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INDUSTRIAL SAFETY SECTION

YOU HAVE TO HAVE A PLAN

By J. R. STONE
Safety Director, Oldsmobile Div., General Motors Corp., Lansing, Mich.

It would not be wise for me to give you the impression that there is such a thing as a universal tailor-made plan for ridding the country of the accident menace. In order to reduce accidents plans must be made on a local basis and then implemented; I can not offer you a package program.

For some reasons, program transplants invariably fail to survive in safety work. Plans proven effective in one plant can rarely be used unchanged in another plant with equal success. The reasons for this are quite obvious once it is recognized that planning, to give results, must be centered around local problems, resident personnel and the depth of penetration of the safety movement in the particular plant. These factors all vary from plant to plant and must be evaluated in each case before a starting point can be established.

However, there are some points of philosophy regarding the safety problem in general that can be followed in all safety program planning. This philosophy is basic and can be applied in any safety problem regardless of who or what is involved. The consideration of this basic safety philosophy and its planned application at a local level gives us what we are looking for. So, instead of dealing with the plans themselves, suppose we discuss only the nucleus around which all effective accident prevention plans are made.

The term "basic" must not be misconstrued to mean second rate. Look at it this way: To be basic is to be essential. In our own personalities basics are the framework upon which our individual characters are built. Think of the influence on our characters of our faith, our trust and our love; or, how we value generosity, kindness, honesty and respect. These are basics. Nuclear physicists are dealing with the more basic when they explore the structure of the atom. Chemists have discovered new chemical elements in their research and have had to change their entire concept of basic chemicals. Anything that is basic is important in that it is viewed in its simplest and most understandable form without any confusing influences. So, we are going to investigate some of the basic factors around which safety planning is done.

The objective of our planning will be to come up with a program to reduce accidents.

What is an accident? The best definition of an accident I have ever heard is that it is where a person gets hurt and didn't intend to be. Actually the injury is the result of the accident and not the accident itself. It is possible to have accidents without injuries, but these do not cause so much trouble. The injury with its emotional factors of pain and suffering always has been and always will be in the spotlight and the headlines. So, in the accidents I will discuss, it will be assumed that someone was injured.

This being the case, it is a good idea for us to find out how people get hurt in accidents.

How People Get Hurt

Falls	7.55%
Struck by an object	41.00
Striking against an object	15.00
Caught in, or between objects	23.00
Exposure to temperature extremes and radiation	1.70
Strain or overexertion	10.00
Exposure to electricity	.50
Inhalation, absorption, ingestion	.20
Exposure to chemicals	1.00
Explosion	.05

These percentages were taken from a study of 1738 accidents at Oldsmobile, and show that there are only ten ways for a person to get hurt in an accident. The fact that we actually analyzed 1738 injuries and found there to be only ten ways for all these people to get hurt makes the job of accident prevention look a little easier. This is a valuable find as it reduces injuries to a basic concept.

This chart throws cold water on the injury as a starting point in a safety project and

points out that we must dig a little deeper. The reason is that the injury is not the accident, but rather the result of the accident. Injuries are always associated with accidents, but are certainly not the accidents themselves.

How do we have accidents? We have accidents by mixing people with hazards. Hazards + People = Accidents. You cannot have an accident unless you have both people and hazards.

If either factor, people or hazards, is taken away, you just can't have an accident. This formula is very simple, but it views accidents in a manageable light. You can do something about accidents when you keep this concept in view.

What are we going to do about people in the accident formula? We can't take people out of the picture entirely. The formula indicates that we *must* work toward keeping people and hazards from mixing because accidents are the result.

Let's now look at the hazard in this formula. What is a hazard? Let's say it is anything or any condition capable of causing an injury. That seems to take in a lot of territory, but maybe not as much as you think.

Basic Safety Hazards

1. **Pinch Points**
2. **Catch Points**
3. **Shear Points**
4. **Squeeze Points**
5. **Flying Objects**
6. **Falling Objects**
7. **Run-in Points**
8. **Electricity**
9. **Gases**
10. **Heavy Objects**
11. **Chemicals and Flammables**
12. **Hot and Cold Objects and Radiation**
13. **Sharp and Pointed Objects**
14. **Slippery Surfaces**

There are only 14 basic hazards which we call the "hazard family."

Most of us are inclined to think of hazards compositely instead of basically. We say a punch press is a hazardous machine, but fail to say specifically what is hazardous about it. In this manner we tie our own hands. If we turn back to the Hazard Formula and take a look at the punch press using the former as a guide, it's much easier. When we carefully single out all the basic hazards and consider them as so many specific safety problems, we begin to make some headway.

Once we have located a basic hazard, we have five options on what to do about it. The hazard which is eliminated is no longer a source of trouble. The same goes for the hazard that is guarded. If it is possible to reduce the hazard, we have have reduced our exposure for an accident. However, when we make no change in the hazard, we literally bet our lives on human nature and are headed for trouble.

Action on Hazards

1. **We can eliminate the hazard.**
2. **We can guard against the hazard.**
3. **We can reduce the hazard.**
4. **We can avoid the hazard.**
5. **We can ignore the hazard.**

In most cases, the need for stepping up safety activity is brought to light by a series of lost time accidents. The safety record is bad, insurance costs increase and somebody hits the disaster button. Everybody gets into the act and a crash program is set up to relieve the pressure, but a crash program entered into as the result of a poor safety record is usually a disappointment. When the safety record leads you around by the nose, it is hard to plan intelligently.

If we refer to the outlined lists, and direct our efforts at these important factors in the accident picture, we will be following a more direct route to the heart of the problem. When our program is planned to bring about reasonable control of basic hazards in conjunction with a continuous safety educational process with our people, we are working in the grass roots area of the accident problem and will get measurable long range improvement.

We cannot process people, but we can enlist the many attributes of human nature to help us in the upgrading of safety standards and safe practices.

We must accept the fact that, in solving the safety problem, accidents themselves are of no value at all except to lead us back to the accident cause. This is where we go to work because accident causes are manageable where accidents themselves are not.

The first step we must make, even before we get down to the formulation of definite plans in the safety problem, is to decide upon certain responsibility distribution in the implementation process. Once plans are made and definite action is decided upon, some individual in the organization must be responsible for each step in

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putting the plans into effect. Probably the most important decision to be made at this point is where you as an individual will fit into the picture. No matter what your primary responsibility happens to be in your plant organization, when you are handed the responsibility for accident prevention, you must take charge from then on.

No matter what your title, no matter what the size of your organization, you have become the administrator of the safety program whether you like it or not. It is up to you to get things going and to employ all the organization and facilities at your disposal to keep them going. Working out a safety program is a man size job and many discouraging factors are involved. It is much easier to keep abreast of basic safety hazards by taking them out of the picture, one at a time, before a safety problem develops.

In the safety training of employees, results are more difficult to measure. However, it must be kept in mind that the objective of safety training is not to second guess human nature, but rather to fit the work environment to the known peculiarities of the human family. This objective requires patience and takes time, but little by little persistence will pay off and the people factor in the accident formula become less of a problem.

It should be emphasized that your most valuable assets in the job that lies ahead are the very people you might consider the cause of your frustration. Plans must be made on the basis that people want to work safely. Objectives and programs must be set up on the basis that they are possible, applicable and reasonable. There is certainly nothing to be gained when the plan is impossible or when it is assumed that everybody is against it in the first place.

After 22 years in safety work, I am of the firm belief that employees, in general, are receptive to safety instruction and will follow them, providing these instructions are given them by their foremen as a part of job instructions. In this approach, safety becomes a recognized part of the job, and each employee is held accountable, by his foreman, for following safe practices.

It is my opinion that safety is primarily a management responsibility. I can't see how it can be anything else. If management is to be held responsible for the consequences of accidents in the work environment, they must, by the same token, be given full authority over programs set up to control conditions in the plant. There has never been such a thing as an effective voluntary safety movement.

It is human nature not to impose regulations on oneself. This is a job for the other fellow. No employee in his right mind would invade his own freedom by placing restrictions on his conduct, even to keep himself from breaking his own neck.

The heavy drinker knows he should deprive himself of that third martini, but he waits for his doctor to lay down the law before he does anything about it. To most employees, safety is for the other guy. It is due to this apathy that management must be seated at the wheel.

Too often when employee safety committees attempt to develop safety rules for other employees, complications arise. On one day the committee draws up the rules only to find themselves defending violators of the rules on the following day. You can't be a switch hitter in the safety problem. You cannot serve as prosecutor on one day and attorney for the defense on the next day. So, for these reasons, management must have both the authority and the responsibility to make the safety program a reality.

I do not think anything has been taken away from the worker in this philosophy, and I know of no satisfactory substitute for this approach. A management sponsored safety program is supported by all the facilities and skill at the disposal of the plant, and the safety program becomes one additional service to the general purpose of the plant.

At Oldsmobile, the safety program is looked upon as an operating function, and the objective of all the safety work we do is not for the purpose of having a good safety record but rather to make Oldsmobile cars safely.

Management in our plant is on record to the effect that safety is indeed their responsibility and even pay employees, through the employee suggestion plan, for pointing out safety hazards and submitting safety ideas.

We expect and get cooperation from our employees in following safety instructions

given them by their foremen, but we insist on "calling the shots."

Our safety program is planned to be a part of running the plant, and running the plant is, and always will be, a management function. In this light, the safety problem is controlled and accounted for as a part of running the plant and is neither a political football nor a game of cat and mouse.

Too often I have heard men in the safety field complain about the lack of top management support. They mourn the fact that the managers of their plants are simply "not interested" in the safety problem.

There is something lacking here. It is doubtful, in my opinion, that these fellows are using the support that is theirs for the asking. The fact that the boss has handed the safety job to an individual is in itself quite a demonstration of interest on the part of top management.

The boss expects to be kept informed about the progress being made by the safety man, and the relationship established between these two individuals must be carefully worked out, using realistic factors. The boss knows he will be called upon to make decisions, but he won't tolerate being imposed upon in these matters. The safety man should go to the boss for a decision only when necessary and should certainly not use this privilege to avoid making decisions himself.

The boss must be given enough information to be in a position to act; he cannot be expected to go out into the plant and get this information first hand. This involves a process of literally taking the plant in and laying it on the boss's desk using photographs, sketches and brief but factual written reports.

I am spending considerable time on management's role in the safety program because of its importance to the success of any planning that might be done. Getting top management support in a safety program is nothing more than the intelligent use of factors available in all successful business and industrial enterprises; namely organizational authority and leadership. The contact between the boss and the safety program must be maintained in the same manner, and information presented to him with the same clarity, as in any other operating function of the plant.

If the safety man uses the basic information in the outlined lists in his dealings with the boss, there will be a minimum of misunderstandings; and he will get the support from the boss that is so vital in this problem. You can see that the safety man himself becomes more and more important as this discussion unfolds. His analysis of the plant's trouble areas, his point of view in proposing action, his tenacity, and his ability to tell his story with conviction often spell the difference between the success or the failure of the safety program.

The safety engineer of today has at his disposal unlimited information on "what to do" in a safety problem. The National Safety Council, the American Society of Safety Engineers and the American Standards Association will furnish all the "What to do" information he can possibly need. It remains for him to dig up the "Where do we hurt" information so that the "What to do" may be applied. He has all the "answers" at his fingertips, but he has to come up with his own "questions."

In referring back to the "People" factor in the accident formula, one thing should be kept in mind. Some safety engineers take a dim view on what they can expect from people in the control of accidents. They talk as though the human race was put on this earth for the sole purpose of confusing the safety issue and the safety engineer.

People are prone to forget and to be preoccupied and to take chances; but I have found that when safety instructions are properly given and supervised, these human weaknesses are practically eliminated in the safety problem. Members of the Human Family are more an asset than a liability to the safety engineer, providing he encompasses their weaknesses in his thinking and his planning.

When we get down to the actual step by step plan, we must develop the ability to keep major objectives in view. With major objectives as index points, we are able to return the program to target even though we drift off course momentarily. Progress in the general direction of the target is often the best we can do for the moment; Insisting that an inflexible course be followed might stop progress entirely.

If you want the guards painted yellow, and the boss insists that they will be green

or there will be no guards, settle for green and your program is still on target. Even the highly specialized technicians in the Space Administration have to make compensations in the flight direction of their rockets to make up for errors in the aim and unpredictable influences on the flight path. A safety engineer must be idealistic, to be sure, but he must be practical as well and must be able to recognize the difference between what is essential and what is superficial.

There are some objectives that should be set up as goals in a safety program:

A. *Hazard analysis and control as a planning activity.*

Since hazards are involved in all accidents and since hazards are manageable, safety program planning should be aimed at controlling hazards. When hazards are eliminated while new facilities are being planned, the facility will be compatible with human nature.

When hazards are thoughtlessly designed into a machine and then must be engineered out of the machine after an accident has occurred, we are actually paying double for the safety factor in addition to the accident.

To pay for an original design, which could have been made safe just as easily, and then to pay for a second design to remove the hazard is not good business.

The control of basic hazards is a factor that helps offset accidents; so, this objective is of paramount importance in safety program planning.

B. *View the safety program as a part of doing business and not as a gimmick set apart from the general reasons for running the plant.*

The safety program should be considered nothing more than a service to the main objective of the plant, namely, producing the product. The safety activity in the plant should therefore be interwoven into the operating activity across the board and should not be degraded by isolating it from other operating functions.

Safety contests, campaigns and the like do little to build a safety program because they set safety apart from the operation of the plant and are never viewed by those involved as a part of doing business. Where else would we give prizes for doing what we are being paid to do.

C. *Hold each supervisor responsible for maintaining a climate of safety in the geographical area under his supervision.*

Once the plans are made, the responsibility for seeing that they are put in effect and kept in effect becomes extremely urgent.

Even the best plans go for naught when they are carelessly implemented.

When each supervisor is thoroughly briefed regarding the safety program, and when he knows that his vigorous support is expected throughout his area of supervision, progress is speedy and uniform. Unless specific responsibilities are clearly defined, inconsistencies will cut down the total effect of the safety program.

So, make certain that your planning includes an understanding with individual supervisors regarding the part they are expected to play in the program.

D. *Give safety instructions as a part of job instructions and follow up until a "contract of understanding" is reached between the supervisor and the employee.*

Safety instructions given to employees by their supervisors as a part of job instructions prove to be better understood. Safety, when presented in this manner, becomes a part of the job in the minds of the workers, instead of something extra that is over and beyond and, therefore, not a part of the job.

A "Contract of Understanding" is nothing more than a state of complete understanding between the employee and the foreman.

All foggy areas and inferences have been cleared through follow up and repeated contacts, until both parties have no question about the work pattern and its bearing on safety.

No safety program planning can be effective without this objective.

E. *Monthly safety interviews between individual employees and their foremen.*

These safety interviews broaden the safety knowledge of the employee by supplying him with general safety information. The employee also has this opportunity to ask questions concerning safety on his

job. The net result is a progressive expansion in the total safety know-how of the entire plant population.

These are the five objectives I would aim towards in putting together the plans for a safety program.

It is quite obvious that the supervisor who is in direct contact with the workers will be the person needing most of your attention. Your plans must keep him constantly in view because he, not you, will be the key man as your plans materialize. The safety engineer who councils foremen and who spends ninety per cent of his time helping foremen with safety problems is making headway.

Each foreman brought into the camp of the safety engineer is one more salesman for safety, and it behooves the safety engineer to work with him untiringly. Foremen are the spokesmen for the safety program. They are the communication system. We must understand them and respect them in the job that lies ahead.

YOUR ACCIDENT RECORD CAN HELP YOU

By W. EUGENE STUFFING
Director of Safety, Carrier Corp., Syracuse, N. Y.

The premise on which this paper is based is that "Records are the basis or foundation of a scientific approach to accident prevention." Records give you, the safety engineer, the basic information necessary to transform haphazard, costly, and ineffective accident prevention work into planned programs so that specific conditions and situations which are causing accidents can be controlled.

So that all of us who are engaged in the profession of preventing accidents can measure our accident experience and progress by the same units of measure, the American Standards Association, with the assistance of many safety experts, has developed two standards. These standards are the basis for the majority of accident records developed and maintained by industries, federal, state and local agencies, and associations such as the National Safety Council and the U. S. Department of Labor.

These standards are: A. S. A. Standard Z16.1 and A. S. A. Standard Z16.2. Standard Z16.1 presents the standard method of classifying and recording injuries and computing injury rates. Standard Z16.2 contains a detailed classification of accident factors and a recommended procedure for classifying and analyzing accidents on this basis. This standard comes in two parts.

If you build your records around these standards, you will be able to provide yourself with an objective evaluation of your safety program. Records will help you identify your high-rate departments and, in addition, will provide you with information on your principal accident causes.

Records can also be used to:

A. Create interest in safety among members of your management by furnishing them with information about the accident experience of their departments.

B. Help you determine your principal accident sources so that your efforts can be focused in directions which will effect the largest reductions in accidents.

C. Provide supervisors and safety committees with information about the most frequent unsafe practices and unsafe conditions, so these persons can utilize their time and efforts to the greatest advantage.

D. Judge the effectiveness of your safety program and activities by showing you whether your accident experience is improving or getting worse.

E. Make comparisons with other companies, industries, or groups.

There are four steps which you must take if your records are to be of value to you. They are:

A. Obtain a report on every injury.

B. Record and classify these injuries in accordance with the A. S. A. standards already mentioned.

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C. Prepare a monthly or periodic summary report which adequately shows the injury rates, as well as the circumstances and causes of the accidents which resulted in the injuries.

D. Periodically analyze the circumstances and causes of the accidents.

Obviously you must be fed basic information regarding accidents and injuries before you can build a set of adequate records. So the first type of report that you must receive is the first-aid report. The Medical Department should provide you with information regarding every injury. This report should give you the injured employee's name and department, the time of the accident, the preliminary impression of the injury, and the injured's description of how the injury occurred.

The other report which must be provided the safety engineer is the supervisor's report of accident investigation. This report is completed by the supervisor as soon after the accident as possible because time has a way of causing us to forget details which could be of vital importance in the prevention of similar accidents.

Supervisors' accident investigation reports vary widely as to format, but you should be sure that the form asks adequate questions to give the information you need. Obviously, each supervisor must know how to fill out the form properly. Otherwise you will find yourself spending needless time going back to the supervisor for additional information. This program of accident investigation reports also provides other interested management personnel with information regarding accidents occurring in their areas of responsibility and interest.

As stated earlier, you should prepare a monthly or periodic summary report which shows the circumstances and causes of accidents which resulted in injuries. The information for the summary comes from the first-aid reports and the supervisors' accident investigation reports. This summary report forms the foundation for all other reports which emanate from your office.

One type of summary report form is furnished companies by one of the leading casualty insurance organizations. Another form more completely describes an injury in terms of the A. S. A. standards previously mentioned. All of the "factors" with which you would work to analyze accidents are contained in this report.

By taking information from the monthly summary report, you can cross match the "factors" involved in accidents with each other, in order to find out what combinations of factors are causing the majority of your accidents. After you have found the combinations which are showing up in large percentages, your next step is to take measures to reduce accidents being caused by said combinations.

You can use your monthly summary to cross match specific "agencies" against "types of accidents." You also could use a similar work sheet to cross match "agencies" against "unsafe acts," or "agencies" against "unsafe mechanical or physical conditions."

Safety performance is relative. It doesn't mean too much until you compare it with the performance of other departments, plants, companies or industries as a whole, to say nothing about comparing it with your previous experience.

To make these comparisons, a method of measurement is needed that will adjust to the effects of certain variables contributing to differences in injury experiences. A standard procedure for developing records, which provides for these variables is included in A. S. A. standard Z16.1.

This procedure uses injury frequency and severity rates which relate injuries and days charged as a result of the injuries to the number of man-hours worked. These rates automatically adjust for the differences in the hours of exposure to injury. Secondly, this procedure specifies the kinds of injuries which should be included in the rates. These rates have been generally accepted by industry as a uniform procedure which will permit the desired comparisons.

Now I would like to mention a few ways in which various types of reports can be helpful to you. Since you are most familiar with your own company's situation, you should look these over from the standpoint of serving your own purposes.

Cumulative disabling injury frequency rates can be used to rank departments. This is only one type of measurement that can be used, but I should warn you that this type of measurement used by itself is no panacea. Departments can also be ranked by monthly disabling injury frequency rates.

A chart showing the variation over a seven-year period of the number of disabling injuries and the days lost from these injuries will show your performance over a long period of time. The peaks and valleys of a chart like this can be smoothed out by making your report, a "moving average" type of chart. I won't take the time to describe this technique, as you can readily learn it by talking to any of your associates who have some familiarity with statistics.

Here are some other types of reports that will help you to sell your safety program and assist you with your efforts. A "man-hours worked since last disabling injury" report enables you to rank your departments by both length of time and total number of man-hours worked.

Another report illustrates how you can show injuries reported to the Medical Department cross indexed between departments and types of injuries. All that is needed here is the names of the departments and the numbers of injuries by types. A simple type of chart which has had wide use throughout industry shows the percentages of injury types by accident frequency.

Another report which should produce support for your safety programs is in the area of reporting accident costs. Although most executives want to make their companies safe places in which to work, they also have a strong sense of responsibility to run their business profitably.

As a result, they may "drag their feet" when it comes to spending money for accident prevention activities, unless they see that they can save at least as much money as they spend. Without information on the costs of accidents, it is just not possible for them to decide intelligently how much they should be spending versus how much they can save. For this reason, it is very important that the top management, right down to the immediate supervisor, know how much they are losing as the result of injuries.

To help you decide which types of cost reports you wish to make, I would like to mention some representative types in general use. One report charts the average costs of disabling injuries over a seven-year span. These average costs are compared with the national average workmen's compensation costs for the same periods, as reported by the National Safety Council.

Another type shows the average workmen's compensation losses per average hourly employee for a seven-year period. These losses are compared to an objective loss rate of $16 per hourly employee. A chart that measures workmen's compensation losses should be of special interest to labor relations personnel who negotiate with unions if it talks in terms of added costs of doing business on a manhour basis.

There are situations where a substantial percentage of your accident losses are caused by a specific situation, or a particular operation or machine. If you can show these losses as percentages of your total losses, it might be all you need to obtain action and support.

Another form of chart shows a type of accident analysis based on accident costs. For example, using information from the National Safety Council's "Accident Facts," suppose your company is making a net profit of 3 per cent and direct losses due to accidents are slightly less than a quarter of a million dollars. This report shows that the company would need eight million additional dollars in sales to pay for these losses.

Still referring to the chart, suppose you were able to reduce your losses to $100,000. This would be the same as your adding four million dollars in sales to the companies total sales picture. Not bad! With a three per cent net profit margin, a company must book $33,000 in additional sales to pay for every $1,000 loss due to accidents. In these days of intense competition and profit squeezes, it is just possible that an effective safety program can contribute more to profits than the company's best salesman.

Now that we have discussed costs and how you can use this information to prepare loss reports in various forms, let's look at another type of accident reporting.

Instead of basing your frequency and severity rates on disabling injuries, you can also use a system of reporting commonly known as the "serious injury index." There are many variations to the index, but the basic concept is the same in all of them. At the bottom of the page you see the types of "injuries" which are most commonly used to compute your index. The index is nothing more than a frequency and severity rate based on the factors you see listed at the bottom.

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The advantage of using an index of this type is that you are provided with a much more sensitive index of safety performance than if you used frequency and severity rates based on disabling injuries alone. You might be interested in knowing that the Industrial Conference of the National Safety Council has recommended to the American Standards Association that the Index be included as a part of A. S. A. Code Z16.1.

An actual report issued at the Carrier Air Conditioning Company shows you that eye injuries requiring the attention of a physician are by far the most predominant type of "serious injury." Since no eye injuries resulted in disabling injuries, you can see that this index has given us a clue to possible serious injuries involving the eye that an index based on disabling injuries would never have shown us—without a detailed analysis of all first-aid cases.

In order to assist you in comparing your accident prevention results with those of like industries, you have several readily available references to help you. Your State Department of Labor issues periodic reports showing disabling injury frequency and severity rates by industries. Similar reports are issued by the Bureau of Labor Statistics, U. S. Department of Labor.

Each year the National Safety Council issues two booklets which are loaded with facts and figures which, if used, can help you in many ways. These booklets are entitled "Accident Rates" and "Accident Facts."

The "Accident Rates" booklet contains frequency and severity rates for all major industries and most minor industries, as well as no injury rates and historical rates for both major and minor industries. These rates can help you in determining how well your plant or company is doing safety wise in comparison with the combined rates of other companies in your industry.

A chart shows the average charge per injury by industries. The table is broken down to show average injury charges in days by (a) all disabling injuries, (b) temporary total disabilities, and (c) permanent partial disabilities.

An annual feature in the "Accident Facts" booklet is a chart that shows what per cent, the injuries to each part of the body were of all injuries, and the per cent of compensation paid for each part of the body as compared with the total compensation costs. Another chart, appearing annually in "Accident Facts," shows the average compensation costs of injuries for various parts of the body, as reported to the National Safety Council by six state labor departments.

It is worthwhile to summarize the various ways in which accident reports can help you.

1. Records give us the information needed to plan programs to control conditions and situations causing accidents.

2. They provide us with a means of determining our progress, or lack of it, in controlling accidents.

3. We can determine how we are doing in comparison to other departments, plants, companies, and industries.

4. We can help interest our management by providing them with information on the accidents that are occurring in our companies.

5. Our records can be used to provide information to supervisors and safety committees about the most frequent unsafe practices and unsafe conditions occurring in their departments or buildings.

6. Finally, we can show our management the costs that are involved in our accidents occurrences.

Accident records are basic to any safety program. Without records we cannot function in an intelligent manner. With records, we are in a position to develop specific programs which will create interest in the safety program, as well as provide us with the tools necessary to control our accidents.

MODERN INSPECTION TECHNIQUES

By ARTHUR G. LAZARUS
Assistant Division Manager, Loss Prevention Department, Liberty Mutual Insurance Co., Boston, Mass.

It is always challenging to develop something new and modern about a subject as old as the hills. The subject, "Modern Inspection Techniques," is definitely in this category. While the word, inspection, is very familiar to engineers, its dictionary definitions leaves something to be desired. Any standard dictionary provides three definitions: (a) to look upon, (b) to view closely and critically, and (c) to scrutinize.

So when we make inspections we look, we view closely and critically, and we scrutinize. What do we do with all of this?

Every accident prevention plan with which I am familiar requires some form of inspection. Too many inspections can be classified as sight-seeing, hand-shaking, back-slapping expeditions. I think we should ask ourselves the question, "how many of our inspections are dry as dust, disorganized, and unproductive?" Our inspection plan should have clearly defined objectives. I will try in this discussion to outline a few ideas which may be of value to you.

The basic duties of a safety engineer may be condensed into five or six words.

1. Inspect (survey).
2. Record.
3. Analyze.
4. Evaluate.
5. Design.

It is difficult to apply the last four items unless we have an honest understanding of the first item. Therefore, for the purposes of this discussion, we will concentrate on the first item.

We must realize, however, that experience is still the best teacher. Accident analyses, accident investigations, and inspections are closely related. Each alone does not provide complete guidance and direction. As further background material, we should have an intimate knowledge of the kinds of troubles that other organizations are experiencing. We should have a knowledge of state and local laws and all the data published by the National Safety Council, the American Society of Safety Engineers, the Bureau of Standards, and the insurance carriers.

In directing our efforts, and the efforts of persons working under our guidance, we should have a clear understanding of one of the greatest human weaknesses, not being able to record and understand what we have seen.

Too often we see what we expect to see. We fail to note a slight alteration or addition. It is also extremely important that we never forget the new hazards, the sleeping hazards, the seasonal and infrequent hazards, that literally surround us. As yet, certain situations may not have caused personal accidents or interrupted production flow in our own plant. This is another reason why we must always be alert to the problems of others, and keep abreast of what is going on within the scope of industrial operations.

Why do we make inspections? In general, to detect and identify physical conditions and unsafe acts which have caused, or may cause, personal or property damage accidents. The inspector should be expected to suggest corrective measures. If he has difficulty doing so, he should be encouraged to review the problem with his superiors. Two heads are always better than one.

We make inspections:

1. To reveal specific hazards (clues provided by accident experience).

2. To analyze new, seasonal or infrequent operations before they begin, for the purpose of eliminating hazards in advance.

3. To detect unsafe personal acts, which may result in injury to the operator himself, his fellow worker or property damage.

4. To further the accident prevention education of management, supervisor and employee.

Inspections may be made by anyone. We assume the inspector will be completely indoctrinated with regard to his status, authority and responsibility. He may serve permanently or rotate with others at regular intervals. Permanent inspectors may go

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stale, whereas rotation spreads experience and education. There is no one in our profession who is able to recognize and measure all possible hazards. There is no one person in any of our establishments who can perform a 100 per cent complete inspection. The person qualified to inspect one piece of equipment or operation may be unqualified to inspect another.

We must know the qualifications of our inspector, and we must define the objectives and scope of his inspections clearly. Let us make sure that the man with the proper background is assigned to each inspection job. Time and effectiveness will be lost if a person with restricted qualifications is assigned to make an indefinite "general inspection." On the other hand, if we must use men with limited backgrounds, we should regard this as an unsurpassed teaching opportunity.

For example, in recent years in certain areas of New England, we have had an influx of various types of injection molders. As a result, two or three of our people know all about the subject, but hardly anyone else has even heard of the hazard. Gradually, the use of this piece of equipment has spread to other areas. It is uneconomical to send one man throughout the entire area to evaluate the problem. Therefore, it seemed sensible to instruct our people about this problem.

We developed a problem evaluation sheet which covers all the points to be checked on an injection molder. I believe this evaluation sheet should have literally thousands of applications. It could be developed for any machine manufactured today, in any industry. It could be, and has already been, adapted as a ladder survey. If such a sheet was made up for ladder inspection, you would be amazed at the many different kinds you would find throughout your organization. The same may even apply to chairs or desks, or circular saws. The reverse side of the hazard survey allows the person making the inspection to record his observations.

This discussion of injection molders could take over three hours. In fact, part of our training schedule with our people does exactly that. I like to believe that we have helped manufacturers and users of this equipment avoid serious accidents from a relatively new industrial machine.

When should inspections be made? There are many variations to be considered.

1. *Periodic*—At regular intervals (weekly, monthly), inspections should be made of the entire establishment, as well as of certain equipment or processes where the controls are especially sensitive or delicately balanced.

2. *Continuous*—These are usually conducted by persons employed on a full-time basis, who are responsible for the operations assigned to them. If a product quality control unit exists in the organization, their able advice and observations should be solicited.

3. *Special*—Area inspections involving high hazards, new, infrequent, or seasonal operations should be scheduled intermittently. Certainly we should "follow up" on areas where previous suggestions have been made to determine progress.

4. *General Items*—Dates set for inspections may or may not be announced in advance. There are advantages in both methods. All multiple shifts should be covered. It is truly amazing what may be observed on the 11 p.m. to 6 a.m. shift (commonly called the grave yard shift).

What should we inspect for? There are many ready-made check lists available. Let us think twice before we adopt them as they are. Further, we should never hesitate to destroy a check list we have been using for years. A change of format is always healthy. Custom-built guides for every establishment are much more effective than any ready-made lists. I have already given an example of an individualistic check list for a special hazard. There is no limit to the special hazards that may be surveyed in that manner. We must never forget that each establishment and each operation is as different as the persons involved.

There is a method for properly surveying the hazards within a department that is as much a check on the powers of observation of the inspector as it is an inspection of the department. The guide sheet simply asks for the grading of a specific hazard and the grading of the controls exerted over these hazards. The lower half of the sheet also asks for details on how the severe hazards are controlled. I wish it was possible to state that this particular guide is the complete answer to inspections, but, alas, it is not. It

simply guides the inspector throughout his inspection.

We have discussed the person who is to make the inspection, when he is to make it, why he is to make it, and what he is going to check. I would like to mention a few of the more personal methods and attitudes which will assist an inspector in doing a more effective job.

1. He must have the physical ability to get into every nook and corner. This may involve walking, climbing, the ability to take noise, confusion, chaos and quiet.

2. He should follow the process from beginning to end. His route should be orderly, but we should remember that on occasion it would be well to reverse the procedure. Many times the inspector may be tired out at the end of his inspection. In larger establishments we may lay out a route, floor by floor or by departments.

3. He should have the good taste to contact the person responsible for the segment of the operation he is looking over. Basically, he should avoid discussing managerial problems directly with employees, unless in the company of supervisors or at their request.

4. He should have an "inquiring" mind; he should be curious about everything he observes. If an inspector intends to observe any operation from a standpoint of unsafe acts, it is worthwhile to sit quietly in some corner and observe what goes on. He may sit and look at an operation for an hour, and things may begin to happen that he has never observed before. One word of caution about this particular procedure: he should have the cooperation and understanding of the supervision of the area under observation.

5. An inspector should never acquire a reputation as a pessimist or an habitual fault finder. Supervisors should not dislike to have him in their departments. To combat this, the inspector should always try to demonstrate his sincerity and desire to be helpful to the supervisor regarding the health and safety of his employees. The single thing that does the most in this connection is recognizing "good" items, as well as "poor" ones. It is amazing how many things are done to avoid trouble. If you haven't used this technique—try it the next time you make an inspection.

6. Do not hesitate to use a camera to photograph conditions needing correction. This important tool may, upon occasion, produce startling results. You should be as eager to take photos indicating good conditions. As stated previously, you should have the whole-hearted cooperation of supervisory personnel on such a venture.

7. Whatever the inspector puts in writing, he should be willing and eager for anyone to review. When writing up the results of an inspection with recommendations, the inspector should:

a. Clearly identify the location, operations and equipment involved.

b. Explain clearly and fully the action suggested.

c. Back up each recommendation with authoritative statements on the potential hazard.

8. He should be properly dressed. He should be provided with the proper personal protective equipment (goggles, hard hats, safety-toed shoes), to indicate he sincerely abides by previously established safety regulations.

9. His own individual habits should be above reproach—on and off the premises. He should lift properly, walk down stairs properly, and drive properly. In short, he should exemplify all that is good in man.

The principle we should never forget is that through our observation and action while making inspections, we help to control a situation which might cause an accident.

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REMOVING THE HAZARD FROM JOB AND PLANT

By T. A. KRAKLOW
Director of Safety, Deere & Co., Moline, Ill.

A safety program can be an important function in any manufacturing, industrial, or business enterprise or it can be one that gets dropped out of the budget because it has not been aggressively applied.

A safety program can be a slick looking book with an imposing cover full of loose-leaf pages of procedures; but the actual carrying out of the functions of a safety program, embracing all management and staff personnel in an organization, is what really makes a working program.

A workable, down-to-earth safety program must have as its primary objective accident prevention. A good accident prevention program covers the investigation and correcting of all hazards that can cause accidents to men, machines or materials.

An ideal accident prevention program must incorporate in its administration all: production operations, equipment, practices, and personnel. It must also include standards for: safe design, purchase, guarding of machinery and equipment, operating practices, safety rules, safety policy dealing with specific problems, investigation of accident reports, and correcting hazardous conditions.

The field of accident prevention that has been in many cases neglected and badly handled has been the guarding of machines and processes . . . in some cases, merely calling the hazard to the attention of the operators and then expecting them to work safely.

Although safety programs are intended *for people*, they are not *of the people* or *by the people*. The significant accident rate reduction in industry is attributable to an aggressive management, improved design of equipment, buildings, processes, operations, and more expert supervision than it is to a sharper attitude on the part of employees. Human beings are subject to impulses that make them do things that, if they had time to analyze they would not do. Industrial accident losses cannot be controlled by relying on employees thinking of safety first. Hazards must be controlled by redesign or guarding.

Accomplishing this purpose depends on pre-planning for safety, taking into consideration the characteristics of people. We need to know something of human limitations and behavior attitudes resulting from environmental conditions. We need to design better today than we have in the past in order to overcome the potential safety weaknesses due to the faults of people. Machines and environments are what we, as management people, make them. They can be built for safe use once we are able to design them to meet human requirements.

The subject of preventing accidents cannot be approached from an after-the-fact angle . . . after the accident, after the man has been injured. We need to investigate the accident and make recommendations; we have to talk accident prevention. We have to prevent those accidents that do not necessarily injure people—the close shaves, short-cut procedures, loose operating practices—yet result in damage to equipment or material. Too often we tend to say that unsafe working practices of employees or disregard of instructions are responsible for a great many accidents. But one needs to dig into the records to find out what went wrong, what caused the injury or the accident in the first place.

We need to get familiar with the standards that apply to various situations, to guarding of machinery, ladders, industrial trucks and many others. A good source of information is contained in the National Safety Council's 4th Edition of the Accident Prevention Manual. Not only does it carry facts regarding safe practices to follow, but it lists various A.S.A. standards that cover specific safeguarding requirements of the items just mentioned and many more. The Manual is usually referred to as the "safety man's Bible."

True investigation of accident reports will reveal that many so-called operator errors leading to accidents have actually been caused by faulty design or construction, poor housekeeping, operating practices, lack of standardization or identification which trap the operator into making a mistake. Think of

accident prevention as the only way to handle killers and spoilers (which is what accidents are). The development of safe working conditions involves procedures that go beyond the safety appraisals or search for such obvious hazards as oil spots on the floor, electrical wiring, or a pinch point on a new lathe.

