an overall picture of what has been done. The industry starts with wood (pulpwood—much of which is not suitable for lumber), in which the cellulosic fibers are bonded together with lignin. In the chemical pulping process, the lignin is taken into solution, and the fibers are separated, screened and washed, and built into a web of paper. Resin is then added to bond the fibers together to form a paper-base laminate. What has been gained in obtaining a product more expensive than wood? The trend in the process is somewhat analogous to that in the manufacture of plywood. The cost of producing plywood is balanced by the advantages gained, some of which are greatly improved uniformity of the material (resulting from the multiplicity of plies), greater strength, more nearly uniform strength in all directions of the material, and elimination of warping and splitting. In the production of paper-base laminate, these improvements are intensified. Uniformity of the product is much greater, because the fibers from tons of wood pulp are mixed, and because all steps in the process are controllable. Most important, however, is the fact that lignin, which is water-sensitive, has been replaced by a bonding agent which is stronger and does not lose its strength in the presence of water.

Plywood surfaced with paper-base laminate is an excellent example of the application of engineering economics to the optimization of factors involved in the combination of products of substantially different cost to obtain an excellent material which can be feasibly employed in a wide variety of applications.



"Kimpreg" surfaced plywood used for the manufacture of pre-cast stone. These forms will withstand in excess of 100 casting operations. Courtesy of the Kimberly-Clark Corporation.

C. I. T. NEWS

TOURNAMENT PARK ON MARCH BALLOT

ALUMNI living in the city of Pasadena are urged to vote in the municipal election March 13, when the question of selling Tournament Park to the California Institute will be included in the ballot. A two-thirds majority is required to "abandon" the park in order to permit Caltech to purchase the 23 acres sorely needed for expansion.

In 1940, with 900 students, the Institute was in serious need of additional facilities for teaching, research, student housing, athletics and recreation. Today the 1940 needs have not been met and the Institute now has an enrollment of nearly 1400 students, of which 80 per cent are World War II veterans, and its research activities have expanded greatly. A situation that was serious seven years ago has today become critical.

Plans for Tournament Park include a gymnasium, with basketball courts and swimming pool, probably the first construction that will be undertaken when funds become available, and a student union building. The northwest corner of the Park will be converted into a parking lot with facilities for from 500 to 800 automobiles. This will help to alleviate the serious parking problem in the vicinity of the Institute. A baseball diamond and a football field and track will be located in the central portion of the Park. Tennis and badminton courts are slated for early construction. The mound which crosses the Park from east to west will be leveled to accommodate these plans.

As part of the program to improve student facilities on campus, a new dormitory, similar to and opposite the present student houses, is planned as a part of the construction program, which includes the gymnasium and student union.

HOUSING ASSEMBLED FOR ELECTROSTATIC GENERATOR

THE wartime ramblings of a housing for an electrostatic generator are finally at an end. Designed and installed just before the war, the eight foot cylinder, 22 feet long, proved to be in the way when wartime research projects crammed Kellogg. Besides, another use was found for it.

The tank, which will permit pressure and humidity control for the accumulation of high electrical potentials, was used as a pressure tank for launching aircraft torpedoes behind the San Gabriel Canyon dam during the war. Pressures up to 200 pounds per square inch sent torpedoes down an inclined tube, 300 feet long, into the San Gabriel reservoir behind the dam, under conditions simulating launching from an airplane.

In the spring of 1940 the pressure tank was installed in a third floor laboratory in Kellogg. The wartime research program was inaugurated before the

generating equipment could be completed, and it was moved into a corner of the laboratory out of the way. Later the housing was taken to the research project where it served until shortly before the end of the war when it was replaced by an especially made tank.

Further research on electrostatic generation led to the changes in the design of the vessel made concurrently with its reconditioning by the Navy. Its makers, the Western Pipe and Steel Corporation, completed this work in December, and the tank was hoisted into the Kellogg laboratory in a week-long operation.

Now being filled with generating apparatus, the machine will follow the design of R. G. Herb of the University of Wisconsin. An important feature of this design is controlled atmospheric conditions imposed on the original large-scale static electricity generator developed by R. J. Van de Graaff of M.I.T. Charges are induced on a moving belt and deposited on a metal sphere. A shield around the sphere aids in distributing the accumulating charge, which is expected to exceed the present limit of four million volts, more evenly through the dielectric, in this case air. The potentials developed will accelerate protons and deuterons down a high-vacuum tube where they will attain energy in electron volts equal to the potential of the sphere. Velocities of the order of 10^8 centimeters per second will render these capable of disintegrating other nuclei, when they impinge on targets of Lithium, Beryllium, and Carbon. Studies of nuclear fragments resulting from such collisions are expected to expand the knowledge of fundamental physics.

