

TRANSACTIONS

34th NATIONAL SAFETY CONGRESS

CHICAGO

October 7-11, 1946



VOLUME I

Part I

General Subject and Industrial Sessions

VOLUME I, Part 2, concludes the Industrial Sessions

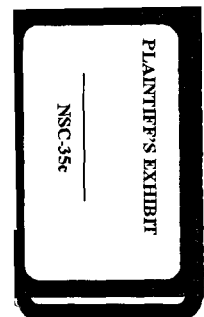
**VOLUME II contains the Traffic, Commercial Vehicle, Transit,
School and College, Home, Farm and Women's Activities Sessions.**

National Safety Council, Inc.

20 North Wacker Drive, Chicago 6

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Foreword

VOLUME I

THE Transactions of the 34th National Safety Congress and Exposition of the National Safety Council are published in two volumes. Volume I is published in two parts, of which this is Part 1, and contains the Annual Council Meeting, the Banquet, the general subject sessions, and the Industrial Section sessions. In Volume II will be found the Traffic, Commercial Vehicle, Transit, School and College, Home, Farm and Women's Activities sessions.

The Transactions are a record of the proceedings of the Congress, condensed and edited for reference purposes. They are, therefore, an abridged version of the papers and discussions. The original manuscripts, some of which have drawings and charts too expensive to reproduce here, are available in the files of the National Safety Council.

The National Safety Council, at its Congresses, seeks to eliminate from discussion matters which are not pertinent to the aims of the Congress, or which may be contrary to the Council's policies. However, it cannot accept responsibility for all views expressed, either in the discussions of the Congress itself or in this record of them.

Extra copies of Volume I (including Parts 1 and 2, which cannot be sold separately) may be obtained by Council members at \$2.50 each. The price to non-members is \$5.00 each. Extra copies of Volume II are \$1.25 each.

THE NATIONAL SAFETY COUNCIL, INC.

20 North Wacker Drive

Chicago 6, Illinois



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48- 97669

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Using the Transactions

Each edition of these Transactions is a library of safety experience. Hundreds of men and women—leaders in industry, transportation, insurance, and governmental agencies—give the best of their knowledge and background to the cause of accident prevention at the Annual Safety Congress.

This knowledge and experience, accumulating year after year, is of great value to progressive industrialists and businessmen.

Plan of Arrangement

Safety ideas, topics, and problems, as well as personalities important in the field of safety, can be found by reference either to the *Table of Contents* or to the *Index* at the end of Part 2 of the volume.

The *Table of Contents* lists (a) General Sessions, (b) Subject Sessions dealing with problems common to many industries, (c) Industrial Section meetings.

Subject Sessions and Industrial Sections are arranged alphabetically. In the body of the book the several meetings of each Industrial Section are printed as they appeared in the daily time schedule of the original program.

The detailed alphabetical *Index* makes it easy to find specific safety material. It lists hundreds of items in three ways: (a) subjects discussed, i.e., absenteeism, dusts, safety shoes, welding; (b) speakers in the case of formal papers. Speakers' names are printed in italics; (c) Industrial Sections, i.e., Chemical, Construction, Food, Marine, etc. Under each Industrial Section are listed the subjects of its complete program.

Use the Transactions...

... To solve accident problems of foremanship, protective clothing, dermatitis, welding operations, ventilation, substitute materials, and many others.

... To aid in meeting such special war problems as off-the-job accidents, war conservation of personal protective equipment, wartime fire protection, and women in war industry. These subjects receive special emphasis in these Transactions. The Early Morning Sessions (Man to Man on the Job) stress the proper approach to employee training problems faced by all expanded industries.

... To obtain speech-making materials for the safety director or business executive who plans to speak on accident prevention. In addition to facts and authoritative opinions, this book contains many splendid examples of safety talks which can be used as guides or models. In addition, much of the material can be used in local publicity, plant publications and bulletin board announcements.

... To learn the points of view held by the leaders of the safety movement. These leaders, as officers or members of the Council's Industrial Sections, or as public officials, contribute ideas which can be used in the organizing of safety programs.

... To gain a better understanding of the National Safety Council's services and the national safety program. A survey of the material contained in the Transactions will supply the reader with increased knowledge of the growing power of the safety movement and of the means by which this power is expressed.

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TUESDAY EVENING SESSION

October 8, 1946

Presiding: W. DEAN KEEFER, Second Vice-Pres., Lumbermens Mutual Casualty Co.
 (Summary of Proceedings)

W. DEAN KEEFER:

The activities of the Standing Committees and of the Chapters are contained in a printed report, copy of which was distributed to those in attendance at Sunday's Executive Committee meeting. Additional copies will be mailed to all Chapter Chairmen and Representatives.

These reports are comprehensive, and cover the principal activities of the Society. I would only supplement these by saying that the ASSE has continued to grow, eight new Chapters having been added during the business year now closing, bringing the total of Chapters to 30. I am informed that several more are in prospect.

I would like to take this opportunity to commend the Secretary, whose untiring efforts have been responsible in no small measure for these increases. In the discharge of secretarial duties, he has visited with each of the chapters and many of the prospective chapters. This has necessitated considerable traveling in addition to office duties.

I also want to take this opportunity to express my sincere and grateful appreciation to the chairmen and members of the Standing Committees. They have served throughout a two-year period, and have each done a splendid job. I especially want to commend the Committee on Revision of the Constitution and By-Laws. They worked diligently on a most difficult assignment. We will discuss their findings a little later in the program.

It was voted that the nominations be closed, and the Secretary instructed to put a unanimous ballot electing the slate of officers presented by the Nominating Committee to serve the Society in the regular offices for the 1946-1947 season.

JOE M. GODWIN (Chairman-elect and Dir., Philadelphia Electric Co.):
 Chairman, fellow-members of ASSE,
 Guests. First, I want to thank the Nominating Committee for selecting me to head

this organization, and also to thank each of you for your confidence in honoring me with the office of General Chairman, and placing me in a position to serve you.

I am not going to make a speech. However, I do want you to know that after many years of activity in ASSE, I believe I am conversant with many of the problems, the aims, and objectives of this organization, and the one promise I make is that I will do my utmost to carry on the affairs of this Society in accordance with the trust you have placed in me.

It will be my aim to help bring safety engineering closer to professional recognition by the other engineering societies. In order to accomplish this, we must have your wholehearted support in maintaining the standards of our Society on a high plane.

I now have a very pleasant duty to perform. Dean, will you please stand up. It is a pleasure, on behalf of the membership, for me to present you with this engrossed certificate in token of our appreciation for your leadership during the past two years. With it goes the hope that you will continue to serve for many years helping us to continue to build ASSE.

A. D. CADDELL (Secretary, ASSE):
 In addressing the members on the important question of the Revision of the Articles of Government of this Society, I believe it to be only proper to point to the magnitude and many difficulties of this task, which confronted the Committee. Because of wartime travel restrictions, it was not always possible for Committee members to attend meetings. Although numerous meetings were held, it was necessary to carry on a large amount of correspondence, all of which was given consideration in reaching the consensus presented to the membership in the August, 1946, issue of the Society's News Letter, as provided in Section I of Article VIII of the Constitution, on amendments.

Air Transport Section

Executive Committee

1946-1947

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It is conceded freely by the Committee on Revision and your Executive Committee that the draft of the Revisions as presented in the report is not perfect, nor does it appear that any group could produce a perfect document for all time. Nevertheless, as now drawn, these Articles of Government do provide for raising the standards of membership, and they also provide necessary implements for the better functioning of chapters, and for the general improvement of relationships throughout the Society.