Some of the factors that are involved in making working conditions safe are unguarded pinch points, not enough clearance, flying objects, dust and fumes, flammable materials, chemicals, crowded work space, poor lighting and other hazards of this type. We have to look at the hazard from this standpoint—can it be guarded? If guarded, they are eliminated. Can they be re-engineered? If re-engineered, then they are either eliminated or reduced.

Be cautious of the first answer that pops into your mind. Sometimes it is not the right answer. For example: the Steering wheel knobs caused a thumb injury when a tractor struck an object on the floor, so knobs were outlawed. One month later, the Operator split his hand severely between the index and second finger when a wheel struck an object on the floor. Actually a better job of housekeeping and control of the height of castings allowed in the tote box should have been instituted.

A safety hazard is anything capable of causing an injury to an employee. In order to recognize hazards one needs to study the movement of machines and the working environment and pick out the hazards as they exist in the various locations. Recognizing hazards breaks down into about ten general categories. By thinking about and looking for these ten, it is possible to analyze a situation and pick out the areas that need attention. This approach can be compared to a ball bearing on a shaft, well oiled to give long life. The shaft represents an accident prevention program—a workable aggressive one. The inner race is investigation and correction of the hazards, and there are ten ball bearings to keep the entire unit running smoothly.

1. Rotating—Hazards created by rotating machinery, i.e., catch points (set screws, keys, extending from rotating shafts), run-in points (in-running rolls, chains, gears, pulleys).

2. Crushing — Hazards created by two objects that come in close contact with one another (traversing machines, clamping fixtures, dies).

3. Shearing—Two objects, close enough when they pass one another to cause shearing action to fingers, hands, feet, legs or body (shears, dies, cutters).

4. Objects—Four types under this heading:
   a. Flying objects (coming from machines or work processes).
   b. Falling objects (from overhead or from various levels causing injury to head, body, or parts of the body).
   c. Sharp objects (castings, parts or material having sharp or pointed surfaces).
   d. Heavy objects (heavy or unwieldy items that cause injury if proper lifting methods are not followed).

5. Power—Air, electric, hydraulic, steam, which require interlocks, fail-safe features, location of controls, operating sequences, all considered in their installation and operation and maintenance.

6. Housekeeping—Everything in its proper place around the work area and in the plant in general.

7. Lighting—Accidents are caused by poor or insufficient light (fixtures clean, no dark spots to cause an injury).

8. Slips and Falls—From different levels or same level (ladder, railings, scaffolds, oil, grease, ice).

9. Poisons, Flammable — Work processes involving storage, handling, or use that would constitute health hazards to employees or fire hazard to plant and personnel.

10. Dust and Fumes — Work processes where inadequate ventilation or not following standards for aire borne contaminants constitute a health hazard.

The ball race holds the ten important hazard balls in place. This ball race represents:

1. Involve Staff (interest and support).
2. Training (of staff and employees).
3. Observing (plant operation to determine hazards).
4. Correct (hazard guarded—is eliminated) (Attitudes—changed or influenced).

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When a safety hazard exists it must be taken for granted that accidents will happen unless provisions are made to control the hazard. By mentally placing an employee in the picture with his impulses, attitude, and behavior pattern, and then reviewing the ten hazards illustrated by the ball bearings, one can then decide what corrective steps to take in order to eliminate the hazard.

Accident prevention is an operating problem requiring constant supervision over equipment, processes and people. Any business staffed to operate efficiently has personnel capable of coping with accident causes if proper attention is given to the problem. Remember, the only way to handle the killers and spoilers is to take aim at the target, "accident prevention," aggressively, to investigate, correct and keep informed.

SAFETY EVALUATION OF A NEW INDUSTRIAL PROCESS

By ARTHUR H. CHRISTIAN
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Philadelphia, Pa.

Make no mistake about it! If we are going to prosper, if our way of life is to proceed as is and to progress at the present rate there will be many new industrial processes to evaluate for safety. And safety must *be included!*

Consider the numerical increases alone that must be made in rather commonplace things like food and the physical comforts of life, if we are to cope with or provide for our population explosion. It is estimated that the world's population is growing at the rate of five thousand per hour, and if unchecked, will cover every single foot of dry land on earth by 2960 AD. Consider our technological explosion, which unquestionably will add to the presently "unknown" for safety evaluation. New chemicals seem to be growing exponentially; some have estimated that there is a new chemical every 24 minutes.

Indeed, the demands for accident prevention knowledge for the future are staggering. Add to the ventures that can be foreseen, such as space exploration, those as yet undreamed of, with all their ramifications—safety included, and the total is impressive.

As now, there will continue to be a wide range of hazards and causes of accidents. Consider two recent well-known examples. On the one hand, we have disasters from minor and well-recognized causes—the death of at least seven infants as a result of confusing sugar and salt (identical in appearance and kept in containers located on the same shelf and probably unlabeled) in the preparation of their formula. On the other hand, we have the more subtle and unpredictable causes from incomplete safety researching, such as the deformations of newborn children from the use of certain drugs.

These examples illustrate several basic points. One is that we will still have major industrial and non-industrial accidents, disasters, loss, and injury from the *simplest* of *causes* and from the most *predictable* of *reasons.* As our civilization becomes increasingly more complex and our processes more exotic and sophisticated, undoubtedly we must increase our efforts to ascertain and evaluate the more subtle potential accident causation factors, at the same time, more effectively safeguarding existing hazards.

It is impossible to imagine that out of all the "big science" underway these days, there won't be many break-throughs that will benefit and further safety, directly and indirectly. However, we'd better not wait around for revolutionary break-throughs in life sciences that will change man's attitude

toward and participation in safety. We'd better push ahead full steam using safety engineering and safety evaluation for the effective safety problem solvers they are. One thing is certain—we can't afford to sit around waiting and praying.

Certainly, there is much literature aimed at helping you evaluate new processes for safety hazards. Much of it is worthy, all of it is time consuming, and little of it can be remembered. I will endeavor to offer a broad outline, suggest some highly pertinent principles and discuss some specifics in the safety evaluation of a new industrial process.

Motivate Management—Get a good organizational setup backing. Although it seems redundant, if safety evaluation of new processes is going to be more than spinning of wheels and really lead to good solid progress in accident prevention, top management must be thoroughly behind the concept and insure that a proper organizational setup will smooth the way. Obviously this will vary widely, depending on the size of the business, the type of process and the hazards associated with it, and even the nature of the process.

Start Early—However, for maximum or even optimum effectiveness the safety engineer must be consulted and participate in all evaluations early in the game, preferably from the very beginning.

Coordinate—Although there may be various disciplines or vested interests involved, such as industrial hygiene, health, fire, or medical, someone certainly should coordinate or be assigned the responsibility for coordinating all the accident prevention or loss prevention activities. The safety engineer should shoulder these responsibilities and often does.

Be an Activist—Probably most important of all, something should be done with brisk energy and dispatch after the safety evaluation, either to eliminate the known or predictable hazards, or to adequately safeguard all personnel from them.

Safetize Sources — Insure a safety conscious research and development, for example. The whole safety evaluation can be accomplished in a thorough and yet easy fashion if the research and development organization (or whoever develops the new process, it may be purchased from another company) is thoroughly indoctrinated and oriented in accident prevention. Not only will they have the benefit of safeguarding themselves as they work towards the creation of new processes, but it probably is axiomatic that safey will be incorporated into the new process to a much greater degree. For example, if there is a choice between a highly toxic or highly flammable solvent and one with a much greater latitude of safety, they probably will use the safer material early in research or development operations and not have to repeat work later on to accomplish such a desirable objective.

Evaluate Gross Hazard—The gross hazards—the most extreme possible anticipated disaster, the safety parameters of the new process—should be evaluated carefully, thoroughly, completely, imaginatively, and systematically. Upon such evaluation will rest important decisions, such as location: whether the plant can be within the city limits or should be in the country; whether it should be quite isolated or can be in the middle of a producing plant; whether or not it should be operated by remote control; in fact, this may decide whether it is economically feasible to attempt to build such a plant.

With increasingly exotic and sophisticated systems, coupled with greater restrictive legislation, it is most important to comprehensively evaluate, in addition to gross toxic or injury hazards to the people operating the plant or explosion hazards to the neighbors, other important aspects like atmospheric or stream pollution, and product hazard. There are an increasing number of different people with wide ranges of vested interests who must be satisfied, ranging from the insurance companies to municipal, state and federal authorities. New procedures may be necessary.

Consider chemical processes. Our Chairman, Mr. Albisser, together with Len Silver of the Merck Technical Staff, presented a thoughtful and effective procedure they developed for preliminary screening of new chemical products, intermediates and raw materials for hazard evaluation before an American Chemical Society safey symposium. This was published in *I & EC*, November, 1960, Vol. 52 No. 11 and reprinted on the October, 1961, National Safety Council Chemical Section Newsletter. Briefly, it outlines a procedure for testing small quantities of the reaction materials, the

intermediates or the products to determine their sensitivity to decomposition, runaway exothermic reactions or other undesirable characteristics.

Fairly simple tests were devised and are used. These include dropping the material on a hot plate and noticing whether it decomposes with a pop, a bang or relatively quietly; and a simple melting point apparatus test to see if there is any evidence of unusual activity as it melts and especially if there is a temperature rise suggesting an unexpected exotherm.

Further tests were devised to determine the minimum temperature at which any exothermic reaction will proceed to a measurable extent under reasonably adiabatic conditions. These last tests are run by remote control in a barricaded area. One involves heating in a sealed tube. The other is a larger sample heated in an open Dewar flask equipped with a quartz electrical heater and a vibrating stirrer. Rate of temperature rise is noted and often reveals surprising and unexpected sensitivity.

If any of these tests indicate possible extreme sensitivity, it usually is wise to have more detailed and exhaustive tests conducted by consultants or laboratories that specialize in determining explosive potential. Use is made of the facts that most, if not all, hazardous reactions involve rapid exotherms and that the rates of all reactions increase with temperature. Hence, by testing for exotherms at temperatures well above the expected operating range, it is possible to uncover potentially hazardous conditions which would be missed by testing in the laboratory in the expected range.

The important point is that the safety aspects of the chemical reaction, the chemical materials, has been as thoroughly researched as the product and process themselves; as thoroughly as the elucidation of the formula and reaction mechanism; as thoroughly as possible toxicity on users, as thoroughly as market research to establish use and market potential. A need existed for a systematic and routine approach to this type of evaluation, and a procedure was devised. This technique might well reveal surprising potential for great loss in processes that have been operated successfully, safely, and uneventfully for years; it has in known cases.

Still considering chemical processes, the hazard potential of many other variables should be considered. In some cases the literature will provide answers; in others, actual tests may have to be run. Here are typical areas:

—Flammability characteristics of materials, including raw materials, intermediates, final product, flash point, explosive range, auto-ignition temp.

—Toxicity of same.

—Safe parameters of such important variables as temperature, pressure, PH, holding times, operating procedures—both simultaneously and sequentially. Effects of excess or deficiency of one or more reactants; change in order of, addition of reactants; contamination by other chemicals, such as might be used in cleaning associated equipment; utilities failure, such as power, vacuum, air, cooling water.

Follow Familiar, Known, Sound, and Proven Paths—Apply known safety standard and codes and known safety solutions to accident problems. If we are to avoid inventing the wheel over and over again as the newer processes are evolved, we certainly must start from a higher plane or level each time in our safety engineering or accident prevention activities. Municipal, state, and federal codes must be met as a minimum standards, an indication of a progressive company when the company standards in actual application are better than such minimums.

Hopefully, all these will be automatically incorporated in original plans; if they are not, the safety evaluation is going to be a real job for the safety engineer. Not only will gross hazards that may even be unsuspected have to be sought out and evaluated, but the nuts and bolts that cause so many of the garden type variety injuries will have to be dealt with—falls, cuts, 110 volt electrocutions. As a principle, it is well to assume little—take nothing for granted. Be painstakingly thorough; no detail is too small to consider. Accident prevention usually is achieved by hard work and good judgment in the application of knowns: stair standards; National Electric Code; fail-safe instrumentation.

Consider the Future—Insure that the process will be safe and happy to live with

after the "new" has worn off. For example, insure that there is adequate head room, adequate space for all degrees of operation whether the process is nicely on stream or in real trouble. Insure that there are adequate working surfaces and access to them for both production operations, quality control and sampling operations, as well as maintenance operations.

One of the best approaches to achieving this sort of environmental safety is to go through a classical job safety analysis. This procedure uncovers hidden hazards that well might not be realized until after an accident or injury. Usually in the planning stage a three dimensional model will be of great help. After the process has been in operation for a reasonable time—six months to a year, it would be well to repeat the job safety analysis. In this fashion it could enlist the active cooperation of employees and establish very valuable two way communication and active participation in safety. Very often there are also gradual and insidious changes in equipment and operating procedures that set the stage for a major disaster or episode.

By the same token, it is all too easy for highly dangerous materials to be introduced into maintenance or rehabilitation. For example, certain plastic systems for pipes, ducts, tank linings, etc., with many fine qualities require methyl ethyl ketone peroxide as a catalyst. Too few plant people are fully aware of the fire and explosion hazards that may be unknowingly introduced into the plant.

Document Well—Insure that there is a complete detailed process writeup with the necessary safety actions incorporated and not something apart. Safety must be included at the logical spot—not as an afterthought. Insure that all procedures for handling both routine operations and emergency operations are agreed to and documented. For example, if personal protective equipment is necessary as a second line of defense, insure that it is spelled out in the process writeup. Secondly in the event of an accident, there should be all reasonable provision for either preventing or minimizing injuries and loss. This, of course, would include fire fighting equipment, explosion venting for either solvents or dust.

Train Early and Thoroughly—For smoothest possible start up and best success, from a safety performance standpoint as well as an economical and competitive standpoint, operators should be trained at the earliest possible moment and as thoroughly as possible. It is not enough to be told to be safe; they must be given skills and techniques as well as have their attitudes influenced in the direction of safety. In other words, their safety morale must be boosted, their safety awareness and safety conscientiousness both tuned and increased.

This is, of course, easy to say, but much more difficult to do. Without question, the time, effort and money spent on thoroughly acquainting the workers with all aspects of hazards and how to either eliminate or to control them, or safeguard themselves, is a valuable investment in accident prevention.

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HEALTH PROTECTION IN NEW MANUFACTURING FACILITIES

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and

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It appears unnecessary to extol the virtues of the practice of building into new manufacturing facilities all necessary health protection for employees. Instead, we have elected to describe, in some detail, an example within our company of the combined emphasis by engineering, production, safety and health specialists on the review of potential hazards during planning and designing stages of a new production facility. The role of engineering models during planning, design and construction and during the training of new personnel is also demonstrated.

Of all inorganic chemicals, chlorine ranks among the top five in terms of tonnage produced annually. The 1962 review of the chemical industry, which appeared in a September issue of *Chemical and Engineering News*,[1] indicates that the U. S. estimated capacity of the production of chlorine was nearly 5 million tons per year as of January 1. *Chemical Week*[2] has reported that additional capacity of 350,000 tons per year is under construction and that by 1967, available capacity will approximate 6½ million tons per year.

The major use of chlorine is in the manufacture of other chemicals including chlorinated solvents, pesticides, bleaching agents, and plastics. Thus, in spite of the volume of chlorine manufactured and handled, potential exposures to chlorine per se are concentrated in the chemical and chemical process industries.

Chlorine is produced predominately by an electrolytic process. The process may employ fused salt cells, diaphragm cells or mercury cells. The latter type appear to be growing in popularity, as indicated by the types of plants now under construction. It is estimated that two thirds of the capacity being added will use mercury cells, whereas, as recently as 1960, such cells accounted for only 18 per cent of the chlorine produced. Of 31 existing plants in the U. S., Canada, and Mexico using mercury cells, 25 per cent employ the DeNora mercury—amalgam cell, one of nine different types of mercury cells and the type which is involved in our discussion today.

You will recall from chemistry laboratory experiments, that when an electric current passes through water, the water molecule is dissociated into hydrogen and oxygen. Similarly, in the electrolytic production of chlorine, a brine of salt, i.e., sodium chloride in water, is subjected to an electric current passing through it, with dissociation of the sodium chloride to release chlorine. As in the case with water, the electrically positive component (sodium) is attracted to the negative electrode (cathode), while the other component (chlorine) collects at the anode.

In mercury cells (of which DeNora is one), the cathode I spoke of is a thin film of moving mercury metal. The sodium, upon collecting at this cathode, immediately forms an amalgam with the mercury, and flows from the cell in this metallic form. The sodium amalgam is subsequently subjected to an electro-chemical reaction in a decomposer with the resulting formation of sodium hydroxide or caustic, release of hydrogen, and a return of the mercury to its pure metallic state. Although in the above we have referred only to sodium chloride and sodium hydroxide of caustic as a by-product, the feed brine in the process may be potassium chloride with the production of potassium hydroxide as the by-product.

In the Monsanto plant I referred to, the raw materials include sodium chloride and potassium chloride, and in one sense, electric power. Necessary to the process, yet neither a catalyst nor used up as a raw material would be, is mercury. The final product is chlorine with sodium hydroxide or potassium hydroxide as a major by-product and with hydrogen usually considered an incidental by-product.

In comparison with many raw materials in the chemical industry, sodium chloride, potassium chloride or their brine solutions present no significant health hazards. Similarly, the sodium or potassium hydroxides as by-products present no significant toxicity problems although obviously skin contact with concentrated solutions must be avoided. The explosive character of hydrogen is a major safety consideration while any potential physiological effects of hydrogen inhalation are insignificant. From a health standpoint, we are thus concerned with two major chemical entities, namely, chlorine and mercury.

At ordinary temperatures, chlorine is a greenish-yellow gas with a pungent irritating odor. In either liquid or gaseous state, it is non-flammable and non-explosive. It reacts readily with many chemical elements and with a number of organic and inorganic compounds. In the animal and human body, chlorine is a primary irritant gas that affects the eyes, upper respiratory tract and deeper lung structures such as the bronchi.

The least detectable odor of chlorine has been reported as 3½ parts per million (by volume in air).[3] Four to five parts per million become unpleasant after about one-half to one hour exposure. Fifteen parts per million is sufficiently irritating to cause coughing. The Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists for an eight hour day exposure is one part per million.[4]

Careful examination of workers exposed daily to "detectable" concentrations, which presumably are between one to three parts per million, has reportedly shown no chronic systemic effects. Prolonged exposure to excessive concentrations is quite unlikely because of the irritation that would accompany such an exposure. Only when individuals are accidentally exposed in such a manner that they cannot escape high concentrations is serious injury due to the inhalation of chlorine likely to occur.

Unlike chlorine, mercury may cause chronic effects. Also unlike chlorine, the presence of mercury vapor in the atmosphere cannot be detected by sight or by odor. Perhaps many of you recall the "mad hatter" in Alice in Wonderland. Perhaps fewer of you are aware that this term was reportedly derived from the symptoms of mercury poisoning which developed in hat makers when metallic mercury was used in the manufacturing of fur felt for hats. Although excessive degrees of chronic exposure in the past have resulted in cases of nervous and psychic symptoms, recognition that excessive exposure must be avoided has led to safe usage and handling in recent years.

The Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists is 0.1 mg of mercury per cubic meter of air.[4] As in the case with all threshold limit values, this represents a guide for eight-hour daily exposure. Comparison of actual plant concentrations with this value must take into account length of exposure, as well as vapor concentration.

To our knowledge, the medical and technical literature has never reported a case of acute or chronic mercury effects related to exposures in mercury cell production of chlorine. Measures to prevent exposure, such as described in this paper, may be given considerable credit for this favorable experience.

The heart of the DeNora process may be considered the DeNora cell itself. The size varies with the amount of Cl_2 to be produced. Typically it is a rectangular trough, approximately 50 feet long, 7 feet wide, and 14 inches deep. The bottom of the trough slopes about 2 inches from one end to the other and is lined with concrete grout and covered with an impervious, non-reactive plastic surface. The slope is provided to allow liquid metallic mercury to flow from one end of the cell to the other serving as the cathode in the electrolytic system. The top of the trough has a cover of suitable plastic material, usually two or three ply natural and synthetic rubber, through which protrude graphite rods supporting horizontal graphite anode plates.

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At each end of the trough is a box with removable covers, which is connected to the electrolysis chamber by a submerged weir with clearance running the width of the trough bottom so as to form a mercury seal. When the cell is operating, mercury is pumped from the mercury well into the box at the upper end of the cell. It flows down the trough spreading over the entire bottom to a depth of approximately ⅛ inch. Wash water flows continuously into the upper box being excluded from the cell by the mercury seal at the weir. This wash water drains from the box through an overflow above the mercury surface.

Salt brine flows by gravity directly into the cell and flows concurrently with the mercury at a controlled brine depth. The sodium-mercury amalgam flows from the cell to a vertical single stage decomposer. This is a lined steel tower approximately three feet in diameter and ten feet high filled to a depth of about six feet with graphite lumps. A countercurrent stream of softened water enters the decomposer at the bottom, rising through the mercury stream and leaving the top of the decomposer as 50 per cent caustic solution. Mercury flows from the decomposer into a pump tank below the cell, from which it is recirculated to the feed end of the cell for another cycle of flow.

A typical DeNora cell contains several thousand pounds of mercury. This heavy liquid, which boils at 357.3 degrees Centigrade, has a vapor pressure of 4.07×10^{-3} at 30°C.[2] This vapor pressure at ambient temperatures is such that a number of measures have been developed to minimize any possible exposure. Perhaps the most important of these are good housekeeping and handling practices which include:

1. The use, storage, and handling of mercury in closed systems or containers;
2. Avoidance of spillage and leaks and immediate clean-up of any spills;
3. Maintenance of a layer of water over the surface of the metal, recognizing that this tends to reduce the vaporization of mercury, but does not prevent it.

To insure that prescribed handling practices and procedures can be adopted with reasonable ease, the design and use of appropriate construction materials are important. To back up good practices and good construction, adequate mechanical ventilation, local exhaust, general exhaust, supplied air or any combination thereof may be provided. We have attempted to tie together and demonstrate the application of all these health protection features of a new production unit.

Exterior of Cell House—Seldom is a single DeNora cell used, although a single modern cell may produce more than seven tons of chlorine per day. A cell house to accommodate batteries of cells of 20 to 50 or more is the usual custom. The construction of a typical cell house shows a trend in industry toward use of newer colorful synthetic construction materials, such as corrugated asbestos siding and shatterproof fire-resistant or non-flammable plastic panels for exterior lighting.

De-chlorination Area—An important part of the process which has not been mentioned up to now is the "de-chlorination" section. The depleted brine flowing from the discharge end of the cell is saturated with chlorine. This is removed in a ceramic aeration tower and collected. Perhaps we should mention here that although this presentation is not intended to include safety considerations per se, it is impossible in chemical operations to divorce safety and health aspects. Protective hand rails, toe plates, ladder cages, etc. are used around the tankage in the de-chlorination area.

Cell House Interior—If you were inside the cell house, you would note the artificial illumination and light transmission through the plastic panels. A longitudinal view of a DeNora Cell shows the bottom surface covered with mercury. This is a test made on each cell after completing the finish of the cell trough floor. It is run to insure that before the cell is placed in operation, mercury flows properly from one end of the cell to the other, spreading completely over the cell floor. A view of a cell with the top cover and graphite electrodes in place would show a walk-way between adjacent cells.

In describing the cell earlier, we mentioned the inlet and discharge boxes at the ends of the cell. Removing a portion of the cover of the inlet box would show the local exhaust connection which keeps the box under negative pressure and thus prevents the escape of mercury to the atmosphere. The covers of the discharge boxes may also be removed for inspection and sampling.

Ventilation—Returning to a close-up view of the cell model mentioned earlier, the duct work providing ventilation to the cell house should be pointed out. This is the feed or inlet end of the cell and includes the decomposer and mercury pump tank. The large duct work is made of glass fiber reinforced polyester. The large ducts supply air to the cell house; the small one is part of the local exhaust system which is connected to the cell end box and the mercury pump tank.

The cell room ventilation system is essentially a forced draft system consisting of vaneaxial supply blowers with individual ducts and diffuses, and secondly, powered roof ventilator exhaust fans, as well as continuous ridge type ventilators. This system was designed to give a sufficient number of air changes per hour and maintain levels of mercury vapor below the Threshold Limit Value.

The vaneaxial fans are located at the ground floor level of the rectifier building. Essentially, this area will serve as a plenum chamber with fixed inlet louvers located in three exterior walls. At each louver, tempering coils are installed to heat the incoming air during winter weather. The supplied air duct with the adjustable diffusers to insure balanced air flow uses no metal dampers. The diffusers for slot discharge may be rotated about the circumference of the duct, making possible appropriate outlet air velocities.

We have mentioned earlier the use of appropriate materials to facilitate housekeeping. Certain features of the ground floor construction of the cell house facilitate pick-up or removal of any accidentally spilled mercury. Perhaps you are aware that liquid mercury on the surface of any semi-pervious material will penetrate that material in minute droplets. In mercury cell house construction, all lower floors are unsatisfactory unless the surface is such that mercury cannot collect in depressions and cracks and penetrate into the concrete.

Secondly, all floors are pitched or sloped to trenches, all sloped to one or more sewer connections. Just ahead of the discharge to the sewer is a trap for collecting any spilled mercury for recovery. It is common practice to maintain a flow of water in all trenches. Immediately after a spill, water hoses are used to flush any mercury to the trenches and then to the mercury traps. Footings or supports for equipment stand on an unbroken concrete floor with all corners rounded so that spilled mercury cannot accumulate in the corners or cracks.

This discussion would not be complete without pointing out that the operators of a cell plant do not spend all their working hours in the cell house proper. Part of their time is spent in control rooms detached to one degree or another from the cell house proper. In our case, the control room is separated from the main cell room by a solid partition and door. This is located on the midfloor level with the stairs going up to the control room from the ground floor level. The door to the cell room is off the landing and to the left. This room will have its own air conditioning system independent of the air supply and exhaust system for the cell room. It will be typical of the many modern instrumented, clean, bright control rooms pictured in so many technical and popular publications.

We indicated earlier that mention would be made of the use of models in training new employees. Although the models in this case are rather simple, the part that these play in describing new operations to new employes should be obvious. Like many companies in the chemical industry today, in Monsanto exact scale models are used not only for design purposes but for training. In new site construction, a dozen or fifteen such models may be built, representing the multiple production units to be built on the site.

In the time allotted for this discussion, we have attempted to highlight the provision for providing health protection from chemicals in a specific chemical operation. The details indicating the timing or reviews in the planning and design of new facilities cannot be covered in such a short period. For similar reasons, we have omitted reference to air sampling and preventive medicine programs, which play an important part in exposure control once a plant is built and operating.

Upon completion of this particular project, it is hoped that a more technical publication, showing the detailed collaboration by production, engineering, safety and health personnel, will be possible. It is necessary only to point out that this presentation would have been impossible without the assistance

of appropriate design, engineering and safety specialists within Monsanto. Any success in building health protection into this new facility has resulted from a "team" approach, featuring frequent review of objectives prior to the development of plans on the drawing-board and subsequent frequent examinations of models which have assisted tremendously in selecting and properly locating protective measures and equipment.

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VENTILATION IN PLANT DESIGN

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Planning ventilation for plant safety would seem to infer a need for a high order of team work. Never has there been a greater need for this approach. The evolution of the modern plant has been evidenced by greatly increased heat loads and the use of thousands of new chemicals and processes, a large number of which have introduced new hazards which have to be controlled in order to provide safe and healthful working conditions for the employees. For these reasons it is not uncommon to find plants through which 3 to 5 million cfm of air must be circulated in order to maintain the desired conditions.

It should be kept in mind that, in the high production plant of today, ventilation is no longer a luxury. It is a necessity and, in many cases, an integral port of the production system. Without these ventilation systems many plants could not operate safely even for a very short time. In others, walkouts or work stoppages would occur or, at best, work could be carried on only under difficult and temporary conditions.

On most jobs, the ventilation engineer must work closely with the representatives of management, production, safety, industrial hygiene and the other engineering and architectural groups, in order to be reasonably sure of designing safe, effective, economical systems.

A starting point in the design should be the review of the objectives of the systems. These might be defined as follows:

1. To collect contaminants, such as fumes, dusts, mists and heat, at the source.

2. To provide the necessary exhaust systems to remove these contaminants safely, and to provide supplementary building ventilation.

3. To clean the effluent within practical limits by means of filters, collectors and scrubbers.

4. Where recirculation is not safe or feasible, to discharge the effluent to the outside in a manner which will minimize neighborhood nuisance and air pollution.

5. To provide supply air ventilation for needed makeup, and to control the environmental conditions of temperature, humidity and air motion. In addition, the ventilation must provide control of the building pressure and thus assure safe entrance conditions at doors, and air flow from clean to contaminated spaces.

6. To do all of the foregoing in an efficient and economical manner.

Building and Process Design Considerations

Duct work and ventilation equipment takes up a great deal of space, and must compete for space with the process equipment, piping, conduits, lighting, structure and other utilities and equipment. Adequate provision must be made in the plant for all of these facilities. By the same token the ventilation systems and duct work should be carefully designed to keep them to the minimum consistent with plant needs.

In addition, we must consider the following:

1. Ample ceiling height must be available to permit the runs of duct work, and the proper connections to hoods.

2. In crane areas, space may be required between the rails of adjacent bays to permit the runs of ducts up and down. Where this is not possible, it has been necessary to use basement or underground ducts.

3. Great care should be taken to insulate hot surfaces, where possible, and to shield others in order to make tenable the heat loads imposed on the workers. High heat loads require large volumes of ventilation air to offset them. Where radiant heat is a problem, ventilation is an ineffective solution.

4. Building roof vents, usually integral with ventilation openings, should be considered for fire protection by heat-release. The NFPA Handbook can be consulted for the desired areas of vent opening.

5. Fire zones must be defined so that it will be possible to design the duct work with a minimum of penetrations through the zone limits.

Hood Design Considerations

In a great number of plants, the exhaust requirements for the hoods will set the ventilation rates. Therefore it is of the utmost importance that the minimum number be used to do the job, that the hoods enclose the source of contaminants to the greatest possible extent, and that the minimum practical face velocities be used. Safety must not be compromised however. About a 10 to 20 per cent excess volume may be necessary, particularly on small systems, to allow for varying conditions of dirt loading, wind conditions, and slipping fan belts.

There are hundreds of hood designs that can be used. The one selected should fit the job to be done. Detailed information on the subject is contained in the Industrial Ventilation Manual, published by the American Conference of Governmental Industrial Hygienists. Frequently hoods will be furnished by the manufacturers of machinery. The performance of the hoods may be acceptable in some cases. Many others will be inadequate and unsafe.

Check all hoods supplied with machinery to be sure that they will do the required job. The machinery manufacturer may be the best in his line. But that does not make him a hood expert. Besides which, air flow has always been a great mystery to machine designers. Early planning and close cooperation between the machinery and ventilation design engineers will result in better hoods and will permit better, more complete enclosures (frequently integral parts of the piece of equipment), which will provide economy in exhaust.

The design of laboratory hoods is also pertinent to this discussion. Particularly so because of the continued building of many new laboratories and the extensive use of these types of hoods in plants manufacturing pharmaceuticals, and electronic and precision components. Initially some agreement must be reached on the proper hood face velocity. This is subject to a great deal of personal opinion, and properly so. There is no universal face velocity which will be acceptable for all hoods and operating conditions. Table 1 indicates suggested values for a range of applications.

TABLE 1

Hood Face Velocities

Theoretical Minimum Capture Velocity	30 FPM
Desirable Minimum Capture Velocity	50 FPM
Recommended Face Velocities (Average):	
1. Control Laboratories or similar spaces having low toxic levels and nominal hazard	50 FPM
2. Most Research Laboratories having wide latitude of chemical use — must handle range of toxic requirements	
—Minimum	65 FPM
—Desirable	75 FPM
3. Low level radio - chemical hood having nominal toxic hazard	75 FPM
4. High toxic level hoods, radio - chemical hoods in warm range	100-125 FPM
5. Radio - chemical hoods at high toxic levels*	100-250 FPM

*In such cases, glove boxes, shields and total enclosures may be indicated. It is not believed practical to apply the higher velocities to the large laboratory type hoods requiring large quantities of air.

These values must be modified by the engineer's judgment as to the control efficiency of the hood. If we assume that 50 fpm is a safe control velocity for a particular condition and we could design a hood with

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absolute flow uniformity at the entrance, hen a face velocity of 50 fpm would be acceptable. But nonuniformity of flow exists, and if the actual velocity at the top of the entrance must be 200 fpm in order to develop the minimum of 50 fpm at the shelf, then the average face velocity must be much higher, perhaps 100 fpm. We should strive for a design which will provide hood entrance uniformity and will conserve on the exhaust requirements.

There are other important factors to consider:

1. Use shaped inlets to the hoods. This provides good flow into the hood and will prevent fumes from being brought to the front of the hood by the negative eddy zones at the sides and shelf. It has been determined that fumes are unlikely to be drawn out of a hood if they are more than 6 inches back from the entrance.[1]

2. Use slotted, perforated or filter type baffles at the back of the hood to improve uniformity of flow. It is my belief that the baffle should be straight (not tipped forward at the top) to take exhaust from the back of the hood. Also, it should be fixed in position after testing to determine the correct slot or other exhaust opening positions for the desired flow. Top and bottom baffle adjustments invite tampering and I have observed many hoods where one or both of these were closed. Design for about two thirds of the exhaust from the top and ne third from the bottom.

3. The design must be such that scavenging air is always admitted to the hood. This can be a door operated bypass opening at the top, a safety door stop at the bottom (which is preferred for vertical doors), or a horizontal sliding door arrangement which does not permit complete closure.

4. Multiple door design using either vertical or horizontal doors will save a great deal in required exhaust volume. The horizontal doors are best, and are increasingly popular because the hood entrance can never be opened fully, and a door can provide a shield for the operator.

It should be kept in mind that there is no such thing as a completely safe open front hood at any practical face velocity. Table 2 helps us to understand why this is true.

TABLE 2

Velocities Pertinent to Hood Design

Walking Speeds:

1	Mile	Per	Hour	=	88 FPM
2	"	"	"	=	176 "
3	"	"	"	=	264 "
4	"	"	"	=	352 "

Critical Velocities in Hood:[2]

Bunsen Burner	
—Difficult to use	Over 100 FPM
—Unscreened Flame useless	200 "
—Flame extinguished	600 "
Fine Powder Disturbed	100-150 "

To assure fume control the minimum velocity at the hood face must exceed the ambient. Note that any walking speed will probably exceed the face velocity. Consequently as a man walks past a hood opening, he will induct a flow of fume out of the hood as indicated by Figure 1. Note also that if the hood face velocity is increased to a high value to offset ambient disturbance,

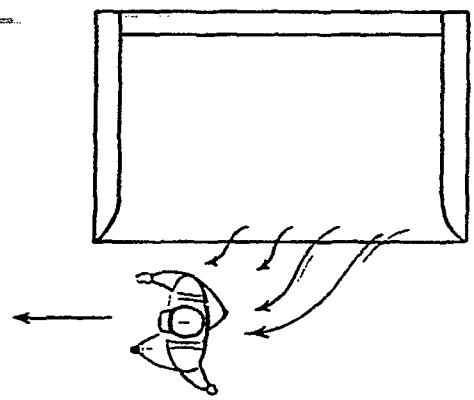

Figure 1

the higher air motion may disturb chemical dust, papers or the Bunsen Burners in the hood.

This makes it evident that it is always undesirable and wasteful to try to offset room drafts by means of higher hood face velocities. By all means possible, prevent the drafts from occurring. This may require more suitable ventilation outlets, such as perforated panels, room door baffles, a relocation of the hood, or baffling of other laboratory equipment incorporating blowers of some sort.

Another safety hazard occurs when a hood operator stands close to a hood entrance. Here he is his own worst enemy, because his body causes downstream eddies which

can bring fumes to the breathing zone. This was amply demonstrated by an operator working with highly toxic chemicals at a hood which had a face velocity well over 100 fpm. It was thought to be a completely safe hood. The operator was rushed to the hospital in critical condition as the result of his momentary exposure. It is believed that the use of a door shield would have prevented this near catastrophy.

Design of the Exhaust Systems

Well designed hoods are worthless without equally well designed exhaust systems. Again, the basic design concepts are well detailed in the Industrial Ventilation Manual. But comments on some facets of the problem are in order. One of our earliest decisions on the duct design must be on material. This problem is important and merits a careful study of the corrosion problem. In many cases black and galvanized steel will be very serviceable, particularly with dust and other non-corrosive systems. In chemical areas aluminum gives excellent service, particularly if moisture is not present in quantity, either initially or by condensation.

In severe cases of corrosion, there has been a general trend toward the use of rigid, fiberglass reinforced plastics, such as polyester, epoxy and furane. These are good but they are also expensive. Including the branch, elbow and other fittings, the duct work, as fabricated, will run about $5 to $6 per square foot. That is per *square foot*, not *running foot*. The plastic furnished should be fire retardant.

The ducts for any system containing moisture (usually from condensation), and this includes most laboratory systems, should be sealed against leakage. This requires welding, soldering or sealing compound for the seams of metallic ducts. But again, a word of caution. Be sure that the gaskets and sealing compounds used are compatible from the standpoints of corrosion and explosion with any chemicals present in the ducts.