BATEMAN RESEARCH FELLOWSHIP

CREATION of a research fellowship in pure mathematics to be known as the Harry Bateman Research Fellowship was announced recently by the Board of Trustees of the California Institute of Technology.

The fellowship was created in honor of the late Harry Bateman, professor of mathematics, physics and aeronautics at Caltech, whose outstanding work in those fields brought international recognition to both him and the Institute.

Candidates for appointment to the Bateman Fellowship should have obtained a doctorate, or expect to receive it, prior to the beginning of the academic year 1947-48. The appointment will be made on the basis of the promise shown of independent research in any field of pure mathematics.

The recipient will devote the major part of his time to research, but will be expected to teach one upper-class course in mathematics. The appointment, which will carry a stipend of \$3,000 for the academic year, will normally be for one year but may be renewed for a second year.

Application blanks may be obtained from the Dean of the Faculty, California Institute of Technology, Pasadena 4, California, and must be returned to that address before March 15, 1947.

RED CROSS FUND

ANY ONE who has read Dixon Wecter's recent book entitled *When Johnny Comes Marching Home* has been shocked to find how badly the returned soldier, who has risked his life for his country and often been incapacitated for life through so doing, has been treated in all preceding wars. This must not happen in the case of the men who have risked their lives and been incapacitated in serving us in World War II.

The American Red Cross is one officially organized agency through which your contribution and mine helps most effectively in the rehabilitation of the eighty thousand hospital patients who served in both World War II and World War I. The fact that during the year 1945-46 the Red Cross was able to aid in one way or another more than a million veterans and their families who needed assistance is eloquent as to the magnitude of the service which it performs.

I know of no other philanthropic agency which has so strong and immediate an appeal for the support, to the extent of his ability, of every man and woman in America as does the American Red Cross.

Robert A. Millikan

GUIDE SERVICE INAUGURATED

SPONSORED by the Beavers, undergraduate service organization, a guide service has been inaugurated on the campus. A Beaver member is on duty weekdays and Saturday from 11 A. M. to 12, and weekdays from 3 to 4 P. M. Five Beavers have been detailed to the guide service: Joe Rosener, chairman, George Austin, Bob Dalton, Rube Kachadorian, and Leigh Sheriff. These guides are on duty in the Y.M.C.A. lounge in the basement of Dabney Hall of the Humanities.

The functions of the guides are either to direct visitors to specific places on campus or to conduct general tours of the Institute to such places as the liquid air production equipment in Bridge Laboratory, Guggenheim Aeronautics Laboratory, and the Optics shop where the 200-inch mirror for the Mt. Palomar Observatory is being ground.

Information concerning the service or special tours may be obtained by contacting chairman Joe Rosener through the offices of the Dean or the Y.M.C.A.

WINTER TERM ENROLLMENT

END of the first term of the 1946-47 school year showed small change in the undergraduate enrollment. The largest drop was among the graduate students, with numbers reduced from 581 to 564. The seniors have added two to their number to a total of 155. Five more men entered the junior class to boost its total enrollment to 212. Sophomore numbers were depleted by 15, from 252 to 237. The freshman class retained the 179 men who started the school year in October.

INSTITUTE MEN AT AMERICAN PHYSICAL SOCIETY MEETING

INSTITUTE faculty and research workers figured prominently in the recent meeting of the American Physical Society at Los Angeles, January 3 and 4. C.I.T.'s President Lee A. DuBridge, who was vice-president of the Society in 1946, presided at the last of the three sessions held Friday morning and afternoon and Saturday morning.

Robert F. Christy, associate professor of physics, and Sylvan Rubin '39, National Research Council predoctoral fellow, jointly presented a paper on the **Angular Distribution of Alpha-Particles from $\text{Li}^7 + p$** . Alone Mr. Rubin discussed the **Angular Distribution of Long-range Alpha-particles from Excited Ne^{20}** . Dr. Christy in collaboration with Mark M. Mills '40 of the Jet Propulsion Laboratories, gave **Auger Showers**. Dr. Christy also presented a longer paper on the **Design of a Small Nuclear Reactor**. Dr. Howard S. Seifert of JPL with Mr. Mills told of **Problems in the Application of Nuclear Energy to Rocket Propulsion**.