If further amendment is required, the

ways and means have been provided. A Committee has been appointed to consider suggestions already presented; this Committee will continue to function under the new administration.

It was voted to adopt the Revisions as presented in the August, 1946, issue of "Engineering for Safety."

Mr. W. G. Power, Representative of Chevrolet Division, General Motors Corporation, Jacksonville, Florida, presented an inspirational address on "Selling Safety Engineering." Mr. Power interspersed his address with numerous illuminated drops.

Automotive and Machine Shop Section

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 *M. A. CLARK, Labor Relations Institute, Detroit, Mich. 1936-1937.
 *H. B. DUFFUS, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. 1943-1944.
 *HOYT L. FRACHER, Detroit Steel Products Co., Detroit, Mich. 1930-1931.
 *G. A. KUECHENMEISTER, Dominion Forge & Stamping Co., Walkerville, Ont., Canada 1925-1926.
 *M. J. MCCARTHY, Fisher Body Detroit Div., General Motors Corp., Detroit, Mich. 1933-1934.
 *ROBERT A. SHAW, Detroit Diesel Engine Div., General Motors Corp., Detroit, Mich. 1920-1921.
 *I. T. COMDR. PAUL S. STRECKER, USNR, Boston Navy Yard, Boston, Mass. 1941-1942.
 *R. F. THALNER, Buick Motor Div., General Motors Corp., Flint, Mich. 1924-1925.
 *V. I. TROTTER, Curtiss-Wright Corp., Buffalo, N. Y. 1940-1941.
 *C. E. WOOLFEVER, A. O. Smith Corp., Milwaukee, Wis. 1942-1943.

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Automotive and Machine Shop Section

MONDAY AFTERNOON SESSION

October 7, 1946

Presiding: V. E. BLUE, Dir. of Personnel, Chrysler Corp.

Safe Utilization of Manpower—Job Analysis

By G. H. METZ
 Wage and Salary Administrator, Camden Plant, RCA-Victor Division

Two important aspects of industrial management today are job analysis and safety engineering. Our experience in the Camden Plant has been that these two functions can so operate that they are complementary to each other.

The safety section can provide guidance and assistance in developing the techniques of job analysis and particularly in applying the findings of job analysis to the specific safety problems encountered in the plant. Job analysis on the other hand provides an important source of information for the safety function and in effect becomes an extension of the safety section in one phase of its operations.

The Camden Plant job analysis program was initiated in September, 1943. Top management had determined the necessity for such a program and had given it solid backing, which insured cooperation of the intermediate and lower levels of supervision. The first eight months were devoted to preliminary ground work and research to establish a manual and a procedure of job analysis, and to develop suitable job analysis schedule forms. A series of pilot studies were conducted to test the material thus developed and changes made dictated by the needs of the operating departments.

At the conclusion of this preliminary period a complete job analysis staff was organized. It consists of four job analysts and one chief job analyst who were scheduled to analyze all the Camden plant jobs over a two-year period. When all was in readiness, a series of supervisory conferences were held in which the purpose and objectives of the program were described and the benefits which supervision could obtain from the program in the form of increased efficiency in solving some of their more serious problems. Similar sessions were

held to which were invited the officers of our hourly union and the shop stewards.

These meetings were designed to elicit the cooperation of the lower levels of management and through them and the union leaders to insure the assistance of the rank and file employees without whose help the program could not succeed.

Beginning in February, 1944, the systematic analysis of jobs was begun and was completed in June, 1945. By virtue of these analyses and subsequent analyses made as required we now have on file a detailed record of every Camden Plant occupation which is invaluable not only for current use but also as historical material.

In developing our job analysis schedule, based primarily on work previously done by the U. S. Employment Service, we decided to gather four types of information. The first type is identification information. The first portion of the job analysis schedule identifies the job, its physical and organizational location, the code or serial number assigned to the occupation and the names of the job analyst and the foreman who are responsible for the content of the schedule. A brief summary of the job is usually included in this part of the schedule also for ready identification of the major details.

Employment information is the second part. One of the more important uses to which job analysis information can be put is the selection and placement of personnel. The use of this information in working with physically handicapped applicants is a specialized application of this section of the job analysis schedule.

The third part and main body of the information gathered describes the work that is done. In this section a detailed description of the various tasks of the job

production and in some cases, it is rather difficult to impress them with the fact they are not going to get out production, efficiently and economically, at least, without getting it out safely.

And then there is the worker! Did you ever go around a shop and try to get just one employee to admit that perhaps he will be in the hospital at the end of the day as the result of an accident due to a cause attributable to himself? If you haven't, try it sometimes and you will really have your eyes opened. Most workers feel that accidents will happen—but not to him. It is always "the other guy" who is going to get hurt and yet, look at the accident statistics—mounting steadily day by day, month by month and year by year.

Why is this apathy displayed by the salient groups which go to make up a successful safety organization? It is because safety is a necessary and dry evil.

Safety is like anything else. To be successfully sold, it must be advertised. I am not going into the ways and means of accomplishing this selling job, I merely point out the necessity of it. Safety must be glamorized and dramatized. We know that most of our work in safety must deal with the human mind—that at least 85 per cent of all accidents involve the human element. It is, therefore, only logical that we must go to the advertising and pub-

licity fields to get our subject across to those whom we wish to participate in the safety effort.

I do not mean to propose that we make a "Barnum and Bailey" sort of a thing out of safety, forgetting the old fundamentals and the actual engineering phases of the business. But I do say we must reach the three units of our safety structure in such a manner that they will take readily to our teachings. I'm of the school that believes "any means to reach an end," so long as that end is the reduction and elimination, if possible, of accidents. Sometimes such an attitude can get us in trouble—like that time I plastered a large, gruesome picture of four severed fingers over the front page of our plant safety paper. But, do you know, we didn't have a single lost time accident for three months after that picture appeared? For a long time there was considerable talk about safety in that plant.

I do not advocate such a thing as a steady diet, but it serves to illustrate the point. Perhaps this talk has not given you too much for digestion on the subject "Use of the Safety Organization." I do hope, however, that it has stimulated a little thought and if it serves no other purpose than to get you to go back to your plant and get something under way for safety's sake, then I feel my job has been well done.

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1946-1947

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The cause of accidents is not always physical. Mental attitudes arising from environment of family or domestic difficulties, worries over financial responsibilities and illness, all contribute to our accident rate as do accidents caused by physical conditions.

Accidents occur when workmen are emotionally upset and in a state of nervous tension. Many accidents are caused from lack of foresight. A man starts to do his job without considering the elements of risk involved or the method of attacking the particular task. Many accidents can be eliminated if we have the knack of using more foresight along with our hindsight. Someone said that no safety device has ever been invented to take the place of the one just above the ears. To make safety procedure operate successfully, it is necessary that workmen understand rules or suggestions for safety not only to the extent of knowing what is expected of them, but why these rules and suggestions are important.

Family strife, finances, sickness and other distracting difficulties are exacting a toll of accidents which is incontrovertible. Management can and should interest themselves in such matters to aid the workmen to relieve the strain, if possible, so he may give his undivided attention to the detailed performance of his work.

Many argue that ill health, rather than carelessness, is responsible for most of our accidents. I cannot join in this belief, but concede that health of any individual is a real factor and any good accomplished by industry or society to raise the standard of health, no doubt, will be beneficial. The results of the recently adopted health and welfare fund and its effect on our safety performance will bear watching with keen interest.