A recent bulletin of the Lawrence Radiation Laboratory, of the University of California, notes a case where litharge and glycerine was used to seal fan housings on systems handling perchloric acid fumes. Only four fingers were lost in the ensuing explosion when the fans were removed for cleaning! *Non-organic sealing compounds and gaskets are now recommended.* This incident should remind us that the exhaust systems should be provided with cleanouts in most cases, or the duct work should be removable for complete cleaning.

Several additional precautions in the design of the exhaust systems are worth noting:

1. Locate the exhaust fans in a penthouse or on the roof so that the ducts in the building will be under negative pressure, and leakage will be *in*.

2. The systems should be designed to be inherently balanced, and should have a minimum of dampers. Dampers are a major source of trouble because of dirt accumulations, resulting system unbalance, and the tendency for operators to inadvertently create non-conveying flow by reducing velocity.

3. It is important that good inlets and outlets be provided for the fans. Poor connections can reduce fan capacity by as much as 20 to 30 per cent. At least six diameters of straight duct should be provided ahead of the fan to assure good fan performance. So requisition space for this arrangement in the early design stages.

An early decision must be made on the use of individual or central exhaust systems. The central system is recommended, because of the fewer fans to maintain and the greater ease in providing a single, adequate exhaust stack for the dispersal of the fumes, in lieu of many small stacks. Individual exhausts are required for non-compatible services, such as sparking systems, or systems for explosive dusts or fumes. The perchloric acid incident illustrates the point.

While perusing a laboratory equipment catalog some time ago, this startling statement came to light: "The only force available for moving air through exhaust systems is the atmospheric pressure—at best not more than 14 pounds per square inch of area. Because of this fact, design must hold frictional resistance to the lowest value." This is symptomatic of the kind of thinking that goes into entirely too much of our industrial ventilation design. This insignificant force is all that holds up airplanes and operates many supersonic wind tunnels.

The statement is dead wrong. Fume exhaust duct work should be designed for a minimum of 2000 fpm and it is preferable

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that this be 2500 to 3000 fpm minimum for fume systems, to scavenge condensed moisture from the ducts. Obviously higher conveying velocities must be maintained for all dust or similar systems. At the present cost of sheet metal work, we cannot afford oversized ducts.

The selection of fans for the exhaust systems is of the utmost importance. With few exceptions, these should be heavy duty cast iron or steel plate industrial exhausters having radial or similar impellers. It is difficult to comprehend the logic for spending thousands of dollars on a well designed, safe exhaust system and then compromising the investment by purchasing a light duty utility type fan.

This is not consistent with quality and reliability. Where these light fans are provided with forward-curved vane wheels, the injury is compounded. The small vanes collect moisture and dirt. When this occurs, capacity may fall off as much as 30 per cent and your *safe* exhaust system may cease to be safe. One or two cleanings of such a fan will pay the difference in cost for the proper fan.

Selection of Air Cleaning Equipment

One of our objectives was to clean the exhaust air. The selection of this equipment is not easy because efficiencies vary greatly with the type of dust, and the equipment must meet the requirements of the loading and operating conditions. In many cases, it will be very worthwhile to require laboratory tests of a proposed collector to determine if its efficiency with the actual service dust will meet the air cleaning requirements.

If this sounds overly severe, keep in mind that the air cleaning field is plagued with shoddy equipment which cannot meet recognized standards for efficiency. The vendors of such equipment grow fat on engineers having too much false pride to recognize their shortcomings in the selection of air cleaning equipment.

The A.S.H.R.A.E. "Guide" and the "Industrial Ventilation" manual have excellent information on the types of equipment and their applications. But this does not guarantee the performance of a specific vendor's equipment or media. To provide reasonable assurance of the safe, continuous performance of your systems, seek out the reputable manufacturers. You will find them cooperative in the use of their testing facilities, and in recommending the proper type of equipment and media for the job.

Design of Discharge Stacks

On the exhaust side, our last task is to discharge the effluent to the outside safely in a manner which will minimize nuisance and air pollution. To understand our problem in discharging effluent properly, we need to know something about the flow of air over buildings. This is complicated. Much additional information is needed in the field. What is presented here are the more important factors which have been determined by a number of investigators in the field.[2, 4, 5, 6, 7, 8]

When air flows over a building, it creates an eddy zone extending back from the windward edge of the roof, as shown in Figure 2. Unless the length across the roof exceeds about three times the building height, the eddy zone will extend the length of the

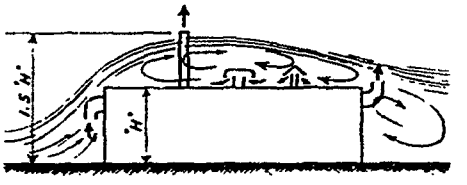

Figure 2

roof.[3] There are exceptions to this depending upon the orientation of the wind with the building shape. The height of the eddy zone may vary from about 0.[illegible] about 1.0 with respect to the building height (1.3 to 2.0 times the building height as measured from the ground).[3, 6, 7, 9]

Any fumes discharged into the eddy zones will spread across the roof and will be carried down to the ground on the leeward side of the building. The eddy zone will bring these fumes back to the building wall. Dilution will occur during this time, but any intakes in the roof eddy zone or on the downstream wall of the building will be contaminated by the fumes. Therefore, the proper location for the fume discharge is well above the eddy zone. But this requires more than just stack height. The discharge velocity must be sufficient to prevent downwash of the fumes.

Investigations of stack flow have indicated that at stack to wind velocity ratios of about 1.5 to 2.0, the effluent will break clean from the stack. At low ratios below 1.0, downwash will occur along the stack which can bring fumes into the roof eddy zone.[3, 4, 5, 6] Considering the normal wind velocities which occur, it will be found that at stack discharge velocities of 2500 to 3000 fpm (28 to 34 mph), the stack will have good discharge except for a very small percent of the time, when the wind velocities are high. We seldom have problems at high wind velocities in any case, because of the better dispersion which usually occurs.

Having established a desirable stack height and velocity, how about caps? These are unnecessary and positively undesirable. The inverted cone or the banded double-cone cap will force or permit fumes to flow down into the building eddy zone. In addition, recent investigations have shown that such caps are far from rainproof. It is understood that a technical paper will be published on these investigations at an early date.[10]

Inverted cone stack caps have been in use for over 100 years. Their continued use is a badge of mediocrity. Today we can do much better. Tests have also indicated that the drain type stacks are considerably drier than the caps. But *this* type of stack discharges the effluent straight up (neglecting wind effect), as it should. Note that any rain in the stack can drain out at the clearance between the upper and lower stack.

The drain type stack is one means for removing rain from intermittently operating systems. In other cases, small drains may be provided at the elbow in the stack base, or the fan casing may be drained, if the stack is attached directly to the fan. *No drains or caps of any type are desired or needed for stacks on continuously operating systems.* The terminal velocity of a raindrop ranges between 1800 and 2000 fpm.[11] If the stack velocity exceeds this, no rain will enter. Velocities of 2500 to 3000 fpm are recommended.

It should be noted that these are the same velocities which will scavenge condensed moisture from the duct systems, and will provide the desirable stack velocity from the standpoint of adequate fume dispersal.

Referring again to Figure 2, it will be noted that if the fumes are properly discharged above the eddy zone, the best location for ventilation intakes is on the roof. The best types of inlets are mushroom or similar canopies, or 180° goosenecks, because these will minimize wind effect. Wall inlets and outlets or other vertical openings are subject to considerable variation in wind pressure. Consequently, with such openings it will be difficult to maintain balance. As a preference, it is suggested that intakes should have canopies or elbows turned down, and exhaust openings for heat exhaust (not fumes) should have elbows turning up. In this way, wind effect will tend to increase, rather than decrease, the rate of ventilation.

The great need for careful selection of the inlet and outlet locations to permit reasonable building balance and the need for proper stack height for the safe discharge of fumes is not understood by architects, in particular, by many members of management, or even by members of our safety, industrial hygiene and design engineering professions.

The problems of blending a few stacks (or spires) into the building design could be solved within the requirements for esthetic beauty if architects would spend as much time on this important aspect as they do on elaborate facades and a country club atmosphere. The exceptional architects "can do." The mediocre architects are so engrossed in building monuments to themselves that they are unable to grasp the fact that industrial plants and laboratories have a functional, profit making role to play, and that this must be accomplished in a safe and practical manner.

If you were to survey the laboratories in this country, it would be difficult to find one where adequate provision has been made to discharge fumes safely away from the buildings. Many are having trouble. Others have unrealized potential hazards. There are numerous reports in the technical literature which relate difficulties caused by poor stack discharge. Most of the outlets terminate at or near the roof level. Some are without caps. Others are provided with inverted caps or banded ventilator heads. Re-entry of fumes into the building, through windows and ventilation intakes, is a frequent occurrence.

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evacuate the building several times because of the re-entry of toxic fumes.[12] It is ironical that a building dedicated to the public well being, the Clinical Center of the National Institutes of Health, should be among the buildings afflicted with this problem.[8] It is equally commendable that their engineers instituted a vigorous research study to find a practical solution to the difficulty. With a better understanding of the requirements for good stack design and inlet location, the problem could have been solved in the planning stage of the building design. It would seem that these examples emphasize the need for clear thinking and early planning for safety.

Figures 3 and 4 illustrate the types and locations of outlets which should be avoided.

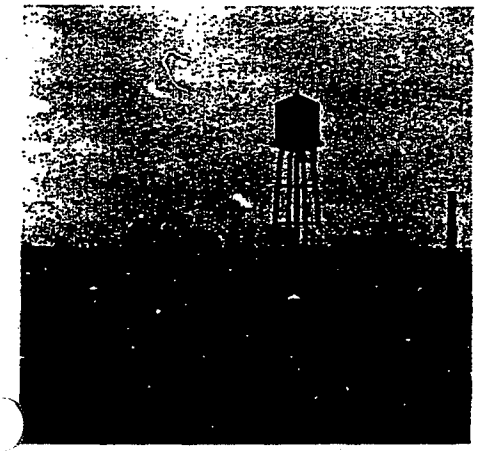

Figure 3

Note that in each case the outlet is close to the roof and that the effluent is either deflected down, or is prevented from rising. Re-entry is always a potential hazard with such outlets. Figure 5 shows a desirable stack discharge. The stack is 66 inches in diameter, 60 feet high and discharges 100,000 cfm at 4200 fpm.

Makeup and Supply Air

It should be kept in mind that the uses of supply air and exhaust air are not interchangeable. Referring to Figure 6,[13] the supply air can be projected into a space at controlled volume, temperature, humidity and air motion. Exhaust air is very effective for removing contaminants at the source.

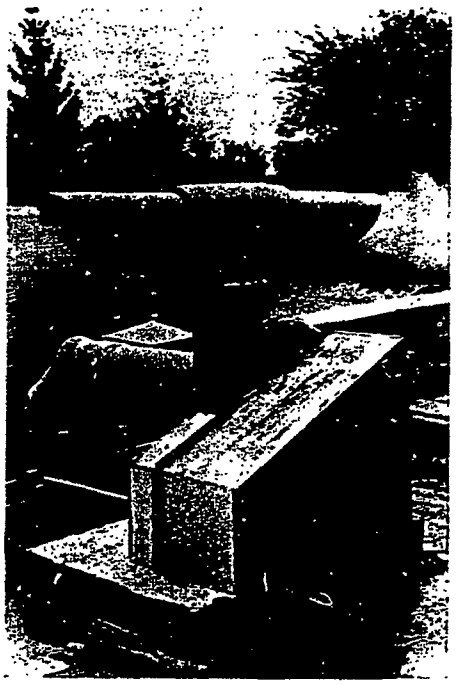

Figure 4

Removal of contaminants by supply air dilution is wasteful and can provide no assurance of the safe removal of local concentrations of fumes. Its use should be restricted to areas of very low contaminant release, or to supplementary ventilation in hooded areas.

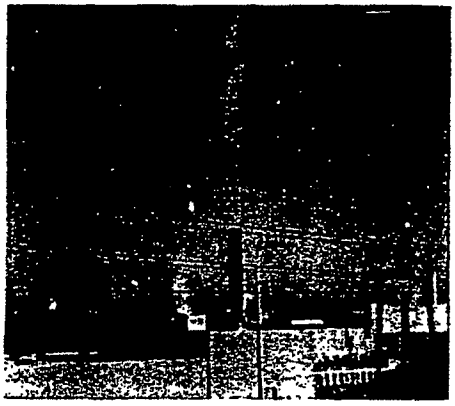

Figure 5

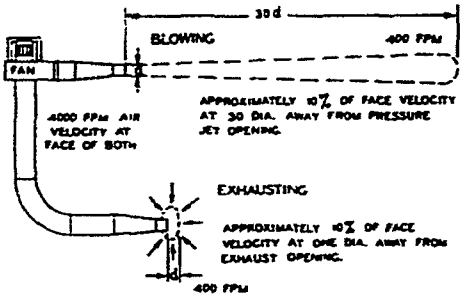

Figure 6

The plague of modern plants is the lack of makeup air. It should be obvious that air cannot be removed unless it is replaced by some means. There is universal agreement on this. But many people are unable to correlate this with the actual plant operation. Table 3 outlines the needs for makeup air:

TABLE 3

Why Makeup Air is Required

1. To assure the required exhaust volumes for:
   a. Safe, effective operation of hoods
   b. Combustion air
   c. Process requirements
   d. General exhaust
2. To eliminate cross-drafts that may:
   a. Make hood operation unsafe or ineffective
   b. Bring in or stir up dust
   c. Affect process
   d. Defeat environmental control
3. To permit a planned source of the cleanest makeup air practical
4. To permit the control of the building pressure

The costs of the necessary process or contaminant exhaust systems are not complete until the costs of the complementing supply systems are included.

Table 4 indicates the negative pressures that may cause problems in buildings which are deficient in makeup air.

TABLE 4

NEGATIVE PRESSURES WHICH MAY CAUSE UNSATISFACTORY CONDITIONS WITHIN BUILDINGS[14]

Negative Pressure, Inches of Water	Adverse Conditions Which May Result
.01 to .02	*Worker Draft Complaints* — High velocity drafts through doors and windows.
.01 to .05	*Natural Draft Stacks Ineffective*—Ventilation through roof exhaust ventilators, flow through stacks with natural draft greatly reduced.
.02 to .05	*Carbon Monoxide Hazard* — Back drafting will take place in hot water heaters, unit heaters, furnaces and other combustion equipment *not* provided with induced draft.
.03 to .10	General Mechanical Ventilation Reduced—Air flows reduced in propeller fans and low pressure supply and exhaust systems.
.05 to .10	*Doors difficult to Open*—Serious injury may result from non-checked, slamming doors.
.10 to .25	*Local Exhaust Ventilation Impaired* —Centrifugal fan flame exhaust flow reduced.

Note: The above table modified from Ref. 14.

Building leakage will provide small amounts of air, but this is a very unreliable source. Such infiltration causes drafts and must be heated in the winter in any case. This can be done better at less cost by means of systems designed specifically for the purpose.

Supply Air Systems

Except for fully air conditioned spaces there is no rational basis for calculating the required amount of ventilation supply air. This must be determined by experience and comparison with other jobs. The arbitrary standards of air change, temperature rise and cfm per square foot of floor space are useless in determining the ventilation required for relief and comfort in work areas. They do serve as *checks* of the overall design, and afford a means of comparison with other similar installations of known performance.

Keep in mind that a temperature rise of 50° is acceptable if the temperature of the work zone is not affected. Likewise a low temperature rise is of no comfort to a person in a hot location in the plant. Averages do not assure comfort. Large volumes of air at high level in the plant will provide a high air change rate, but will do nothing to improve the comfort of the worker.

The key to effective supply air ventilation is good distribution. This should be no more complicated than necessary to do the job. In most cases, makeup air can be let out into a large area with a minimum of distribution. In hooded areas having high air change rates, perforated panel outlets or other means may be necessary to avoid drafts at the hoods.

If the supply air serves the additional purpose of heat relief, the air should be

delivered to the *work zone*, about 10 feet above the floor for general ventilation, and 7 to 10 feet for spot cooling air. Vigorous air movement is required for maximum benefit. The use of evaporatively cooled air will increase the effectiveness of the systems considerably. In order to permit variation in the amount of relief with variations in outdoor temperature, the outlets should be of the directional type, equipped with volume control in most cases.

By means of a smoke test, it can be shown how the air is delivered to the work zone by the low level outlets. This might be called displacement ventilation because the relatively cool air is delivered at floor level and displaces the warm air rising from the equipment. By this method it is possible to maintain the work zone within a degree or two of the supply air temperature. Another such installation has directional grilles to permit the air to be directed down in the summer for heat relief, and up in the winter where it can mix with the hot ceiling air.

This is an excellent means of heat recovery. Such systems can supply air at 10° to 20° below room temperature in the winter with comfort, and a considerable reduction in boiler load.

Wherever possible the ventilation equipment should be centrally located to the areas served. This will aid in distributing the air and will save expensive duct work. An accessible roof is an excellent location for fans and equipment penthouses. When the roof construction will not permit this, floor space must be made available or equipment rooms of ample size provided.

Architects seldom understand the word "ample," and it is necessary to establish the equipment needs and the required space early in the game to avoid space problems. In some cases the equipment may be located in truss areas. Unless there are catwalks accessible by stairs, the equipment will not be serviced, and even with catwalks, this is not a desirable area. In some plants, "lean-to" fan rooms have been provided along the sides of the building for the equipment.

Like all other equipment there is a need for quality and accessibility for the supply systems. Unfortunately too many people buy on price. The usual package type equipment bought on this basis has not proved satisfactory for the industrial applications from the standpoints of dependability, long life, uniformity of volume, freeze protection for steam and hot water units, and ease of maintenance. The use of well designed, built up supply air systems is recommended for all important applications, in particular.

This point can be illustrated by the experiences at several plants of a large midwestern manufacturer. A package type supply air unit was installed in the truss space of a new plant. This was out of the way and saved floor space. But by the time the building was complete and had been in operation for a while, the unit was almost obscured by conduit, piping and many other plant services. Because of malfunctions, several of the air heater tubes in the unit were frozen and damaged. The maintenance crews found that it was expensive and difficult, almost impossible, to make the repairs with the handicaps of height and the maze of interferences.

In a subsequent plant, the package units were installed in roof penthouses for better accessibility. But the basic shortcomings of these units, as previously enumerated, still existed. With the construction of still another plant, a major step was taken to improve system design by installing built up systems with walk-in compartments. Here all components are readily accessible for inspection and maintenance and the equipment can be designed, selected and installed for good, reliable performance. This is *industrial* equipment.

Finally, let us remember that the figures on a drawing are no assurance of performance in the field. The systems must be designed, operated and maintained correctly. Performance must be proved by tests. Subsequent changes should not be made which will render the system inoperative.

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FIRE PROTECTION IN PLANT DESIGN

By JOHN J. AHERN
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Detroit, Mich.

Modern architecture combined with the demands of industry for large open areas has presented us with the finest manufacturing facilities in our history. Pre-planning has become commonplace and a complete scale model of a proposed plant enables the designers and planners to anticipate and solve many of the problems which will be presented when the plant is completed. These range from the placement of machinery and the flow of materials to the security and fire protection problems presented by the design and configurations of the structure. By the time a plant is completed, is is *too late* to build in many of the catastrophe preventatives I will discuss with you.

For this reason, it is absolutely vital that the major elements of fire control be incorporated into the basic design phase of a modern industrial facility. Back of this compelling need is the basic fact that modern industry, must of necessity, utilize vast quantities of combustible materials and *fires will occur*. Our design must be based upon this condition and also on the demonstrated fact that a large building fire is uncontrollable; you don't actually put it out; it burns out! Our need for large undivided areas and unrestricted movement has placed our fire fighting efforts at the outside perimeter of the building where we must wait for the fire to come to us. When this occurs, the results are all too familiar; the beautiful plant, which was to be an important part of our American production potential, is reduced to a steaming smoking mass of twisted steel and broken hopes.

Fortunately, the foregoing sequence of events is not inevitable. Methods and procedures are available to control and limit the spread of fire, if they are properly applied. They involve basically the prompt detection of an incipient fire and immediate application of an extinguishing medium, plus effective removal of smoke and products of combustion by efficient ventilation and skilled handling by a well-trained fire fighting brigade. These features are available to every industrial facility but they don't just happen! They are the result of careful planning and constant attention.

Now, let us take a look at these features

ep by step as they go into a modern industrial plant under construction. You will recall we stated that the first step in our control program was the detection of an incipient fire and the prompt application of an extinguishing medium. In practically all cases this means *water*, not just a *trickle*, but *water* available in sufficient quantity and pressure to produce an application rate great enough to overcome the heat build-up in the materials which are burning. The basic features of a good water supply include a gravity tank, reservoir, city connection, loop around the building, and hydrants.

Right at this point, let me emphasize the importance of having the water supply intact *during* the construction period. This is the most vulnerable time in the life of any building. So frequently, buildings go through this period, not only without adequate water supplies, but also without means of access to all sides of the building for heavy fire fighting equipment. Make your water supplies available and install your access roadways before the side walls are started.

Of course, having water available is not enough; it is necessary to detect the fire and apply the water. We have seen that it is not effective to wait for the fire to burn its way to you. By means of an automatic sprinkler system, equipped with modern water-flow alarm devices, it is possible to both detect an incipient fire and also apply water to it while it is still small and controllable. The record of automatic sprinklers has been a triumph for the sprinkler industry. Year after year, statistics have shown a performance of better than 96 per cent efficiency. As a result, industry is moving towards 100 per cent sprinkler protection for all manufacturing areas—a *must* for the large open area buildings now in use.

Buildings still under construction should also be under sprinkler protection. It is worth emphasizing again that during this period many combustible materials will be brought in and contractors' employees, *never* noted for their fire prevention practices, will present a severe fire hazard which can only be controlled by automatic sprinklers.

The draft curtain has become an extremely important part of the over-all protection and control program. It serves several functions. Its obvious purpose is to prevent smoke and hot gases from rolling along the underside of the roof, but in addition, it enables the emergency roof ventilation to function efficiently. Many tests have shown that draft curtains are required to obtain good emergency ventilation. They are also an important factor in conserving water supplies, as they prevent the opening of sprinkler heads except in the immediate fire area. Draft curtains need not be unsightly. In addition, they may be utilized to obtain fringe benefits; for example, as a sound absorbent surface with a resulting reduction in noise levels.

The finishing touch to our protection system is the provision of extinguishers, hose drops, and an in-plant fire truck for use by fire brigades. These constitute the first line of defense, and, if properly employed, make it unnecessary for the sprinklers to operate, although they should always be there as a back-up measure.

The need for, and use of fire walls has been one of the most controversial subjects in the field of industrial fire protection for many years. Unfortunately, early attempts to fix arbitrary limits on undivided floor areas, without regard to construction, flammability of contents or manufacturing requirements, resulted in serious misunderstandings between fire protection authorities and industrial architects. Several basic facts are apparent in this controversy. Fire walls can be provided in modern industrial plants. However, their use should be tempered with judgment.

Our tests have shown that with complete sprinkler protection, draft curtains and emergency roof ventilation, we can control the spread of fire in large area buildings with normal combustible contents. Under these conditions, such walls would only complicate manufacturing processes and restrict flexibility. As one executive recently said, "If we are going to have to provide numerous fire walls and cut the plant up into cubicles, we might as well build many separate buildings!" This, of course, would become prohibitively expensive. On the other hand, there are many situations where severe hazards exist, or where there is a concentration of high combustibles and good judgment dictates that fire walls be provided to isolate these features. There is no easy answer to this problem; it is a matter which must be decided on the merits of each particular installation.

A number of references have been made to emergency roof ventilation. Modern monitors are installed on new industrial buildings today. Years ago, these were commonplace —installed *not* for fire protection purposes, but for light and ventilation. The development of efficient methods of lighting and ventilating eliminated the need for monitors and with them went the excellent emergency ventilation they provided. Today, they are once again being used but for fire protection purposes.

There are many installations which cannot utilize monitors for a varied number of reasons. In these situations, continuous ridge type vents provide, not only emergency ventilation, but as a side benefit, continuous ventilation for greater employee comfort. By means of fusible link devices the typical vent installations will open fully under emergency heat conditions.

The foregoing measures will provide reasonable protection against a fire catastrophe. Unfortunately, this is *not* the entire answer. Constant threat can destroy our best protected plants. Explosions can destroy the protective features by rupturing sprinkler piping and depleting the water supply. For example, a completely sprinklered multistory building was completely destroyed by fire with some loss of life. It started as a result of a violent explosion in an adjoining building which ruptured the sprinkler piping.

A well-known candy plant was damaged by a corn starch explosion, proving that severe damage can be inflicted upon a heavy reinforced concrete fireproof building which is completely sprinklered. This explosion not only ruptured sprinkler piping, but caused reinforced concrete columns to fall in tension as they were stretched by the tremendous explosion pressure.

While explosions are almost impossible to control, their effects can be minimized by providing adequate pressure relief. The building where the corn starch explosion occurred sustained severe structural damage. The building was rebuilt as it was originally, with one exception: the window glass was scored to provide explosion relief. Sometime later, another similar explosion occurred. The results were dramatic—each pane of glass fell out relieving the pressure and minimizing the structural damage. The only solution to the explosion problem is an effective prevention program utilizing the latest developments in safety controls and adequate pressure relief.

The foregoing is a brief discussion of the basic factors involved in the design of fire-safe industrial facilities. There is sufficient data and knowledge available to carry out these measures. All that is needed is the decision to use them. That decision may determine whether your plant will be destroyed or remain in good condition and continue to fulfill its role in our national economy. *The decision is yours!*

BUT THAT ISN'T WHAT I MEANT!

By RICHARD C. GERFEN
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When you offer a professor an opportunity to talk before your group, you honor him with a distinguished audience. You provide him a chance to share his ideas and opinions—even his prejudices—with a group of dedicated people, people dedicated to making this world of ours a safer and better place in which to work, travel, and play.

Now your job title may be safety engineer or safety director, and mine may be professor of business communication, but we are both concerned with the problem of how to change human behavior, the problem of how to convince other persons that our ideas are worthwhile, to persuade them to change their ways of doing things, to provide them with information that will help them know *how* to change once they decide they *want* to.

In short, we are both concerned with how to convey meaning—with how to make sure we are not pushed into a corner and forced to say: "But that isn't what I meant."

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Let's start with some questions.

As a safety engineer, supervisor or manager, what is your job? Is it to do things yourself? To attend to details? Or is it to see to it that things get done? To get other men to do the work?

Will you agree that to do your job well, you need to exchange information and ideas with the men who work with you? That your men have to know what you want them to do, why you want them to do it, and how you want them to do it?

In short, will you agree that your major task is to communicate effectively? To make sure you don't have to say "But that isn't what I meant"?

Perhaps you haven't thought of your job in this way. So let's take a specific situation.

Let's assume you are Joe Black, safety director of Plant A. You've just settled down for a dictating session in your office. You've got your feet parked on the desk, and you're feeling pretty good because finally you've got some time to get the morning mail answered.

The telephone jangles. An excited voice says: "Joe, No. 3 machine has just gone haywire. Bill Brown's been hurt. You better come right over."

You were not there. But it's your responsibility to find out exactly what happened and to report this information in usable form so that

—the injured man can be taken care of.

—equipment faults can be corrected.

—operations can continue with a minimum of delay.

—repairs can be made.

—compensation claims can be fairly evaluated.

—responsibility can be fixed.

—a claim can be made to the insurance company.

—procedures can be devised to prevent similar accidents.

Obviously, you are involved in a multitude of communications problems. You have to listen to other peopple; you have to ask questions of other people; you have to report to other people.

You will have to talk with the men on the spot or read their reports of what they saw and did. And out of what you hear, what you read, what you observe yourself, what you record, you will have to fashion a message (or maybe many messages)—perhaps in written form, perhaps in oral form.

You will have to report to those who, like you, weren't on the spot either, but who have to make decisions and take appropriate action. Often, all these men will know is what they hear from you and what they read in your messages—or what they read *into* these messages—or what they read *between the lines.*

So, money will be spent; the board of directors or the executive group will make some decisions; men will be promoted or demoted; jobs will be affected; the union may take some action; families will be disrupted; employee morale will improve or deteriorate, and your efficiency and initiative will be evaluated.

And all of these things may or may not happen because of that report: because you've communicated clearly, or because you have not communicated clearly; because others have communicated clearly to you, or have not communicated clearly to you.

Joe Black is not a unique character, with a unique problem. We all face his problem many times. And it represents a challenging, difficult task. It's so easy to misunderstand. As someone has said: "If what you say or write *can be misunderstood,* it *will be.*" That's why all of us, at some time or other, have had to say: "But that isn't what I meant."

Even communications that seem clear can go haywire. Here's an extreme example from Stuart Chase's book, *The Power of Words.* You'll agree that the incident Chase describes had world-wide effects.

A Japanese word, "mokusatsu," may have changed all our lives. It has two meanings: (1) to ignore, (2) to refrain from comment. The release of a press statement using the second meaning in July of 1945 might have ended the war then. The Emperor was ready to end it, and had the power to do so. The cabinet was preparing to accede to the Potsdam ultimatum of the Allies—surrender or be crushed—but wanted a little more time to discuss the terms. A press release was prepared announcing a policy of *mokusatsu,* with the no comment implication. But it got on the foreign wires with the *ignore* implication through a mix-up in translation.

"The cabinet ignores the demand to surrender."

To recall the release would have entailed an unthinkable loss of face. Had the intended meaning been publicized, the cabinet might have backed up the Emperor's decision to surrender. In which event, there might have been no atomic bombs over Hiroshima and Nagasaki, no Russian armies in Manchuria, no Korean war to follow. The lives of tens of thousands of Japanese and American boys might have been saved. One word, misinterpreted.

Not long ago, I read a memorandum which included the following sentence: "We have been authorized to make monthly advances to Miss Wade."

That same day, in the conclusions section of a report, I ran across this statement: "In order to produce a minimum amount of confusion, certain home office personnel are needed."

When the authors of these sentences were challenged, they said: "But that isn't what I meant!"

The man who wrote "All defects found in the machinery are to be forwarded to the maintenance department" in a procedural manual said: "Of course I didn't mean that they should send the defects to the maintenance department—you know what I meant."

Why do statements like these persistently occur in memoranda, reports, instructional manuals? Why are instructions misunderstood? Why does work have to be done over? Why do assignments have to be explained again and again? Why are feelings hurt? Why do tempers flare?

Much of the answer, I think, lies in the impatient attitude of the man who said "You know what I meant." What he was really saying was "Why should I bother to express my meaning precisely? Why should I bother to define terms, give 'for examples,' support my statements with verifiable evidence, clarifying detail? Anybody with any sense can figure out what I mean."

We've just illustrated a few "word" problems people have. But these problems are really symptoms of deeper problems. For example, what kind of person is this fellow who often finds himself saying "But that isn't what I meant"? How do we recognize him? Actually, he has many identities and many aliases. Here are a few of them:

Vernon Verbose: the words pour out, and who will put his finger in the dike? He writes bloated copy. He uses a paragraph to express a sentence idea. He drowns meaning with a flood of words.

Sam Smart: Sam has no respect for his reader; his arrogance shows through his copy. And we get so upset, so angry—and our irritation causes us to lose his meaning.

Oblique Ollie: He writes as he thinks—obliquely. He beats around the bush and hates to come to the point. To get to his objective, he talks like a sailboat beating upwind. And before he gets there, his audience is *beat*—too tired to get his meaning.

Detail Dan: Dan swamps his audience with detail. He hides his points in word heaps. His reader's reaction. "Too much chaff, not enough wheat."

Peter Procrastinator: He just can't get started. Or once started, he can't finish. He's forgotten that operating information is perishable.

Disorganized Dave: Dave never plans, never outlines. He and Rambling Ralph have much in common. His meaning, if any, gets lost in a maze.

Fearful Freddy: Freddy always sweeps unpleasant things under the rug. He gives the boss only the things he thinks the boss wants to hear. Or he's like Harry, the Hedger: he habitually hides behind an umbrella of meaningless generalities, qualifications, and conditional clauses. He's determined to protect himself at all costs.

For example, a utility administrator said: "It's important that my people keep me informed. When they tackle a problem, they often run into things that are mighty important for me to know. And by giving me such information, *they are taking care of my interests as well as their own.* One of my biggest problems is their tendency to shield me from unpleasant things."

A trust officer of a bank said essentially the same things, and added: "The result of trying to shield me usually means more unpleasantness for me. I may make some faulty assumptions or take some faulty action. And if I suddenly run into a crisis some three months later, my reaction is, 'Why didn't somebody tell me?'"

Do you recognize any of these people?

If you do, perhaps you'll agree with me that a lot of people and ought to do so

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The First Variable

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[1] Adapted, with permi vised by Professor State University for Agricultural Commun used in the Project's program.

that a lot of people have writing problems ought to do something about them.

Now—is this the point at which the shay breaks down? Or can we really do something about our communication skills? Can we really avoid having to admit "But that isn't what I meant"?

Of course we can. And perhaps the first step is to understand the special nature of the problem. As Lewis Carroll, the author of *Alice in Wonderland,* once wrote "One of the hardest things in the world is to convey meaning accurately from one mind to another."

Why is this true? Why is it so hard to communicate?

Basically, I think, it's because communication involves people.

We talk or write to some person with unique abilities and attitudes, on a specific occasion, about definite things which involve an on-going social, business, government, or industrial situation, and our message can reach him only through a filter of his own values and circumstances. And this can create problems.

The first problem, and perhaps the most important one, is that we too often assume that effective writing and speaking involves nothing more than learning a few techniques, a few principles of rhetoric. Moreover, we also assume that if we read a lot of the "right" books, that such reading will almost automatically make us good writers.

Now it's important to know the conventions of our language, to know the "rules of the road," but it's even more important to recognize that there is no easy way, no simple formula that will guarantee effective communication. So I think that if you wish to make sure your messages "get through," you must not only know the "rules of the road," you must also recognize that *how* you say something is tied up with *what* you are and *how* you got that way.

That's why I'd like to talk now about three variables that affect communication efficiency and effectiveness:[1]

The First Variable—The Source:

All communication must come from some source. This source may be one person, a group of persons, or even a corporate or governmental entity. As a source, the way a person communicates will be determined by four factors:

1. *His communication skills:* his ability to think, to speak, to write, to draw, to gesture.

Now, whenever we write or talk, we have to make choices. We have to choose one word rather than another; one arrangement of words within a sentence rather than another; one arrangement of sentences within a paragraph rather than another; one sequence of paragraphs rather than another.

For example, you may choose the word "hide" in one instance, the word "conceal" in another. You may prefer "We suggest this procedure be used" in one report and "It is suggested that this procedure be used" in another. You may decide to tell your reader "The lineman ignored our safety procedure" immediately. Or you may prefer to withhold this information until the end of the report.

So you have to make choices. The natural thing is to choose the word or group of words which, from your own point of view, expresses the idea best. But if your choices disregard the reader and his preferences, you will defeat your own purpose.

2. *His attitudes:* how he feels about his audience, his subject, himself.

For example, do we see things as they really are? Or is what we see inextricably tied up with what we are? With our feelings, our prejudices? Is what we see or hear *reality,* or what we want to see or hear? Generally we see what we believe—we see and then distort what we see to fit our own beliefs.

Worried, fearful employees see threats in everything they hear. If new equipment is being introduced in a department, such employees fear the worst. Everything they observe is interpreted as confirmation that they will suffer. "I saw the supervisor looking at the seniority list—they're probably going to lay off half the department after that new machinery comes in."

Suppose a supervisor sees a group of employees laughing together.

a. If he believes that hard work has to be unpleasant, he decides the employees are wasting time and should be given more and tougher assignments.

[1] Adapted, with permission, from a model devised by Professor David Berlo of Michigan State University for the National Project in Agricultural Communications. The model was used in the Project's communication training program.

b. If he believes that good work and cheerful attitudes go together, he will decide he is a good manager.

c. If he is personally insecure, he may decide that the employees are laughing at him—making jokes about him.

3. *His knowledge:* what he knows about his subject, his audience, himself, and the communication situation. It's pretty hard to write brilliantly about nothing to nobody. A man with nothing to say has no words.

4. *His background and environment:* where he grew up, where he went to school, where he lives, where he works, who his friends are, what groups he belongs to, how he is used to doing things, his relationship to the receiver of the message (underling, equal, boss, newcomer, old hand).

As one illustration of how environment affects the way we communicate, here is a passage from John Steinbeck's new book, *Travels with Charley:*

"But now for the first time I became aware that each state had also its individual prose style, made sharply evident in its highway signs. Crossing state lines one is aware of this change of language. The New England states use a terse form of instruction, a tight-lipped, laconic style sheet, wasting no words and few letters. New York State shouts at you the whole time. Do this. Do that. Squeeze left. Squeeze right. Every few feet an imperious command. In Ohio the signs are more benign. They offer friendly advice, and are more like suggestions. Some states use a turgid style which can get you lost with the greatest ease. There are states which tell you what you may expect to find in the way of road conditions ahead, while others let you find out for yourself."

In summary, the communication process begins with a source—someone who starts things going. *How* this fellow will communicate will depend on his skills, attitudes, knowledge, background, and environment. So, if you are giving an order to Bill Jones, you ought to ask yourself:

Have I thought these instructions through? What words will I use when I write this memo to Bill?

How do I feel about Bill? About this order? Do I know enough about what is involved to explain it clearly?

Does it make any difference that Bill and I are from different backgrounds? Do I understand the order one way and is he likely to understand it another because we are used to doing things differently?