Charles C. Lauritsen, Ph.D. '29, and Thomas Lauritsen '36 Ph.D. '39, father and son, professor and assistant professor of physics, together with Dr. William A. Fowler Ph.D. '36, also professor in the Physics Department, presented two papers, **A Device for Introducing Short-lived Radioactive Samples into a Cloud Chamber**, and **Gamma-Radiation from $\text{Be}^9 + \text{H}^1$** .

Dr. Robert A. Millikan, professor of physics, emeritus, and vice-president of the Board of Trustees, considered **The Interpretation of the East-West Effect**.

The Jet Propulsion Laboratory of the Institute received almost as much representation at the meeting as did the Physics Department, for besides Mr. Mills and Dr. Seifert, Dr. Jacob M. Schmidt presented the **Atomization of Liquids**, and Martin Summerfield, M.S. '37, Ph.D. '41, dealt with **Escape from the Earth by Multiple-Step Rockets**.

BASKETBALL

VARSITY basketball to date, with 70 per cent of the season passed, shows a middle of the road trend with five wins and five losses. Of the five conference games played, two wins have been registered, over Occidental and Pomona.

Captain Harry Moore in the forward spot, who was on the 1942 and 1943 teams, and center Paul Saltman, who lettered as a freshman in 1946, are the outstanding players on the squad. As the scores registered to date show, most of the games played this year have been hotly contested.

There are three league games yet to be played; with Occidental, Redlands and Whittier, followed by a contest March 1 with the San Diego NTC in San Diego.

Here are the season's scores:

Caltech 32	La Verne 27
Caltech 43	Chapman 35
Loyola 40	Caltech 39
Pomona 47	Caltech 35
Chapman 48	Caltech 46
Caltech 39	Occidental 33
Redlands 46	Caltech 42
Caltech 40	Pomona 38
Whittier 69	Caltech 36
Caltech 46	La Verne 30

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The San Francisco Chapter meets weekly for lunch at the Fraternity Club, 345 Bush Street, on Mondays.

KENNETH S. PITZER '35 DOING GASOLINE RESEARCH

DR. KENNETH S. Pitzer '35, chemist at the University of California, is working on a method by which he may be able to produce 140 octane gasoline. He has already increased the octane rating by passing hexane over solid aluminum chloride, but in order to accomplish a permanent change, he must alter the other parts of petroleum. He is attacking the problem at present by passing gasoline over liquid hydrogen and cooling it to 400 degrees below zero, F.

ROY E. MARQUARDT '40 OUTLINES RAM-JET PROGRESS FOR A.S.M.E.

SPEAKING to a student-sponsored meeting of the Aviation Division of the Southern California Section of the American Society of Mechanical Engineers on the U.S.C. campus early in December, Roy E. Marquardt '40 outlined the progress that has been made in this country on ram jet propulsion. Roy is president of Marquardt Aircraft Company, Santa Monica, and during the war was in charge of the Navy Jet Propulsion Research Program at U.S.C., of which he is now consulting engineer.

ALUMNI SEMINAR DATE SET

THE TENTH Annual Alumni Seminar has been scheduled for Saturday, April 26. To be held at the Institute from 9 A. M. to 4:30 P. M., the yearly program under the direction of Chairman Nicholas D'Arcy '28 will feature talks by representatives of biology, the humanities, geology; of civil, mechanical and electrical engineering. Institute public relations will also be discussed.

Speakers and subjects already promised are James F. Bonner, Ph.D., associate professor of plant physiology, who will discuss "Some Developments in Plant Biology"; Arthur P. Banta, M.S., associate professor of sanitary engineering, "Case Histories of Some Air-field Construction"; Robert T. Knapp, Ph.D., associate professor of hydraulic engineering, "Harbor Development at Guam and Studies on Cavitation," illustrated with movies; Harvey Eagleson, Ph.D., associate professor of English language and literature, "An Insight into the Modern Novel"; and Gilbert D. McCann, Ph.D., associate professor of electrical engineering, "Development of an Electronic Calculator". Mr. George H. Hall, administrative assistant to President DuBridge, will explain the Institute's public relations program.