The gross carelessness of shiftless work-

ers is one of the real problems from the accident standpoint. These are men who cannot be educated, instructed or warned. This type of worker will soon find it difficult to secure employment. Regardless of the characteristic habits of the employee, no one has a right to expect more than a good day's work. No man should be forced to do a day's work which brings fatigue to a point where he is apt to be injured. It is just as sinful to require a man to do more than he is capable as it is to permit him to do less. Common ordinary horse sense, with future planning, will correct the problem.

Our accident records show that accidents among the non-English speaking classes are greater than those of the English speaking classes. Management cannot offer the excuse that the problem of the non-English speaking employees cannot be properly attacked. There is a way to do it and, where facts reveal accidents on that account, management must shoulder the responsibility.

We are living in a most competitive age. Profits per unit of production are being reduced, and the proportion of accident expense that the investor bears is forever being increased. Speed is the order of the day. Timesaving seems to be the factor but, in spite of speed in production, travel by water, land or air, the accident records, as a whole, show constant improvement.

Discouragement and unhappiness are potential causes of accidents. The distress and unhappiness brought about by the great war was of devastating effect. We have felt its effects but, even so, we must be on the alert to keep alive the will to live and act safely. We know that industry is now on a full speed schedule so we must keep pace with our safety work. The job is big, but let's prove we are equal to it. If we furnish leadership, I am sure you will find that the men in the mines are 100 per cent behind you.

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American Association of State Highway Officials

O. F. GOETZ, Tennessee Dept. of Highways & Public Works, Nashville, Tenn.

American Institute of Architects

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Executive Committee 1946-1947

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PAUL ACKERMAN, Pullman Standard Car Manufacturing Co., Chicago, Ill.

WEDNESDAY AND THURSDAY AFTERNOON SESSIONS

October 9 and 10, 1946

Presiding: GENERAL CHAIRMAN HERBERT F. HEIL, Editor, Factory News, The National Cash Register Co.

Summary of Proceedings

The sessions of the Employee Publication Section opened with a joint luncheon sponsored by the Industrial Editors Association of Chicago. Westbrook Van Vorhes, of the "March of Time," was the speaker.

Transactions of the Employee Publications Section are being published separately in the November-December News-Letter of the Section.

The Contest

Certificates of Merit were awarded to 15 employee publications which had done outstanding work in presenting safety material. All certificates are of equal rank.

Class I—Magazines

- The Seeburg Voice—J. P. Seeburg Co., Chicago.
- The Carbuilder—Pullman Standard Car Manufacturing Co., Chicago.
- Midvale Safety Bulletin—The Midvale Co., Philadelphia.
- Studebaker Spotlight—The Studebaker Corp., South Bend, Ind.
- Petty News—Petty Geophysical Co., San Antonio, Tex.

Class II—Newspapers

- The Chatham Blanketeer, Chatham Manufacturing Co., Elkin, N. C.
- Contact—Canadian Industries Limited, Montreal, Que.
- The Bendixline—Bendix Products Div., Bendix Aviation Corp., South Bend, Ind.
- Wierton Steel Employees Bulletin, Wierton Steel Co., Wierton, W. Va.
- The Kearnygram—Western Electric Co., Kearney, N. J.

Class III—Mimeograph, Misc.

- Carborundum Safety News—Carborundum Co., Niagara Falls, N. Y.
- T. L. L. Safety—Trinidad Leaseholds Limited, Pointe-a-Pierre, Trinidad, B. W. I.
- Safety and Health and The Accident Record—Western Electric Co., Hawthorne Works, Chicago.
- The Safe Supervisor and Do's and Don'ts—Western Electric Co., Kearny, N. J.
- Your Safety News—U. S. Gypsum Co., Chicago.

Food Section

Executive Committee

1946-1947

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1946-1947

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MRS. ALTA WHITLEY, R.N., Allis Chalmers Company, Springfield Works, Springfield,
Illinois.

Visual Education—HEIDE HENDRIKSEN, R.N., *Chairman*, Dept. of Health, University of
Minnesota, Minneapolis, Minn.

Secretary & Staff Representative—JANE S. WEIR, R.N., National Safety Council.

have no medical setup there, but we do. I said they should call the Henry Street nurse, and they will do that. He said they can't do that because the union would get mad. If we spent two hours there in the day shift, the twilight shift and the midnight shift would want two hours, too. What's the answer to that?

MISS HARMON: That's a real problem. We are constantly being faced with it. It goes back to management's fear that what is given to one group of workers, if it is not given to all groups, will cause more disruption in labor relations.

We have gone on the premise that whenever possible, and when the individual nurse is willing to work at odd hours, we will supply as much nursing service on the other shifts as we do on the daytime shift. That is only possible when your nurse is willing to do it. We have had nurses go

out at five o'clock in the morning, for instance. Right now we have one who works from six thirty in the morning until eight, although our regular working hours are from eight-thirty until five. We have one nurse who has gone out at eleven o'clock in the evening to cover the change of shifts.

I don't think that is a solution for the problem at all. It is merely an attempt on our part to give as much service for each group of workers as the group during the day is getting. But I am afraid that it will become increasingly difficult for us to do that, as time goes on, and certainly, where you have only a small group of workers on any one shift, it isn't possible to employ a full-time nurse for each shift. The solution to the problem depends upon how willing your nurse is to sacrifice her working hours, and probably very few of them would be.

Marine Section

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1946-1947

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TUESDAY AFTERNOON SESSION

October 8, 1946

Ship Construction and Repair

Presiding: H. GERRISH SMITH, Pres., Shipbuilders Council of America

Report of General Chairman

By W. C. GARBUTT

General Chairman, Marine Section, and Mgr., Industrial Relations, Pittsburgh Steamship Co.

Two years ago when we last met, I expressed the fear that the Marine Industry might expect rising frequency and severity accident rates because of the new and unusual conditions to which both construction and transportation were being subjected.

There was a war to be won and the order of the day was "speed" and "Haste makes waste." Ships and more ships were to be built. In many instances workers were hastily trained and equipped. The vessels were eventually loaded by other inexperienced workers and manned by green crews. That accidents and injuries were more numerous is not surprising, but we are gradually returning to normal and the lessons we have learned will undoubtedly reflect themselves in future statistics. There is even now reason for congratulation and commendation to the marine safety engineer that both frequency and severity rates through the war years were in line with the decreasing trend begun in 1936. Our efforts are pledged to bring our safety record to comparison with that of less hazardous industries. The return of our experienced men to teach and direct those who will follow them makes for assurance that this will be done.

Those of us who, of necessity, remained behind have endeavored to carry on the work of the Marine Section, despite transportation and hotel accommodation problems. Most of our contacts were through correspondence, although those residing in the New York area met several times and so them is the deserved credit for this excellent meeting. Special thanks of the entire Section should go to Past Chairman Carl Holmes whose unstinted service and wholehearted cooperation has largely contributed to the success of our program.

The Council suffered a serious loss on

the West Coast when Past-Chairman Byron Pickard passed on. "Pick" was one of those fellows to whom you take an instant liking and never changed your opinion. You could work with him or play with him. He was always your friend, ready with help and advice at all times. His experience was extensive, but he never suggested superiority. His mantle has fallen upon Joe Travers whom we welcome into our circle and wish for him the success that was "Pick's."

Our activities on the West Coast are still being carried on by Andy Schmitz, Frank Blackstone, Ed Lange and others. To them, our sincere thanks for their continued cooperation.

The Gulf Coast operations are being ably handled by Slim Schroder and his helpers. Many of them were not able to devote much time to the Section affairs because of their war duties, but as they return to normal occupations, we can expect increased activity in the South.