Whatever time you spend in this way is time well spent. It will probably help you avoid having to spend a lot of time explaining "But that isn't what I meant."

This is the hardest job of all, but it's where all genuine communication must begin. For people do not so much listen to *what* we say as to *how* we say it: two men can write the same report, and one will be accepted, the other met with suspicion or disbelief.

The Second Variable—The Message:

The message is the information, data, ideas, or subject matter the *source* wishes to present. The *message* poses a number of problems for its originator:

1. He has to select and organize its *content*—the ideas, the thinking, the interpretation, the information he wants to get across.

That is, he has to choose the *elements* (ideas, data, etc.) to be included, select and test supporting evidence, and then arrange or *structure* all of this.

2. He has to choose a *code* in which to deliver his *message.* The *code* he uses might be a *language,* such as English. Or it might be another kind of language: gestures (sign language), art (blueprints, drawings, graphs), mathematics (tables).

Since we're talking today about words, let's look for a moment at some of the barriers that confront us when we encode our messages in the Anglo-American language using Anglo-American words.

Why do we make the language choice we make?

Of course, our language may be slovenly because our thinking is slovenly. At the same time, of course, slovenly language makes it easier for us to have slovenly thoughts. Basically, I think, those who use slovenly language know better. They resent such language when they have to listen to it or read it.

Executives often complain to me about the writing of subordinates. They are shocked when I tell them that the reports and letters they have to read are essentially carbon copies of their own reports and letters.

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Why does this unhappy situation exist? Why aren't executives aware of faults in their own copy when they can so readily spot these same faults in the writing of others? And why do both executives and subordinates find it so difficult to make the "right" choices? Of the many possible reasons, I'd like to talk about several I think important.

We tend to imitate those we regard as successful.

The boss is a successful man; therefore he must write pretty well. This indefensible generalization traps many a young man. He says, "The boss writes this way; I can't go wrong by writing like he does." Hence, he copies the language the boss uses, language that is often jargonish, legalistic, long since outmoded. He doesn't stop to consider that the boss probably did the same thing when he was a young fellow on the way up.

So, the old adage—"experience is the best teacher"—just doesn't work when we apply it to business or industrial communication. We often learn the wrong things from experience. Moreover, we continue to apply the language usages we have learned from experience in new situations which we do not recognize as new, simply because we cannot see that these usages do not apply in these new situations. Too often, therefore, business writing consists less and less of words chosen for precise meaning, and more and more of phrases tacked together like the sections of a prefabricated hen house.

We cling to old habits. We resist change.

We cling to these habits we've learned because it's natural to resist change. And our experiences militate against change because *of the comfort of the familiar.*

An old shoe always feels better than a new one. The old cliches are so easy to use. We don't have to think. Thinking is hard work—why spend the effort to say something in a new way, a more appropriate, a more exact way?

It's very easy to dictate "With reference to your letter of June 6 and the proposal contained therein, please be advised that . . ."; it's harder to take time and to spend mental effort to dictate simply and directly "We agree with the ideas in your proposal of June 6 . . . " But if we really want to communicate, we have to take time and make the effort—we have to work at it.

In short, if we want to speak and write effectively, we won't tape together strips of words already set in order by other writers. We'll avoid the ready-made expressions, the stale figures of speech or mixed metaphors, the hackneyed phrases that choke off meaning like potato peels clogging a sink.

We assume our readers are always "tuned in":

Let's spend a moment on another point. All of us have asked someone for instructions on how to get some place in a strange town. Have you ever gotten some like this? I've paraphrased a passage from Steinbeck's *Travels With Charley.*

"You want to get to Highway 38? Throw those maps away. Just turn around, go two traffic lights, that'll bring you to Egg Street. Turn left there and about two hundred yards on Egg turn right at an angle. That's a twisty kind of street and you'll come to an overpass, but don't take it. You turn left there and it will curve around like this—see? Like this." His hand made a curving motion. "Now, when the curve straightens out you'll come to three branching roads. There's a big red house on the left-hand branch so you don't take that, you take the right-hand branch."

Such instructions are almost always followed by "YOU CAN'T MISS IT." Why? The reporter observed from his point of view, not ours. Do we do this when we try to explain things to our superiors and colleagues? Do we ever write like this when we explain some process or technique to our readers?

Instructions are a frequent kind of reporting task. Instructions like the one I've mentioned are examples of what Edgar Dale has called the "clear only if known" fallacy; i.e., the report helps only if you didn't need it in the first place.

We don't take time to be concise.

In an article in *This Week* magazine, Carl Larsen grumbles about traffic signs that are "often misleading, confusing, and poorly written." He cites a sign on Lake Shore Drive that reads "Disabled Vehicles Are Required To Pull Off Roadway" and asks: "Why write 'are required to' when 'must' would do the job?"

Two more illustrations: While driving in Minnesota, I noticed signs saying "Absolute Speed Limit." I also noticed that most everybody drove a bit faster than the "*Absolute* Speed Limit." Why "absolute"? If it's a speed *limit*, it's a speed *limit*. Adding the word "absolute" doesn't change the fact that the *limit* is 60 miles an hour. And "absolute" doesn't make anyone drive more slowly; it simply makes the signs harder to read.

How often have you read "Arrived at the conclusion that . . ." when "concluded" would do the job? Or "In my opinion it is not an unjustifiable assumption that" when the writer merely means "I think."

We don't take time to be precise.

Frequently, either because of lack of communication skill or because of a "don't-care" attitude, a person may not say what he really means. For example, a member of a communication workshop in the Traffic Institute tells the story of a police officer who arrested a drunken driver for speeding. The driver was somewhat abusive, and, to cut a long story short, the officer gave him several tickets. Later, the man filed a complaint against the officer.

The usual investigation was made, and in the report of the inspector who made the investigation this sentence appeared: "Smelling of liquor, the officer arrested the driver." At the hearing, the defense lawyer used this sentence as the basis for his motion to dismiss the case.

The officer, however, jumped up and said "Why, that's just not true. I neither smoke nor drink." And the inspector said, "Officer Jones is right. Everybody knows that he doesn't smoke or drink. That statement doesn't say what I meant." But there it was: "Smelling of liquor, the officer arrested the driver." In grammar, we call that a dangling participle. Actually, the statement simply was not true to fact. It was imprecise.

I have another example. Here is the last sentence of a London news story about a race won by a horse from the Royal stables: "Sired by the royal stallion, the Queen could not but feel satisfaction at the result."

We don't take time. Period.

Sometimes when we write or dictate, we are pushed for time, so we don't proof-read. Sometimes we just don't bother to take into account what a person will read between the lines. For example, consider the following sentences:

This will acknowledge your communication addressed to our Mr. Black who is out of town with a carbon copy of your Miss White.

We are so sorry the toilet seat we sent you was unsatisfactory. We know exactly how you must have felt.

We forget words have no meaning. Only people do.

Finally, we too often forget that words are only symbols, that words don't have meanings—people do. The words you use are not exact replicas of what you see in your mind. They are merely "stand-ins" for your ideas. Actually, a word can mean anything, provided you and I can agree on its meaning. You can call your television set a "smoogle" if you and I can agree that we are watching a football game on a "smoogle."

Any word can have a wide range of meanings, meanings which vary with its placement in a sentence, the context in which we use it, and our experience with it. "Frame" is a common word, but when we use it we may mean "window frame," "to frame someone," "frame of mind," or "frame of reference."

In summary, words do not have meanings in and of themselves—they are only symbols, cues which cause us to bring our own meanings into play. They never mean exactly the same thing to two people. The meaning of a word is your private property—and mine. Fortunately, we usually find other people with meanings similar to ours; when we don't, we can't communicate—or at least, not well.

The third variable: The receiver.

The final link in the communication process is the receiver—the person or persons on the other end of the process from the source. Since communication is a two-way process, it must end with some receiver. This receiver may be one person, or it may be a group of people.

Obviously, the factors that affect the *source* also affect the *receiver:*

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2. *His attitudes:* is he prejudiced against the *source,* or against the idea? What assumptions, opinions, or feelings does he have about the situation or the sender? Does he typically resist change or typically welcome change?

3. *His knowledge:* does he know a lot about the situation, the subject matter of the message? Or nothing at all?

4. *His background and environment:* Where did he grow up? Where did he go to school? Where does he work? Who are his friends? How does he do things? What is his status: underling, boss, equal, newcomer, old hand? Is he an innovator? Early adopter of new ideas? A conservative who subscribes to the axiom so aptly stated by Alexander Pope: "Be not the first by whom the new are tried, nor yet the last to lay the old aside"? Or a "foot-dragger" who says "We're doing all right. Why change?"

In addition to these four factors, we also need to recognize that our readers are nearly always unwilling readers. They read out of duty, not from any deep interest in our messages. They read with half their minds; they rarely make an all-out effort to get our meaning. And if they read with only half their minds, are they really reading at all?

Reading is tiring; it requires energy. As you read complicated material—technical explanations, mortgage contracts, government regulations, and the like—you have probably felt this tax upon your own energy. Moreover, as readers, we find other interests tugging at our minds. For all of these reasons, we often begrudge the effort it takes to read something.

Consequently, to present our information and our ideas to our readers, we must choose words and combinations of words that will require our readers to use the least amount of energy. If we want a reader to understand our ideas, we must use words he can use without having to translate them. We must make the relationships between these words easily apparent to him. And if we can save his energy in these two ways, our reader will have enough energy left to get our meaning—just what we were after in the first place.

In summary, when we tell something to somebody, we need to make sure our message "gets through." Once it's "through," we need to make sure this "somebody" understands both the content and intent of our message. Once he understands, we need to know how he acts or reacts. In short, the measure of our success as communicators is how well we involve, inform, and motivate other people.

Thus, the ultimate test of all communication is whether it produces the desired results quickly. There is no other test. Although both the sender and the receiver have a responsibility, if the sender has to say "But that isn't what I meant," he has failed. For the receiver, like the proverbial customer, is always right.

WHY THIS MISSILE IS NEEDED

By HOWARD PYLE
President, National Safety Council, Chicago, Ill.

The language of the space age has infiltrated our everyday speech with what we might call super-sonic jet speed. Virtually everyone is preparing a count-down, launching a campaign, and putting one sort of program or another into orbit. Always in step with the times, the National Safety Council is using the missile as a metaphor for the very vital work of programming safety off the job. It's a guided missile that we're talking about, one guided by American industry. It has a very specific target, accidents on our highways, in our homes, and in our public places. They are the enemy, and we won't be happy with anything short of unconditional surrender.

In spite of the launching pad lingo being used to describe off-the-job safety, the idea is almost as old as the safety movement itself. Fifty years ago, at the first Co-

operative Safety Congress, a resolution was passed to create an organization dedicated to the prevention of work accidents. Right after the second Congress in 1913, that organization came into being; it was called the National Congress for Industrial Safety. But the dedicated men who formed the organization realized almost immediately that they were limiting themselves to only part of the nation's problem and only, part of their own industrial problem.

Those are two big reasons why the name of the organization was changed to the National Safety Council; why it has remained broad in scope these many years. The national problem is some 40,000 traffic deaths every year, the business problem is more than 17,000 workers killed in off-the-job traffic accidents. The national problem is 16,500 public deaths, other than motor vehicle accidents; the business problem is 6,200 workers killed in public accidents. The national problem is 26,500 accidental deaths in the home; the business problem is that more than 5,500 of these deaths involved workers off the job.

In all, nearly 29,000 working people are killed by accidents away from work, as compared to 13,500 who die from accidents at work. This is indeed a tragic human loss. It's certainly not necessary to recount to you the pain and suffering caused by these needless accidents. And it's hardly necessary to remind you that for every fatal accident that occurs off the job, there are nearly 80 accidents that result in disabling injuries to workers. What does this mean, apart from human agony?

It means that off-the-job accidents cost the employers and employees of this nation an estimated seven billion dollars. That's more than $100 for every man and woman employed. It must not be forgotten that even though those staggering costs are for off-the-job accidents, a large portion of the financial burden is borne by the nation's employers. Some of this is paid directly, as wages to absent workers, and as the cost of hiring and training replacement workers.

But some of the costs are hidden. For example, a top-notch salesman who is injured may not be immediately replaced. His loss, even temporarily, means lost sales, delivery troubles and sometimes, even a loss of confidence in the company. Other hidden costs are also very real. A rise in accidents in the community means a rise in insurance costs, taxes and welfare contributions. I might add that even when the worker absorbs part of the cost of an accident, it affects the employer. No man can leave his troubles completely at home, especially financial worries. They affect performance on the job; they can even make an employee subject to work accidents because his attention is focused elsewhere.

Here, then, are the ways you, as employers and representatives of management, pay for accidents that occur away from work:

1. You pay the direct cost of off-job lost-time accidents.

2. You pay the indirect cost of off-job lost-time accidents.

3. You pay the indirect cost of off-job non-lost-time accidents.

4. You pay the insurance premiums on policies covering off-the-job accidents. The categories of costs and cost-accounting can be extended, analyzed and broken down into many component parts, but they all add up to a single thought: off the job accidents cost management plenty!

We at the National Safety Council have been attempting to gather and correlate the off-job accident experience of our members. The response we received was limited, of course, to those companies that have inaugurated off-the-job safety programs. Therefore, the reports, probably reflect what we might call the best experience in off-the-job safety. During the first six months of 1962 we received reports from more than 300 companies. Those companies employ nearly two million persons, exposed to off the job accidents for three-and-a-half billion hours. This is a small portion of the Council's membership and an even smaller portion of the nation's total number of employees.

It is, nonetheless, a significant report because it shows the specific experience of a known group of businesses; it is not simply a statistical estimate. Here is the most up-to-date information available. Among those who reported to us this year, the injury frequency rate was 7.41—that is, 7.41 disabling injuries for every one-million man-hours of exposure. The rate was some three times higher than the indicated injury rate for the same employees while on the job.

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Let's take a closer look at some of the reporting companies. One organization, which employs nearly 1,200 workers, experienced 10 on-the-job injuries, resulting in 486 days lost. That same company's workers sustained 76 off-the-job injuries, which resulted in 1,900 days lost. The company's costs totaled $38,000, $500 per injury, or $32.45 for each and every worker on the staff. A smaller organization, employing just over 300 workers, experienced no injuries on the job, no lost time. However, the workers sustained 13 injuries off the job, losing 136 days. The cost to the company was $11,462, $881.60 per injury or an average of $36.97 for every employee.

Let's say the latter company was operating on a margin of five per cent. The $11,000 it lost because of off-the-job accidents wipes out the profit on more than $220,000 gross sales! A random sample of the organizations reporting to us shows that 12 companies lost a total of $338,740 from off-the-job accidents. Again, estimating an average margin of five per cent for these companies, those accidents meant that more than six-and-three-quarter million dollars of gross sales went down the drain!

We learned three important things from our surveys:

1. Off-the-job injuries run much higher than work injuries among the same employees.

2. Relatively few companies are doing much, if anything, about off-the-job safety.

3. There are virtually limitless opportunities to be seized in the area of off-job safety—and these opportunities will pay tremendous dividends, not only from a humanitarian viewpoint, but in terms of good business.

It would seem to me that good business requires that American industry undertake a crash program to launch this missile of programming for off-the-job safety. The seven-billion dollar burden that we carry today is one that will put this nation in an ever-decreasing competitive situation in world trade. Consider what the built-in cost of doing business means when we price our goods in this new world of international economics. While we applaud the construction of such edifices as the European Common Market, we must recognize that they are challenges that must be faced. We must seek more and more creative means of holding our price lines, in order to retain our share of this vast world market.

Reducing the cost of off-the-job accidents can and will diminish what we have come to consider "fixed" costs. I tell you that these costs—the costs of accidents away from work—are not fixed. They can be reduced by as much as one half in the very near future. They can and will be reduced when American industry applies off-the-job safety programs. We recognize, of course, that work safety is the less difficult task. The control of environment and of behaviour within the work situation is impossible—not to say undesirable—in the areas off the job.

But since the organization of the National Safety Council, we have witnessed tremendous progress in the non-work areas. Home accidents rates have been cut nearly in half. Public accident rates have declined some 70 per cent. The trend in traffic deaths right up to this year has been down, down, down. This progress can be attributed in part to the few companies that have instituted full-scale programming to prevent non-work accidents. Look at the field of motor transport. Here is exposure to the comparatively uncontrolled environment of our streets and highways; yet some of our largest fleet operators have the lowest frequency and severity rates of any organizations.

There is nothing mysterious about the success of these large companies in reducing off-the-job accidents. The ways and means are known to virtually everyone in industry. They rest on the same fundamentals of accident prevention now in practice for 50 years. There are no secrets to safety on the highway, in the home, and in public places. The knowledge, the methods, and the science have all been set down and documented. They exist in manuals, in action programs, and in the day-to-day reporting of those organizations now actively promoting and harvesting the benefits of off-the-job safety.

GETTING OFF THE LAUNCHING PAD

By V. J. MEYERS
Assistant Superintendent, Medical Services & Safety, Western Electric Company
New York, N. Y.

I'm happy to say that Western Electric, recognized long ago the need for an effective off-the-job safety program. In 1959, we started to compile statistics on off-the-job injuries as a part of our regular absence data program. The results were a real eye-opener. The question once we recognized the magnitude of the problem was "What can we do about it?" In retrospect, our answer, and the action we took was by far the most important step in our program. We asked and received the enthusiastic support of our management.

At our first company-wide safety conference in May, 1961, our president, Mr. Romnes, voiced his concern with and interest in this problem. So did our vice president in charge of personnel and public relations, our personnel director, our director of public relations, and our company medical director. All were convinced of the importance of doing something about it. All promised total support; and more important, they have all fulfilled this promise. Without their help and interest our program could well have stepped into oblivion.

We set our sights, then, in May 1961. Assured of top-level support, we set those sights high. We proposed incorporation of off-the-job safety into our regular, formal company safety directive; we laid the groundwork for a company-wide auto seat-belt program; off-the-job safety functions were added to existing committee responsibilities and new committees to further the project were planned. We began to strengthen lines of communication, by distributing booklets and reports emphasizing the all-important subject.

All of these projects have come to fruition in the past 18 months. The planning and enthusiasm have paid dividends. Off-the-job safety is pretty much a creed at Western Electric. In terms of improved communications, I would like to share with you some details of a specific program we adopted in January this year, called "Working Together for Safe Living." I'd like to tell you why it was developed, how it works, the reception it has had so far, and what sort of results it has brought about.

First of all, why such a program? You might say the program came about because Western Electric has an outstanding safety record. In fact, the National Safety Council has honored Western Electric with its Award of Merit—the second highest award in industry. This means that Western Electric is one of the safest places in the country in which to work. But as I indicated earlier, in studying accident reports, management discovered that while Western Electric employees have few accidents on the job, they have an alarming number at home and on the highway.

In fact, for every job accident in 1961, there were nine off-the-job accidents. Of course, most companies report similar ratios. During 1961, because of off-the-job accidents, 77,000 man-days were lost at Western Electric. That's enough lost labor to run one of our typical distribution centers employing 229 people, for over a year.

During 1961, Western Electric paid nearly two million dollars in disability benefits for off-the-job accidents. It is impossible to estimate hidden expenses, such as costs of training replacements, inefficiency due to absenteeism, visiting nurse work, and administrative labor.

Most important, we were concerned with the pain and hardship that off-the-job accidents caused our employees. All of these factors made us realize that the need for an off-the-job safety program was very real. What was the best way to go about it? Western Electric decided to use a tried-and-proved method. It's called integrated employee communication—IEC for short.

Basically, IEC is a planned, coordinated program of communication that focuses every available media upon the problem being tackled. It reaches its target, the employee, through the written word (booklets, magazine and newspaper articles, letters), the spoken word (lectures, speeches), visual aids (posters, photo-bulletins, displays), and

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what could be called the "shared word" of group discussions.

A good IEC program has four elements. They are:

1. Motivation—telling the employee about the problem and giving him a sense of sharing it.

2. Guidance—showing him what can be done about it.

3. Recognition—indicating the reward in success.

4. Repetition—a constant flow of information on the problem.

Industry has successfully used IEC programs in many areas. For example, one company used it to bring about additional freight tonnage. Another company has used it to get more cooperation and teamplay. Other IEC programs have resulted in a greater awareness of delivery problems, fewer foreign materials in products, improved competitive spirit, and a drop in petty grievances. So Western Electric developed an IEC program aimed at getting better off-the-job safety.

All the media employed work together on common problems, month by month. The heart of the program is the monthly group discussion meeting of the supervisor with his employees. It is given on company time. For the supervisor, there are leader's guides. The guide contains a review of techniques of leading group meetings. It also contains the material to be covered in the meeting, in both outline and note form. A list of suggested questions and cues on when to use flip charts is provided with the guide. Correctly used, the leader's guide can be very effective in drawing out employees, and getting true audience participation.

Supporting the group discussions are several other media. Photo-bulletins appear on all company bulletin boards at two week intervals. Posters are put up on the alternate two-week periods to complement the photo-bulletins. Letters from the plant managers are used. W. E. Magazine, the Company's bi-monthly employee publication, features safety articles.

"News for W. E. Editors," a news syndicate providing material for plant newspapers, supports the safety campaign. Our 17 plant newspapers run stories on safety. Special booklets are distributed to all employees, and safety films are also available. Supervisors are further urged to use any other material they wish.

Western Electric's off-the-job safety program was started in January 1962, and will continue indefinitely. By the end of the first year, headquarters will have distributed some 23,000 leader's guides, 17,000 bulletin board photos, 6,500 posters, and 1,800 flip charts. Here is our audience: seven manufacturing locations with about 29,000 people; Headquarters, 7,000 people; Defense Activities, 13,000 people. This comes to a total audience of about 76,000 people.

The monthly schedule for the first year's meetings looks like this:

1. January—introduction.
2. February—what a major accident can mean.
3. March—why accidents occur.
4. April—seat belts and traffic safety.
5. May—poisons and poisonings.
6. June—vacation safety.
7. July—sports safety.
8. August—community safety.
9. September—slips and falls.
10. October—fire prevention.
11. November—do-it-yourself safety and home work tools.
12. December—Christmas safety.

You will notice that wherever possible, the safety theme is tied in with the time of the year. In April when the open road beckons, we stress driving safety. June and July feature vacation and sports safety. October's fire prevention work coincides with National Fire Prevention Week, and, of course, December sees Christmas safety.

Each of these monthly sessions on off-the-job safety has been designed to incorporate the IEC elements I mentioned before. We trust the employee will be motivated to take action. We provide the guidance to help him. And we repeat the message in every way possible. And what about recognition, the reward for taking action? That comes as the employee finds himself and his family safer, notices how few of his fellow workers are absent because of off-the-job accidents, and sees the plant and company accident figures substantially reduced.

As of right now, it is still too early to tell just how well the program is succeeding.

All we can go on are statistics from the first six months. These show that the program is being extremely well received. Locations using the technique are most favorably impressed with it. Of those locations using IEC, several show a significant drop in off-the-job accidents. The other results are inconclusive—some steady, some up. However, no improvement was shown by any plant not using IEC.

Before concluding, there are two points I'd like to emphasize:

1. While we are vitally concerned with the problem of off-the-job accidents, and have spent a lot of time, effort and money in this realm, we have not, at any time, reduced our efforts to prevent all work injuries! On the contrary, we have recently devoted considerable attention to this phase of safety. Not only have we strived to maintain our good record with respect to disabling injuries, we have also intensified our efforts to reduce the number of nondisabling injuries. I could go on at great length on this subject, but for now it should suffice to say: Off-the-job safety is just as important to Western Electric, as On-the-job safety.

2. The program I have discussed is an extremely important phase of our over-all off-the-job safety program. However, it is by no means the sum total of our efforts. This year, for example, several of our locations conducted rather elaborate pre-vacation safety fairs for employees and families. More than 10,000 people including local government officials, attended, and the interest shown was very gratifying. Two other locations cooperated with the National Vehicle Safety Check Program, setting up free inspection lanes adjacent to the plants. Close to 1,000 employee cars were thus given a mechanical seal of approval, prior to vacation.

We are very pleased with the progress we've made in stimulating personal safety consciousness beyond the company premises and after work hours. However, we are not completely satisfied. I'd like to quote President Romnes' words when we were launching our program last May. It seems to me they characterize our work to date and show the direction and attitude of our missile in the future.

> **As long as there are any cases in which employees or their families are caused suffering, we will continue to intensify efforts . . . I think the goals of a safe, sound Western Electric population, and a contribution to the reduction of our national accident toll are worth our very best efforts.**

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ORBIT CONTROL PROBLEMS

By STANLEY F. SPENCE
Director, Safety & Loss-Prevention, American Cyanamid Co., Wayne, N. J.

Industrial management, with the guidance of qualified safety specialists, has done much through the years in improving its work injury experience, and during the past 50 years occupational safety has developed into a well identified science. Experience and good reasoning also demonstrated during the years that management's program for safety must extend outside the plant or place of business, it must extend between that place of business and the home, and it must encompass the home and the places where people travel, enjoy themselves, and carry on their private tasks.

Let us take a brief look at the nationwide accident problem. There are over 180 million people in the U. S. Only 38 per cent of these are in the working force and the direct efforts of Safety Engineers in commerce and industry reach but a small proportion of this 38 per cent. The 1961 accident toll in the U. S. is further indication that the total accident problem extends way beyond the "work injury" category. Note the National Safety Council "Accident Facts" of 1962. The disabling injuries resulting from work accidents accounted for only 20.2 per cent of the total. All of the deaths which resulted from accidents in 1961 had only 14.3 per cent of their source in work accidents.

I feel that a safety engineer is not truly a

safety engineer in the fullest sense if he restricts his functional and professional interests to the area defined by his immediate job. In order to be a complete safety engineer and, therefore, to fulfill his responsibilities to the profession and to society, he must extend his aggressive interest and best capabilities to the solution of the accident problems that affect the safety of his family, fellow employees and neighbors in the home and in public areas.

In designing the off-the-job safety program one must recognize the family as the unit which must be reached, rather than the employee himself, and the mother of the family as the individual who must be motivated. Figuratively speaking, this must be done by "going out and ringing doorbells." Of course, it is not literally done that way, but is carried to the home through the employee, the local schools, the local PTA, direct mailings to the home, and all the other available or invented media.

When a company decides to undertake off-the-job safety as part of its over-all safety program it must recognize certain facts.

1. It must be prepared to conduct it with good planning and full vigor. There must be no let-down.

2. All concerned — management, safety committees and others—must fully understand the purpose of the project, the method of conducting it, and the details of accident interpretation and classification.

3. Definite and dependable procedures must be established for the collection of accident data and reports.

4. Once the procedure for the collection of accident data is established, it must be under constant surveillance to guard against error, oversights, misinterpretations. It will not run forever automatically.

5. If the company has multiple operations, it must realize that the effectiveness of the program will depend upon what is created and produced at each individual location. The central office can only provide the foundation, the machinery, and some of the basic raw materials. The local plant must turn out the product.

6. All areas of management must be convinced that the off-the-job safety program is not only "nice," but is a necessary adjunct to the over-all safety program. Certain questions can be anticipated, and answers to them *should be prepared in advance.* The National Safety Council has the answers—consult them. Here are a few typical questions:

a. Won't the employees consider this an intrusion upon their private lives?

b. Aren't we busy enough in job safety? Are we presently doing a perfect job on that? If not, why divert an important portion of our time and effort? This procedure of reporting and compiling data will stack more paperwork detail on a mass that already seems intolerable.

d. What is it going to cost? Will the economic benefit to employee and employer justify the costs?

I mentioned that before a program is activated, there must be complete understanding as to what constitutes an "off-the-job accident," and the basis of classification. The subject is worth some discussion. We shall talk about the definition of an off-the-job accident, loss of time applied to off-the-job injuries, and the method of determining frequency. Off-the-job injuries are all injuries, except work-connected cases, experienced by our employees and result in the loss of one of more full working days, whether scheduled or not. Fatalities and permanent partial disabilities are included.

The lost time applied to off-the-job injuries includes total calendar days lost from work, plus all intervening holidays, vacations, and other scheduled time during which the employee is unable to work. There is no schedule of time charges against permanent partial disabilities or fatalities. Only the actual loss of time is counted. Thus, there can be off-the-job injuries in the record with no loss of time applied against them. The basis for determining frequency is 312 exposure hours per employee per month. This is arrived at by considering eight hours per day for five days per week plus 16 hours each Saturday and Sunday, multiplied by 4⅓ weeks per month.

There are certain situations which deserve special comment. For example:

1. If an employee is injured in our plant parking lot and the case is not admissable as a work injury under American Standard Z16.1, it is an off-the-job injury.

2. If he is hurt on a "moonlighting" job,

it is an off-the-job injury for us, as his principal employer.

3. If he is injured while on vacation and disabled for a couple of days, even though he is fully recovered before reporting back to the job, it is an off-the-job injury.

4. If an employee is injured in an off-the-job accident and dies of his injuries the same day, a fatality is listed but no loss of time is applied.

5. If an employee using a sickle on the weeds in his yard cuts the tendon of a finger, and a practical loss of use of the finger results, an off-the-job injury is charged, even though he actually loses no time. From the foreging, it can be readily seen that the question of just what an "off-the-job accident" is must be thoroughly understood by all reporting sources, and that there must be frequent checking of this understanding to ensure validity of the experience.

The monthly summaries of off-the-job accident experiences for individual units are compiled by the supervisors of safety in my company's plants and laboratories. In the branch offices and warehouses they are prepared under the supervision of the branch manager; in the sales organizations, by a member of the staff of the regional sales manager. It must be kept in mind that such reports usually are prepared by clerks, following instruction from their supervisors. Clerical people, as others, are changed, and sometimes the replacement is not correctly or adequately briefed and errors occur. Therefore, the managers responsible for signing and submitting these reports should do more than mechanically sign their names. They should review the reports and make sure they are correct.

The monthly unit summaries of off-the-job accidents are prepared from the individual case reports. While the designation of responsibility for getting the case reports through is not complicated, there is difficulty sometimes in ensuring that supervisors get proper information from their subordinates. This can happen in the case of off-job accidents sustained by scattered salesmen operating out of their homes, and technical and service specialists in the field. The manager responsible must carefully check all of his subordinates' time records for the occurrence of time-losing injuries. Incidentally, one must be careful to see that the time reports used in sales and technical service organizations make a clear distinction between off-the-job injuries and illness, as classifications designating absence from work.

The problems of checking individual cases and preparing case reports on them appear to be simplest in the line organization of the plant. Here the employee's immediate superior obtains the details, completes and signs the report, and transmits it to the plant supervisor of safety. As stated before, this individual prepares the monthly summaries for his operating unit and sends it to our headquarters.

The question sometimes is asked, how does a department supervisor in an operating unit know when one of his people is injured in an off-the-job accident? Indeed, this question was posed by one of our larger plants when we were contemplating initiation of our company-wide program in 1955. They considered it a serious stumbling block. This has not proved to be a problem, for practical reasons. It is a moral, if not necessarily a contractual, responsibility of an employee to notify the plant when he is not coming to work.

If employees are not required to make such notification on the first day of absence, then management is to blame for not requiring or otherwise investigating the cause of absence! Far from being a stumbling block in our experience, the requirement of prompt notification of the supervisor, or the supervisor's prompt check of the cause of absenteeism at the beginning of the day's work, has established a rapport between supervisors and employees which did not exist before. We also find a better acceptance of responsibility on the part of each.

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SAFETY ADMINISTRATION IN MULTIPLANT OPERATIONS

By ROBERT M. GILMORE
General Safety Supervisor, Rayonier Incorporated

Rayonier Incorporated is one of the world's leading producers of chemical cellulose, supplying foreign and domestic industries with basic material which goes into more than 6,000 products. From cellulose made in our plants others manufacture rayon fabrics, Tyrex tire cord, certain plastics, cellophane, paper products, acetate films, and many other products.

Our mills draw their supply from over 1,000,000 acres of forest lands, carefully managed to insure a perpetual tree crop yield. The firm is owned by more than 22,000 stockholders and employs over 6,000 people.

Rayonier is more than mills and forests; the name is synonymous with research. Three separate but highly coordinated research centers are engaged in basic and applied natural resources chemistry.

The manufacture of wood pulp requires complicated and massive equipment. Over the years, however, our industry has successfully minimized the risk of personal injury to the individual worker. Rayonier has been a leader in this effort and has maintained an outstanding safety record through the close cooperation of employees and management. Our program is not one of sporadic drives and spurts, but it is a fully organized continuous day-to-day effort woven at all times into all phases of operations.

As a result of this coordinated effort, the average frequency rate for all company operations has been reduced steadily in the past 17 years. In the same period our manufacturing divisions achieved an 88 per cent reduction in the number of disabling injuries per million employee hours worked, but perhaps what is truly remarkable is the drop in severity rates over the years.

This lowering of severity rates has been followed by lower costs to the company in the form of premium charges for workmen's compensation coverage, but of greater importance is the fact that this successful safety program has resulted in avoidance of suffering and personal losses to employees who were not injured as a direct result of the constant improvement made in safety experience. We look at accident prevention as an important factor in cost reduction.

Motivation of the employees in safe practices is maintained with a "soft thumb" pressure that never lets up. The worker is indoctrinated with safety principles and shown how to do his work without injury through such methods as safety contacts on the job by supervisors, demonstrations, moving pictures, safe practice handbooks, bulletins and posters. "Safety Ray," our safety symbol, plays an important part in the visual aids used throughout the company to emphasize safety to employees.

The company makes available protective equipment that applies to the job, such as special eye protection, masks, safety shoes and hard hats.

Operating equipment in the mills, the woods and the laboratories is continually inspected to eliminate or protect danger spots. Well equipped first aid facilities are maintained at every operating division.

Some of the main points of the organization approach to accident prevention which comprise our overall effort are:

1. A clearly stated outline of policies and safety procedures with a good system of communication to reach all employees. In this we mean the implementation of the safety policy contained in the Industrial Relations Manual of our company. A copy of this policy has been given to every supervisor and periodically it is re-interpreted by the managers and department heads so there will be no misunderstanding as to its application. Beyond the establishment of a written policy, a system of comunications through supervision is maintained to reach all employees.

2. Top management control and active participation is evident in the day-to-day personal attention to accident prevention given by the division manager and his immediate staff of department heads. We mean the strict observance of posted safety

rules. This includes the example and leadership which management people set in order to foster the proper climate for safety at a division.

3. Notwithstanding all of the work done by staff people, the major responsibility for accident control and safety in a department is at all times placed squarely on the shoulders of the line supervisor. Our program is geared to carry this practice out to its fullest extent.

4. Statistics and factual cause information is available through effective accident investigation, reporting and analysis procedures. We start this with the use of the basic form entitled Supervisors Report of Accident. Good results have been obtained in getting supervisors to report on all injuries. We feel that a good reporting system is the very foundation block on which an effective safety program is built. All of the final statistical information drawn off from the records hinges on the quality of the first report which is made by the foremen and supervisors. Annually we completely break down and analyze all medical treatment cases as to type and probable cause of injury.

5. Each new employee gets a careful indoctrination in safety commencing in the personnel office with his initial talk with the safety supervisor. Visual aids are used here to give impact to this talk. This is continued out in the department where his foreman and others talk to him regarding the specific safety keypoints of his job. Every effort is made to get the new man started right from the very beginning. At our mills we give a complete hearing test and an eye test in connection with the physical examination.

6. Direction and application of the details of the program are handled by safety supervisors at each division. We have been fortunate in having capable, well qualified full time safety specialists working in the field of accident prevention at each division.

7. Direct participation or involvement of employees is accomplished through displays, safety letters from the manager, certificates of safety achievement, educational meetings and through safety committee work. The usual format of safety committees at a division of our company is to have a Central Safety Committee composed of equal numbers representing labor and management. This overall committee is further backed up by a safety committee in each of the principal operating departments in the plant.

All of this results in a healthy involvement of employees in safety activities. The rotation feature of these committees makes it possible to ultimately take in a large number of employees at any one division. We use to good advantage pocket-size booklets, General Safety Rules, and another booklet entitled "You As Safety Committeeman." Another involvement feature of interest is the impressive little ceremony which is held whenever a certificate of safety achievement is presented to a department which exceeds 1000, 2000, or 3000 days without a disabling injury.

I made reference to the company policy on accident prevention. In this policy this language appears: "The management of Rayonier Incorporated considers no phase of operation or administration as being of greater importance than accident prevention."

We interpret this literally to mean that safety and accident prevention are equal in importance to any other duty or responsibility which a supervisor must carry out. We require that it be given a place of equal importance to anything else in the normal course of the operating program. In this regard, there have been many incidents in Rayonier where good production records and excellent safety performance have been achieved during the same period of time. This is inevitable, as we see it, since on-the-job injuries to people are always accompanied by delays and interruptions to the normal production schedule.

The policy on safety contains a list of items which we consider to be the direct responsibility of supervisors for accident prevention. I would like to give you the first two of these items as they are considered in order of importance on the list:

1. The provision of complete safety instruction to employees prior to assignment to duties. This is very important because a man who "doesn't know" is dangerous to himself and to others. Keep a job-safety list of important keypoints which should be covered with the new man. Instruct your men to work safely, as you would guide and counsel your family at home—with persistence and patience.

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2. Enforce all rules of safety which have been adopted. Follow up your instructions constantly. See to it that employees make use of the personal protective devices and safeguards provided them. If necessary, enforce safety rules by disciplinary action.