BAY AREA ALUMNI TO HEAR DUBRIDGE

PRESIDENT Lee A. DuBridge will speak to the San Francisco Chapter of the Alumni Association on Friday, March 7, 1947. This will be the first chance Northern California Alumni have had to hear the new president. Dr. DuBridge spoke to the New York Chapter in September on the changes taking place at the Institute.

Graduates who have been away from Caltech for some time will be given the opportunity of meeting Dr. DuBridge and of learning some of the new plans for the future of the California Institute at this March stag meeting.

The meeting will be held at the El Curtola Restaurant, 510 Seventeenth Street in Oakland, between San Pablo and Telegraph Avenues, opposite the Roxie Theater. Dinner, costing \$2.50 including all expenses, will be served at 6:45 P. M. The upstairs dining room will be open early for pre-dinner mingling.

Double postal cards will be sent out to Bay Area Alumni late this month for reservations. Alumni who have not received notification through omission from the membership list, or who plan to visit in the bay area on March 7, should contact Robert P. Jones '35, secretary of the San Francisco Chapter, 1431 Park Boulevard, San Mateo.

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ROBERT COX '40 SAILS TO FLORIDA

TRAVELING from New York to Fort Lauderdale in his floating home-and-office, Robert Cox '40 has established winter headquarters in Florida waters for his new enterprise, Cox Industries, in which he serves as consulting engineer specializing in small gasoline engines and engineering for yachtsmen. Bob was formerly chief engineer and sales manager for Atlas Aircraft Products Corporation.

The trip down the inland waterway along the Atlantic Coast was filled with adventures. Bob was accompanied by his wife, Cathleen, and one crewman. The voyage began early in November, their 83-foot motor sailer, *Ungava*, loaded to the limit with parts of old cars, boats and engines, tools, and on the back deck the Cox's Mercedes Benz automobile.

According to their account, first night at sea was spent bumping against the municipal wharf at the Battery while the mast lights were being rigged. The second day they ran aground twice in the harbor at Atlantic City but continued the next day to Cape May and then through canals and up the Delaware to Chesapeake City. Originally intending to go on to Annapolis, a thick fog changed their plans and they headed for Baltimore, moving blindfold until they were stopped by Pratt Street, two blocks from the center of the city.

The party spent a week at Bellhaven and were impressed with the hospitality of the local people who brought them home-cooked dishes and invited them to their homes. At Morehead City they attempted to

maneuver into a recently-dredged yacht basin recommended to them by a Marine major. After scraping bottom three times they gave up and headed for the City, became involved in strong currents, could not find the red guide light in the channels and went aground again.

Invited to an oyster roast at Beaufort, S.C., the trio could find no available dock space for the *Ungava*, finally began to pull in and tie up alongside a fishing boat when the engine quit. "Ahead of us was a long bridge, the current was running at seven miles and there we were, helpless! We . . . were aiming straight for the bridge. We hit and hard . . . the whole bridge swayed way over . . . we broke through the wooden cross pieces and stopped. A few little gouges were (our) worst damages. We didn't discuss the bridge with anyone there." After futile attempts by a fishing boat to pull the bow off and the tide rising and threatening to cave in the deckhouse against the overhanging members of the bridge, "Herman came to the rescue . . . Some kind soul had raced wildly across the river to Herman's fishing boat and he came full blast while all the townspeople assured us we had no further worries: 'Herman is coming!' We gave him a rope and off he went. We heeled way over and off we came—it was terrific! Incidentally it rained and the oyster roast was off!"

They went on down the Georgia coast past Savannah, St. Simon and Brunswick to Mayport, Florida, on the St. John's River. From here the party ventured onto the high seas into what the Coastguard called "Moderate Southeast Winds." The *Ungava* began "rolling from rail to rail, plunging up and down and the water was coming over the deckhouse in sheets. We knew the boat was safe enough but wondered what the insurance company was going to say if we reported the Mercedes Benz 'lost at sea.'"

"We staggered into Fort Pierce about 7:00 that night tired and hungry. The boat was a shambles—everything including heavy filing cases fell over, the refrigerator was filled with a sour mess of milk, coke and French salad dressing with pulverized glass."

Bob spent the following day (his birthday and Thanksgiving) cleaning and repairing the boat's generator and the voyage eventually came to an end in Port Everglades, nearest available parking place for 83-foot sailboats.