The East Coast has always been the hub of the Marine Section. The number of members in the New York area permits closer personal contact. The thanks of your retiring Chairman is especially due to John Hunter, Frank Cogan, Ed Herges, Harold Segrave and Harold Wick, who have never been too busy with their personal affairs to prevent them lending assistance and counsel to Carl Holmes. Your new Chairman will find that the return of Ed Holden will add further energy to the New York group.

We are also indebted to Arthur Toole, who has generously included the Marine Section in the activities of the Propellor Club.

Our thanks are also due to the Regional

Metals Section

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MONDAY AFTERNOON SESSION

October 7, 1946

Presiding: EARL H. FYLER, Supt., Industrial Relations, Carnegie-Illinois Steel Corp.

The Safety Problems of a Small Plant

By CHARLES S. CRAIGMILE

Executive Vice President, Belden Manufacturing Company

What has the size of the plant to do with the handling of safety? Usually it is just this—in a large plant you find more full time positions and fewer "jack of all trades" jobs so characteristic of the small plant. You will probably find a full time safety director in the large plant, with a department of considerable size under him. In the small plant safety may be directed by anyone from the president down, and almost surely will be only one of several responsibilities assigned to him.

Right there the difference ends as far as I am concerned, and I believe that generally we make too much of the difference. I hear large-plant safety men say that if they could only have the close contact with employees which the small plant executive has, their safety problem would be a cinch. Just as vehemently the small plant man says that if only he could have a safety director, a full time doctor, a nurse and a safety staff, of course he could make a fine showing.

Experience proves that they can both be wrong. Size is not and never will be a measure of safety efficiency. What is essential is that the spark of safety consciousness be alive in someone's breast whether he be the president, the vice-president or the janitor, and then the means of translating that spark into safety power.

Specifically then, what should top management do about safety? To start with, the chief executive officer or the executive designated by him to be responsible for safety, should either organize and conduct a carefully integrated safety program, or definitely assign that responsibility to one of his subordinates, preferably, of course, not too far down the line. Whether he assigns the function or not, he must keep in touch with it and give it his full co-

operation, and I mean by that he must attend plant safety meetings on invitation, watch the plant safety record, and show clearly that he considers it a major responsibility and not just a side line of minor consequence. Employees take their cue from management and if top management is indifferent to safety they should not be surprised if the whole organization follows suit.

In the second place, the "brass" should see to it that their company joins the local safety council if there is one, for specific help in carrying on their safety work, and also joins the National Safety Council to assist in the broad job of safety education and coordination. To keep any movement alive and efficient you must have organized effort.

Third, our plant manager should give some of his time to safety council work. All such organizations are plagued by individuals who are perfectly willing to agree to serve on boards of directors but who actually contribute nothing. Many of these individuals claim they are too busy, but I often wonder just what they are so busy doing. Personally, I am afraid in many cases a diary of their activities might indicate a lack of proper evaluation rather than time.

Let us turn now to the job of the safety director, whoever he is, and see if we can point out some of the important steps he will find necessary to success.

1. *Organize a Safety Committee.* Safety direction is not a one-man job. The safety supervisor needs the support of the whole organization, and one of the ways of getting it is to appoint a representative safety committee. The members should be rotated and nomination can be used to recognize out-

sensitivity, but generally there is this maximum allowable amount, so you approach the problem in this way: If possible, don't get it on the skin at all, but if it does get on the skin, get it off as soon as possible.

MODERATOR RIDINGER: We have time for one more question: "Should a safety engineer remove or have removed a hazard over the objections of a foreman? In either event, how would you do it?" Bob Ferguson.

MR. FERGUSON: I think it would be

a mistake for a safety engineer to go into a foreman's department and try to do something over his objections. The men in our organization have definite instructions, when they see a hazardous job to just shut down, but to be sure they are right.

The thing to do in a case like that is to get the department head immediately and decide then and there whether it is right or wrong. I don't think anyone should try to usurp the foreman's authority in a given department.

Mining Section

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- HOWARD I. YOUNG, American Zinc, Lead & Smelting Co., St. Louis, Mo.

Staff Representative — G. G. GROVE, National Safety Council, Inc., Chicago, Ill.

Past General Chairmen

MONDAY AFTERNOON SESSION

October 7, 1946

Presiding: C. M. FELLMAN, Safety Eng., The Montreal Mining Co.

Safety Equipment and Methods Used by the Climax Molybdenum Company

By EDWIN J. EISENACH
Safety Director, Climax Molybdenum Company

Throughout the history of the Climax operation, the company officials have shown an active interest in maintaining high employee morale. They have provided modern homes, schools (both grade school and high school), modern hospital facilities, and recreational facilities.

A continuous study of modern methods and equipment is carried on, and installations adaptable to the mining and milling of the molybdenum ore are made. Careful consideration is given to every suggestion for improving conditions of safety and production made by employees. A small award is given for any suggestion that is used. Occasionally a suggestion appears to be of little value but leads to a study of the objectionable condition, and major installations or alterations are made.

Stationary spot lights suggested for use in slusher drifts were first rejected. However, later experiments revealed that a properly mounted 200 watt spot light greatly increased the safety and efficiency of slusher operations. These lights are mounted so that they may be easily removed during heavy blasting.

To illustrate how suggestions may grow, I wish to describe our car-cleaner. Damp muck frequently freezes in the bottoms of the 10-ton Granby cars and will not dump. The cars were side-tracked and a crew of men loosened the muck with picks and shovels. This method was slow and somewhat hazardous, and moils operated by jackhammers were used to loosen the muck, but this method was not successful. Then spaced holes were drilled and loaded with dynamite and the muck blasted. This added hazards to both men and equipment. Other experiments were tried, including: a swinging steel plate hinged to the top of the side opposite the door, drag chains, blasting

holes in back of the car, and rubber mats on the car bottoms. A device operating on the principle of a steam-shovel was proposed, and the idea of fingers operated by a compressed air piston with suitable guides was developed. This solved the problem. It is possible to clean and dump a train of 20 cars in approximately four minutes.

The method of mining at Climax is block caving. Both the grizzly and slusher system are used in handling the ore. A paper describing the details of these two methods was written by Mr. Robert Henderson, the mine superintendent, and is available upon request. The slushing system is safer and more efficient than the grizzly and chute method. The accident frequencies are about the same, but the loss of time for chutes is over twice as high. Injuries due to falls and blasting are more numerous in the chute system because of the need for working over an open grizzly and blasting in two places instead of one.

The ore drawn from either the slusher drifts or chutes is hauled to the crusher bins in 10-ton Granby cars. A train consists of 20 cars, drawn by a 19-ton Atlas Trolley Locomotive on a 36 inch gauge track with 60 or 90 pound rails. The first six cars are equipped with air brakes. All cars are equipped with automatic couplings and safety chains; the safety chains are a protection in case the coupling fails or become unhooked.

All trains approaching and entering the tunnel are controlled by an interlocking switch-board installed in the underground dispatcher's shack. Haulage accidents are numerous in most mines and are our second largest problem. Some serious wrecks were caused by two trains trying to occupy the same place at the same time. The out-going trains come from two sections of the mine

from the edge of the open stope. Loading near the stope is necessary at times and all loaders wear safety belts. Every precaution is taken against a premature blast. Drilling is kept away from loading; electric cables and pipes are maintained at a reasonable distance; blasting lines are grounded; and leg wires are shorted against stray currents. Special blasting lines and panels are installed underground. The rings of blast holes are shot from these panels by a shift boss after the area is clear of all men.