As a staff member of management, the general safety supervisor (in the person of myself) is charged with advising the executive offices through the industrial relations manager on the development and administration of safety policies and plans designed to safeguard employees and to promote interest in accident prevention.

He recommends for approval proposals for safety policies throughout the company.

He establishes safety programs and procedures implementing approved company safety policies, and coordinates the interpretation and administration of these programs in the operating divisions.

He maintains reports of injuries, inspections, and other records that are necessary for study in connection with revision and development of corporate safety policies. He circulates a safety progress report monthly to show the cumulative industrial injury rates of all divisions.

He guides and assists the managers of the divisions and their staffs in the administration of safety programs and serves as advisor to them in matters pertaining to industrial insurance and workmen's compensation.

He interviews and recommends personnel placement in safety activities in the operating divisions, and assists in training personnel to the degree necessary for the fulfillment of their responsibilities.

He prepares the necessary safety educational aids and publicity materials, and conducts management safety meetings when requested.

He establishes liaison contact with local, state, and federal agencies and legislative bodies in matters pertaining to safety. Much of this work is done through membership on subcommittees of the employers' associations.

He establishes and maintains contact with associations in the pulp and paper industry and the logging industry to the end that these groups are assisted in the development of procedures and plans for greater safety in these industries.

He represents the company in local, state and national safety activities, and cooperates in assisting these groups in the development of plans and procedures for greater industrial and public safety.

He maintains those professional contacts that are necessary in the fulfillment of these responsibilities.

The division safety supervisor functions primarily in an advisory or staff capacity; however, under the broad policy on safety endorsed by our executive management it is understood that his recommendations and suggestions for accident prevention shall be given careful attention by all line supervisors.

A safety supervisor should know safety and should be sympathetic and understanding in his approach. He should be able to inspire confidence in the work and must believe that improvement can be made in the safety record of the division through constant application of basic fundamentals of the organized program. The job involves two principal problems: First, he must initiate proper action to remove physical hazards from the plant or operation; secondly, he must find the means of substituting safe practices for the unsafe practices of employees. In this work he must exercise good judgment to a very considerable degree.

Here are the major responsibilities and duties of a division safety supervisor ranked in order of their importance:

1. Establish satisfactory relations with all supervisors and coordinate all accident prevention activities of all departments so that objectives and purposes will dovetail.

2. Establish safe practices—work with operating department executives and with supervisors in developing safe operating methods, safety rules, and departmental safe practice regulations. The safety rules of the division should be under constant review to be sure that they are kept current. Recommendations should be made for safety on all installations of new equipment, new processes or chemicals prior to use. The safety supervisor should act in an advisory capacity on all matters pertaining to safety as required for the guidance of the division manager and all supervisory personnel.

3. Study accident causes—determine the causes of accidents and fires and suggest measures to obviate accidents in the future. Any pattern of predominant accident causes at the division should be promptly brought to the attention of the division manager and

also should be discussed with the Central Safety Committee.

4. Investigate accidents—receive a detailed report of every accident. Investigate all disabling injuries and serious accidents whether disability results or not. Proper accident investigation is an exacting science and each safety supervisor should become skilled in this work. The investigation should be made primarily for the purpose of determining the direct cause of the accident and seeing that prompt corrective action is recommended to prevent a recurrence.

5. Assist in training supervisors in accident prevention techniques. Work closely with the General Safety Supervisor on this program.

6. Initiate corrective action to prevent accidents. This should be done through close cooperation with the department supervisor involved.

7. Inspect for hazards—carry on a constant plant inspection; study the reports of inspections, discuss them with department heads and supervisors to see that prompt follow-up action is taken on hazards which show up on the inspection report.

8. Assist in developing safety rules. Become familiar with all applicable state codes and standards governing safety, standards pertaining to mechanical guards and operating procedures.

9. Initiate safety publicity at the local division level. Constant effort should be made to properly advertise the positive aspects of the safety program.

10. Keep accident records necessary to satisfy state, National Safety Council, industry association, company, and division requirements. This involves the safety committee minutes, reports of any disabling industrial injuries, the monthly industrial injury report and the reports required by industry associations.

11. Schedule safety meetings. Assist in organizing safety committees in departments and prepare material for consideration of accident prevention committees. Act as secretary of these meetings.

12. Handle the details of compensation cases, the report of accident which must be filed with the insurance company or the Department of Labor and Industries, and contacts with the doctors.

13. Assist in indoctrination of new employees in broad policy matters relating to accident prevention.

14. Confer with engineering personnel on the design of machine guards.

15. Arrange special educational activities, poster displays, or visual aid materials to be used in the promotion of the safety program at the division. Effective advertising of the positive aspects of the safety program should be carried on constantly.

16. Assist in standardization of first aid and personal protective equipment.

17. Assist in arranging for first aid classes and training.

We believe that we have an effective accident prevention program. We believe that we are adequately geared to the problem of anticipating and meeting the future industrial safety and health problems which may arise at our plants.

I SHOT AN ARROW INTO THE AIR

By W. C. BREMNER
Supt. of Safety, Commonwealth Edison, Chicago

Many years ago Henry Wadsworth Longfellow wrote his now famous poem beginning, "I shot an arrow into the air, It fell to earth, I know not where." The thought behind this delightful verse was that once an arrow is released, where it goes, what it does, and what effect it has, may be unknown to the archer.

I believe that the arrows in our safety program are like those of Longfellow's poem: what they accomplish, whom they influence, and how effective they are, are often an enigma to the man who creates the program, or who instigates its adoption, or who pays for it.

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monwealth Edison, don't ask me how effective any particular activity has been. I don't know—any more than a preacher knows which sermon kept someone from straying, or a parent knows what action was most helpful in bringing up a child, or a teacher knows which lesson was most helpful in molding a mind toward understanding of a subject. I do know that the overall effect has been a satisfying frequency rate reduction in the last eight years.

Now don't misunderstand me. We don't pretend to have all the answers, and we're not up in the clouds wearing a halo. What we are doing isn't necessarily right, and may not fit your situation at all. But I hope that some of the ideas, schemes, and gadgets I shall describe will help you in your all-important work of preventing accidents, injuries, and fatalities.

First of all, let's look at our problem. Commonwealth Edison generates electricity in 13 generating stations, one of which is atom powered, and delivers it through 5,600 miles of cable and 31,000 miles of overhead lines to 2,000,000 customers located in an 11,000 square mile territory ranging from the Mississippi river to Lake Michigan, and from the Wisconsin line southward about 115 miles.

To accomplish this job, we have 13,000 employees; about a fourth of them work in our generating stations, about one third are offices or shops, and the rest are scattered the system in small crews consisting of one to ten men. We drive about 30 million miles a year in 1,500 passenger cars, 1,000 trucks, and 500 trailers, cranes and assorted vehicles.

We operate equipment ranging from small meter calibrating devices on a work bench, to boilers almost as large as our 20 story, quarter of a block square main office building, which burn 150 tons of coal an hour.

The responsibility for doing this job safely is the responsibility of everyone, from the president on down, but the safety section is charged with the specific job of accident prevention; so let's look at the organization of the safety section, which is part of the industrial relations department. Reporting to the superintendent are a safety engineer and two safety supervisors.

The safety engineer has a safety advisor, a stenographer and a statistician; the two safety supervisors have functional supervision over 11 safety advisors assigned to our seven divisions. This makes a total of 18 people, or about one safety man for every 700 employees in the company, which, I believe, is about average for the industry. Our budget amounts to about $1 per month per employee.

Policies are determined by the Safety Policy Committee, composed of the managers in charge of construction, power production, engineering, operating, and industrial relations; the personnel director; and myself. This high-level group meets every three weeks and not only sees to it that when a decision is made, the idea will be carried out, but also helps me by providing guidance and leadership. There are eight subcommittees of this main committee which study the details of various proposals and recommend action to be taken.

Our thirteen generating stations have a safety council consisting of the superintendent of all stations as chairman, and staff personnel and the assistant chief of each station as members. In addition, every station has its own safety committee to handle problems within that station.

In several of the divisions, each district has a safety committee. In some, the members are selected by the superintendent; in others, they are voted into office by their fellow employees. Several of our present safety advisors became interested in safety work when they became committee members years ago. We also have tool committees and other groups who keep safety in mind when making decisions on tools and equipment. And a representative from the safety section is a member of each of the committees mentioned.

But no safety program can succeed without the backing of top management. One of the indications of our top management's attitude on the importance of accident prevention is the fact that the annual report (mailed to all employees as well as to stockholders) contains a statement of our safety progress. And each fall, at our all-day management conference, where the president, vice presidents and other executives discuss past results and future activities, the subject of safety is prominent. One of the highlights is the presentation of the president's medal to those employees who have saved someone's life, either on or off the job.

Another tradition at this annual meeting is the awarding of prizes for the first, second, and third best suggestions, and for the most suggestions accepted. Suggestions on safety lead all other classifications and account for about one seventh of all those received.

Now, let us discuss some of the many programs, ideas and innovations we have initiated or have perpetuated to make our employees safety conscious. First, of course, is that old reliable activity, the safety meeting. It it is a large meeting, we increase its effectiveness by inviting a top official to attend. It is not unusual for a division vice president to appear and speak. There is nothing more effective than for the men to hear, right from a top executive, what the company's attitude is toward safety.

If it is a small meeting, we may make a game out of it. In "Tic Tac Toe—What Do You Know." the men are split into two teams. A man from one team chooses a category, selects one question from a group of 10, and if he answers it correctly within a two minute period, places his "X" or "O" in the proper space. The other side then gets a turn. The members of the winning team get an inexpensive prize—such as a cigar or candy bar for each man—and the participants, as well as the onlookers, have learned a safety lesson, while enjoying it.

If it is inconvenient to bring the men into a meeting, we go to them by means of a slide projector, altered so it can be operated on 6 volts as well as 120 volts. The leads can be connected to a truck or car battery, and the cover has a built-in screen. With this, we can hold small safety meetings right in the field; or by changing the 6 volt bulb to a 120 volt bulb, we can use it in a meeting room and describe recent accidents, demonstrate the correct or incorrect ways of working, and describe pictorially all the other information which safety people constantly bring to employes.

Where applicable, we use a working model for demonstrations.

If there is an area which has an especially poor accident record, we may invite the foremen to a series of evening dinner meetings. We choose a well-known restaurant, bring in about 50 foremen at a time, and have a company official, such as a vice president, discuss the company's position and attitude on safety.

At one such series we asked the foremen for their comments; and no matter what each foreman said, no matter how impractical his idea, or unwarranted his gripe, we made no attempt to argue, or to justify the company's position or policy. We merely noted their comments, thanked them, and assured them that we would make whatever changes we could as soon as practicable.

After the series of meetings was concluded, we summarized all the comments, and analyzed the ideas and suggestions to determine which ones were most often mentioned or were giving the most trouble. Then we set out to change or correct these items—with the result that in those areas involved, we had the greatest decrease in the number of accidents in the next few years.

In our construction areas, foremen are furnished material for use in a weekly tailboard conference—so-called because it takes place at the "tailboard" of the truck. Some of the topics are discussions or editorials, and serve as a basis for the foreman to analyze the actions, attitudes or habits of people, or the hazards of the job. Other topics are pictorial, and illustrate unsafe practices.

In handling the pictorial topics, the foreman gives each member of the crew a copy of a picture, where the lineman has dropped a wrench; then asks leading questions such as, "What is the safe way to raise or lower tools to or from a lineman on a pole? Is there anything in our safety rule book regarding this practice? Why should everyone wear a hard hat?" etc.

We also discuss recent accidents, using cartoon drawings, which, with the descriptive material, explain what happened. These tailboard topics can also be used in a shops area, and can be issued monthly or quarterly —depending on how often you believe they will be most effective.

A moment ago, I mentioned a safety rule book. I believe that most large companies have one, and all companies have policies or practices which could be regarded as rules. We have a "general" book which applies to all employes, and special sections which are added to the general book that contain the rules for a particular type of work, such as stores, meter, shops, underground, generating stations, overhead, etc. We also have a series

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work practice manuals. These show the approved ways or methods of doing the work and differ from the safety rules in that they go into detail as to how a particular job should be done. For example, a safety rule might state that a transformer must be tested before it is connected, but how it should be tested is described in these manuals.

However, no matter how many rules or rule books we have, no matter how many work practices have been tried and approved, no matter how many tools have been safely designed, we still must sell every employee for until a man is fully sold on safety, he is not a 100 per cent safe worker. Now there are a lot of ways to sell, and a lot of ways to advertise—which is a preliminary step in the selling process.

One of these ways is to use signs. I'm sure all of you use them in some form or other and to some extent Since first impressions are important, every applicant coming into one of our employment offices sees the statement, "Safety is a MUST in our Company and helps make it a good place to work. Make sure of safety first."

From the time an employe signs on with us, until he signs off many years later, he is besieged with signs. They may hang on the wall of a district garage and carry a message for operating personnel, or be large outdoor affairs, so located that both employes and the public can see it. It may paraphrase the well-known G. I. slogan, "Joe was here—and worked safely," and be pasted on the side of a transformer so it will be discovered by the next crew assigned to this location; or it may be a catchy message cemented to the aisle of our shop, where mechanics, carpenters and painters can see it—if they watch their step.

For bulletin boards, we buy posters from the Edison Electric Institute or National Safety Council, or we originate our own. To illustrate the importance of using protective equipment, we conceived 12 posters using a sports professional as the theme. The "Old Pro" sez: The other eight are in the field, but still the game must wait: Until he dons his safety gear, he won't go near that plate." Each month a different sport is depicted: Basketball in the spring, football in the fall, hockey in the winter, etc.

Each of our construction crews is furnished a card every month. These are hung in the crew compartment of the trucks where the men will see them as they ride from job to job. Some of the cards are aimed at a specific season of the year, others at a specific date. When we have our annual drive or campaign, which I'll describe later, we design a card to augment whatever other publicity is used.

For many years, our construction crew foremen and their supervisors were issued cards. Each four week period, a star was pasted in the proper space to indicate a perfect record. If a lost time accident occurred, it was recorded in the second period. Similarly, two non-disabling or no-lost time accidents are shown in the fourth period. We discontinued their use several years ago, not because the idea wasn't effective for awhile, but because many years of use had dulled their impact.

We believe that in safety salesmanship, you have to keep using different and novel techniques to maintain interest.

Every four weeks we issue an Accident Experience Report showing the total number of accidents occurring during the four weeks, and year-to-date; the number of disabling injuries; and the frequency rate, compared with the previous year. We also describe the disabling injuries during that period. The seven divisions are listed with the one having the best record on top, the poorest on the bottom; the generating stations are similarly arranged, as well as the miscellaneous departments. This gives an incentive to each group to get their name on top.

Similarly, a monthly motor vehicle accident report lists the number of car and truck accidents and the rate per hundred vehicles. We use this comparison rather than accidents-per-mile basis because of the difference in traffic conditions between our rural areas and Chicago. Both the injury and vehicle reports have company-wide circulation, so that everyone has access to the figures. Transportation Memos, varying in color and carrying a different message each month, are pasted on the dash or other conspicuous place inside our cars to remind the driver that he should be a "better than average driver."

Also, we issue from time-to-time bulletins on hazards that come to our attention which

might not be obvious to the average person. Thermal insulating underwear, for example, is wonderful for outdoor work or play. But when first sold, if a spark from a cigarette or campfire set it on fire, the synthetic it was made of would melt and create a hot, sticky lava which could flow down a man's body and burn him from chest to feet. Similar bulletins have warned against trying to burn batteries with the trash, flammable cleaning solvents, dangerous toys for children, and hazards encountered when working near plants which use radioactive materials.

In indoor areas like generating stations and shops, accident charts show the progress being made. The top red line indicates our 1954 experience; blue, 1955; green, 1956; orange, 1957; etc. These can be placed near bulletin boards, in locker or assembly rooms, in hallways, or near dispensing machines—anywhere they will be seen by a large majority of the employes.

In many locations, the number of days which have elapsed since the last lost-time accident is recorded daily, and woe unto him who breaks a long-standing record. I saw a cartoon some time ago, in which the injured man says, "Oh, the arm happened on the job and my co-workers did the rest—seems I ruined a five year safety record."

Some divisions issue a monthly bulletin to all supervisors which shows the date of the last disabling injury, the number of accident-free days, and the number of manhours completed for each district within the division.

Of course, we wouldn't pass up the opportunity to use our monthly magazine, and we try to report safety news items of sufficient interest to be printed. When an event of unusual significance occurs, we ask for the front or back cover, and the editor has been very gracious and accommodating.

Now let's discuss some of the gadgets, gimmicks and glamorous, glittering, graphic guile we have used to remind employes that the company has a safey program.

Many of you, I know, are served by electric utilities which use Reddy Kilowatt as a symbol of electric service. Our company uses "Little Bill." Shortly after he was introduced to our customers, the Safety Section created "Bea Safe" to represent our many safety activities. We think she is very attractive and a first-class attention-getter.

For example, when we make arrangements with the window display manager to devote one of the windows in our main office building to safety equipment, Bea Safe is there to be seen by the public passing by as well as by our employees. Whenever we have an open house, such as upon the completion of a new building like our Technical Center, a new generating station, or district office, we try to hornswoggle space somewhere to preach the safety message. If families are invited, we may show Mickey Mouse movies to the kids, or distribute an inexpensive prize to each child. And many times after mama has seen what protective equipment papa is supposed to wear, she makes sure he uses it.

Since pencils are pretty universally used, we requested our purchasing department to buy them with safety mottoes imprinted. There is no charge on large orders, and the manufacturer has been furnished with several dozen slogans.

Everyone drinks water sometime during the day, so what is better than a drinking cup slogan, calling attention to safety at a time when an employee is relaxed and his mind receptive to a safety message?

Another gimmick we used for awhile was a telephone message device. Once a week, or oftener, we dictated a message on safety to a recording machine. It was connected to our main switchboard, and at *any* hour of the day or night, *any* employee, *any* place on the system could dial and hear a brief safety message. It can be rented from the telephone company for about $25 a month, and should be connected to an easily remembered number such as 7233, which spells SAFE on the telephone dial. The message might give advice on accident prevention, report the details of a serious injury, or be a reminder of the season's traffic hazards. During World's Series time, we reported the score at the end of each inning.

Another gadget available is an automatic slide projecting machine. This holds 16 2 x 2 slides in a revolving disc inside the box. Each of the slides is projected automatically for six seconds onto the built-in screen. A minute and a half is required for the cycle to be completed before the first slide appears again. The device can be placed in a building lobby, near a water fountain, coffee dispensing machine, or any other location where employe traffic warrants it. You can load it

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with slides for linemen one day, for boiler mechanics the next, then direct it toward firereroom hazards, or shift it to the girl's lounge and warn the gals against slippery floors, high heels, open file drawers, supervisors who pinch, and other hazards encountered by office girls.

Our 10,000 and 20,000 volt rubber gloves are turned in for testing every 3 months. First, they are washed and sterilized, then carefully inspected, electrically tested, and sealed in boxes for re-use. Just before sealing, a card is inserted to remind the linemen and others who use them that a glove on the hand is worth two on the truck. The cards are varied, bringing a new message every quarter.

Another effective tool is the use of Safety Achievement awards. When a small group—half a dozen men—has worked one, two, three, or more years without a disabling injury, this award is presented by the division safety advisor. For larger groups, who accumulate 50,000 or more manhours, a framed certificate is awarded, signed by myself and the president of the company. When 250,000 manhours are completed, a red certificate is presented.

These are all dated one year, two years, three years, etc. since the last disabling injury. And on those important occasions when a department achieves one million manhours, an impressive golden plaque serves to remind all employees involved that they have accomplished an outstanding safety achievement.

The Edison Electric Institute is happy to give national recognition to groups who have worked 1,000,000 or more manhours without a disabling injury, and a similar plaque is available from the Greater Chicago Safety Council for firms in the Chicago area.

Usually "coffee and" is provided when the first award is presented; after several years a breakfast may be served; and when a million manhours is celebrated, a full course dinner marks the occasion. We realize that a $4 dinner for 250 employes is $1,000; but we also know that an analysis made in our company several years ago, showed that the average cost of a disabling injury (exclusive of fatalities was $442. Thus, if we eliminate just one lost-time accident in each of the two years it takes a group this size to reach a million manhours, we are money ahead, for the saving of the indirect expenses and the reduction in the number of minor accidents are plus values which completely offset the price of the dinner.

Many times, individual awards are made to each member of the group, with suitable engraving which serves as a constant reminder of the occasion. In addition to the items shown here, there are many others available—key chains, ash trays, tie clasps, nail clippers, small tool kits, steel rules, etc. We encourage the awarding of these gifts, because other employes see the item or hear about them, and strive a little harder to win something themselves. It is a peculiar trait of the average employe that he'll work all year for $5,000, but for $5,000 plus "coffee and," or breakfast, or dinner, and a souvenir, he'll work *safely* all year!

When a group is getting near an award date, cards or certificates are sometimes issued several weeks in advance to stimulate further interest in reaching the goal. Some people are superstitious, saying, "Let's not talk about it until the day it happens"; but we feel that the more publicity there is, the more safety consciousness is created.

To increase pride in the wearing of hard hats, we designed and issued Scotchlite emblems, symbolic of the department or type of work involved. Whenever a man has been spared a severe injury, or perhaps death, by wearing a hard hat when struck by a falling object, we present him with a special hat, emblematic of his membership in the Turtle Club. The hat becomes his personal property and the ceremony usually occurs at a safety meeting. We average about one presentation a month. What an easy way to recognize the saving of twelve injuries a year!

Similarly, a Wise Owl Club certificate, presented to a man whose eye has been saved, stimulates interest in the wearing of safety glasses and goggles. Both the Turtle and Wise Owl clubs are glad to furnish the equipment and accompanying certificates either free or for a small charge.

Some of these selling ideas apply only to certain departments. We try to reach every employee. One year I mailed a letter to everyone's home, announcing the decrease in the number of disabling injuries in the previous year. The next spring, a similar letter was prepared and our advertising department helped me "pep it up" a little in format. I

also wrote a personal letter to every department head congratulating him on the improvement in his disabling injury frequency rate; or, if his group hadn't done so well, encouraging him to do better. I know these letters were effective from the answers I received. Sometimes the department head used my letter as a basis for one of his own which he issued to the employes in his area.

Here is a very effective tool for pinpointing those areas which need special attention. At the end of the year, we analyze all accidents occurring in a division or generating station. First, we list the accidents according to the foreman whose men were involved. Second, we record the classifications of the workmen injured, and their age groups. Then we list the injuries by type: falls, burns, electric shock, etc. Next we show the reasons: improper tools, lack of adequate instruction, omission of protective equipment, violation of rules, etc. Then we go over every item with the superintendent and his assistant so that they get a complete and accurate picture of their accident problem and can take steps to correct their deficiencies.

About once a year, we put on a special drive or campaign. In 1955, we had Safety Week. A letter was mailed by the manager of industrial relations to the home of every employee. The goal was to have the entire company work one week without a disabling injury. Buttons were issued, to be worn by everyone during the drive. They were made of celluloid and, much to my embarrassment, a welder in one of the shops set his on fire and we almost had an accident!

The back cover of our monthly magazine carried the theme, "Let's dwarf the number of accidents with the safe seven—and keep the record clean." Crew cab cards for men using trucks, and posters on bulletin boards for shop and office workers reminded everyone they should be extra careful from March 20th to 26th. The week was a success, and with almost 16,000 employes working 40 hours apiece, the entire company reached 600,000 manhours without a disabling injury for the first time in history.

In September, 1955, we tried to double the figure; this campaign was called, "Shooting for a Million." Our shops built a rocket, we picked a pretty girl to touch it off, and arranged with the editor to use both the front and back cover of the *Edison Service News*. Again a letter was mailed to all employees, and pins worn by everyone during the two weeks. This time, we had them made of cardboard.

Each day was sponsored by a company official, and a daily bulletin was issued. These bulletins had a picture of the official, and a little corny verse to add interest. Each successive day showed the rocket moving farther from earth and closer to our goal of 1,000,000 manhours. In spite of all this publicity, however, "Sputnik" turned out to be "Sputternik."

But we feel our efforts were not in vain, for several areas determined they would get a million manhours themselves. Two of our generating stations made it, and a third reached 870,000 manhours before an injury broke the record.

Our campaign in 1956 was a slogan contest, with cash prizes ranging from $200, down to $5, for the 25 best slogans. In addition to the publicity in our magazine, we put posters on all bulletin boards and used our telephone message device to encourage participation. Included with my letter to every employee was a set of rules and an entry blank. When the contest closed, we had received over 6,000 entries, indicating the interest shown by employees all over the system.

The 1957 program utilized the very powerful safety movie of the U. S. Steel corporation, "Knowing's Not Enough." Publicity included cards in elevators and on lunch room tables, posters on bulletin boards, flags at each headquarters, crew cab cards, and the back page of our magazine. Everyone seeing the film was given a small K N E flag to wear on cap, blouse, or lapel, and our safety advisors wore specially made ties with yellow flags showing against a blue background.

Our campaign in 1958 was called, "Get Safety into Orbit around the Edison System." Division vice presidents, station superintendents, department heads and safety personnel wore handkerchief and neckties specifically made to illustrate the theme. Foremen wore arm bands during the two weeks of the campaign. In addition to magazine and poster publicity, each employe was sent a letter, and specially designed match books were distributed by an attractive "Bea Safe"

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gal in various stations, division offices and porting headquarters. We also arranged to ve a message from "Bea Safe" imprinted on every employee's pay check envelope.

In 1959, when we adopted Mouth-to-Mouth resuscitation as the preferred method of artificial respiration, we showed the film, "Rescue Breathing" to every employee on the system. We also distributed wallet cards to replace those formerly issued on the Back-Pressure Arm-Lift technique.

The 1960 campaign was based on a movie which was written, directed and produced by our own personnel, using professional help only for the recording and editing. "Take Another Look" is a 16 millimeter, sound, color motion picture which portrays six accidents typical of those which might occur on any electric utility system.

Using a golf outing as a background, this 27 minute movie uses "flashbacks" to illustrate each accident. We followed it up with posters on every washroom mirror. We have sold about two dozen copies of the film to other companies at $150 each; if you are interested, contact me; there is no charge for a preview.

In 1960, we held an essay contest in connection with company-wide showing of the National Safety Council movie, "Safety Everywhere — All The Time." Employees were urged to send in essays of 100 words or less on the theme, "I should practice Safety Everywhere—All The Time because ——." Entry blanks were mailed to homes, nd $625 in prizes were offered. Award checks were presented to the 26 winners at a noon dinner, with suitable pictures and publicity.

This year, we adopted "Cardiac Compression" or "Heart Massage" as a life-saving technique to be used in conjunction with Mouth-to-Mouth or Mouth-to-Nose respiration on victims whose hearts have stopped because of electric shock, heart attack, drowning, gas inhalation, or other cause. Our medical director trained a group of specialists, who in turn trained other employees in the proper technique.

We try throughout our contacts to *sell* safety rather than force it, to convince people they *ought* to work safely rather than penalize them when they don't, to remind supervisors and foremen that accident prevention is *their* responsibility and that we are there to *help* them, not to *dictate* to them. We also stress the fact that we are available 24 hours a day. If a night shift wants to hold a safety meeting at 11 p.m., or 2 a.m., or 7 a.m., we'll be there to handle our part of the program.

In spite of all these activities, however, accidents do occur, and when they are serious, a formal investigation is made. A committee of high-level supervisors is selected by the safety policy committee to investigate all aspects of the accident. The investigation has a two-fold purpose: First, to learn exactly what happened so that recommendations can be made to avoid similar mishaps in the future; second, to impress upon the group and others, that the company really means business when it comes to accident prevention. A union representative is always invited to attend to see that his men get a square deal and, later on, when the report of our findings is published, to stop any rumors or incorrect statements by saying, "Now wait a minute: I was there at the investigation, and the report is correct."

The reports are normally three or four pages long and are addressed to the safety policy committee for appropriate action on the recommendations. Copies are distributed so that everyone knows the facts. Usually a picture or drawing is included to aid the reader in visualizing the job conditions. If the accident is less serious, but could have been bad, an informal investigation is conducted in the same manner, except lower-level supervisors are on the committee.

Whenever an employee has had three or more accidents in a short period of time, I write a letter to the station superintendent, or division vice president so that appropriate action can be taken, if necessary. The employee may be careless, have poor eyesight, not enough training, the wrong attitude, or some other characteristic which adversely affects his work.

But the backbone of our safety program is the work done by our safety advisors out in the field, shop, or generating station, contacting men day after day, counseling with foremen, inspecting job conditions, and participating in safety meetings.

Now, perhaps you are wondering how well we are doing. In 1954, we had 569 disabling injuries—an average of 11 per week. In 1961, we had 100 disabling injuries—slightly less

than two per week. In 1954, we were 18th out of 20 large electric utilities (those having 5,000 or more employes). Last year we were better than the average, and while we still need to improve, we have cut our disabling injuries 82 per cent and all injuries 48 per cent in the last seven years.

I want to emphasize that all these gimmicks, gadgets and ideas I've described are merely the advertising which calls attention to the fact that we have a product—safety—to sell to our employes. The actual accident prevention work is done by competent engineering; adequate education and training; strict, but fair enforcement; and last of all, enthusiasm.

In closing, let me quote the motto that is on the wall of my office—a statement that was written by one of our supervisors back in 1922:

"And the end is that the workman shall live to enjoy the fruit of his labor; that his mother shall have the comfort of his arm in her age; that his wife shall not be untimely a widow; that his children shall have a father, and that cripples and helpless wrecks who were once strong men, shall no longer be a by-product of industry."

HOW TO START A TRAINING PROGRAM

By J. G. CULLEN
Manager for Plant Training, Johns-Manville Corp., New York, N. Y.

Many a training effort has produced disappointing results because of inadequate preparation. The importance of intelligent, thoughtful preparation in place of hasty, ill-advised starts cannot be overemphasized. If you haven't the time to prepare for training, then you had best not do it at all; you might well be attempting a solution without knowing what the problem is.

The subjects I will cover are:

1. Fundamental considerations that shape the preparation of training, and
2. The preparation of training
   a. Management policy
   b. Analysis of training needs
   c. Program design

Two separate but related fundamental considerations shape the preparation of training. The first concerns a definition of training itself. If we're going to prepare something, we ought first to know what that something is; then our preparation is more assured of following the right directions. There are many definitions of training. For our purpose let us define it not in terms of what it is, but what it does.

Training causes change. This change can fall into one or all of three areas: knowledge, skill or attitude. To use an oversimplified example, suppose this paper gives you new knowledge about training and suppose further, you are then more skillful the next time you plan a training program. If this happens, some training has taken place because you have received knowledge and have used it. This might even cause you to have a different attitude about training —a better attitude, I hope.

Training, then, creates change and this is our first fundamental consideration. When we undertake a training program, we attempt to bring about change in knowledge, in skill or in attitude. This line of thought leads to our second consideration. Our preparation should do all possible to create an environment in which the change can successfully take place—an environment which will support the change.

Imagine that a certain line represents the performance of a group of supervisors before, during and after a training period. Performance is low in the subject areas beforehand, during the training period it rises, after the training period it slips back to the same or to a lower level. Often, but not always, this is not due to a deficiency in the training itself, but to environmental influences that negate the effects of training. The change was accomplished but not held.

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pose that a group of supervisors are trained in some fundamentals of accident prevention. However, in their daily working situation, no performance goals are set, nor is any emphasis placed on their results either in the day-to-day contacts with their superior or in more formal periodic appraisals. In this situation the maintenance of any improvement would be highly doubtful. To summarize the second fundamental in a sentence: In preparation for training, create an environment that will support the desired changes.

Now you may ask: "How do you create this environment?" This leads us to the next major area of consideration—the preparation of training. You recall that the preparation requirements fall into three categories of activity: (1) Management policy, (2) Analysis of training needs, and (3) Program design. Continuing with the need for creating an environment that will support the desired changes, we ought to consider the management policy aspect of preparation.

All worthwhile training efforts stem from management's recognition of a need and the genuine desire to do something about it. If this cannot be said of a training endeavor, we should be skeptical about its validity. The most successful training efforts are those where line management takes the responsibility to obtain the results which only training can help them to achieve.

An appropriate example follows: One of our multi-plant divisions once decided to bring about drastic improvements in accident prevention performance. The development, implementation and follow-through of this effort embraced the following elements:

1. They set goals for their plants to meet.
2. The top manager personally followed up on every disabling injury occurrence.
3. The top manager required written action plans for each plant.
4. Results in accident prevention became a major consideration in performance appraisal of all levels of supervision.
5. Assistance was given each plant management group in the form of training in principles and techniques.

In examining this pattern of approach we see that training was one of a number of elements of a total effort. The effort was successful. Goals were met and held and largely because it was a line effort, supported by training, from the start. To put it succinctly, in preparation for training, establish the training as an integral part of line management's policy.

Analysis of training needs is the next aspect of preparation. Obviously, analysis is indispensable. To treat the subject thoroughly, however, would be too lengthy. Let me, instead, suggest some thought starters. Training needs rarely exist in isolation without other related problems. A study of the overall, total situation out of which the training need has grown will provide insight into separate but pertinent problems in the organization unit. This insight serves several purposes.

First, it serves to specify and weight the effect of each problem in the total situation. It makes possible a separation of those things that training can help, from the things training can do little about. Management then has a realistic view of what results can be expected from training and what other problems need to be acted upon if full results are to be achieved.

A few examples, in the form of questions, will clarify the concept of related problems. In the area where training will take place:

1. Are supervisors overloaded or spending their time in such a way as to prevent adequate implementation and follow-up of the training?
2. Are work methods and facilities having a bigger effect on the problem than lack of training?
3. Are there serious, uncontrolled hazard exposures in the environment in which the trainees are required to work? These are only a few questions that analysis will answer. You can no doubt think of many more.

Second, analysis is necessary to define every major knowledge, skill and attitude element in the training area. This is an absolute necessity because line management will sometimes make a vague request for "some training for these boys." A good analysis will convert this request into a specification of the knowledge, skill or attitude requirements of the training program. From this specification, a formulation of concrete training objectives or goals is possible. Basically, if you can't state your objectives, you can't communicate them.

Program design is the third and final point of preparation. Program design is the putting together of a usable, efficient training program that will satisfy the needs your analysis has indicated. There are three main activities related to program design.

1. Structure
2. Controls
3. Follow-through

Since design, too, is a lengthy subject I will only touch on the necessary considerations and decisions.

Structure deals with:

1. The content of training

   What subjects should the program embrace to obtain the desired changes?

2. The sequence of training

   How are the subjects related? What necessarily comes first? How will knowledge, skill and attitude be built up in a systematic way?

3. Time allocations

   What is the value of each subject? How much time will be devoted to it?

4. Training techniques

   What methods will be used? Lecture, conference, project assignments, cases, films, are a few possibilities.

Controls over training are necessary simply to tell you if your objectives are being met and to what extent. To establish controls I would suggest this pattern:

1. Decide upon the factors that training should affect.
2. Find ways to obtain information to tell you what is happening to these factors.
3. Interpret what the information means.
4. Decide what action to take if the information indicates that desired changes are not happening.
5. Act.
6. Review the results.

Although controls are used during the implementation of training, it is also necessary to build them in during preparation of the program. If objectives are not being met, it is obviously necessary to determine why and to decide what can be done about it. An example will illustrate the function of controls.

Suppose that accident frequency is running at a level of 10.0 and your goal is to reduce it to 5.0 in a given time. This would be one factor of control and there would probably be more. The program is launched, but your control information shows that frequency is the same or gets worse. Some pretty serious investigating should be done to find out why. Is the program deficient or are there other disturbing influences concurrently at work in the situation?

Another quick example of a type of control over a less tangible aspect might be the study or spot-check of equipment proposals to see if engineers who receive training in principles actually use the principles in equipment design and planning. Quizzes, tests, study of data trends are all examples of control information. To summarize: In preparation for training, plan your controls.

The third and final point of design deals with planning for follow-through. Preparation should always include plans for follow-through.

A Plant Manager once said to me, upon completion of an extensive training program covering accident prevention principles, "These are good principles, but what are we supposed to do now?" We then realized that our planning had missed a point, and we went back and modified that portion of the program. We built in a series of quite specific recommendations on how the plant organization could really implement and continue to use the principles outlined in the program. Stating the final point briefly, in preparation for training, plan your follow-through.

I have suggested a number of considerations fundamental to starting a training program. Experience shows that if any of these basic requirements are minimized or overlooked, the total effort will fall short of the desired goals and people will be disillusioned and disappointed with training results.

FACE-TO-FACE CONTACTS IN SAFETY

By EARLE S. HANNAFORD, Ph.D.
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All of our skills and learning in the field of communication have been pointed at bridging time and space barriers between participants. Two-way communication, such as the telephone, gives an immediacy, interchange and feeling of contact that one way vehicles, such as books, newspapers, motion pictures, radio and TV, lack. Yet in terms of the added emotional dimension of face-to-face contact, the telephone doesn't quite make it either.

My discussion will focus on the still irreplaceable factors that give face-to-face contacts their power and the way to use them successfully. Although my applications will be in the safety field, the fundamentals hold true for all human communication in the person-to-person area.

My paper is divided into three parts:

First it behooves us to check over the key psychological factors upon which the power peculiar to face-to-face communication is based. But *I am not* going to flood and overwhelm you with professional and technical terms—we'll keep it in layman's language.