Incidentally, a full-color picture of the *Ungava* in her prewar state is featured on the cover of the December issue of *Yachting* magazine.

T. D. YENSEN '27 LECTURING ON SCANDINAVIA

T. D. YENSEN '27, manager of Westinghouse magnetics department in East Pittsburgh, Pennsylvania, spent a month in Europe last summer surveying the magnetic materials field. Since his return he has given a broadcast and several illustrated lectures on "Postwar Reconstruction in Norway," "The High Standard of Living in Sweden," and "The Russian Menace to Peace in Scandinavia—A Myth or an Actuality." He presented four more lectures in January.

In addition to his chief occupation with magnetic research, from which he expects to retire in 1950,



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he is chairman of the Technical Committee of the United Smoke Council which is working on methods of smoke elimination to be extended throughout Allegheny County during the next year. Through the Allegheny Civic Club, he also is actively engaged in projects concerning stream pollution and pure water supply. He is section chief of the National Ski Patrol and Wilderness Patrol in the Allegheny Mountains and serves as chairman of the finance committee of the Unitarian Church.

FRANK STREIGHTOFF '40 BACK AT LILLY

SINCE his graduation from California Institute in 1940, Frank Streightoff has acquired further education, two jobs, a discharge button and four new dependents. With his B.S. in biology in hand, Frank Streightoff entered the University of Chicago where he studied biology and pathology for one year. In November, 1941, he joined the firm of Eli Lilly and Company, pharmaceutical manufacturers, where he was employed in the Biological Research Department. In May, 1942, Streightoff entered the Army as a food nutrition technician. Shortly after his entrance into service, Frank married Ann Mitchell of Indianapolis. Streightoff served the Army until December, 1945, when he was discharged from the Vitamin Retention Laboratory he had set up for the Army in Washington, D.C.

Mr. Streightoff is the father of two daughters and a very young son. He has reentered the employ of the Lilly company in Indianapolis.

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PERSONALS

1921

HAROLD O. FLETCHER has left Pasadena to take up residence at Lonely Valley Ranch, Saugus, California.

1924

WILLIAM C. DREYER is employed as manager of the Engineering and Service Department of the Houston, Texas branch of the Westinghouse Electric Corporation.

1925

DWIGHT O. SMITH, whose whereabouts have been unknown to the Alumni Association for sometime, is with the American Baptist Mission in Rangoon, Burma. Mrs. Smith is living in Redlands, California at present.

1927

RICHARD M. DODGE has recently moved to San Gabriel, California.

The resignation of JOHN H. MAXSON, Ph.D. '31, assistant professor of geology, has been accepted effective 1 July 1947. Dr. Maxson will take a position in the petroleum industry.

ROLAND W. REYNOLDS is now living in Long Beach, California.

1929

RICHARD G. ROFELTY is now residing in Vancouver, Washington.

WILLIAM LITTEL BERRY has moved to Sacramento where he is now employed by the Division of Water Resources, Department of Public Works, of the State of California.

THOMAS H. EVANS, head of the Department of Civil Engineering, at Georgia Tech. has recently been appointed chairman of the Athletic Council of the faculty.

1930

HERBERT H. DEARDORFF visited the Alumni Office recently while on vacation. At present Herberr is living in San Francisco, California.

JACK PRITCHETT is on temporary transfer with the Western Ocean Division of the Engineer Board. In February, he will go to Las Vegas, Nevada where he will take up the duties of chief engineer at the Army Airfield.

JOHN C. SHIELDS holds the position of civil engineer with the U. S. Engineer Office at Sacramento, California.

1932

WILLIAM BERGREN, Ph.D. in biology '41, is employed by U. S. C. as a research associate, working on nutrition at their Monrovia Clinic. He also maintains a consulting practice on the side.

1933

WILLIAM W. MOORE has been elected president of the Structural Engineers Association of Northern California. He is a member of the engineering firm of Dames & Moore.

LOUIS A. PIPES, M.S. '34 and Ph.D. in electrical engineering '36, has recently written a book *Applied Mathematics for Engineers and Physicists*, published by McGraw-Hill Book Company Inc. of New York. Mr. Pipes, now in the Research and Electronics Division, Hughes Aircraft Company, was formerly assistant professor of engineering sciences and applied physics at Harvard University where the material in the book has been used in the Graduate School of Engineering during the past five years.