In bulldoze chamber work, men are working below an open draw hole and over an open grizzly of large size, both dangerous operations. The hazards result in serious accidents, as 36 per cent of our fatalities occur in bulldozing. The reduction in the size of the draw hole and the elimination of work over a grizzly has helped appreciably to reduce serious accidents.

The use of slushers has decreased the

number of men employed on ore drawing from 42 in bulldoze chamber work to 15. Only a single lost time accident was charged to ore drawing in 1945. Other minor improvements have been better guarding of secondary blasting and better control over the ventilation.

Records on dust generated in development headings show, with the exception of raises, that the size of the working place has a definite bearing on the dust concentrations. In powder pockets dust concentrations are reduced in proportion to the size of the heading. This is also partly true in the mucking phase of development work, as conditions are now nearly equalized by the use of mechanical mucking machines. The operation of diamond drills also shows a lower generation of dust than in percussion drilling operations. The elimination of the small-sized headings and the replacement of development work by diamond drill holes has resulted in healthier conditions.

Headings	Size	Drilling	Mucking	Barring and Setting Up
Haulage Drift	8 by 9	100*	100*†	100*
Blast Hole Drift	7 by 7	63	83‡	—
Slusher Drift	7 by 8	197	102‡	—
Service Drift	6 by 8	182	92‡-120	90
Powder Drift	4 by 6	213	125	181
Powder Pocket	3 by 4	360	384	459
Raises	Various	532	—	119
Winzes	6 by 14	136	100	—
Stopes	—	169	—	74
Diamond Drills	7 by 7	59	—	—

*This figure taken as 100

†This figure for Mechanical Mucking

A comparison of dust conditions in the ore drawing system shows only a slight advantage in favor of the slushers. The control of ventilation is simpler and more effective in the slusher drifts.

Type Operation	Slushing	Bulldozing
Slushing Ore	100*	—
Sluicing Ore	—	173
Secondary Blasting	117	287
Run of Ore	338	331
Barring on Grizzly	—	131
Drilling Plugs	130	148
Cleaning and Mucking	—	76
Along Slusher Drifts	182	—

*This figure taken as 100

Summary

Diamond drill blast hole ore breaking and drawing with slushers have resulted in

safer and healthier working conditions, as follows:

1. Reduction in exposure to hazardous raise work.
2. Elimination of large undercut stopes.
3. Elimination of powder pocket development.
4. Increased use of mechanized equipment in stope development.
5. Reduction in exposure to handling of powder.
6. Improved conditions of ore drawing by utilizing mechanical ore handling.
7. Improved conditions of primary ore breaking by utilizing the diamond drill.
8. Improved development ventilation through the use of working faces of larger area.

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MONDAY AFTERNOON SESSION

October 7, 1946

Presiding: GEN. CHM. L. R. SIMPSON, Safety Dir., The Brown Paper Mill Co.

Is Safety Your Business?

By WALTER A. CUTTER, Ph. D.
Center for Safety Education

If we wish our calling as men of safety to be highly regarded and to take its rightful place among other professions and occupations, then we must see to it that our standards and the standards of our performance compare favorably with the work and the men in other lines. Similarly we must have a clear idea of the objective of our work, the training necessary for it and the standards of performance which should be expected. There can be no haziness on these points, if we are to be clear in what we are doing.

In contacts with safety men of all degrees of educational and experimental background, I have found unanimity on one major point, namely that accidents are bad and should be stopped. There seems to be no general unanimity on such points as these: Where should safety be in an organization? Should it be tied in with production? Personnel? Industrial relations? What should be expected in tangible terms as the result of a safety program? Should the safety man throw his weight around, or be unobtrusive and deferential? How much authority should he have? Is there a sound measure of his performance?

It would seem that if safety is our business, there should be some general agreement on such questions as these. The following thoughts are submitted for your consideration as the objective of work in safety, or as we now say more commonly, accident prevention. Men perform many operations, ranging from simple uncomplicated maneuvers to highly complex operations. In these various performances, sometimes there are interruptions or failures which prevent the orderly, and sometimes the successful completion of the operation. Some of such interruptions are called accidents, because they represent unintended and injurious interruptions to successful operations. It is at this point that the safety specialist enters. Insofar as it is

the failure of men, machines, or materials which cause accidents, it is his business to analyze the accidents that occur, to determine not the apparent but the real causes of these failures, and on the basis of sound recommendations to see that proper steps are taken to prevent a recurrence.

Obviously, therefore, safety belongs on the main line of activity and not on a siding. Safety is not window dressing. It is in the very nature of things, as integral a part of production, as is any other part of production. Or again, it is not something apart. It is a "part of." This seems very elementary, but it is clear that a great deal of confusion would be avoided, if all safety personnel, and all managements recognized that safety "belongs" and is not a luxury to be indulged when the mood is propitious. How much of the frequently heard argument would be voided, if we were all skilled and resourceful in pointing out to management that safety is an aid to the successful completion of whatever the firm is engaged in doing. On this basis, for a management to oppose safety would be tantamount to opposing the making of products, or, worse yet, profits.

All that safety intends is to so help direct and control the actions of workers, to so help control the mechanical and other means of production, the physical surroundings and conditions, that production will not be impeded or stopped by reason of injury. Quite obviously it belongs in with production, or with whatever type of operation characterizes the firm. What a stupid thing to hear a production man or a superintendent of manufacturing say that "safety gets in the way" of production. What a limited comprehension of his own objective if he believes such a thing!

As to the precise place in the plan of organization which safety should occupy, that will vary. A case can be made out for putting it in with personnel. Men have

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TUESDAY AFTERNOON SESSION

October 8, 1946

Presiding: GEN. CHM. JOHN C. ASKAM, Safety Dir., The Ohio Oil Co.

Management's Responsibility in the Accident Prevention Program

By JAMES TANHAM
Vice-President, The Texas Co.

This country has been torn with industrial strife for well over a year. The outlook for peace in this field is not very promising; in fact, many people expect even greater unrest and turmoil in the months ahead.

Our subject of safety offers one area of non-controversial mutual interest between management and employees.

Here if anywhere there is agreement—agreement among management and men universally on the necessity of safe operations, of protecting and conserving lives by preventing accidents.

In such an atmosphere it seems somewhat irrelevant to inject the word "responsibility!" You don't really have to spell out responsibility when interest and desire are so compelling.

But, of course, in business, objectives must be crystallized so that great groups of men in a common enterprise may have a common understanding and thereby more effectively operate as a team. If, as management, we believe that accident prevention is desirable among our employees, we will implement that conviction. We will organize for that undertaking; we will have capable and sufficient instructors. We will arrange classes convenient for our employees to attend. We will manifest our interest in many ways.

Management could make a great contribution by showing a personal interest in safety—wherever possible, a man-to-man contact between department managers, vice-presidents, and even presidents, with the men in the field who carry on the daily and sometimes seemingly monotonous routine of safety engineering. I see in many companies many men who are actually starving for a word of commendation or appreciation from some one higher up.

This may sound like a little thing, and maybe there are men so callous, so self-sufficient, that a slap on the back has no echo in the heart. But I have never met one.

Management, particularly that part sometimes called higher management, must accomplish its objectives through people. We owe it to those people to show our interest in them and in their work. We owe it to them to tell them when they have done a good job—just as when they are not doing well we have to get busy and find out why and help them to improve. So I should label as management's number one responsibility in the accident prevention program:

Take time by personal contact and every available means, to give timely credit and encouragement to the men who are actually doing the job.

Then I should suggest, as a second responsibility, the provision of clear-cut organization and complete understanding of authority and duty. Perhaps some one will say this should be first. I don't think so. I don't minimize the importance of good organization. But with or without organization nothing really worth while is ever accomplished without enthusiasm.