Secondly we will review the practical step-by-step procedures in face-to-face communication and how to make sure they are working effectively and

Third and last, our workshop will consist of several brief role-playing demonstrations illustrating and applying the step-by-step procedures we have developed. Volunteers from the group will be used in the role-playing.

The emotional dimensions which only face-to-face communications have are actually achieved by overcoming certain emotional blocks. This is what makes it such an absorbing and interesting challenge. Unless we know and recognize the symptoms of these emotional blocks our success is largely a matter of chance with the odds being stacked against us.

Of course I can just go ahead and name these emotional barriers for you, but I am not going to do so. Why? Because that would not be a realistic approach.

So, I am going to describe some actual cases in which these symptoms appear, for that's the way we run up against them in real life situations. After I describe each case, we will draw from it the primary symptom or symptoms of emotional blocks to face-to-face communication and then we will decide what to do about it. The cases are all accident cases; however, they could just as well be chosen from other face-to-face communications situations for, as I said, the fundamentals apply and hold true for all such communications endeavors.

Case I—Description: Twenty-two year old Carl's right hand was badly mangled in a large forming press; his sixth serious disabling injury to his hands or arms in six years of employment. His job had been changed several times attempting to get the right one and his various bosses had given him continuous personal attention and training on a face-to-face basis.

The surgeon was very doubtful about saving any of his fingers. When his boss insisted on trying to save them, Carl broke in, saying bitterly, "They are no good to me and never will be—take 'em all off." As the result of exceptional, persistent work by the surgeon, all but his index finger were saved.

Investigation disclosed the following:

1. Carl had had to leave school at 16 to help support his widowed mother and several brothers and sisters.

2. He was a good golfer and caddied week ends to earn more.

3. He passionately wanted to be a professional golfer but couldn't because of having to help support the family from pay day to pay day.

4. With his fine coordination and quick reflexes he could easily have avoided the injury to his hand.

Emotional Block—Symptom I

People tend to "listen" to themselves, i.e. their own thoughts and desires—not what you are saying.

Emotional Block—Symptom II

An individual's acceptance, happiness and morale seem to depend more on what he expects of the future than on the pleasantness or unpleasantness of his present situation.

Emotional Block—Symptom III

A person responding with or showing emotion, i.e. anxiety, fear or tension, does not know precisely what to do. One who knows what to do and has the skill responds rationally.

Emotional Block—Symptom IV

The commonest of all emotional blocks is the instinctive drive to resist coercion, whether it be from a frustrating and seemingly inescapable life situation, or what appears to be pressure from some individual or group.

Obviously, I chose this case because it is complex enough to give rise to four key emotional symptoms rather than use four separate cases. Of course all cases are not that complex, but all four symptoms are so interrelated that the recognition of any one and its treatment could have insured effective face-to-face communication. So let's discuss what to do when our diagnosis reveals such symptoms of emotional block.

In the interest of simplicity and saving time, I am going to designate each symptom by a word or two. Thus in our discussion reference to them will be easy and direct.

Emotional Block Symptom	*Recall Nickname*
I	Self-Listening
II	Future Expectations
III	Anxiety Response
IV	Resisting Coercion

Piercing the human barriers to face-to-face communications.

We humans identify and relate most readily to ourselves and our own desires. So we have our own goals and persist in trying to achieve them. Thus "self-listening" is natural and automatic. Our piercing this emotional barrier calls for:

1. Identifying ourselves and our goal or goals with the other person and their goals.

2. Giving them help in selling themselves on our goal so it becomes theirs rather than ours. "Build cupola's" when indicated. (I'll explain this in a moment.)

3. When they won't identify our goals with theirs, we must create enough positive tension so they will substitute our goals for theirs.

Since we are intent on selling our own goals, sincerity in helping people sell themselves is vital. They have to sense your desires. This calls for "empathy," not just "sympathy." Empathy is the ability to put yourself emotionally in their situation. Through our unconscious we sense such things.

Because they have generated so much tension for their goals we must create positive tension. I said *positive* from their standpoint, for our goals.

A moment ago I mentioned "building cupolas." Let me illustrate. An engineer brought his supervisor a beautifully done set of plans for a small building to house a substation in a residential neighborhood. The supervisor said "The plans are perfect but I want you to put a cupola on the building."

"It will ruin it," said the engineer. However, he did as he was told.

The supervisor knew from long experience that the chief engineer always had to leave his personal identification mark on everything by changing or adding something to it. So he built a cupola on a perfect plan he didn't want changed. Sure enough, the plan came back with big, slashing marks striking out the cupola and the note.

"Take off that damn cupola! It spoils an otherwise excellent job."

Yes, sometimes we may have to "build cupolas" so as to focus tension where we want it. Particularly where empathy paths may be blocked or not working at the time.

Symptom II, "future expectations," deals with probably the most baffling of all human emotional blocks, one that is often cruelly and consistently exploited. Why is it that "pie in sky" can override "meat on the table today"?

George Bernard Shaw once said, "Remember, our conduct is influenced not by our experience but by our expectations."

It shocks us to find that a person's attitude, acceptance, happiness and morale depend more on what he expects of the future than on what is happening to him right now. And yet without hope we cannot survive and may even seek death or injury as in Carl's case.

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proper question.

Politicians aren't the only ones who exploit this "future expectations" symptom with colorfully contrived word pictures based on obvious fallacies. Let's face it, we use it on each other and also on ourselves. In safety, as in all sane motivation for rewarding living, we must use ethical means in the true interests of the individual. And this can be done. Actually it involves seeing "cloud 9" in its real true colors so we face up to today's problems realistically. Here's the treatment for this symptom.

1. Insight into the true nature of anything comes with knowing and perceiving the interrelationship between events and things in terms of their togetherness, *not* as isolated events.

2. True insight is based upon organizing the facts and information given, *not* using large amounts and frequency of exposure to overwhelm reason and play upon the emotions.

3. Goals and incentives must be personalized by identifying them with the individual and things already known and accepted by him. This is a two-edged sword for it can be used just as effectively in convincing that something is true even though it is false.

4. A person passively agrees or disagrees until "insight" takes place, then he acts.

Symptom III, "anxiety response" is one we test for early in any face-to-face communication single episode or sequence. We must not do all the talking or selling. Early in the contact we must elicit a response to our pitch. If it gets an emotional one, i.e., if the individual's response shows fear, anxiety or tension, you can be sure he does not know precisely what to do. Moreover he is "listening to himself," not you. He has not got the "insight" we discussed in connection with the "future expectations" symptom.

Listening at the right time is indispensable to finding out who he is listening to. Unless he is comprehending and accepting, you are worse than wasting your time for he unconsciously construes it as opposition to his goal and he resents such pressure or coercion.

Remember the old teaching-learning axiom, "It comes out of the head just the way it went in." If it isn't getting into the head your way it can't come out that way. The only check is a listening check keyed by the proper question.

Moreover a key, pivotal item is finding out whether we need to drain off existing anxiety or fear (tension) before we can build tension for our own goal or goals. In this connection it is very important to remember that "anxiety response" is ambivalent. By that I mean it can result in either of two directly opposite symptoms depending upon the person's personality. In one, the individual may be violently and aggressively outspoken—in the other he may be quiet, unresponsive, withdrawn and non-communicative.

Here's a case which aptly illustrates the "anxiety response" symptom and one of its treatments.

Case II:

Mary is a restaurant worker. She has had 12 injuries in 15 years, eight of which were serious, disabling ones. A check showed that each of the eight occurred shortly after she had had to be disciplined. Mary was the type that needed frequent attention and retraining because she consistently and repeatedly violated instructions and safety rules.

Just after her most recent "face-to-face" session wih her boss, Mary was making sandwiches in the cafeteria line when she looked up and saw the safety engineer waiting for a sandwich.

"Hello, Mary," he said.

"Mr. Joe, we have the lousiest safety program in the world," shouted Mary, waving the sandwich knife.

All activity in the cafeteria stopped and all eyes and ears were focused on Mr. Joe and Mary. Some obviously were thinking, here's where Joe gets his lumps.

"That covers a lot of territory, Mary," said Mr. Joe. "Do you have anything in particular in mind?"

"Yes, see this bottle opener on the front of this counter? We don't open bottles here any more. I just know it's going to make me have a bad accident—I just know it will," said Mary vigorously and viciously slicing a sandwich in half.

Mr. Joe stopped around and checked the opener. It was round and projected very little and just wasn't a hazard.

"Mary," he said, "I'll have some one up here in a few minutes and remove it."

"Well—OK," said Mary.

Mr. Joe got his sandwich without a garnish of fingers but when he was 30 feet away down the line, Mary got in a last punch.

"Mr. Joe," she shouted, still waving the knife, "don't you forget it, now, you hear?"

The opener was removed and Mary has not had her usual follow up accident and three years have come and gone. Also, Mary is being given opportunities to talk it out, for then she seems to follow rules she used to ignore.

Now let's review briefly the things we can do to overcome the "anxiety response" symptom.

1. Ask a question or questions to see if the "anxiety response" barrier is present.

2. If the response shows emotion, bleed it off by helping them talk it out. Then and only then can we build tension to get action on our goals.

3. Remember, good listening is needed in face-to-face communication. Silence sometimes is really golden.

4. Check on how it is coming out of the head, *not* just how it's going in.

Our fourth and final symptom, "resisting coercion," is best overcome when the other three have been disposed of. That's because there is an element of resisting coercion present in all of them. If "self-listening," "future expectations" and "anxiety response" have been properly compensated for, the reminder falls easy captive. Here's how.

1. We learn best by seeing, and seeing things in their proper perspective cancels out fear of coercion.

2. Words alone are just symbols and are not convincing. They must produce images in the "mind's eye." Eighty-five per cent of what we learn comes through "seeing." Words are a tool to arouse pictures based upon previous experience. Actually we do not see with our eyes. They transmit impulses to our brains where images are created. The sounds we hear are also transmitted to our brains where they, too, create images or pictures in the same way. This is the "seeing" I am referring to.

3. Use words selectively so that their images or pictures are in terms of the person's desires, experiences and background, not ours.

Because, and only because we have explored the emotional barriers to face-to-face communications and know how to detect and handle their symptoms, we can now devise a simple stey-by-step procedure.

The practical step-by-step procedure for face-to-face communications in safety:

Motivation is one of the word symbols of our day and times. Product motivation unceasingly assails our ears and eyes, in fact most of our five senses. Thus it would behoove us to relate our step-by-step procedure to sound motivational principles even if it were not essential: however, it is vital to our objectives. Persuasion and motivation are identical twins that practically defy separate identities. In fact our step-by-step procedure is in many ways an extension and amplification of the three fundamental steps in sound motivation so let's look at them first.

Steps in Motivation

I—Identify yourself and your goal or product with the "buyer."

II—Remove any emotional blocks to action so as to insure "insight."

III—Set your goal for him and create enough positive tension so he will achieve it.

These three steps or factors in motivation are true for dealing with both individuals and groups. But before we begin our actual pitch we must know just what our goal and objective is and how it is to be achieved. Any type of communication fails if we are not clear on where we are going ourselves.

So we must decide which of these is our purpose:

The three possible purposes of face-to-face communications:

I—To direct, order or instruct.

II—To get their ideas or opinions and then direct or order.

III—To help them decide for themselves.

We are certain to create or entrench emotional blocks if we fail to make it clear which of the three is our purpose. Sure, sometimes the situation defines the purpose or it is or can be implied, but both we and our co-partners must be aware of the purpose for our get together.

Unless you have decided upon your purpose and specific goal or goals before—I said, *before* the actual face-to-face contact —don't have it. You will just be riding off

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n all directions at once. So decide. In living situations which arise quickly, it doesn't take long to fix on our purpose and goal. We can do it in a few seconds if we have to and do so constantly all our lives. Is your purpose to direct, order or instruct? If so on what, and what is the goal? sometimes you want to "sense them out" and get their ideas and reaction before you direct, order or instruct. This relieves tensions and keeps the line "clear." Finally we may want to have them develop what they want or should do and then help them to set a goal and how to achieve it.

Having set our purpose and goal we are ready for the contact.

Steps in face-to-face communications:

I—Identify, define purpose and goal. (Get responses.)

II—Check for and remove any emotional blocks.

III—Achieve insight and create action tension.

IV—Get a "playback" and "patch in" as needed. (If emotional blocks develop or reappear start over with step II.)

V—Reaffirm goal and have them initiate action as soon as possible.

When using the step-by-step procedure, it is important that it is done naturally and is not stilted or rigidly routine. It is best to learn the steps and know them and how o recognize the symptoms of emotional locks and what to do to overcome them. Once in mind, go ahead and do it without outlines or check sheets. Missing an item here or there is not as important as giving the feeling of naturalness, sincerity and achieving empathy.

Based upon our discussion prior to setting up our practical steps in the face-to-face communication process, the steps and their use are self-evident. So we come to the third and final part of our own discussion, that of illustrating them by using a few brief role playing sequences. Role playing is a powerful communications tool for we achieve identification through the individual's unconscious and conscious projection of himself into the roles being played.

Group procedure

All persons in the group observing the role playing are to be given copies of the "Face-to-Face Communications Performance Check Sheet," Attachment A, and complete one after each of the role playing cases checking the items according to his own appraisal. Following the role playing the check sheets form the basis for a question and answer discussion period.

Role playing—Case A:

Setting and orientation

A supervisor who had observed an employee servicing large, open type storage batteries the day before without wearing his eye shield, contacts him to sell him on using the eye shield. The company provides the eye shield and has safety rules requiring its use at all times on that job. The supervisor, John, contacts the employee, Bill, in the battery room where Bill is working.

Supvr.—Got a minute, Bill? I want to talk to you.

Bill—OK. Shoot.

Supvr.—I noticed you weren't using an eye shield on that battery job yesterday.

Bill—Yeah?—so what else is new? (Starts to walk away.)

Supvr.—Hold it, Bill. Come back here. I'm not through yet.

Bill—Aw, I got work to do, John—you should know that—you gave it to me.

Supvr.—I've got work to do, too, and talking to you is it.

Bill—Gabbing doesn't service batteries. I was working on them long before you started here. Remember? I broke you in, Kid.

Supvr.—Yeah—I lived through it. Now what you got against wearing the eye shield? This isn't your first miss, Bill.

Bill—When I get to be, ... I mean if I was boss, I'd change plenty around here.

Supvr.—Well you're not. See? Get with it and tell why you won't wear it.

Bill—I've told you before. Not having to wear glasses, the shield annoys me. It fogs up and it's uncomfortable and I've never splashed acid yet. I know my job—anyway they're my eyes.

Supvr.—They won't be worth much to you with a load of acid in them. Where's your shield? You should have it on for this job now.

Bill—Here in my pocket.

Supvr. (angrily)—Put it on and keep it

on, unless you want a couple days off without pay to think it over. Got it?

Bill—OK, Boss, OK, if you say so. (Bill takes shield out of his hip pocket and puts it on.)

Supvr.—I do say so. (Pauses.) Look, Bill. I'm doing this for your own good—you know that.

Bill—Yeah, you sure are Boss—I know that.

Note—Two days later a syringe broke under pressure when Bill wasn't wearing his eye shield. His eyes got a load of acid and are far from being as good as they used to be. Bill was alone at the time. He panicked when he couldn't see. Washing them out was delayed as well as getting him to a hospital.

Role playing—Case B:

Setting and orientation

When revolving doors are folded back so as to line up in the center of the opening and give clear passage, metal screw plugs are removed from the floor sockets, so locating rods holding the doors can drop into them. If these plugs are not replaced when the doors are put back into use as revolving doors, the open holes are a hazard for women with spike heels. If heels get caught in them while doors are revolving serious injuries result.

Slim, the maintenance man, had not replaced the plugs and Al his supervisor had received a number of complaints. The supervisor, Al, had asked Slim to come to his office.

Case B—Dialogue:

Supvr.—Come in and sit down, Slim, I want to talk with you.

Slim—OK, Boss. Something wrong?

Supvr.—Not wrong, Slim. It's something it's up to us to watch out for to protect other folks.

Slim—Yeah? What?

Supvr.—It's those floor plugs in the revolving doors. They weren't put back yesterday and a couple of women caught their heels in them.

Slim—Oh, that. You know, Al, some days I feel I can't suit you no how. Maybe you ought to get another boy! I'm not getting anywhere around here any how.

Supvr.—Now, Slim, I like your work OK generally. Something in particular bothering you on the job?

Slim—Yeah and I'm fed up, you hear? Fed up to here, see? (Puts hand under chin.)

Supvr.—Gee, I didn't know. Spill it.

Slim—I been here going on two years as mechanic and all I'm doing is odd jobs and you give Pete, who has six months less time, a machine maintenance job—not me. Looks like you are playing favorites, Al—and me working my heart out for you.

Supvr.—Didn't you know——

Slim—(breaking in) Know what? What I want to know is how come? That's all, see? How come?

Supvr.—Pete had three years machine maintenance before he came here and I had to have a man quick—no time to train someone.

Slim—Oh yeah, I see! Looks like as I said I'm getting no where here.

Supvr.—Look, Slim, I've already made arrangements for you to get five hours training a week so when the next opening comes you'll be ready—if you cut the buck, that is.

Slim—You have! Gee, thanks, Al.

Supvr.—That's OK, Slim. Now about those floor plugs. I know you and the other boys don't skip them deliberately. They are small and get lost or misplaced.

Slim—But, Al, no one's been hurt yet.

Supvr.—Not yet, here. But at Block's store a customer caught her heel in an unplugged hole, the revolving door was moving fast and hit her before she got loose and she broke her ankle.

Slim—I hadn't heard, Al.

Supvr.—Well, the store heard plenty. A big suit is being filed. (pauses) I wish I knew the answer, Slim. It's got me stumped.

Slim—I been thinking, Al. Suppose we take a piece of wide adhesive tape and tape the two plugs to the door. They're only ⅜" thick and ¾" diameter.

Supvr.—I think you've hit it, Slim. May not look too good on those bronze doors, but it will work.

Slim—Yeah, it wouldn't look too hot, and some kid might peel it off, too. Here, I've got it now! A small matching metal box

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Supvr.—Now you've got it, boy. That's it! Good work! Wish they were on now! Here make me a sketch of what you have in mind. (hands Slim pencil and paper)

Slim—OK (makes sketch). See, I put on the dimensions.

Supvr.—Which side up is it mounted?

Slim—With the spring down, see?

Supvr.—OK.

Slim—I'm sure the shop can make up the boxes or buy them and I'll get them on in a day.

Supvr.—OK, Slim, you see the shop foreman. I'll tell him to get you what you want and give him your sketch.

Slim—Al, we can tape the plugs on until I get the boxes installed. The doors are folded open to-day so I'll do it now.

Supvr.—Good idea! Thanks, Slim.

Concluding remarks—Note: These remarks follow the question and answer period based upon the role playing.

Of course, as previously mentioned the role playing served the purpose of identifying what we have developed as the "practical step-by-step procedure for face-to-face communications" with each one of us and our own personal problems in face-to-face communications.

re particularly though, the role playing ht before us the intangible, yet vital, interchange factors that come to life only when person-to-person contact takes place. A time-worn simile is the tuning of a radio or TV receiver to the transmitter on the same frequency. In our discussion today, we have called it empathy, the ability to put or project oneself emotionally into the other person's situation.

It is something we can not achieve through "willing it." It must be based upon a sincere desire to help and serve in the interests of the other person and, when we achieve it, it is transmitted and sensed unconsciously. However, we must retain our objectiveness and goals and not lose sight of them. We must keep ourselves in command.

In the limited time available to us today, it would not be possible to cover all aspects of our intriguing annd many faceted subject. This is particularly true of the additions to the fundamentals which are helpful when dealing with more than one or two conference or meeting groups of 10 or 20 and large audiences, also. However, we have, I believe, explored together the more vital and significant practical concepts for day-to-day use in living situations and their applications in safety.

Attachment A

FACE-TO-FACE COMMUNICATIONS PERFORMANCE CHECK SHEET

	CHECK ONE
PURPOSE	
To direct	_____
To order	_____
To instruct	_____
To get opinions, then direct, order or instruct	_____
To have them develop own answer	_____

	Answer YES	or NO
Was purpose made clear?	_____	_____
Did contact appear to show advance planning?	_____	_____
STEP I		
Identification achieved?	_____	_____
Goal defined?	_____	_____
STEP II		
Were emotional blocks present?	_____	_____
Self Listening	_____	_____
Future Expectations	_____	_____
Anxiety Response	_____	_____
Resisting Coercion	_____	_____
STEP III		
Insight achieved?	_____	_____
Positive Tension Created?	_____	_____
STEP IV		
Was there a "playback"?	_____	_____
Was there a "patching in"?	_____	_____
Did emotional blocks reappear?	_____	_____
If yes, did contact revert to Step II?	_____	_____
STEP V		
Goals reaffirmed	_____	_____
Action provided for as indicated?	_____	_____
GENERAL		
Was contact successful?	_____	_____
Was empathy achieved?	_____	_____
If contact unsuccessful, note any comments or suggestions	_____	_____

THE PSYCHOLOGY OF MOTIVATION

By GEORGE O. BAEHR, Ph.D.
Clinical Psychologist, Industrial Relations Center, The University of Chicago

Why did kamikaze pilots dive their planes into the warships of their enemy? Why did Edmund Hillary take the ultimate risk and climb Mt. Everest? Why did Florence Nightingale expose herself to the danger, disease, and dirt of the Crimea to minister to sick and wounded British troops? Why do people again and again go over Niagara Falls in a barrel? Why do men dare anything that involves considerable immediate risk to their health or life? The answer lies in motivation.

It has been said that self-preservation is a primary instinct of man. If this means physical self-preservation, then the task of safety engineers ought to be comparatively easy, for the instinctual drives are the most powerful motivational factors we know. If safety engineers have such a strong ally, then they need to concern themselves only with preventing equipment failure and eliminating ignorance about dangerous situations.

However, I think we must abandon this approach. The fact of the matter is that safety engineers do not have any such strong ally. I am not forgetting that equipment failure is often responsible for accidents, but our considered belief today is that in almost 90 per cent of all accidents, the human factor is predominant. This means, primarily, human behavior, and that, brings us to motivation.

To put the situation boldly: the safety engineer does not have as strong an ally in self-preservation as may have been thought. Instead he has a cunning enemy in the self-concept. "Self-concept" is an abbreviated expression we use in referring to what a person conceives himself to be like. The self-concept is usually favorable in regard to oneself and manifests strong tendencies toward internal consistency. Aspects of behavior which are inconsistent or unfavorable tend either to be rationalized until they appear consistent or to be rejected as not true.

Consequently, we see intelligent people engaging in acts in which a supposedly intelligent person would obviously not engage. Once we accept the principle that it is our self-concept rather than our physical self that each of us strives to preserve, then much of the unsafe behavior that we see around us becomes more understandable.

On January 3rd, 1961, the first (and to date only) accident involving a nuclear reactor occurred at the Idaho Falls, Idaho, testing station. An explosion killed three people. The results of the investigation, which was begun immediately, were released in September of this year. Equipment failure was ruled out. The immediate cause of the accident was removal, by human hand, of the central control from the fissionable material, which accelerated its activity to the point of explosion.

The investigating board suggested four possible reasons why the control blade was pulled out too far by the maintenance personnel working on the reactor:

1. Inadequate training of personnel. (The board added, however, that this was not likely.)
2. Human error, such as "incorrect manipulation of the blade owing to preoccupation of the manipulator with extraneous matters."
3. "Involuntary performance of the individual manipulating the blade as a result of unusual or unexpected stimulus."
4. "Deliberate malperformance, motivated, for example, by emotional stress or instability."

Such seemingly preventable industrial accidents are not uncommon today in spite of the fact that widespread and elaborate safety programs are now well-established. Many groups have become interested in the safety problem: safety engineers, top management, workers themselves, sociologists, psychologists, and many others. One reason that the number of interested groups has grown so large is that everytime one of the big safety problems of earlier days has been cleared away, another just as big has been found hidden behind it.

However, it should be noted that there, too, factors of motivation are involved. Each group, each individual, has become involved

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cause of motivation. The motivation is not the same from group to group or from person to person. And, to make the matter even more complicated, any one group's or person's motivation does not need to remain the same over time. It changes in accordance with the need or needs that require gratification both immediately and in the long run.

At this point, we should establish a precise meaning for the term "motivation."

I define motivation as the dynamic relationship between the need of an individual and its possible sources of gratification which, if attained, reduces the tension that characterizes the need.

The most basic needs are those we call homeostatic needs. For example, the composition and temperature of the blood stream must be within tolerance limits if we are to survive. Also included in this needs-category is the need for an optimal balance between sensory, intellectual, and emotional stimulation. The needs for rest after activity and for activity after rest belong here as well. We gratify some of these needs by taking in water and food, by clothing ourselves appropriately, by eliminating waste products, etc. Others are gratified by looking, hearing, studying, etc.

The next level of needs can be identified as the need for security, current and future. Gratifiers of the security need are protection against emergencies and catastrophies, a personally meaningful religion or philosophy of life, and the ability to appreciate science as a source of personal comfort. On the job this need is gratified by seniority, the feeling that one's skills and knowledge will continue to be needed, that one will continue to be adequately rewarded financially for one's work, etc.

The third level of needs has been labeled the need to belong. This includes the need to identify with family and other formal and informal groups, and the need for love and affection. On the job, a person can become highly frustrated if he is rejected by some group to which he wishes to belong or if he cannot identify himself with the goals of the organization.

The next higher level of needs is the need for esteem, in other words for achievement and reputation. An important gratifier of this need is money, since it represents power and achievement in its acquisition, possession, and use. Other gratifiers here are mastery, competence, reputation, respect from others, and self-esteem. Note that healthy self-esteem is based on deserved respect of others, not on external fame or celebrity, unwarranted adulation or insincere praise.

The pinnacle of needs, the fifth level, is the need for self-actualization, for realizing one's potential, for expressive-emergent creativity. In operation, this means that the person must do what he can do. Otherwise he becomes restless and inefficient. The musician must make music. The artist must paint, and the poet must write if he is to be at peace with himself in any ultimate sense. To gratify the needs involved at this level, one strives to become everything that one is capable of becoming, even at the expense of not gratifying certain lower-level needs.

In general, each level of needs must be at least minimally gratified before the next higher level needs become activated. However, this is not a hard and fast rule. For example, a person who is starving and dying of thirst will endanger his life, his acceptance by the group, and his reputation in order to obtain food and water. To put it another way, until his homeostatic needs are gratified, he will have no interest in his needs for long-term security, for belonging, for esteem, and so forth.

On the other hand, poets and artists and others have been known to eat minimally, socialize very little, throw the opinions of others to the wind, all for the sake of actualizing themselves through self-expression.

For each level of needs there is a broad range of gratifiers both on and off the job. There is no one-to-one relationship between needs and gratifiers. Furthermore, the gratifier that one person finds adequate another person, for any number of reasons, may not. For example, consider praise, money, and having done a good job. All three, and many more, can serve to gratify the need for esteem and may be equally affective in the case of a particular individual. There are persons, however, to whom it means much more to have done a good job according to their own evaluation than to receive praise. Some people prefer praise and recognition over money.

I shall be referring to this theory of motivation again as we proceed. Most important for us is how these needs are gratified and the emotional and on-the-job problems that arise when they are frustrated or thwarted.

Now that we have outlined our theory of motivation, let us look at safety and motivation in historical perspective.

Both directly and indirectly, the workmen's compensation laws have been the most important factors in motivating management in business and industry to organize and maintain safety programs. But, we might ask, what was the motivation behind the original workmen's compensation legislation?

Before the advent of workmen's compensation laws, the only legal recourse available to a person who was injured on the job was to sue his employer for damages in a court of law and to prove that the injury was due to negligence on the part of the employer. The court remedy was slow, costly, uncertain, and, until the upsurge of public opinion, was almost certainly against the worker. The survivors of a fatality, the widow and orphans, had no legal recourse at all. Many workers sought to be indemnified for injuries and disablement suffered on the job. But it was much more difficult for the worker to prove that the employer was negligent than for the employer to take successful recourse to one of the following three common law defences:

1. Contributory negligence. The worker could not collect damages if he himself had been negligent in any degree, regardless of the extent of the employer's negligence.

2. The fellow-servant doctrine. The employee could not collect damages if it could be shown that the injury had resulted from the negligence of a fellow worker.

3. Assumption of risk. The injured man could not collect damages if injury was due to an inherent hazard of the job of which he had, or should have had, advance knowledge.

At that time compensation for injury, disablement, death, etc., as a result of the job was not conceived of as an expense of running a business; and industrial managements, as well as many of our courts, were motivated by the fear that establishing precedents for such compensation would erode profits.

Thus, the safety problem grew to a formidable size toward the end of the nineteenth century. The industrial death and accident rates became an alarming public liability. The bereft and the injured and their families had to be supported through private charity and public welfare funds, and the courts were clogged with costly personal injury suits. Companies were beset by work stoppages because of accidents and dissatisfaction over working conditions. As time went on, the problems of work safety became increasingly burdensome and serious to all the parties involved.

The history of the emergence of workmen's compensation laws is tortuous and complex. Different vested interest groups took first one position and then another and then reversed themselves again. This is true of labor unions as well as of industrial managements. The doctrine of occupational risk gradually took over. This doctrine states that the risk of economic loss through personal injury on the job should be borne by industry. It states that the economic loss which results from such disablement is to be considered a cost of production, and should be incorporated in the price of production in accord with the current price system.

The major incentives which motivated legislators to enact workmen's compensation laws can be grouped under five headings:

1. To provide certain, prompt, and reasonable compensation to victims of work accidents and their dependents.

2. To free the courts of delays, costs, and the excessive work load associated with personal injury litigation.

3. To relieve the financial drain on public and private charities.

4. To eliminate economic waste on fees to lawyers and witnesses.

5. To replace concealment of fault (the other party, not I, was negligent) by an objective study of the causes of accidents with an eye toward their reduction or elimination.

The workman's compensation laws developed in an attempt to reconcile the interests, needs, and motivation of all those concerned.

Almost every industry now has safety devices peculiar to the needs of its plants,

such as fire doors, gridded stair treads, steel-toed shoes, helmets, goggles, and so forth. Manufacturers of capital equipment such as punch presses, lathes, cranes, and so on (as a matter of course) engineer safety devices into the design to avoid accidents.

These safety devices are so common now that we tend to forget the time when they were not, when many managements fought them with the best lawyers they could get. It was in the 1890's, during the first attempts to organize the coal mines and steel mills and improve working conditions, when an owner said, "All they need is a pair of overalls and a lunch bucket."

We have come a long way since those days. This attitude is now out of date. It does not serve the immediate or long-term needs or motivation of anyone concerned, from the individual worker all the way through to the country as a whole.

Most managements are acutely aware of the cost of accidents and as a result are highly motivated to minimize them and thus keep production costs down. To spread their liability for the costs of accidents involving their employees on the job, most industrial firms now carry casualty insurance in the form of compulsory state insurance, or through private casualty companies, or through self-insurance. Since the premium rates reflect the accident rate, managements can be motivated to support programs that help keep accidents to a minimum.

Depending on one's point of view, the cost of accidents is either a cost of operating a business or a reduction in profit. In either case, it represents a loss of money. The cost of accidents can be broken down as follows:

1. The premiums on compensation insurance or payments on compensation by self-insured companies.
2. The cost of the wages paid workers for the time lost by workers who were injured.
3. The cost of the damaged equipment.
4. The overtime made necessary by the accident.
5. Possible decreased output of an injured worker when he returns to the job.
6. Expenses attached to hiring and training a new worker.

To management, loss of money means reduced power, reduced achievement, and lowered esteem. Nowadays the self-concept of most managements includes a positive attitude towards safety efforts. Cost factors should be used in any attempt to set up a strengthened safety program.

Another strong motivation involved in accident prevention is that of the insurance companies. Obviously, premiums must cover benefits paid out. A number of costly accidents in excess of predictions of the actuarial tables could seriously hurt an insurance company's financial status. While the company could compensate for the loss by increasing its premium rate in the future, such an increase might endanger its competitive position.

It is no wonder, then, that casualty companies have taken a position of leadership in accident-prevention activities. Insurance company safety engineers assist management by studying causes of accidents, designing remedial equipment, planning corrective programs, and reporting their recommendations for management to evaluate and apply.

Despite an unprecedented increase in industrial employment, the accident rate in industry has been maintained at a low level. The credit for this accomplishment belongs largely to the accident-prevention engineers, who have conquered many of the safety problems engendered by new industrial processes, by inexperienced help, and by untrained supervision.

We have seen how needs motivated the inception of the workmen's compensation laws. We have examined the needs that motivate management and the casualty insurance companies. Let us now look at motivation in direct relation to accidents.

In the beginning, the safety problem was seen primarily as a technical one relating to physical circumstances. Thus, the safety engineer focused his attention and effort on building safety into machines, processes, and plant design. In instances where danger could not be contained, the obvious approach was to guard the workers from it by means of more and better protective armor: the special helmets, goggles, gloves, shoes, and so forth which we now take so much for granted.

This kind of engineering has not been a complete success, although it certainly seems to be in the interest of everyone concerned

that it should. It was and is in the interest of management to keep production up and insurance costs down. It is in the interest of workers to keep their health and life. And it is in the interest of the engineers themselves in order to keep their jobs and reputation.

"However," as one engineer of that period put it, "punch press operators still crush a finger or a hand in spite of the fact that the machine is designed with two widely spaced buttons that have to be pushed simultaneously with both hands. Veteran foundry workers still take off their protective goggles while pouring molten metal and lose an eye because of flying splashes, although they know that the risk of accident is high. Shipping clerks still break a leg falling down stairs because they are in a hurry and neglect to turn on the stairway light."

We may call this approach to accident prevention the mechanistic period. Safety doctors were treating diseases, with patients attached, and achieving respectable but not spectacular success.

Gradually it became evident that about 95 per cent of all accidents were caused primarily by unsafe acts of persons, and only 10 per cent by faulty physical conditions. The humanistic period came into being, and the safety doctors began to think in terms of treating patients, with diseases attached.

The human failings that result in the disease named "accidents" were identified. It became evident that workers lacked education regarding safe methods of operating machines. Secondly, operators often lacked the necessary skills to work safely. And third, such factors as fatigue, boredom, and carelessness were recognized as causes of accidents.

As a result, enlarged safety programs were developed to educate and influence workers. The general idea was that more training and safer and more attractive working conditions would yield better morale, and that this would lead to greater safety. Greater safety it was felt would bring about more efficiency, increased productivity, increased benefit to everyone, and, as a consequence, would be a strong motive for all concerned. Motivation was at last recognized as the primary force to be considered in dealing with the human factor, in treating the patient rather than the disease.

For a while, the concept of the personality motivated to be accident-prone looked as if it might represent a major break-through. There was a strong belief that as the concept was refined through the accumulation of records and the typing of personalities by means of various tests, it might develop into a sure tool for identifying or predicting problem situations.

If we accept this concept, however, we must recognize that there are at least two types of accident-prone personalities. These I would like to distinguish by labeling them "schlemiel" and schlamozzel." Most of us have probably heard of the schlemiel and failed to distinguish him from the schlamozzel. The schlemiel's actions are quick but erratic, whereas the schlamozzel has a slow reaction time. The schlemiel causes accidents; the schlamozzel is the innocent bystander who happens to suffer the result.

For example, the schlemiel is bringing a pitcher of syrup into the dining-room and trips over the edge of the carpet spilling the syrup into the schlamozzel's lap. For the syrup, you can substitute any number of discomforting or lethal objects: boiling soup, or hot coffee, or molten metal. There are also any number of substitutes for the tripping foot. I am sure your mind's eye can see a thousand variations to this situation.

The idea that there is a personality syndrome which can properly be termed accident-proneness has not gone unchallenged. The challengers base their attack on an analysis of the research procedures and experimental designs used by the researchers who claimed to have identified the accident-prone personality. Some students have attempted to demonstrate the existence of accident-proneness by reporting that over, say, a two-year period 65 per cent of the accidents were incurred by 15 per cent of the work force. Others have tried to validate the concept by reporting that over a specific period of time certain persons had more accidents than others.

The weakness is that in the first kind of study the 15 per cent group may remain at this size over a longer period of time, but with a changing composition. In the second kind of study, if the time period is extended, the number of accidents people have relative to one another may tend to even up. This type of criticism is valid.

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However, I should like you to consider two additional points before we conclude that accident-proneness does not exist. Point number one is that the people who argue against accident-proneness have not, to my knowledge, produced a single empirical or experimental study to demonstrate that there is no such syndrome. Since this is the case, is it possible that accident-proneness carries a social stigma and that the lengthy arguments against it are in reality motivated by the arguers' sensitivity.

My second point is this: If someone said, "I have identified a syndrome of characteristics by means of which I can predict better than chance which people are likely to have accidents and which not," we ought to pay attention and look at his evidence. Such characteristics have been identified. Such predictions have been corroborated by empirical evidence.

My conclusion, therefore, is that there is sound scientific evidence for the existence of the accident-prone syndrome. That the concept once served as a bandwagon onto which unqualified people jumped is irrelevant.

Thus, the present state of insight into this complicated connection between motivation and safety is that no simple formula can express it and no action can be permanently programmed to motivate people toward safety all the time and for all time. Our past experience has been that most efforts to achieve safety have worked to some extent and for some period of time.