1934

JAMES R. CAMPBELL is employed with the Paul Henry Company of Los Angeles.

PAUL KARTZKE has been transferred to Bakersfield, California as division manager for Shell Oil Company.

ARZA F. PORTER has taken a position in the Design Department of the C. F. Braun Company of Alhambra, California.

ALFRED I. SWITZER has returned to his prewar position in the U. S. Engineer Office in Los Angeles as assistant chief of the Civil Works Branch, Engineering Division. During the war he held the rank of major in the Corps of Engineers. From March, 1945, to June, 1946, he was in the Philippine Islands as chief of the Engineering Division of the General Engineer District, which was charged with all non-tactical military construction and with reconstruction of the major cities in the Islands.

GARFORD GORDON is now residing in Los Angeles, California.

HUGH M. O'NEIL recently announced the establishment of his independent practice as an architectural and structural engineer. His organization, the H. M. O'Neil Company, Consulting Engineers, of Oakland, California will continue in the business of designing industrial plants and commercial buildings.

1936

DR. R. W. DODSON, assistant professor of chemistry, has resigned to accept an appointment from Columbia University.

DR. SIMON RAMO, research director of Hughes Aircraft Company, has recently been appointed research associate in electrical engineering.

MAURICE SKLAR has been transferred to the Midland, Texas office of the Shell Oil Company.

ROBERT B. VAILE, lost for some time to the Alumni Association, is living at present in Western Springs, Illinois.

EUCLID V. WATTS has been named general chairman for the spring meeting of the American Petroleum Institute's Pacific Coast Division of Production. He is employed with the General Petroleum Corporation.

1937

WALTER L. MOORE, recently a research engineer with Lockheed Aircraft Corporation, has been appointed associate professor of hydraulics at the University of Texas. He will take up his new duties in February. In 1944, Moore was awarded the Collingwood Prize of the American Society of Civil Engineers for the best paper presented by a junior member in the preceding year.

1938

LT. COMDR. RICHARD B. FORWARD is now living in Santa Barbara, California. In July, 1942 Lt. Comdr. Forward was awarded the Distinguished Flying Cross for heroism.

HENRY T. NAGAMATSU recently moved to West Los Angeles, California.

DR. VERNER F. H. SHOMAKER has been granted leave of absence for the 1947-48 school year to accept a Guggenheim Fellowship. Dr. Shomaker is an assistant professor of chemistry at the Institute.

1939

MARCUS HALL is now working with the Brown Bevis Equipment Company.

NORMAN H. HOROWITZ, senior fellow in research at the Institute, was recently appointed associate professor of biology. Professor Horowitz came to the Institute in July from Stanford. After graduating from the University of Pittsburgh, Dr. Horowitz held fellowships at both the California Institute and Stanford prior to his recent appointment.

JOSE PULIDO ORTIZ reports from Mexico that as of December of last year, he has been appointed as director in charge of the Maritime Works, Secretary of the Navy.

DAVID H. SCOTT is now located in Bakersfield, California.

1940

ALEXANDER F. BREWER recently moved from Hollywood to Wilmington, California.

ROBERT W. WAYMAN is chief design engineer of the Detroit Transmission Division of General Motors, manufacturers of the Hydra-matic transmissions used in Oldsmobile and Cadillac automobiles. During the war his division equipped many vehicles including the M5 and M24 light tanks and the General Pershing heavy tanks.

CHARLES H. WILTS, M.S. '41, National Research Council Predoctoral Fellow, has received an appointment as assistant professor of applied mechanics at the Institute.

1941

GLYN FRANK-JONES is located at present at the Ships Supply Depot, Naval Supply Center, Guam, Mariannas Islands, as a technician for the Radio Corporation of America. He expects to remain in Guam until the first of July, at which time he will return to the United States.

ROBERT B. LEIGHTON, M.S. '44, National Research Council Predoctoral Fellow in Physics, has been made a research fellow in physics.

1942

ROGER BRANDT recently moved his place of residence from Phoenixville, Pennsylvania, to Weatogue, Connecticut.

STEWART DAVIS is presently employed with the Western Electric Company in Allentown, Pennsylvania. Stewart was married on July 20, 1946.

JOHN A. DRAKE has moved to Balboa, California.

FRANK A. FLECK is now working at Consolidated-Vultee Aircraft Company in Downey, California.