But we should have good organization, and it's management's job to provide it. We have to spell out relationships between people. We have to define the fields in which people are to operate. And we must be sure that the authority delegated is equal to the responsibility. Why do we have to do all this?

Well, one reason is that people always act like people. As much as we may dislike to admit it, people don't just automatically get along with each other. We have organization charts so that everyone

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TUESDAY AFTERNOON SESSION

October 8, 1946

Presiding: GEN. CHM. C. A. DeMONGE, Safety Dir., Kelsey Hayes Wheel Co.

Power Press Accident Facts

By G. W. GREENWOOD
Safety Director, Western Electric Co.

The crucial importance of all safety people contributing to a common goal has been overlooked by most safety specialists in industrial accident prevention. Only as the underlying structures of the safety profession are healthy and strong, and perform their indispensable functions regarding service to engineering and training fields, can that profession be strong. To the degree that safety personnel are weak in knowledge, or isolated from the main currents of thought of the profession, does that profession become weak and disintegrate. Thus with all the accident problems of the Nation pressing for solution and the energies of all safety people mobilized to solve them, consideration of specific factual accident cause data is still imperative.

We may be searching for machinery to accomplish our purpose, for a plan, or ways and means, but one thing we are not looking for is a formula because it has been in existence for a long time: the formula of democratic cooperative effort.

Our conception of the heritage of safety knowledge is far too restricted. It has, for all practical purposes, embraced little more than the thought of the minority of the profession. In order to attain unity of purpose in our safety work, we must know both the specific accident experience and the specific prevention activities of all people in the profession. We must understand not only their accident experience but also their prevention efforts in successfully coping with such experience. If our profession is to meet its responsibility in the post war world and the unprecedented expansion period that is emerging, the framework from which we construct our safety activities will have to be rebuilt in considerable degree. We must develop, too, the willingness to experiment boldly, to invent new techniques and to modify old ones so as

to make them adequate carriers of our new all inclusive program.

Many people by the exercise of influence have tried, quite unsuccessfully, to change their accident trend. All of them forgot, and have had to learn, that, while specific guided direction in safety work gives influence, the reverse is not true. Influence is not direction in safety work.

In the accident situation of industry to-day only specific direction of safety effort, not merely influence, can change the accident trend downward. Too many people believe that all that is needed to do the safety job is management interest. If their beliefs were true, why has the national industrial frequency rate remained static since 1930?

We are too apt to observe hastily and in generalities, confusing the result with the cause. A knowledge of specific accident causes is the only sound basis upon which preventive safety work can be promoted. To overcome this weakness in the safety field the action taken by the Power Press Section is different in kind from all the others. Here in the analyses distributed to this audience are present all the essential ingredients of a genuine policy for the future. In the early stages of growth every movement has suffered from misconception, lack of definition, and direction.

There are two qualifications necessary for a problem to be considered a national safety problem. First, it must concern large numbers of people. Second, we must be able to do something practical about the problem.

The Bureau of Labor Statistics, United States Department of Labor, have recorded approximately 21,000 power press accidents for 1945 showing that the power press problem is of national concern. It does affect large numbers of people.

services in the problems of safety by committee work, safety training panels, investigation boards, etc. Be sure, however, that the work has direction and is based on needs as shown by adequate factual data based on valid cause analysis.

9. Probably one of the best training devices is a good, well planned, accurate, continuous system of channeling information about safety results or achievement to levels of upper management too often these people are contacted when problems arise and their help is sought.
10. Continue analysis and study of accident causes with emphasis on psychological point of view try by every known device, such as consultation with industrial psychologists, medical people, and personnel men to understand the "Unsafe Personal Factor."

In summarizing your reports show that "instruction" is heavily relied upon to con-

trol employee behavior, yet that employees who possess "know-how" continue to get hurt. This may be explained by the fact that a suitable "climate of safety" does not exist which permits the employee to use the knowledge gained by job training. Real safety training aims at fostering a climate of safety and there is no conflict of function between safety training and job training. Much research is needed in the field of accident causes, and, until more positive factual data is gathered, safety training will not fulfill the high expectations of many safety men.

Probably one of the most effective activities, from a training standpoint, that members of the Power Press Section can engage in is in gathering and accumulating factual data related to injuries to workmen. When a sufficient body of cases is ready for study and analysis, many useful training techniques may reveal themselves.

Of this one thing however, we can be sure—"know-how" is not enough to prevent injuries to press room employees.

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1939-40, H. A. PTOLEMY, Public Service Co. of Northern Illinois, Chicago, Ill.

1940-41, CHARLES S. BOWDEN, Ohio Public Service Co., Elyria, Ohio.

1941-42, P. L. G. HASSKARL, Pennsylvania Power & Light Co., Allentown, Pa.

1942-43, D. C. DUNCAN, Appalachian Electric Power Co., Bluefield, W. Va.

1943-44, E. S. MINER, American Telephone & Telegraph Co., New York, N. Y.

Special Representatives—

D. C. STEWART, Niagara Hudson Power Corp., Buffalo, N. Y. (E.E.I.)

H. T. JAYNE, The Philadelphia Gas Works Co., Philadelphia, Pa. (A.G.A.)

J. E. YATES, Pacific Power and Light Co., Portland, Oregon. (Mountain States Pacific Area)

Staff Representative—EDWARD M. JASPER, National Safety Council, Inc., Chicago, Ill.

Public Utilities Section

TUESDAY AFTERNOON SESSION

October 8, 1946

Presiding: GEN. CHM. J. T. O'BRIEN, Safety Dir., Jersey Central Power & Light Co.

What Gets Results in Safety

By ADAM A. BENNION
Vice President, Utah Power and Light Co.

To find among companies engaged in the same business a spread in accident frequency from 2 to 34 prompts the question "Can operating conditions vary that much?" Or wouldn't it be intriguing to change safety staffs and watch consequent changes?

Pondering this, and studying the methods followed by successful companies, I undertook to set down an answer to the query "What Gets Results in Safety?" I decided to bring you seven approaches to safe performance. I offer no brief for the order in which they are set down.

1. *The Selection of an Honest-to-Goodness Safety Man*—call him what you will: safety director, safety engineer, safety counselor. He must be more than a statistical clerk or a traveling inspector. He ought to be a man with experience—enough to know thoroughly this safety business, with personality—to get along with men, with ability—to direct and to teach, with enthusiasm—to spread a contagion, and with strength—to command respect. His is a dynamic job—it is in his power to do these ten things:

1. *He keeps the safety program alive.* He sets out the objectives, he formulates the plan, he devises new methods to heighten interest in routine performance.

2. *He teaches other men.* He explains—he counsels—he inspires. He tells—he shows—he checks.

3. *He previews with the men the jobs they are to do.* Of course, most of the time he does this through the regular foreman, but he establishes job analysis.

4. *He discovers hazards or faulty habits and corrects them before accidents occur.*

5. *He sees that whenever an accident occurs it is completely analyzed to find the cause, to fix the responsibility, and to devise remedies which will avoid a recurrence.*

6. *He institutes and follows through regular, systematic inspection of tools, equipment, and good housekeeping.*

7. *He makes a special point of checking the use and care of rubber goods, hot-line tools, and all other safety devices.*

8. *He visits with men on the job to see that safety isn't merely taught—but that it is practiced.*

9. *He devises and has used report forms, charts, films, and other visual aids to measure results and make progress certain.*

10. *He recognizes fully the unique nature of his assignment.* He works closely with all three groups of employees in an organization, he confers with management, directs and counsels with the supervisory staff, and mingles with the men.