In dealing with accidents that cause human injury, the tendency is to be all factual, materialistic, and orientated toward explanations which are based on sensory observation: sight, hearing, smell, touch, etc. If they were not so tragic, some of the reports could be funny.

One story goes as follows: A shear operator had difficulty in positioning the stack of paper he was trimming. In applying his genius to the problem, he cut off the top of his middle finger. After proper treatment and the necessary convalescent period, he returned to the job.

During the course of his first day back at work, his foreman approached him, saying, "Look we've got every safety device on that shear. How could you clip your finger? What did you do?" The worker proceeded to show him. This time also he had difficulty positioning the stack of paper. He again applied his genius to the problem. He stuck a pin between the right-hand activator button and its housing. Thus, he had his right hand free to keep the stack of paper in position.

Before the foreman could stop him, the man had pressed the left activator button and clipped off the middle finger to the next joint. Another period of treatment and convalescence followed. Perhaps this episode comes under lack of safety information.

I have no idea whether this story is true. But to the extent that such stories circulate they are an indication of the magnitude of the human problems that safety engineers are trying to understand and solve.

How does the human engineer design an activator system that is "fool proof" and cannot be circumvented by the use of pins, tapes, or paper clips. Clearly in the original accident it was the man's need to do his work well that overrode the need for safety. But, if we are to understand the cause of the accident, our inquiry should not end there. We should take a look at the attitude of management. In its thinking, was quality of production more important than safety? If the answer is "No," then we might ask if a worker whose thinking was as concrete as this one's should work on such a machine.

Now let us look at an accident where motivational factors were clearly identified. The need for comfort often overrides the need for safety. In one small foundry, workmen were melting down some aluminum scrap. It was a new operation, but care had been taken to provide the area with proper ventilation, and the workers with safety shoes and other personal production equipment including goggles to keep sparks out of their eyes.

One unusually hot spring day, when the supervisor returned from lunch, he found the men working without their goggles. Management was sincerely safety-conscious, the supervisor was safety-minded. Yet, here were the men working without goggles. When the supervisor asked the men why they were not wearing their safety goggles, they told him that they could not see with them on. At first he could hardly believe his ears. But it did not take him long to discover that in the heat, beads of perspiration

collected in a pool at the bottom of the goggles, and they soon steamed over. Also the salt from the perspiration burnt the men's eyes. The goggles were obviously not designed for the purpose for which they were being used.

As another example, the need for status has also been known to overshadow the need for safety. A general contractor noticed that the electricians he had hired were not wearing safety helmets as he had requested. Fearing that such behavior might set a precedent which would result in the collapse of his entire safety program, he called the electricians together and asked them why they were not wearing helmets. One of them, who turned out to be the informal group's chosen leader, explained that the helmets were hot and totally unnecessary because the electricians worked in areas of the building where there was no danger of things falling from overhead.

This explanation told the general contractor that he was not getting at the facts. Something else was involved, because the electricians did in fact have to walk through areas where construction was in progress. The contractor then pointed out to the electricians that they were endangering his safety program, and appealed for further information. He discovered that they were annoyed by the fact that when they wore their helmets, people confused them with the menial construction workers. I do not know how the conflict was resolved, but there are several possibilities:

1. The electricians could have yielded to the appeals of the general contractor and returned to wearing the helmets everyone else wore.

2. The electricians could be provided with helmets of a different color.

3. The electricians could be provided with helmets of a different shape, e.g., with visor only and without extended sides. The rationalization for this, if any were needed, would be that electricians had to work in close quarters and the sides of the helmet would interfere with their work.

Let us look at another factor which can cause accidents.

We all know that if needs are frustrated or thwarted on the job this can lead to an explosion between husband and wife at home. Suppose a man who is expecting praise from his boss for a job well done receives instead insulting criticism from an irate boss for something he neglected to do. His need for esteem is thwarted. Immediately, the man becomes angry, but he cannot let out his hostility on the boss. As the afternoon wears on, his simmering disgust comes to a boil. By the time he gets home, he is blind with rage. He almost runs over Junior's bicycle which Junior left lying in the driveway. He gets out of the car and throws the bicycle onto the lawn, barely missing the cat. He walks into the kitchen and sees the sink stacked high with dirty dishes, not only today's but last night's too. His wife not being in sight, he bellows through the home. Does she think he is going to work his fingers to the bone and come home to a pig pen? Then he trips over Camellia's doll house and knocks his head against the wall.

You can carry on from there. Many wives have learned that their husbands vent on them the frustrations generated on the job. Many supervisors and safety engineers know that workers bring to the job the frustrations generated in the home. Many accidents are to be understood within this framework. Note also that in our example each incident added insult to injury. The man's boss had berated him because of neglect. He gets home and what does he encounter? A neglected bicycle, neglected dishes, neglected doll house. Neglect, neglect, neglect! All reminders that he had been accused of neglect and had his need for esteem frustrated.

In the foregoing narrative, the worker waited until he was at home before tripping and bashing his head against a wall. The predisposing incident, however, occurred on the job and could easily have precipitated an accident there.

In understanding the causes of accidents, we need also to consider work-group morale. Are there personality clashes between the boss and any of his men? Are there personality clashes between any of the men? Does the physical and human environment gratify as broad a range of physical, mental, and emotional needs as possible? Or do the workers experience frustration at every turn? Are the workers friendly with one another and satisfied with their jobs? Or are there symptoms of anxiety, fear, worry, divided attention, moodiness, disorientation, indifference, confusion, hostility, euphoria,

overconfidence, and the like? These are the backdrop for the human error, for the human failure, in accidents. They generate accidents not only because they cause inattention to the dangers in the work but also because they may be symptoms of suicidal or homicidal tendencies.

As a clinical psychologist I do not advocate that persons who manifest such symptoms be fired for I know very well that work sustains emotional health. However, it is desirable that such persons be assigned to jobs where the hazards are minimal.

With this general background on the causes of accidents, we can now ask, "How do we motivate persons to work safely?"

As is true in many other situations, an ounce of prevention is worth a pound of cure. All causes of accidents except equipment failure are directly or indirectly traceable to human error. Even in the case of equipment failure, human error may be involved. Why does a pile of ingots topple over and crush a man? Because a human being stacked it improperly. Why does a man fall off a collapsing platform and break his shoulder? Because a human being neglected to inspect the platform supports for rust, corrosion, and decay. Why is there too much glaring light? Why is there insufficient air change? Why is there excessive heat? Because of human error or failure.

In accident prevention, it is usually best to build as much safety as possible into the equipment, leaving as little as possible to human decision, error, and failure. If there is an unsafe process or ingredient, it is better safety engineering to alter the process or to substitute a safe ingredient than to insist that employees wear personal protective equipment.

To give you an example, in one plant there was an often-used corridor which led from an otherwise distant section of the plant to the cafeteria. At one point, two six-inch water pipes ran across the floor. People frequently failed to step completely over these and would stumble. This was an unsafe condition. Several courses of action are open to us in such a situation. We could permanently lock the doors at each end of the corridor. But this would arouse the ire of the people for whom it is the most convenient passage. We could post a large sign with the words "Pipes, watch your step." This is the cheapest positive step. We could relocate the pipes on the ceiling. But this would be quite expensive. Lastly, we could build an inexpensive slow-rising bridge over the pipe. Note that the last two approaches all but eliminate the possibility of human error. The sign does not.

Having built all possible safety into methods, machines, and procedures, we then must appeal to people's needs to motivate them to safe practices.

Lack of safety knowledge and skill can be largely overcome by education and training. Such education and training should start the moment the man comes to the machine. I am repeatedly appalled by how few workers really appreciate what formidable instruments of self-destruction their machines are. One highly successful safety training program recommends that the following five steps be followed:

1. The supervisor should describe the safe methods of performing each job operation and sequence in simple but adequate detail.

2. He should point up the various hazards, and describe the relationship between these and the steps in the safe method.

3. In teaching the man, the supervisor should proceed through these steps:

   —tell him

   —show him

   —have him do it

   —correct him until he does it right

   —supervise him to see that he goes on doing it right

4. The reasons for requiring the wearing of personal protective equipment should be carefully explained and its proper use and care taught in full detail.

5. Specific safeguards for the protection of the worker and his fellow workers are similarly taught.

Conceptually allied to training in safe machine operation and safe production methods are devices for warning workers of specific dangers. Included in these devices are signs, horns, lights, etc., that warn of potential or immediate danger. To be effective such devices must be used accurately and consistently, and violations must be taken seriously. No smoking must mean no smoking. Blow horn must mean blow horn.

Stop must mean stop. High voltage must mean high voltage. Any signs used should be regularly renewed. A dirty, torn, scratched sign referring to a safety precaution has the psychological implication that no one really cares about safety.

A thorough safety program takes advantage not only of specific training and specific danger indications but also of the generalized promotional media. Among these are posters, plant bulletin boards, the plant newspaper, messages in pay envelopes, slogans, safety films, the suggestion system, and the dynamics of informal groups. Each of these media has its special strengths and weaknesses.

Safety posters as a means of education and propaganda should accomplish their intended task of informing, warning, or cajoling the viewer into safe practices. Individual workers may not obey the message for any of a number of reasons, but at least we want to be sure we have done everything we can to get the message across. Posters and cartoons must tell an important story instantly. Therefore, the artist often uses symbolism. A great deal is known about the impact of symbols on people. Gory, repulsive, hideous symbols may make people recoil with aversion and not, therefore, achieve their aims. Furthermore, symbols can have the opposite effect from that intended by the artist or be entirely meaningless to the viewer. Let me give you a specific illustration of this.

Last year I had the opportunity to go to South Africa and learn about some of that country's problems in teaching safety. The Bantu of South Africa, the indigenous Africans, exposed to posters designed by people with Euro-American background, sneered at one which was seriously meant to inform them. It was a picture of a crocodile with its toothy jaws wide open. In the background, but seen through the open jaws, was a machine with sharp, pointed cogwheels. The two objects were drawn according to our own laws of perspective, which handle the problem of representing three-dimentional reality on a two-dimentional plane by, among other devices, making a distant object smaller than a nearer one. Bantu art, however, has not been concerned with perspective. The Bantu interpreted the picture as a crocodile with a machine in its mouth. They thought it was merely ridiculous, because obviously a crocodile does not swim about with a machine in its mouth.

There were a number of things wrong with this poster besides the technique of representing distance. For example, if the symbols of one culture are to be used to influence a person from another culture, that person has to be educated to accept certain symbols as representing certain things or concepts. The conventional symbols and the concepts must both be understood. For instance, the crocodile obviously symbolized danger to the whites, and they assumed, erroneously, and without experimentation, that it meant the same thing to the Bantu. If danger was not one of the main ideas the Bantu associated with crocodiles, that symbol was irrelevant to the purpose of the poster. In point of fact, danger was no more the most important thing about the crocodile to the Bantu than it is about an automobile in a showroom window to us. Of course, if the crocodile had been mangling a man in his jaws and the car were mowing down a pedestrian, that might be a different matter. Or if in the poster, the crocodile had been mangling a man and the machine also mangling a man, the point of danger might have been made.

Machines are still something rather new to the Bantu. We really do not know what their main associations with the idea of machines and cogwheels are. As I said earlier, even our own workers surprise me with their lack of real understanding of the formidable source of self-destruction that modern machinery is, despite the efforts of their engineers.

These are only some speculations about possible reasons for the ineffectiveness of the poster. To identify the reasons in a scientific manner would take a team of qualified researchers a considerable length of time. If my speculations are correct, then there is still another problem. If we discover what the Bantu symbolic conventions are, do we teach him through his conventions or do we first educate him to accept ours? This problem is not easily resolved.

It is not likely that many of us in this audience will have to cope with Bantu safety symbolism in the near future. However, we are currently faced with the problem of understanding the symbolism of the vari-

ous cultures that even now constitute the work force of this country. You need only to consider the migrant farmers in the West, especially in the South West, or the Southern Negro who has migrated to the North and finds employment in heavy industry. We also have numerous imigrants from Europe.

Just as the sense of humor of the English, Germans, French, and Italians is in each case quite different from our own, might not also their attitudes toward safety symbols be different? While we are speaking of posters and cartoons, consider also how different their approach to advertising is from ours. The question that should be uppermost in our minds is: Do our safety symbols motivate people to act safely?

Many individuals, operating as individuals, practice good safety precautions, once informed, entirely because of enlightened self-interest. They know that they do not want to lose an arm or leg or suffer injuries of any sort. Different approaches have been devised and refined to reinforce this attitude. One important principle is that of active participation. Workers, supervisors, and safety experts come together in committees to educate and inform each other through up-and-down and lateral communication with the aim of involving wider groups in safety problems and the attempts to solve them.

Even Winston Churchill was once insufficiently educated in safety in America as opposed to England. On his first trip to the United States, some thirty years ago, he got out of his car on the wrong side in the heart of New York's downtown traffic. Fortunately, he did live to tell the story.

Safety campaigns also came into the picture at this point, as part of the education-through-involvement theory, to encourage the cooperative team spirit, and reinforce the idea that both individual and group interests are served by avoiding accidents, injuries, and their unpleasant consequences. Sometimes, however, these campaign cars get off the track when they involve competition among individuals or groups. Rivalry sometimes causes cheating, and so-called minor accidents are concealed in order to win, sometimes with disastrous results. And the prize itself, whatever it may be, becomes a primary goal, while safety is demoted to a means toward a temporary and trivial end. If safety is presented as a game to win or lose, motivation becomes muddled.

Indirectly, the creation of a cooperative milieu is one of the most effective sources of motivation and action. Some years ago, some studies were done at Western Electric on the west side of Chicago. Many interesting things were learned through these studies. However, the most important discovery was made much later, when the investigators became aware that their very presence and implicit interest, and the evidence of management's interest, caused performance improvement beyond all expectation. The workers became better friends, developed a set of coherent relationships, and became almost fond of management. Meanwhile, production increased steadily over the whole time. We do not know what the accident rate was during this period, but it would be interesting to find out.

Many individuals are motivated toward safe or unsafe behavior through identification with informal groups, and their support or rejection of the program. We are now keenly aware that there are always informal groups which handle and manage important aspects of the worker's job life. These informal groups exist independently of the formal managerial hierarchy of an organization and often cut drastically across organizational lines. They may be composed of people who eat together, people who take coffee breaks together, a car pool, a bowling team, etc. The leaders of informal groups are people who have earned their leadership status they are not leaders by fiat.

On the job informal groups have a code of ethics, their own rules and regulations, which may enhance or vitiate the efforts of the formal organization. If safety happens to be linked to their values, they will establish sound practices. In any program of safety, these groups are among the most important influences for or against the dissemination of education, new ideas, and propaganda. The members of an informal group will bring subtle pressure to bear on a member who deviates from practices accepted by the group, be we dealing with safety, housekeeping, or anything else.

The natural leaders of these informal groups should be recognized and their support unobtrusively enlisted. Since natural leaders are, as a rule, rather independent, they must be respected and encouraged in

their roles. The rest of the group will generally tend to accept what the leader advised and suggests. A natural leader, in turn, respects and encourages the members of his group, so that they have confidence in him.

It is very seldom that a leader rises, with the group's assent, who does not enjoy the group's confidence and respect. He is soon discarded if he does not live up to their expectations or neglects them. For these reasons, it is important for management to know who these leaders are and to try to work with them. Note that informal groups do not remain static and that care must be taken to remain alert to changes in them.

Informal groups constitute the root and branch of an organization's grapevine. Many people belong to a number of different informal groups. Through them information about management actions or plans which are believed to affect them and others is rapidly disseminated. The motivation of informal groups needs to be carefully judged. They can make a safety program or ruin it.

We have seen that motivation enters into accident causation and prevention at numerous points. The historical development of the safety movement has its roots in motivation. The common law principles that guided the legal relationship between master and servant during the cottage industry period were recognized as no longer meeting the needs of the workers in the age of mechanization. The cobbler no longer pricked his finger on the awl. Instead, the stitcher mutilated his hand when he caught it in the sewing machine. Formerly other persons could come to the coachman's rescue when he dropped his reins and could not stop the horses. Now the engineer and fireman lose their lives when the locomotive boiler explodes.

Motivated by the fear of losing control over their members, some unions were very much opposed to the idea of state compensation laws. Motivated by fear of increased production costs, managements also fought against the idea. But the general public, the officers of public and private charities, newspaper editors, the judiciary, and many more, motivated by indignation, a sense of humanity, and also private interests, induced the legislators of one state after another to pass workmen's compensation laws.

We can motivate managements to support safety programs by presenting reduced production costs, reduced shut-down time, higher morale, and a more favorable public image as incentives. Casualty insurance companies are motivated to guide industry to safer working conditions and production methods by their desire to remain solvent, profitable, and competitive.

An examination of accidents from the point of view of motivation can help us understand the cause of an accident. We said that only about 10 per cent of all accidents are not traceable to humans and 90 per cent of all accidents are due either directly or indirectly to human error or human failure. In recent years, we have come to the conclusion that there are considerably fewer accident-prone persons than we once thought.

Many accidents occur in situations where the need for personal physical security and safety is overshadowed by some other need, for example, the need for comfort, the need for esteem, the need for attention, and the need to reject authority. Many other accidents are caused by divided attention where the need to give one's all to the job is diluted by non-job-related needs, like those associated with wife, children, and home.

Another large number of accidents occur as the result of frustrated needs. In these cases, we find the symptoms of indifference, confusion, disorganization, moodiness, hostility, regression, and the like which cause the worker to be less than fully attentive to his job. Finally, we need to recognize that some accidents are the result of suicidal and homicidal tendencies.

In conclusion, we have considered how motivation can assist us in the promotion of safety attitudes and safe production methods, and examined some of the strengths and dangers associated with the use of these approaches. Signs, posters, and cartoons can vary from positive through neutral to negative in their effects.

Lastly, we discussed informal groups, their leaders, and the grapevine as strong allies who can assist or powerful enemies who can thwart our safety programs.

In all of this, preservation of the physical self is an ally of the safety engineers only to the extent that this need is represented in the integrated self-concept of the individual they are attempting to motivate to safe action.

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WHAT IS THE MATERIAL HANDLING PROBLEM?

By L. A. FAULKNER
Director, Plant and Elevator Service, Loss Prevention Dept.,
Liberty Mutual Insurance Co., Boston, Mass.

As one reads various trade publications, advertising and articles on safety and automation, one is apt to be lulled into a false feeling of security. Such literature gives the impression there will soon be no accident prevention problem involving materials handling.

Manufacturers of materials handling aids are constantly engineering new devices, developing novel applications of materials handling aids, and improving the effectiveness and safety of existing products. Within the last few years there have been many new codes or standards developed by manufacturers who have eliminated many exposures that in the past have been serious problems. Lighter weight materials such as aluminum alloys and plastics are being used in the manufacture of many products and the design of many material handling aids.

The effect has been to minimize the severity of injuries previously attributed to excessive physical job requirements. An increased application of automation for more efficient materials handling is becoming a major objective in many plants. Reduced handling costs are at present the goal of industrial management. Efficient operation requires it. Competition demands it. These are but a few examples of the benefits of technological advances in industry that will reflect a change in the accident experience and require new accident prevention approaches.

A lack of authoritative statistics providing a significant relationship between use of modern materials handling equipment and accident occurrence indicated the necessity for a special all-industry evaluation.

A study was completed of 718 high-cost accidents, each of which involved a total medical and compensation cost exceeding $2,500 per case. These cases were selected from a total of more than 3,000 reported materials handling accidents, and represented approximately 70 per cent of the total costs. All accidents occurred within the past year and were carefully investigated to determine major and/or secondary causes. The chart indicates the extent of the problem—manual vs. mechanical handling, the accident results, the basic causes, and suggested accident prevention approaches.

It has been estimated that 90 per cent of all industrial activity involves some type of materials handling. In the future this pattern will change slightly but only to the degree that a smaller percentage will be mechanized materials handling.

In the manual handling of materials, exposure to accidents is somewhat in relation to the weight and size of the object to be moved, the relative dynamic position or positions required, the height it is to be lifted, and the distance it must be transported. This is quite basic and uncomplicated, but it is not the whole story. The safety engineer must consider these major causes, but should not overlook the secondary causes. Most lifting injuries occurring in manual handling result in strains to muscles, ligaments, or internal body parts. These strain exposures result from one or more of the accident causes listed on the chart.

Accident causes 1 through 3—lack of handling equipment, devices that are inadequate, and poor work area conditions—are engineering problems.

The solution to these problems is the selection and provision of the proper type of materials handling aids, the replacement or redesign of those now inadequate for the job and the ever-present problem of maintaining good housekeeping conditions.

The solution to the problems as indicated in accident causes 4 through 9 should be recognized as being in the areas of employee education and supervisory training. New training aids must be developed that consider, in addition to the continuous manual handling operation, the emergency situation involving heavy lifting during any interruption in automated production process.

Item 10 emphasizes the need for an effective job placement program as indicated to

ACCIDENTS ARISING OUT OF MATERIALS HANDLING

Total cases	718
Total cost	$3,546,366
Average case cost	$ 4,939

ARISING OUT OF MECHANICAL HANDLING OPERATIONS

No manual effort

Mechanical handling cases = 165 or 23%
Total cost = $1,161,800
Average case cost = $7,040

ACCIDENT RESULTS

Traumatic injury
(Equipment failure or misuse)

Traumatic injury
(Falling objects)

ACCIDENT CAUSE	NUMBER OF ACCIDENTS Major	Secondary
1. Objects falling from carrier	0	48
2. Equipment not properly guarded	29	18
3. Poor layout of plant facilities	9	5
4. Devices in use inadequate for the job	23	3
5. Poor housekeeping	5	0
6. Equipment design questionable	10	35
7. Equipment in poor mechanical condition	9	1
8. Horseplay, recklessness	0	9
9. Failure of operators to use available handling equipment	3	4
10. Unauthorized use of equipment	9	6
11. Unsafe operating procedures	42	26
12. Inadequate training of operators	24	40
13. Lack of protective clothing	2	5
	165	200

LOSS PREVENTION APPROACHES

Engineering and methods
1-2-3-4-5-6 and 7

Supervisory and employee training
8-9-10-11 12-13

ARISING OUT OF MANUAL HANDLING OPERATIONS

Lifting
Carrying
Pushing
Pulling

Manual handling cases = 553 or 77%
Total cost = $2,484,566
Average case cost = $4,493

ACCIDENT RESULTS

Acute strains-(Hernias, ruptured discs, tenosynovitis, etc.)

Traumatic injury—(dropped objects)

Aggravation of pre-existing physical condition

ACCIDENT CAUSE	NUMBER OF ACCIDENTS Major	Secondary
1. Lack of handling equipment	66	17
2. Devices used inadequate	32	6
3. Poor work area conditions	37	9
4. Incorrect handling	127	138
5. Workers handling too much weight	24	15
6. Lack of coordination in team effort	11	38
7. Show-off or uncalled-for handling	15	24
8. Failure to use available handling devices	29	8
9. Failure to use or lack of protective equipment	15	4
10. Pre-existing physical condition	114	41
11. Alleged injury	69	51
12. No unusual or hazardous condition	14	43
	553	394

LOSS PREVENTION APPROACHES

Engineering and methods
1-2 and 3

Supervisory and employee training
4-5-6-7-8-9

Job placement and medical
10

No loss prevention principle involved
11 and 12

be assured that the employee is able to meet the physical requirements of the job.

The safety engineer will always be plagued with the types of cases indicated in items 11 and 12. These are perhaps personnel problems but he should be sure to explore any possible underlying circumstances that warrant referral to the medical department.

Mechanization alone has sometimes been considered the answer to all material handling problems, but going back to the accident analysis, it is apparent that this is not

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e case. When mechanized devices are put use, strain injuries are minimized but other exposures are introduced. This is demonstrated by a significant increase in traumatic injuries due to falling objects, equipment collisions, improper guarding, and unsafe operation.

Accident causes 1 through 6 involve problems of inadequate guarding, improper design and use of mechanical handling equipment, and poor layout and housekeeping. These are engineering problems that will become more serious as electronic, hydraulic, and pneumatic equipment replaces manual handling.

When purchasing materials handling equipment, management should not be influenced by price alone. At least two basic design features should be considered in the selection of materials handling equipment. First, the equipment should be designed to adequately handle the job for which it is selected and second, it must meet minimum standards of safety.

The need for a preventive maintenance program is indicated by item 7. The complexities of some modern materials handling equipment require maintenance contracts with the manufacturer. The user should be assured that the maintenance includes all items necessary to safe operation.

The use of mechanized materials handling equipment requires effective employee education and supervisory training programs if accidents are to be prevented and damage to equipment minimized. Items 8 through 13 emphasize the need for lift truck driver training programs, safe operating specifications for more complicated devices, lock-out programs, and control over unauthorized use.

The highly specialized handling requirements in this age of space exploration and operations involving exotic materials have been and will continue to be a challenge. The basic principles of safe materials handling must be an integral part of any future industrial developments if the well being of the workers, however skilled, and the adequacy and safety of handling equipment, however complicated, is to be assured.

MUSCLE POWER AND MACHINE POWER

HANDLING BY CRANES AND HOISTING EQUIPMENT

By LELAND F. STANLEY
Head Engineer, Whiting Refinery, American Oil Co.
Whiting, Ind.

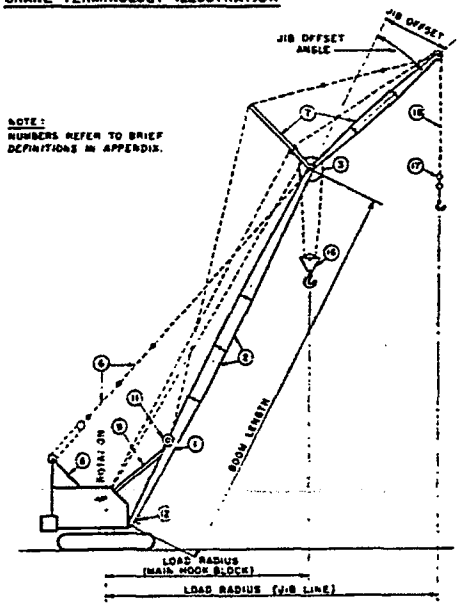
Safe use of cranes and hoisting equipment requires fundamental understanding of the equipment, its operation, and its capabilities. I hope to clarify some of these areas largely by discussing mobile cranes and by presenting data taken from a general course on crane equipment developed for presentation to our operators, mechanics, supervisors, and engineers. These data were assembled as a course in 1958 when investigation of a number of crane accidents revealed poor understanding of recently acquired long-boom cranes. From our experience, I suspect that there is a widespread misunderstanding of safe operation of long-boom cranes with wide stability bases, as developed in recent years.

Let us begin with Figure 1 and consider some fundamentals. The load radius is the horizontal distance from the intersection of the centerline of rotation and the ground to the vertical line of fall of the hook or hook block. This definition is correct whether the crane is sloped or level. Commonly, but incorrectly, load radius measurements are made from the front of the turntable or from the boom foot. Such errors are highly unsafe as we shall see shortly.

Notice that the boom length is measured from the boom foot to the centerline of the head sheaves at the top. Also notice that the boom foot is located both above grade and forward of the centerline of rotation of the crane's superstructure.

FIGURE 1

CRANE TERMINOLOGY ILLUSTRATION



The offset extension at the top of the main boom is called the jib or jib boom. The numbers in Figure 1 are reference numbers to brief definitions which appear in the Appendix to this presentation. Number 8 is the gantry or structural members to aid in raising and handling long booms. This will be discussed later.

Our 50-ton crawler crane at Whiting, with a 50 foot boom at its minimum radius of 12 feet, can safely lift 100,000 lbs.; with a 100 foot boom at its minimum radius of 20 feet, it can lift only 44,700 lbs. Such a crane is normally rated when it is equipped with its normal basic boom at a specified maximum capacity in tons at the minimum load radius of 10 or 12 feet. Basic booms commonly range from 30 to 70 feet, varying with crane size. The minimum load radius is the closest radius with the boom in the highest position. Ordinarily this radius is controlled by the maximum boom angle of some 80 to 85° from the horizontal, to provide the crane with about 15 per cent rearward stability and to prevent tipping the boom backwards.

Safe load limits are given in load capacity charts furnished by the manufacturer. These are mounted in the crane cab and they are included in operators manuals. Important rating aspects are listed in notes at the bottom of these charts. Typically, one of these notes advises that the crane chart lifting capacities do not exceed 75 per cent of the tipping load with the machine *on firm level ground*. This tipping percentage normally varies by type of crane as follows:

a. Crawler Cranes—
   75 Per Cent of Tipping Load
b. Wagon or Truck Cranes—
   85 Per Cent of Tipping Load
c. Locomotive Cranes—
   15 Per Cent Over Chart Capacity Will Tip

Notice particularly that the rating is a maximum for lift crane service with the machine on firm level ground. For uneven or unfirm ground, for rough work such as magnet or bucket work, or for traveling, these capacities must be reduced substantially. For rough work, capacities are usually reduced to two-thirds of the tipping load instead of to the three-quarters of the tipping load of the charts. Also the manufacturer normally limits the maximum boom length.

Figure 2 shows capacity chart data for our No. 354 crane at Whiting. With a 50 foot boom at the minimum radius of 12 feet, the capacity is 100,000 pounds; at a 14 foot radius, it is 78,500 pounds; at a 16 foot radius, it is 64,200 pounds. Thus a change of 4 feet in load radius has reduced the capacity by one-third. With the 100 foot boom, the change from the minimum radius of 20 feet to 24 feet has dropped the capacity from 44,700 to 34,400 pounds, or almost one-quarter. Therefore, it is imperative for safe operation to know the correct load and radius or to be conservative.

Obviously, any operation which causes the load radius to shift alters capacity substantially. Such factors include settling of soft ground, travel, swinging the load or lowering the boom. The manufacturer's safety factor takes care of normal operations. However, substantial deductions should be made for travel, uneven ground, or soft ground.

Contrary to the belief of many, the load capacity charts are not made up for pay load. Figure 3 shows a copy of weight data for accessories for our No. 354 crane. Notice that some items such as the 50 ton hook

Fig. 2. LIF

Radius Ft.	
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Fig. 3. ACCESSORI
No. 354, 50-TO

Accessory	
30' Jib Boom—	
10 Ton Capacity..	
20' Jib Boom—	
5 Ton Capacity....	
Swivel Hook and Tw	
Weights—6.8 T Ca	
3 Sheave Hook Block	
50 Ton Capacity...	
58.5 Cu. Ft. Heaped	
Digging Clamshell	
Rudomatic Tagline V	
Model 1248 Deduct	
Rock Grapple	
24" Single Sheave Ho	
30 Ton Capacity ..	

Fig. 2. LIFTING CAPACITY CHART FOR No. 354, 50-TON CRAWLER CRANE

Radius Ft.	BOOM LENGTH—FT. 50	60	70	80	100
12	100,000				
14	78,500	78,100			
16	64,200	63,800	63,400	63,000	
18	54,200	53,800	53,400	53,000	
20	46,700	46,300	45,900	45,500	44,700
22	41,000	40,600	40,200	39,800	39,000
24	36,400	36,000	35,600	35,200	34,400
26	32,800	32,400	32,000	31,600	30,800
28	29,700	29,300	28,900	28,500	27,700
30	27,100	26,700	26,300	25,900	25,100
32	24,900	24,500	24,100	23,700	22,900
34	23,000	22,600	22,200	21,800	21,000
36	21,300	20,900	20,500	20,100	19,300
38	19,900	19,500	19,100	18,700	17,900
40	18,500	18,100	17,700	17,300	16,500
42	17,300	16,900	16,500	16,100	15,300
44	16,300	15,900	15,500	15,100	14,300
46	15,300	14,900	14,500	14,100	13,300
48	14,500	14,100	13,700	13,300	12,500
50	13,700	13,300	12,900	12,500	11,700
52		12,600	12,200	11,800	11,000
54		11,900	11,500	11,100	10,300
56		11,300	10,900	10,500	9,700
58		10,800	10,400	10,000	9,200
60			9,900	9,500	8,700
62			9,400	9,000	8,200
64			8,900	8,500	7,700
66			8,500	8,100	7,300
68			8,100	7,700	6,900
70				7,300	6,500
72				7,000	6,200

NOTES:
1. Above ratings are maximum recommended working loads in pounds and are computed at 75% of tipping load with boom working across crawler; machine on firm level ground.

block and the jibs are quite heavy. Data of this type have been provided for each of our cranes to aid in safe lifts. Deductions from chart capacity must be made for each accessory on the crane at the time of the lift. Deductions must also be made for the slings, the blocking, and the rigging in arriving at a safe maximum lift weight. Another way of saying this is that the load in the capacity chart is the total weight of the object lifted, the rigging and blocking, and the crane accessories on the crane.

Fig. 3. ACCESSORIES AND WEIGHTS FOR No. 354, 50-TON CRAWLER CRANE

Accessory	Weight	
30' Jib Boom—		
10 Ton Capacity	2900 lbs.	
20' Jib Boom—		
5 Ton Capacity	1600 lbs.	
Swivel Hook and Two Overhaul Weights—6.8 T Cap.	325 lbs.	
3 Sheave Hook Block—		
50 Ton Capacity	1360 lbs.	
58.5 Cu. Ft. Heaped Digging Clamshell	8050 lbs.	Empty
Rudomatic Tagline Winder		
Model 1248 Deduct ½ or	325 lbs.	
Rock Grapple	5300 lbs.	Empty
24" Single Sheave Hook Block—		
30 Ton Capacity	600 lbs.	

In making up the load capacity chart, the manufacturer considers many factors. Five major design criteria are ordinarily used:

1. Stability or tipping resistance.
2. Boom strength.
3. Machinery and frame strength.
4. Rigging (boom suspension) strength.
5. Turntable strength.

Notice that tipping is but one of five criteria. One common, but false belief, is that a crane will tip before failing structurally. For older cranes with short booms, many operators relied on this tipping. Today, most capacities shown for short radii are structural capacities. By widening the crawler bases of cranes and by providing extendable outriggers, the manufacturers have increased tipping stability substantially and made structural failure the mode of failure at close radii.

Long booms for cranes are a fairly recent

phenomena and the lengths are still increasing. Prior to 1955 at Whiting, cranes commonly carried 50 and 60 foot booms. Since 1955, 80 to 100 foot booms plus jib booms became standard. Today on our 125 ton crawler crane, the 170 foot boom plus the 40 foot jib is quite common. High capacity, long boom cranes provide unique advantages in both horizontal and vertical reach. They can minimize costly manual handling and rigging. However, they do introduce certain problems which are not so critical on short boom cranes.

The most critical consideration for long boom crane use is side load. Side loads are those which cause the hoist cables to pull sideways on the boom. With an offset jib boom, side loads are even more critical because of the twisting of the boom by the jib. Unfortunately crane manufacturers do not advise regarding safe side loads, since cranes are designed for vertical lifts. Our practice is to try to keep the maximum side load within five per cent of the maximum capacity of the crane at all radii. This corresponds to keeping the angle of the hoist cables within three degrees of vertical. All control operations must be slow and smooth with long booms to minimize both side loads and impact loads.

Making a lift or traveling on uneven ground is hazardous because rocking of the crane will cause the boom, the jib, the hook block and the load to whip around. This also adds impact and causes the load radius and side loads to increase. The longer the boom is, the greater the whipping action becomes. This whipping may cause the load or the hook block to strike the boom, causing structural damage. For stationary lifts, the firmness of the ground should be tested prior to the lift. We have sloped the crane for heavy lifts at high boom angles to insure the ability to boom up if the crane should settle under load. In traveling, the load should be kept as close to the ground as possible.

Also when traveling unloaded, particularly on grades, the boom should not be at the highest boom angle to avoid the whipping of accessories against the boom and the possibility of overturning the boom. Since the hoist cable acts somewhat like a spring in absorbing impact loads, the greater the distance between the head sheaves and the hook block the less is the impact load. For high lifts, we try to allow at least 10 feet clearance. Since many lifts with long booms are made at close radii, precaution must be taken to insure that raising the load to its highest position will not cause the load to strike the boom. Normally we try to allow some three to five feet clearance between the load and the boom, if it is at all possible. We also employ tag lines to control the load to minimize the possibility of striking the boom.

Therefore, to summarize precautions for long boom work.

1. Provide assistance to raise the boom.
2. Minimize side pull and impact loads.
   a. By making vertical lifts only.
   b. By slow speed raising and lowering.
   c. By slow and careful swinging.
   d. By operating on firm level ground.
   e. By operating to avoid the load striking the boom.
   f. By providing maximum clearances between the hook block and head sheaves.

Jib booms also warrant special consideration. They are used extensively to provide an offset or reach over obstacles which the straight boom would strike. Jibs introduce several elements into load consideration. The load radius is measured to the fall of the hook from the jib. Therefore, the load must meet the chart radius requirement at the top of the jib. In addition, the manufacturers have imposed a maximum capacity on each jib, often varying with the length of the jib and the angle of the offset. The load must be within the safe limits of both the load radius capacity of the crane and the jib capacity.

In computing the load radius capacity, the manufacturer also advises that a substantial deduction must be made because of the weight of the jib. When using jibs, lifts can be made, utilizing the main hook block on the crane with the jib in position. Since the jib overhangs the load in this instance, we normally make a deduction of 1.3 times the weight of the jib in correcting for the jib in the load capacity rating. When the lift is made on the jib, we deduct the weight of the jib as furnished by the manufacturer.