WILLIAM B. HICKS works as sales engineer for U. S. Rubber Company and is living in Pasadena.

1943

DAVID R. ARNOLD recently moved from Menlo Park, California to Los Altos, California.

EDWARD I. BROWN is now residing in Ocean Park, California.

ROLAND STANLEY SAYE is the father of a baby girl, Marilyn, born January 7.

CHARLES P. STRICKLAND, JR. has taken a position in the sales division of the York Corporation, Refrigeration and Air Conditioning, at York, Pennsylvania.

WILLIAM C. THOMPSON, JR. is now working at the Naval Ordnance Test Station at Inyokern, California.

1944

WILLIAM P. BAIR has moved to Pasadena temporarily. He is employed with the Southern Counties Gas Company.

ROSS ALTON BUCHANAN was recently married to Miss Marion Jane Doherty of San Francisco. The young couple is living in the bay city at present. Ross is employed with the Otis Elevator Company.

HERBERT J. CABRAL is working with the Westinghouse Corporation in its East Pittsburgh plant.

LEWIS LEROY GRIMM is now living in Temple City, California.

JAMES G. KERR has a new job with the Department of Metallurgy, Lehigh University, Bethlehem, Pennsylvania.

JOSEPH STEWART MARTIN has moved from Monterey to South Pasadena.

JOHN NELSON is taking graduate work in mechanical engineering at M.I.T.

HANS NEUTZEL has left the Los Angeles City Department of Water and Power to accept employment with the U. S. Department of Commerce, Technical Industrial Intelligence Division. After receiving instructions in Washington, D. C., he was sent to the occupation area of Germany, with headquarters at Haechst. He is currently engaged in a survey and analysis of German advances in hydraulics, highways and movable dams. His wife and year-old daughter reside in Los Angeles.

JOSEPH SOLOMAN, recently with the AAL Naval Detachment, Moffett Field, California is back home in Los Angeles.

1945

EDWARD R. ELKO has recently moved to Rosemead, California.

WILLIAM S. TATLOCK returned to his home in Terre Haute, Indiana at the beginning of December. Bill had served with Weather Reconnaissance Squadron Three, which operated in the Caribbean area during the hurricane season. He is planning to re-enter college in the fall for work on a Master's degree in chemistry.

DONALD GUY FURST is now residing in Whittier, California.

1946

JOHN A. ANDERSON is employed by North American Aircraft in Inglewood, California.

ROGER CLAPP reports that he is working at Hughes Aircraft Company in Culver City along with TECK WILSON, DICK LAGERSTROM and JOHN TABER. They were visited recently by J. C. EVANS, who is employed at North American nearby.

BENJAMIN S. HALNE III is employed by General Petroleum Company.

J. R. JACOBSEN is working with the Radioplane Company at the Metropolitan Airport in Van Nuys, California.

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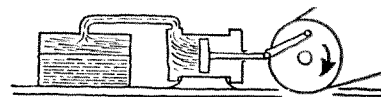
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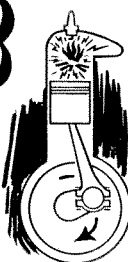
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3

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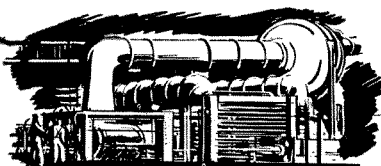
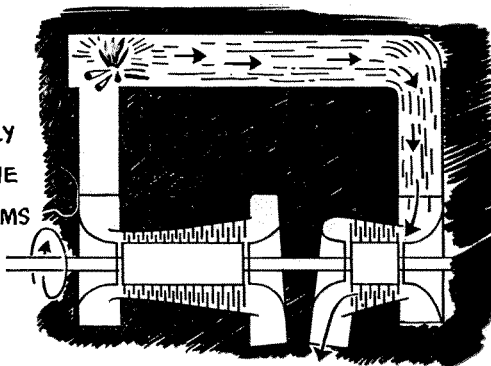
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4

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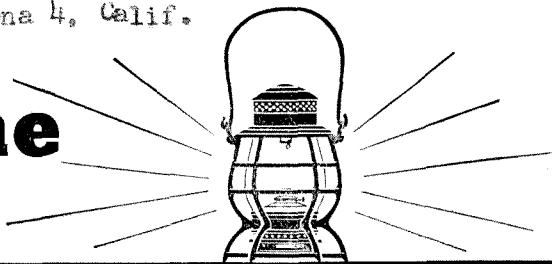
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This letter is one of many we've received commenting on our highway billboards.