Such a man should be given full responsibility—and he should be paid as he measures up to that responsibility.

11. *Complete and Thorough Training of All Plant, Line and Service Men in the Fundamentals of Safety and First Aid.*

Such training makes certain that every employee involved not only knows the company safety code but that he is schooled in habits of safe performance. The code is his safety Bible, but safe routine is his ritual. He is fully aware of the hazards of his calling and knows and practices the use of all the safety appliances in his profession. He is keyed to such a safety consciousness that he cannot pass by a nail protruding from a board, or a spot of oil on a floor, or an object resting hazardously on a ledge.

111. *Pre-Job Analysis.* Fortunately our daily routine offers an excellent laboratory in safe performance. The day's work can be proof-read all our training. Every job should be looked through in advance. Greater hazards call for greater precautions.

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1946-1947

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*G. R. SPANGENBERG, Rainfair Incorp., Racine, Wisc.

*P. VAN CLEEF, Van Cleef Bros., Chicago, Illinois.

Representative—E. A. VAN ALTA, National Safety Council, Chicago, Illinois

General Chairman

5. Confine operation to the fewest number of workers.
6. Provide one starting source only.
7. Provide wrinkle removing rolls where practical.
8. Provide safe footing.
9. There is no substitute for safe workers.
10. High order selection, instruction, training, and follow through are essential.
11. Set up standards for starting liner on shell by hand.
12. Effect rigid inspection procedures.
13. Discipline if necessary to effect proper and safe control measures.

Steam Railroad Section

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D. W. NAFF, Supt. of Safety, Norfolk & Western Ry., Roanoke, Va.

Staff Representative—L. W. DUTTON, National Safety Council, Chicago, Ill.

TUESDAY AFTERNOON SESSION

October 8, 1946

Presiding: L. E. HOFFMAN, Inspector of Operations, St. Louis Southwestern Rwy. Lines.

Opening Remarks

By L. E. HOFFMAN

Vice Chairman, Steam Railroad Section and Inspector of Operation,
St. Louis Southwestern Railway Lines

I am appearing before you today because our chairman and friend, George Elste, is ill. I know you are all as deeply sorry as I am that George cannot be here—but at the same time glad that he is doing the wise thing in taking care of himself.

I do, however, want to pay tribute to the faithful and excellent work done by Mr. Elste and the chairmen and members of the committee of this section. I particularly want to thank John Tenney and the members of his Program Committee for the fine things they will spread before us these three days.

This is the first chance that we railroad safety men from all over the country—in fact, all over the continent—have had to get together in two long years. Let us make the most of the opportunity.

During those two years, momentous things have happened. Two years ago, we met here in the midst of a tremendous war. Now, we meet after a year of peace—more or less. The mighty deeds of the railroads during the conflict are well known to us. We know, too, how they managed these accomplishments and still kept safety as of first importance. Shall we do less now?

Already the sound of war is fading from our memory. But peace has not ended the war on accidents. During the time of battles, we had powerful aids at our command—patriotism, the need for production and for the delivery of armaments and fighting men at ports of embarkation. We had slogans that were glamorous and exciting.

We don't have those crutches to lean on now. So we must find new appeals, new ideas, new approaches. We must keep alive to modern trends in accident prevention. We must contribute some new ideas of our own.

One of the modern trends is toward education—and I mean real individual educa-

tion. We are being forced more and more to study the worker—to analyze him and find out what it is that makes him have accidents. And we are finding very often that it is because he doesn't fully know his job. This is based on another modern idea, namely, that the safe way and the right way are identical. The ways that have been handed down from generation to generation, in many cases, are wrong ways.

The remedy is to take hold of the worker with a friendly hand even before he comes into our service, start educating him personally and individually that day, and never stop teaching him until he quits, dies or takes his pension.

And I don't mean just saying to the trackman every morning, "Joe, be careful today." I mean taking him step by step through every job he has to do, in infinite detail, making certain he learns the lesson, and then keeping up the process of telling and showing him forever.

Coming down to the actual work of the Steam Railroad Section, one of the great jobs now in progress, and one which we all feel sure will be continued and expanded in the future, is the program, carried on jointly by our section and the Safety Section of the Association of American Railroads, for the prevention of grade crossing and trespassing accidents.

The two great railroad safety organizations are cooperating in this common endeavor, and this is as it should be. Our combined efforts can accomplish anything we set out to do.

We are members of a cooperative association. The National Safety Council is not just an organization with offices in Chicago—we are the National Safety Council. As such, we have here at headquarters a staff of men who have just one purpose—to help

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TRANSACTIONS

34th NATIONAL SAFETY CONGRESS

CHICAGO

October 7-11, 1946



VOLUME II

Traffic, Commercial Vehicle, Transit, School and College, Home, Farm and Women's Activities Sessions

VOLUME I contains the General Subject and Industrial Sessions

National Safety Council, Inc.

20 North Wacker Drive, Chicago 6

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Printed in U.S.A.

Safe Practices in Steam Boiler Operation

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Operating manuals, printed instructions for the boiler operating engineer, A. S. M. E. Suggested Rules for Care of Power Boilers, and various other publications cover the subject of safe practices in steam boiler operation in considerable detail.

A competent operating engineer is thoroughly versed in the procedure he must follow in making a boiler ready for operation, in placing it on the line, getting the best out of it while it is operating, taking the boiler off the line and in protecting it while it is idle so that it will not deteriorate. Correct procedures are automatically followed in the well supervised boiler plant. They become second nature for the experienced operating crew.

There are, however, many other factors not mentioned in printed materials, but of equally great importance for the safe performance of the boiler. Unless these factors are taken into account they can cause serious boiler accidents.

Boiler accidents fall in three distinct groups. The first and largest group includes boiler accidents caused by the failure of the human element. They were caused by lack of clear thinking, by inexperience, bad habits and just plain ignorance. There are two necessary steps in preventing or at least reducing the number of these accidents. They are careful selection of the personnel entrusted with the boiler followed by thorough training.

Apprentice boiler operators must be made to understand that the primary object of their studies and practical training is not merely to receive the license issued by an examining board, but rather to obtain the knowledge and understanding of the working of a boiler, to know what is going on in drums and tubes and in the furnace, and to realize which factors affect safe and reliable performance.

The boiler operator must be made conscious of the importance of his job by realizing that the safety of his co-workers

and of costly equipment depends on his doing the right thing at the right time. Most important for the safe performance of his job is thorough familiarity with the design and the detailed construction of the equipment in his charge. No part of the boiler must remain a mystery. Strong and weak points of the boiler must be known. In this way the measure of confidence will be established without which the operator would be unable to get the best out of the equipment under the varying conditions of the boiler house.

Warren D. Lewis, Chief Engineer of the Hotel New Yorker, gave this apt specification:

"The good operating engineer doesn't lose his head. Assuming that he knows his plant and his business he must learn by experience to sit tight and think things out when he finds himself in a jam. Nothing is more costly than a wrong answer put into action because it was the first that came to mind when the heat came on."

One operator's experience with a large pulverized coal fired boiler is a good illustration of the disastrous results possible by "putting the wrong answer into action." The boiler had a slag tap furnace with the furnace floor covered by a pool of molten ash which was intermittently tapped off. One morning while the manufacturer's plant was going at full capacity a house turbine accidentally tripped, which temporarily shut off the power supply to motors of fans and pulverizers.