The clearance between the jib and the obstruction over which the jib or main boom

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projecting must be checked to insure proper clearance. We prefer to maintain a clearance of three to five feet, wherever possible, to insure that the boom will not strike the obstruction in settling under load or movement. It is also important that no rough work, such as magnet or bucket work or extensive traveling, be performed with the jib on the crane, since the whipping of the jib is likely to cause damage or to flip the jib backwards if the boom is at a high angle.

In regard to crane accessories and reeving, it is important to note the following points. Cranes are designed for a specific maximum single line pull. This single line pull cannot safely be exceeded and it must be used to determine the number of lines required to reeve all accessories. When selecting crane buckets, hook blocks, and other reeved accessories, cable grooves should match the crane cable size and sheaves should be as large as practical. Cable grooves and sheaves will pinch the cable if the grooves are too small and will flatten it if too large. Both conditions and small diameter sheaves weaken the cable and cause rapid deterioration. This point applies to all rigging and hoisting equipment, as well as to crane equipment. In general rigging work, snatch blocks, hoisting blocks, and drums should be checked for this condition.

Perhaps the most important operational check made upon cranes and hoisting equipment is the cable inspection. When a number of strands of cable snap, the cable must be replaced. The older, common rigging cable does not have preformed strands and, therefore, when the strands snap they would stick out clearly from the main cable. Today, however, preformed cable is extensively used and the strands, though broken, are tightly nestled against the main cable. Therefore, very careful cable inspection is required. For major lifts we normally replace the hoist cable on crane equipment. In our plant, hoisting and rigging equipment is checked carefully each time such equipment is returned to the central toolroom and similar field checks are made by the operating groups when the equipment is on extensive assignment.

Rigging failures in routine cable lifts constitute the greatest safety problem. From our personal experience and from observing contractors working on small lifts, field personnel tend to use makeshift and undersized slings and riggings. For major lifts, care is taken to insure that the sling is used within its proper rating, that the load will not be damaged by crushing, that suitable blocking or spiders are used to insure that the load is not damaged, that cutting of the sling cable is prevented by suitable corner protectors and that cable bends are of a reasonable radius. Load rigging could well be the subject of a paper by itself in view of its complexity.

The most complex lifts are those which require the use of several cranes on a single lift. In this case, it is imperative to control the distribution of the load between the various cranes throughout the lift. Equalizer beams are used to balance the loads between cranes, and cranes must be matched for capacity and speed control. Such lifts require detailed analysis which should be done by engineers. Coordination of two to four cranes is probably the biggest operating problem encountered.

We have utilized hand signals, telephone hand sets, and radio communication among the rigger foremen, crane operators, and the riggers on such lifts. Prior to making the lifts, all parties involved should understand the nature of the lift in detail and they should feel confident of performing their part. Therefore, we not only check the crane and hoisting equipment for condition and proper set up, but we also check the attitude and knowledge of the personnel involved.

One problem is easily overlooked. In a plant such as our Whiting refinery we have many large underground facilities such as sewers, drums, and major electric facilities. Extreme care must be employed when cranes make lifts on top of or adjacent to such facilities to insure that they will not be damaged or that the crane will not settle under load because of collapsing the structures. The entire operational area, above and below grade, must be carefully checked prior to a lift.

The most critical lifts are those in which a load is lifted from tall structures with the base at a considerable distance above grade and those which necessitate moving the load over other costly facilities. In these cases, the crane must work within safe limits or substantial damage will be caused. In mak-

ing all normal lifts, the load should be maintained as close to the ground as possible. This will insure minimum chance and amount of damage to the load, to the crane, and to any related facilities.

The following is a list of general safety regulations we have issued to our personnel:

For safe crane operation, do not:

1. Overload the crane or its accessories.
2. Extend the boom or jib beyond manufacturer's rated limits.
3. Use a greater jib offset than manufacturer recommends.
4. Work the crane on a slope.
5. Fail to check hazards in lift area.
6. Rely on tipping crane before expecting a structural failure.
7. Fail to decrease loads substantially for uneven or soft ground, for slopes, for rough work, or for movement.
8. Fail to use gantry or aid in lifting long booms, when required.
9. Allow the load to strike the boom or jib boom.
10. Work without reasonable clearance between the head or jib sheaves and the hook or block.
11. Permit avoidable impact or side loads.
12. Pull on the load or drag the load so as to increase the effective load.
13. Raise the load higher than necessary for reasonable clearances.
14. Make critical lifts without checking the operator and the crane.
15. Travel with the boom in the highest positions or so that the load can strike the boom.
16. Allow loads to swing extensively.
17. Travel or perform rough work with excess accessories such as jibs or whip lines on the crane.

Cranes today are equipped with many safety devices, such as boom back stops, automatic declutching devices, torque converter control, powered load lowering, and the like. We developed a check list for crane hook work to enable those concerned directly with operation and supervision to evaluate fully all normal crane lifts.

Section A of this check list summarizes the total hook load data as discussed before. It sums up the weights of the load, the slings, harnesses, spreader beams clevises, blocking, and bracing. Section B requires the checking of the hazards to be encountered in the lift and access areas. This includes checking underground facilities, at grade facilities, and overhead facilities, particularly the location of power lines, steam lines, process lines, sewers and all other physical facilities which might affect the lift. Section C summarizes dimensional clearances of the access area, the boom raising area, the lift site, and the crane dimensions.

Section D summarizes the pertinent ground conditions. Section E determines the required boom, jib boom, and gantry, by summing up the requirements of the load height and radius, the length of the slings and riggings, and the hook block length. In some cases, detailed sketching is required for the lift and models are helpful in analysis. Section F summarizes the crane capacity requirements. The hook load with pertinent accessories cannot exceed the capacities of the hook block, the jib, and the crane as applicable.

Section G summarizes the crane load radius capacity by tabulating the weights and deductions for all of the crane accessories. This section has columns "A," "B," and "C" to cover the three types of lifts; namely, lifts on the jib boom, lifts on the main boom without jib, lifts on the main boom with jib. By following the procedure outlined in this checklist, our operating personnel and supervisors can safely evaluate routine lifts. They also can determine critical lifts which should be reviewed by engineers.

In regard to rigger hoists, personnel guards are desirable in the event that cables snap. Hoist areas should be roped off to keep out unnecessary personnel. In setting up winches and hoists of this type, the load protection and rigging problems are the same as for the cranes. However, some additional considerations are important. Care must be taken to impose the lifting and pulling loads on structures to which snatch blocks and "catheads" are fastened, so they are not damaged.

The fleet angle of the cable leaving the hoist drum should be as small as possible. We try not to exceed 3° for angle between the cable and a line perpendicular to the centerline of the hoist drum. A large fleet

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gle results in excessive cable abrasion and proper wrapping on the drum. Cable conforming to the equipment manufacturer's specifications for the specific winch or hoist should always be used. Cables have specific properties, such as abrasion resistance, corrosion resistance, and flexibility, which make them suitable to specific services such as general rigging, extra flexibility, guy cables and the like. Improper use is very hazardous.

In selecting hoisting equipment, we prefer the type with the brake directly on the drum. Some equipment has the drum brake acting through multiple shafts and gearing. Failure of shafting or gearing will drop the load on this type of equipment. Also do not apply power to hand winches indiscriminately. Many hand winches do not have suitable construction for either the power or the speed. Cast iron and poorly cut gears, undersized bearings, and poor braking equipment will cause rapid failure under power even though they are satisfactory for low manual speeds and power.

With regard to overhead crane equipment, most difficulties are encountered because of overload and side pulls which cause the cable to wrap improperly and cutting of the cables. Such equipment is designed for vertical lifts and it gives little trouble, if properly used and maintained.

In summary, safety is inherently a major consideration in the selection, operation, and maintenance of all cranes and hoisting equipment. Its highly specialized nature requires competent training in all phases. Complacency should not be tolerated in personnel associated with such equipment, and constant efforts must be made to improve the operators, the equipment, and work methods.

APPENDIX

COMMON CRANE TERMINOLOGY APPLYING TO FIG. 1

(figure 1 illustrates items except those with asterisk)

1. *Boom Base Section*—Two piece, tapered, minimum boom containing boom foot and top sheaves.
2. *Boom Inserts* — Intermediate boom sections to extend the length of the basic boom. Usually in lengths of 5, 10 and 20 feet.
3. *Boom Head* — (Boom Point or Head Sheaves)—Main sheave assembly at top of main boom.

*4. *Butt Connected Boom*—Boom sections are connected by bolting through a pad or foot at the four corners of each section of boom insert.

*5. *Pin Connected Boom* — Fast connections using one pin at each of the four corners of boom inserts.

6. *Pendants*—Cable inserts with quick coupling eyes on the ends to enable quick and easy extension of boom hoist cables. Generally sized to length of boom inserts.
7. *Jib Boom*—Generally, though not always, a removable boom tip extension for light loads. Normally permit offset lifts to reach horizontally over obstructions to the main boom.
8. *Gantry*—Structural members to aid in raising and handling long booms. Types: Rigid, Collapsible, Mast, Backhitch.
9. *Boom Backstop*—Device to limit maximum boom angle to prevent folding boom back over cab. Some are hydraulic shock absorbers to limit motion as well as to serve as backstops.

*10. *Lagging*—Fixed or removable shell for winding hoist cables on main drums.

11. *Tagline or Tagline Winder* — Spring loaded line or device used to prevent twisting of cables in clamshell and magnet work. (For magnet work, this device is the electrical take-up reel.)
12. *Fairleads* — Guide-sheave assembly mounted on front of rotating upper structure for inhaul cable in dragline service.
13. *Outriggers*—Rigid or telescoping supports to extend the lifting base for greater stability on wagon, truck, and locomotive cranes. May be powered or manual.
14. *Screw Jacks and Floats*—The adjustable jack and foot pad at the end of each manual outrigger.

*15. *Rigging*—May refer either to the crane or to the load. For cranes, the boom suspension cables and accessories; for loads, the slings, harness, equalizer beams, etc.

16. *Hook Block*—Main sheave block with hook for main load. Uses multiple line reeving.
17. *Hook and Overhaul Weight*—Light duty hook for single line operation with weight to pull cable off drum by gravity (commonly called headache ball).
18. *Whip Line*—Single line with hook and overhaul weight for fast operation from either head sheaves or jib tip sheaves.

CONVEYORS

By ROLAND JONES
Jervis B. Webb Co., Detroit, Mich.

Today's material handling systems, to receive the approval of an astute management, must not only be capable of delivering a pre-determined volume of materials faster, more economically and without damage, but must do so with perfect safety for employees or other persons approaching the moving conveyors. Industry can no longer afford to overlook the accidents that could be avoided through the use of recognized safety devices and employee education.

"Conveyors are more widely used through industry than any other type of heavy machinery, yet less than one per cent of all accident compensation cases involve conveyor equipment." This fact, published by the Conveyor Equipment Manufacturers Association, CEMA, dramatizes two very important points about conveyors.

1. Conveyors by their nature tend to prevent accidents.

2. Manufacturers of conveying equipment are successfully designing safety features into their equipment to make them even more foolproof.

Take point number one, for example. What is meant when we say that "conveyors by their very nature tend to prevent accidents"? Materials are brought to and taken away from operators; therefore, lifting, carrying, or wheeling is lessened or eliminated. The operator need not leave his station and walk into trouble elsewhere, nor need he join that unfortunate group who sustain lifting injuries. A survey several years ago showed that manual handling accounted for 27 per cent of the total accidents in the state of Illinois, for that year. Handling by conveyors helps eliminate the necessity for manual handling.

Material coming to the operator mechanically eliminates momentary inattention to the machine operation. Conveyors help good housekeeping because they are installed on definite lines of flow, and their continuous operation cuts down piles of sub-assembly goods in process. Less manual handling reduces fatigue and thereby cuts down in employee mistakes. Working along a conveyor at a constant uniform speed, being fed material on an even flow basis, operators develop a rhythm in their work which makes for sureness and fewer mistakes. Compare the modern mechanized coal yards, foundries, paint shops, and chemical processes to their old, unhealthy, back-breaking, dangerous manual counterparts.

In addition to the above-mentioned advantages brought about by the use of conveyors, there are many jobs that they alone can perform. Carrying parts through heat, through plating operations, through bad atmosphere, into cutting heads of machines and under water are only a few of the jobs that would be fatal to men. This is what we mean when we say that conveyors, by their very nature, help to prevent accidents, and make a better, safer and more enjoyable place of work.

So far as point number two is concerned, manufacturers are constantly striving to build safety devices into their equipment, devices that are designed to take the chances out of conveyors. In addition to safety designs, manufacturers and users have combined under the sponsorship of ASME and written a safety code on the use of conveyors. This code is called the "American Standard Safety Code for Conveyors, Cableways, and Related Equipment, B 20-1-1957." You may all be familiar with it. It constitutes a landmark in the analysis of safety problems in the machinery industry, and the manufacturers of conveyors are watching closely to see that their products will conform to its provisions.

We cannot discuss all the various phases of the code here; however, we can give a few general do's and don't's, which are covered in greater detail by the Code. Do guard driving machinery . . . Don't load beyond rated capacity . . . Do design mountings in such a way that catching sharp edges or possibility of pinching are minimized . . . Do keep lubricating points piped out to safe locations . . . Do have accessible adjustments to takeups or drives . . . Do use anti-backups and anti-runaway mechanical

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ety stops on slopes as protection in the nt of chain breakage or power failure . . . Do use overload protection . . . Do enclose counterweights . . . Do use guard rails. Interlock conveyors electrically to prevent jamming and the danger which occurs when one conveyor shuts down and the one feeding it is still operating . . . Do watch design of transfer points from one conveyor to another; here lies the possibility of pinch point and dangerous free materials . . . Do make sure supports, particularly for portable conveyors, are substantial, so that they will not tip under loads.

The code covers clearance and accessibility. Leave space for maintenance and for operators. Provide visibility so oncoming loads may be seen. Provide guarded catwalks up high. Wherever wall or floor openings occur, guard well with rails, for these are dangerous points. Provide inspection doors and peep holes where conveyors are enclosed. Make proper provision for crossovers, aisles and passages, leaving ample clearance and headroom. Define travel ways clearly with paint, signs or lights.

Under inspection and maintenance, the code suggests the importance of lubrication on a regular basis. Keep takeups properly adjusted; periodically examine cottered connections and couplings for weaknesses. Replace worn parts. The code advises that ated structures, such as tunnels, pits, pers, chutes, where conveyors are in use should be considered in the overall safety design.

Some good, general safety rules are: to obey rated load signs, mark "stop and start" stations clearly, make them easily accessible, and put them where they provide a clear view of the conveyor. No riding on conveyors; no stepping on conveyors. Don't service conveyors unless on regular maintenance crew. While servicing, stop the conveyor and lock out normal starting push button stations. In case of overload cutouts, locate jam and use lockouts before starting or attempting to service.

The code refers specifically to its relation to and dependence on other codes, including those of mechanical power transmission, electrical, elevators, dumbwaiters, escalators, cranes, derricks, hoists, buildings, bridges, walkways, floor and wall openings, railways, toe boards, dust explosions and boiler construction. The ASME, ASA and ASTM code numbers are listed therein.

The code suggests the following safety provisions for men who must ride on trippers or belt conveyors; totally enclosed bucket elevators; hand rails; guard plates along chain conveyors to protect hands, feet and clothing; stops at open ends of gravity conveyors; elimination of all pinch points on live roller conveyors; substantial guards with sides under overhead trolley, power and free conveyors; and solid covers on screw conveyors when possible.

The B20 code cannot hope to cover every possible detail concerning conveyor safety. Users and conveyor manufacturers must work together to reach the right balance of safety in conveyor systems. Greater consumer safety consciousness is a must. In any competitive industry, there are those who skimp on safety features to have the lowest price. Users must study proposal specifications and demand that safety features be outlined as specifically as the conveyor itself. Then these provisions must be adhered to.

They should consider carefully before they rule out a supplier who includes what others might call, "excessive safety features." Get copies of the Safety Code, and make sure the provisions are incorporated into your conveyor system. In considering the proposal, also consider these points: Has the system hemmed in workers too much . . . created fire hazards . . . allowed wide enough aisleways . . . left normal exit facilities? It is also wise to watch wall floor openings for their effect on the safety of employees on both sides of these walls and ceilings.

The education of employees is also very important in the overall effort for good safety policy. If a conveyor is being serviced and is shut down, as it should be, make sure the work is not being done too closely to another moving conveyor. Serious accidents have occurred where the serviceman, absorbed in his work, leaned back into another moving conveyor, or a slowly moving load came along and squeezed or pinched him against the stopped conveyor or to a wall opening.

Watch loading of conveyors. Be sure the hookup is secure if it is a hooking job. If

materials are piled on the conveyor, make sure they are not top heavy. Always remember clearances between conveyors and walls. Clearance for a man to walk through should, where possible, be based on the largest load carried on the conveyor. Authorize certain persons to operate certain conveyors, just as you would for a machine tool; keep others from starting the system. Speed variations in conveyor lines should be entrusted to one who understands the effects these changes might have on the system as a whole.

If overload cutouts are continually operating, or shear pins continually shear, contact the manufacturer of the equipment to find out the cause of jamming. Check as to whether the system is overloaded, by means of a dynamometer. If the design is light, make it heavier before trouble starts.

In closing, I would like to quote some figures taken from a recent survey made by The Conveyor Equipment Manufacturers Association, under the direction of Mr. R. C. Sollenberger.

We surveyed safety officials in all fifty states and two territories, to see what safety measures they had on their law books and to see what influence the new safety code, B 20.1-1957, might have. Of the 52 agencies surveyed, we found that 47 had no safety regulations applying specifically to conveyors. Four said that conveyors were named and nine replied that they applied general machinery safety rules. In all, 31 reported that they used B20.1-1957 as their guide. One, Maryland, refers to B20 in the state code, thereby giving it the status of a state law.

I think these figures indicate the critical need for wider recognition and dissemination of safety codes within our industries. Code B20.1-1957 is made available through the American Standards Association. Also available, from the Conveyor Equipment Manufacturers Association, is a short article, entitled "Plant Safety, Everyone's Job." These are recommended to anyone concerned with the manufacture or use of industrial conveyors.

ASSOCIATIONS SECTION

WHY? SELLING SAFETY AT THE LOCAL ASSOCIATION LEVEL— SHOWING THAT PATIENCE AND HARD WORK PAY OFF

By LESLIE J. INCH
Director, Accident Reduction Dept.
Hotel Association of New York City, Inc., New York, N. Y.

My remarks will be based chiefly on the activities of the Accident Reduction Department of the Hotel Association of New York City for its 160 member hotels and their 35,000 employees. This department of the association has been in existence since 1945. There are certain facts relating to its development and its method of functioning which I am sure will be of interest to those of you who have or are planning to organize safety departments within your group. After all, the reason for this session is to stimulate action on the part of association members and to develop and improve safety programs within their association.

A little background will explain what we are endeavoring to accomplish. Back in 1932, when many New York City hotels, and in fact hotels in many sections of the country, were finding it too difficult to meet their interest and taxes, a few farsighted, safety-minded hotelmen got together and organized what became known as the Hotel Section of the Greater New York Safety Council. Their aim was to promote safety measures within hotels and to develop policies for educating hotel employees in safe practices, as well as stimulate their interest in systematic procedures that would prevent accidents.

This Hotel Section continued to grow as the years went on. However, it was not until the late 30's that the informal support of the Hotel Association was sought in furthering the group effort. Unfortunately, however, cooperation was chiefly confined to those hotels that had representation actively engaged in the committee's work within the Greater New York Safety Council, less than one third the membership of the Hotel Association of New York City.

In 1944, the Hotel Association took formal recognition of the accomplishment of the Hotel Section of the Council and authorized the setting up within the association, as a standing committee, a safety committee, the membership of which comprised the executive committee of the hotel section of the council. This new committee immediately moved toward the development of the idea of making their work a direct activity of the association whereby all members might be given an opportunity to participate without the payment of any fee other than their regular association dues. Studies were made by this committee to ascertain the most practical method of expanding their activities.

As a result of these surveys, it was recommended to the Board of Directors of the Hotel Association of New York City in February, 1945, by the chairman of the safety committee that a new department be set up within the association for the express purpose of encouraging all the members to participate in accident prevention and in general develop ideas which might tend to bring about greater safety in hotel operation, reduce the number of lost-time accidents and eventually develop more favorable experience ratings for individual members. The board of directors, having had an opportunity to see the result of the safety committee's work, authorized the establishment of such a department to take over and expand the activities formerly performed by the hotel section of the council. Harry A. Mason, now retired, was appointed the first director of the activities of this committee.

One of the first steps projected by this department was a survey of member hotels to ascertain their 1944 accident reports, ob-

tain the names of their insurance carriers for both Workmen's Compensation and public liabilities and to get authorization to secure from the rating boards and their insurance companies any data which would be beneficial in developing and setting up records. The hotels were, in general, most cooperative and in a short time we had a rather comprehensive picture of the employee accident record of most of our members for 1944.

We next made a survey of the experience rate modifications of each member hotel as they affected the hotels' individual Workmen's Compensation insurance premiums. These figures once obtained were completed against the standard manual rate and released in a comparative report, each hotel being designated by a confidential code number known only to the hotel and the association. From this chart we were able to show which hotels were paying high premiums because of their past bad accident records and those which had been doing a good job in safety and therefore had a reasonably low premium rate.

The data obtained from hotels also furnished us with a basis for competing and comparing the accident ratios per employee in each hotel. From these ratios we could pick out those hotels whose current records were bad and needed correction. For those hotels whose current accident records indicated they were sorely in need of safety education, we contacted the hotel's insurance carrier and together with one of its representatives we met with the manager of the hotel, went over the accident records, discussed the causes and arranged, wherever possible, the adoption of a systematic safety program within the hotel.

In the initial phase of our activities, we endeavored to impress upon the minds of our members the necessity of maintaining a safety program at all times. We tried to show them by facts and figures how their safety records reflect their Workmen's Compensation premium rate and how a bad record can more than double the cost that might otherwise be possible if a good record were maintained. We sought to bring home to them the fact that they, themselves, can determine in a large degree how much their Workmen's Compensation insurance premiums will cost by the type of safety record they turn out. We certainly stressed that this is a long range program. Therefore, to save money in future years, it is necessary to begin building up a good accident record now.

As an example of how this worked out and is still working out, in 1944 the manual premium in New York State was $1.65 for each $100 of a hotel's payroll. It then rose steadily until it reached $2.53; then it gradually dropped and in 1961 it was $1.65, the same as it was in 1944. Since 1946, we have been making comparison of all the hotels as to the charges or credits that are applied to the manual rate. In 1960 with a basic rate of $1.80 before deductions for discounts or dividends, the hotel with the greatest credit paid $1.13, while the hotel with the highest charge modification paid $2.59 per $100 of payroll. You can see that the difference is $1.46. Apply these rates to an annual million dollar payroll and you can see the dollar saving. The irony of these comparisons lies in the fact that both hotels received the identical insurance coverage, yet one paid $1.46 as compared with $2.59 for the same type of coverage.

Our next move to get our safety message to our members in a way that would not bore the management executives was to inaugurate in April of 1945 a monthly bulletin known as "Star News"—the word "Star" being the first letters of our slogan "Save Through Accident Reduction." In these releases we have discussed varied topics relating to accident control, along with short news items. We stress the role that management must play in sponsoring a safety program and how, before accident control can become a reality, top management must give its blessing to the activity. We outline methods of safety with special attention directed toward instructions to new employees. We prepared and distributed safety posters, safety rules for employees and specific suggestions for inspectors to follow in spotting danger points. In short we use every known means to keep safety first and foremost in the minds of hotel operators.

Believing that competition is an effective means of arousing interest and enthusiasm in any activity, our department instituted on January 1, 1946 an inter-hotel accident reduction competition to determine the hotel that could develop the lowest lost-time accident frequency ratio. For the first twelve years, we ran this on a ten-month basis. The

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contest now runs for the full twelve months. the first year, we had 104 hotels partici-ating, with 53,660,745 man hours, 747 lost-time accidents—Frequency ratio of 13.92. In the last year (1961), 113 hotels, with 67,532,-752 man hours, 615 accidents—ratio 9.11. Our best year was 1957, 161 hotels, with 60,024,395 man hours, 491 lost-time accidents —ratio 8.18.

In this contest we group hotels according to size:

Group A—Large transient hotel.

B—Large semi-transient and resident hotel.

C—Hotels with over 30,000 man hours per month.

D—Hotels with 20,000 to 30,000 man hours per month.

E—Hotels with 10,000 to 20,000 man hours per month.

F—Hotels with 10,000 or less man hours per month.

Each year we award safety plaques to those hotels which are first in the letter grouping. Last year 30 hotels had no lost-time accidents. These plaques are awarded at the Hotel Session held during the Safety Convention and Exposition sponsored by the Greater New York Safety Council each year. This year the session was held on Wednesday, April 11.

You will recall I said the contest originally ran for 10 months. When we decided to award the plaques at the Safety Convention and Exposition, we extended the contest to a full year and made the award as part of our session. In addition, we usually declare the week of the conventions as Hotel Safety Week and run a contest in which all the employees of member hotels are eligible for cash prizes. In the past, we have had a Limerick Contest Cartoon Slogan. Each year participation is greater than the previous and the comments from hotel employees and employers have been excellent.

Twice a year, we compile statistical data relative to the accidents that has happened during the past six months. These are broken down into the type of accident: falls, strains, cuts, burns; lost-time accidents by categories; loss of time by department; frequency of accident by department and average day lost per lost-time accident. It might be interesting to note that in the six months ending December 31, 1961, we came up with the following facts and figures.

A Review of Lost-Time Accidents by Hotels

Comparisons of accidents and days lost by percentage ratios.		First Half 1962	Second Half 1961	First Half 1961
Comparative frequency of accidents by categories	Falls	30.3%	42.4%	35.0%
	Strains and Sprains	21.9%	14.8%	18.4%
	Bumps and Bruises	21.5%	19.3%	18.7%
	Cuts	15.7%	8.6%	9.8%
	Burns	3.3%	5.8%	6.4%
	All Others	7.3%	9.0%	11.7%
Comparative loss of time by categories	Falls	33.8%	55.7%	36.8%
	Strains and Sprains	26.2%	17.7%	25.2%
	Bumps and Bruises	20.6%	13.1%	15.8%
	Cuts	10.3%	4.6%	4.7%
	Burns	.6%	3.4%	5.1%
	All Others	8.5%	5.5%	12.4%
Comparative loss of time by departments	Housekeeping	35.4%	38.8%	36.5%
	Kitchen and Steward	26.3%	20.0%	21.5%
	Dining Room	12.6%	16.0%	16.6%
	Engineering	14.0%	11.7%	13.2%
	All Others	11.7%	13.5%	12.2%
Comparative frequency of accidents by departments	Housekeeping	30.3%	33.4%	39.5%
	Kitchen and Steward	30.3%	24.8%	22.2%
	Dining Room	18.6%	15.9%	14.4%
	Engineering	10.2%	11.4%	10.6%
	Front Service	6.9%	7.9%	6.5%
	All Others	3.7%	6.6%	6.8%
Average Days lost per L.T.A.	Housekeeping	26.1	25.6	32.3
	Kitchen and Steward	19.4	17.8	30.7
	Dining Room	14.8	22.2	25.8
	Engineering	30.6	22.7	24.0
	Front Service	28.8	19.9	39.7
	All Others	16.7	21.5	27.5

Early in 1952, with the approval of the board of directors, certain member hotels formed what is known as the Hotel Safety Trade Group. It actually came into being on June 1, 1952, and began with eight members. The current membership is 73. Only members of the association are eligible to participate in this group. In addition, participation is purely on a voluntary basis. The purpose of forming the group was to promote accident prevention and improve claims handling, thereby obtaining a reduction in insurance premiums.

The hotels currently members of the group were paying $1,000,000, for Workmen's Compensation insurance in 1952. This year after dividends and discounts, this premium will have been reduced to just under $500,000. In the number of accidents, these hotels averaged over 2,000 accidents per year prior to the formation of the group. This last completed year there were 1,009 accidents. Individual records are as follows:

In Hotel A: The 1952 premium was $45,000 on a payroll of $1,800,000. In 1959 that premium had dropped to $32,000 on a payroll of $2,600,000. These are all before dividends have been taken into consideration. These are premiums paid to the State Insurance Fund.

In Hotel B, an average sized hotel: The premium in 1952 was $15,750 on a payroll of $580,000. In 1959 this premium had dropped to $8,600 on a payroll of $768,000.

In Hotel C: The 1952 premium was $8,150 on a payroll of $233,000. The 1959 premium was $3,280 on a payroll of $385,000.

In order to accomplish all this, certain requirements have been set up that are rigidly enforced in the group operation. Each hotel is required to have a safety program satisfactory to the executive committee and the group manager. They are required to use preplacement physicals for all new personnel. The State Insurance Fund, which underwrites the group, makes an agreed number of safety inspections dependent upon the size of the hotel, with reports filed in the group manager's office. All claims must be filed immediately by the hotel with the group manager's office. The claims receive preliminary action before they are sent to the carrier in order to determine the facts in the case.

The subcommittee of the executive committee meets once each year and reviews the individual records of each hotel. If they are found to be neglecting their duties as a member of the group, they may be relieved of their membership. This is done to insure the compliance of the rules and regulations. The Group Manager maintains an attorney at the Workmens Compensation Board who represents each hotel in every action brought against that hotel. In many of the cases wherein the question of the legality of the case is involved, we actually assist the claimant by obtaining a prompt and fair settlement. In the rare instance where the claim made is a false one, it is our job to see that the case is disallowed.

In the 1,009 cases reported during the last completed group year, there were 36 controverted cases which were not believed to have risen out of employment. Twenty-four of these cases were closed in favor of the employer. The balance of the cases are still open and have not yet been settled. There were 542 hearings held during the same group year for member hotels, at which they were represented by legal counsel. There are many other activities within the sphere of proper claim supervision which are too detailed to go into at this time. Our group represents a venture into the active prevention of accidents, thereby obtaining substantial reduction in insurance premium.

In my attempt to outline briefly the activities which the Hotel Association through the accident reduction department is trying to carry on for its members, I believe that you will see that our particular aim is to install in the minds of each and everyone of our members the conviction that accident prevention is just as important in daily routine as any other phase of operation. We are endeavoring to make them thoroughly safety-minded and constantly on the alert to see that every possible safety precaution is afforded to safeguard guests and employees against accidents, that a systematic plan of safety education is provided and consistently maintained for the training and supervision of employees and that these employees perform their assigned tasks with safety to themselves, their fellow employees, and guests.

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of the employees. We ask that each unsafe condition or act is promptly reported by each employee to his or her supervisor. We also ask that when an accident occurs, the details be fully and promptly recorded on a Standard Report of Accident Investigation form and that if any employee is injured, regardless of how minor it might seem, it immediately be reported to his supervisor. We recommend that an active safety committee be maintained in each hotel and that this committee, in coordination with management, supervise the application of a safety program adapted to the hotel, being certain that all safety rules and regulations are strictly obeyed as are all other orders or directions of management. If we attain this goal, we will have reduced accidents materially.

I want, at this time, to inject a note of warning to those of you present who may be considering or planning the inauguration of a safety program for group application. Don't expect too much in the beginning. You will, no doubt, meet with negative reactions from some quarters and you will probably receive only passive acceptance from others. The visible results of your efforts may be almost negligible some time, no matter how extensive or intensive your endeavors or how successful they may seem to be. You must always bear in mind that accident control is a long-range project. It may take years to reflect the benefits achieved today.

Education, application and cooperation of all persons concerned are necessary to achieve positive results. All three of these requisites are not easy or quick to secure, especially if some of the members of the group are speculative owners with little or no interest in benefits that may accrue in the future. Begin your program with an avowed purpose of aiding those who want or are willing to accept your assistance. Start with a solid foundation upon which you can build and expand as your safety education progress. An accident control program well developed and consistently carried out is bound to win in the end, but it will take perserverance.

The period during which safety and accident prevention activities have been under the supervision of the Hotel Association of New York City has produced results. The reduction in the number of accidents over the years has produced material savings and we hope that it will become greater in the years ahead. We believe that we are offering our members a service, the kind of service which they need and which will reflect its benefits manyfold to those who heed our suggestions and consistently follow our byword: "Save through accident reduction."

WHAT? EXECUTIVE MEMBER ASSISTS ASSOCIATION'S SAFETY ACTIVITY

By ROY L. COFFEE
Vice President, Lowenstein Cotton Mills, Inc., Anderson, S. C.

I come from a textile company that belongs to trade associations in several states. Some of the associations have been very helpful in offering assistance in developing safety programs; others have been so busy with Legislative Proposals, tax changes, and proposals on business markets, etc., that they have failed to push safety!

There is definitely a place for the associations to help their members in this important field. If one of your members is doing a good safety job, you certainly should pass on what they are doing to the other members and tell *how* they are doing it. Perhaps you feel your members will resent being told how someone else is making out, but this is not so. They are always ready and waiting for outside assistance. I know, for in our company, we have received much valuable information this way.

Your National Association's Accident Prevention Program is one of the most complete outlines for a basic safety program that I've ever seen. On Page six of your Basic Guide,

you present a "Simple Basic Outline of Steps to Safety" for member companies to follow within their plants. This is an all-inclusive program, going all the way from management responsibility and policy to determining effectiveness of the program.

The National Safety Council's award for the promotion of safety by associations surely must be an incentive for every association present to push safety to its members. The Associated Industries of Georgia won a top award last year, and we are well acquainted with the safety activities of this association in our sister state. Many associations are doing such a fine job. Another good example is in Virginia; the Virginia Manufacturers Association worked with the Commissioner of Labor in getting its members to accept a week or two weeks' training for middle management people. This has been most successful all over the state, and they have reduced the accident frequency and losses in Workmen's Compensation and improved the efficiency of the middle management staff.

Another function associations are performing down my way—the textile associations in South Carolina, Georgia and Alabama—is to conduct safety contests among their members. They provide awards for industry at the associations' annual meetings. The Georgia Textile Manufacturers have done an outstanding job in their safety work. In addition to the annual safety contest, they are presently raising funds to produce a safety film that is badly needed in *all* textile mills. They had 131 different plants enter their safety contest last year—a record high!

We've looked at a few of the activities of associations, and we know you are already doing a fine job. But let's ask ourselves now: just what can an executive member of an association do to assist Associations' safety activity?

1. He will freely offer his full cooperation. He will contribute his time and money. He will be willing to serve on committees, when asked, even if it involves attending meetings!

2. A member will contribute accurate information according to A. S. A. code to any competition his plant is taking part in, for this is the only way that the true picture of his industry can be obtained.

3. He will assist in any research project coming out of the committees that will benefit his industry.

4. If he is a large member and has a full staff, he will offer his staff's services, particularly those of the safety department. Thus, he gives the smaller members the benefit of his experiences.

5. He will provide pictures and illustrations, drawings of machinery and equipment and housekeeping from his plants.

6. He will offer to the association whatever his company does to get safety outside the plant and help the community relations program, insofar as off-the-job safety is concerned. This includes traveling to and from work, recreational, sports, etc. The Virginia Manufacturers Association program already mentioned is a good example.

7. Endorse objectives of the association and give his enthusiastic support and publicity to the association's program.

8. He will always try to exceed the aims of the association.

9. If the association fails to bring it up, a member can bring up in the association meeting the need for a safety program.

I am planning to talk to the textile section this afternoon on the subject of "Management Can Create a Safety Atmosphere" and thought that your association leaders might be interested in some of the key points of this talk.

Two factors affect safety: (1) technological—machines, materials, processes; (2) human—operators, foremen, management. Most important are the human factors.

Ordinarily, safety is looked on as a set of rules. We believe safety really is not a program as such, but results from a climate or atmosphere generated by management tactics that sometimes seem poles removed from safety topics as such.

Look at the executive sitting in his office, making decisions all day long. He may feel that he can delegate authority to the safety director and accomplish the desired results, but this is not so. Safety is something that emerges from the way his decisions are made and the way the climate is generated by the executive. This executive, in creating this climate, *demands* results but, at the same time, makes his decisions in such a manner as to create confidence in himself and his company.

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A properly oriented supervisor will operate a safe department whether or not a program is in effect. The management team must understand the human side of responsibilities, failures and accomplishments. This climate is the basic attitude of our people that is defined by management's activity and decision.

How management receives ideas and communications from below in the company structure is also very important. Communications lines must work up as well as down. According to Dale Yoder of Stanford University, 84 per cent of employees agree morale is closely correlated with productivity and 95 per cent agree that employees work harder to carry out decisions when they help make them.

Progressive management today tries desperately to motivate the people so they feel they are part of the company. Some supervisors say safety is dull, the same old story. They are failing to look at the big picture. If they got total concept, there wouldn't be enough hours in the day.

All of us drive automobiles each day, and we do it instinctively. We do not have a set of rules on the windshield or in our pocket. If a child darts out in front of us, we instinctively put our foot on the brake and swerve the car to miss the child. We can, by proper training, create a similar attitude about safety in our employees as they go about their daily duties. If a company can attain the proper climate—and some already have, their labor turnover will be better, absenteeism reduced and their safety record greatly improved.

I said earlier that safety to me was really not a program as such. (We like to look at programs as being things about Christmas, Thanksgiving, 4th of July.) Safety is an activity, a way of life that is with us forever.

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