"Next time, try the train" has been quoted in innumerable newspapers and magazines, and on radio programs. It has appeared in several motion pictures. We think this friendly invitation has persuaded a good many motorists to let the engineer do the driving, for a change.

Not that we have anything against motoring. Most Southern Pacific families have automobiles. But we think there are times when the train has very definite advantages.

The big thing about train travel is that somebody else does the work while you relax and take it easy. No traffic to fight. No worries about tires. You arrive really rested.

On long trips there's a big saving in time because trains keep rolling night and day. Hundreds of miles slip by while you sleep.

Next time you go somewhere, try the train. We think you'll enjoy an occasional vacation from your steering wheel.

Good Neighbors

You may have read about it in the papers not long back.

A two year old girl had been blind from birth with congenital cataracts. Ernest Hiehle, Southern Pacific telegrapher, took up a collection among his fellow railroaders and raised \$400 to pay for the operations necessary to restore the little girl's sight.

It was just an act of human kindness that anyone might do, but it reminded us that Southern Pacific men and women have performed an unusually large number of such acts through the years.

Perhaps the most dramatic inci-

dent occurred during the war. You may remember it. A freight train was coming down the High Sierra. A child was playing on the tracks ahead. There wasn't time to stop the train. Tug McDaniel, Southern Pacific brakeman, leaped from the locomotive, outraced the train and saved the child.

Such deeds make us think that by and large, Southern Pacific people are pretty good neighbors—nice to have around in emergencies.

Railroad Slang

Like men who go to sea, railroad men have a salty, picturesque language of their own.

Railroad slang varies from one line to another, and it's hard to get railroaders to agree on what's in current use and what isn't. So the following digest of railroad terms must be regarded as strictly unofficial.

A locomotive is a "hog", "calliope" or "jack". If it is of ancient vintage, it may be called a "teapot".

A freight train is a "drag", and a fast freight is a "hotshot". Passenger cars are "varnish". (The boys irreverently call our streamlined *Daylight* the "circus train" because of its bright colors).

A switch is a "gate" and a torpedo is a "gun". The caboose is a "crummy" or "parlor". The engineer is a "hogger", "hoghead" or "eagle eye", and the fireman is an "ashcat". The conductor is "captain" or "skipper". The brakeman is a "shack". A switch engine is a "goat". Refrigerator cars are "reefers".

A train on a siding is "in the hole", and the dispatcher who put it there is the "delayer".

A telegraph operator is a "brass pounder", "lightning slinger" or simply "OP". "DS" means dispatcher, and "YM" yardmaster. A railroad official is a "brass hat" and a division superintendent is "whiskers".

Demerits are "brownies", and everybody tries not to get any of

those, thanks. "Highball" is the signal to start, and the "smoky end" is the front end of a train (only our locomotives don't smoke much because they burn oil).

These aren't all the railroad slang terms by any means, but they'll give you the general idea.

Our Nat'l Park Collection

When the Big Bend National Park was created in Texas, we started totting up the national parks we serve and discovered—somewhat to our surprise—that we now serve seven. No other railroad has a collection quite that big. Here they are, reading from north to south:

Crater Lake National Park in Oregon; Lassen Volcanic, Yosemite, Kings Canyon and Sequoia in California; Carlsbad Caverns in New Mexico (via El Paso); Big Bend in Texas.

Big Bend National Park, incidentally, is named after the Big Bend of the Rio Grande, which forms its southern boundary.

See Twice As Much

Sometimes we wish that Southern Pacific had only one route to the East. It would certainly simplify the advertising problem.

As it is, we have four. Our Sunset Route goes east via the Southwest, Texas and New Orleans. Our Golden State Route follows the Sunset Route as far as El Paso, then heads north-east through Kansas City to Chicago. Our Overland Route is the shortest, fastest route between San Francisco and Chicago, and our Shasta Route between the Pacific Northwest and California forms a transcontinental route by connecting with northern U. S. and Canadian lines.

You can add variety and interest to your journey by going east on one of these S. P. routes and returning on a different S. P. route.

In other words: "Go one way, return another. See twice as much."

—H. K. REYNOLDS

S·P The friendly Southern Pacific