When the boiler operator in charge noted the drop in steam pressure and found the pulverized coal burners dead he could not take time to think. His natural reflex forced him to act quickly and his entire effort was concentrated on keeping the boiler on the line. There were steam atomizing oil burners for starting up and to carry low loads. All he thought to do was to turn on the oil. Unfortunately he forgot to open the valve for the atomizing steam and he had not taken the time to check draft gauges so

that he was unaware that the fans had stopped running. The oil burners would not ignite, but solid streams of oil poured on the pool of molten ash on the furnace floor. The oil vaporized - - -. When the operator picked himself off the boiler room floor and after the boiler house atmosphere had sufficiently cleared for him to see, it was found that the boiler casing was badly bulged and the heavy steel reinforcing members of the setting were bent out of shape. The steel boiler casing withstood the explosion and confined the damage to the boiler setting.

It cost about \$30,000 pre-war dollars to repair the damage and to return the boiler to operating condition. The boiler insurance company paid for this damage, but loss of production during the outage of the main boiler of this manufacturing plant was many times \$30,000, and there was no way to recover this loss.

The operating engineer was a capable man. He had passed the examination of the licensing board with flying colors. He knew his boiler inside and out. He was able to get the best out of it in day-in and day-out operation, but when "the heat came on" he fell down on the job. His training lacked that part which makes a man sit tight and think things out before jumping into action. No matter how pressing the need for instantaneous action appears to be at the moment of an emergency it is imperative to take the time necessary to survey the situation and plan for the next step.

The second group is smaller and consists of those accidents which were the result of misjudgment of the designer and manufacturer of the boiler. Most of these failures could have been prevented by more sensible design, but hindsight is so much more convenient than foresight. When the design is original and enters an untried field it may be excusable if its first execution is not completely successful. Progress in the art of steam generation required some measure of pioneering. There are, however, the more common errors that are repeated time and time again. The following are a few examples:

Probably the most popular mistake made in boiler design is lack of provision for unrestricted natural circulation. Some boiler and water-wall tubes produce steam

at rates as high as 40 lbs. per sq. ft. per hour. Steam must be swept away from the inside tube walls as quickly as it is formed and must be replaced by water, otherwise the tube will overheat and fail. Only, if it is made possible for water to flow thru the circulatory system of the boiler and water-walls with a minimum of resistance and for the steam to release itself quickly without binding in tubes, will the natural circulation be maintained at velocities necessary to keep the tubes cool.

Too often the design of the boiler and water-wall system contains restrictions in the path of water and steam so that the force producing natural circulation is used to overcome obstructions and circulation slows down, stops or may flow in reverse direction to which it was intended. Safe boilers are designed with liberal areas for the feeders supplying water to steaming tubes and for the connections between steaming tubes and drums.

Insufficient capacity of feeders supplying water to water-wall systems and of releasers conducting the steam-water mixture from water-walls to the steam release drum not only results in circulation troubles and water-wall tube losses, but also lack of lively circulation in the water-wall system may permit precipitation of suspended boiler water solids in the low points of the system and the resulting accumulation of sludge and mud may still further obstruct the path of circulation.

The blowdown valves of some early water-wall systems were padlocked so that they could not be operated with the boiler in service. It was found that the water supply to water-walls was so critical that tube losses were experienced whenever an attempt was made to use the water-wall blowdowns with the boiler under load. The operator had his choice either to use the blowdown valves periodically to remove the sediment but in so doing lose tubes from insufficient water supply, or to keep the blowdown valves shut and let mud and sludge accumulate, but lose water-wall tubes by obstructing free circulation.

The failure of a boiler or water-wall tube is in itself only a minor calamity, but a tube failure often results in a seri-

ous furnace or gas pass explosion. In any event a burst tube shuts the boiler down and may in turn cause costly production losses.

There are many boilers in which the steam release drums are too small and where steaming tubes enter the steam release drum below the working level. The steam must thus find its way thru a body of water before it can leave the boiler. This may produce a dangerous condition for piping, engines and turbines because a sudden load change may throw a heavy slug of water into the steam line.

Other points of potential danger to personnel and equipment which must be laid on the designer's doorstep are pressure vessels of considerable wall thickness exposed to high temperature. It is, of course, argued that one of the oldest types of boilers, the horizontal return tubular boiler, has its drum shell exposed directly to the furnace, to radiant heat and live flame. But it must not be forgotten that the HRT boiler shell is comparatively thin. This boiler is not used for high pressures and the drum shell thickness is not determined by tube hole ligament efficiency, as is the case with a water tube boiler. Just the same, bagged drum shells caused by overheating are not unusual with HRT boilers.

Exposing the drums of a higher pressure water tube boiler to furnace heat and live flame is dangerous. Even if there is no evidence of weakness during the first few years of operation it must be realized that the outer skin of the drumplate may be heated to over 2000 F. while the inner skin remains at boiler water temperature (as long as the surface is clean). The temperature difference between outer and inner skin of the drum plate may be more than 1500 F. and if it is realized that every fibre of the metal in the outer skin is trying to expand three times as much as the metal fibre in the inner skin it does not require much imagination to foresee the eventual destruction of the metal and the possibility of a disastrous drum explosion. Unfortunately this can happen without prior warning because the change in metal structure will be detected usually by micrographic examination only.

Pulverized coal furnaces for large modern boilers are often quite high. There

are some which could house a 6-story building with room to spare. If ash and slag are given an opportunity to find a foothold along the furnace walls they will stick and may form clinkers unless the operating engineers are on their toes and continuously poke and lance. Here again the designer should be taken to task for allowing ledges and protrusions to exist on furnace walls on which ash and slag can lodge. It is dangerous even with a cold boiler. Maintenance men are often injured by falling slag when it is necessary to enter the furnace of a coal fired boiler for inspection or maintenance.

Some years ago a number of floor screen tubes of a pulverized coal fired boiler tore out of the headers into which they were rolled. The steam and hot water suddenly released into the boiler room killed two of the operators and sent two more to the hospital. The furnace of this boiler was some 35 ft. high. A heavy clinker had formed in the upper regions of the furnace and with a change in load broke loose and hit the floor screen.

A screen of tubes laid across the bottom of the pulverized coal furnace is a nice thing to have because pulverized coal ash can sift thru this screen and is chilled while it drops into the ash hopper, but when the furnace is high and when there is a possibility of ash and slag to accumulate a considerable distance above the floor screen then there is danger. Maybe the operators should have noticed that the slag on furnace walls approached dangerous proportions and should have done something about it, but the capable designer knows that his product must be safe even without the complete cooperation of the men to whom it is entrusted.

It may be true that a simple screen of tubes crossing the furnace floor is less costly than a hoppers furnace floor consisting of steeply sloped tubes, supported over their entire length, but no amount of money saved in first cost will justify gambling with safety. A little extra money spent for safety of personnel and equipment is the finest investment.

Fortunately, accidents caused by faulty design are diminishing. This, in spite of new designs of steam boilers, higher operating pressures and steam temperatures and greater work done per unit of heating

surface. Design and construction engineers are rapidly learning their lessons from the earlier experiences. There is nothing mysterious or very difficult about the planning of a safe boiler. If the designer starts with a conscientious study of all requirements, keeps his mind open to suggestions, especially those coming from the operating field, draws from a liberal background of personal practical experience, refuses to be influenced by preconceived ideas and above all, uses good common sense, the boiler produced is bound to be safe and reliable.

Boiler accidents caused purely by wear and tear of equipment in service comprise the smallest group. It is true that boilers cannot last forever, but there are few cases on record of accidents caused by the disintegration of boiler metal. The useful life of a boiler is usually governed by obsolescence, rather than by general breakdown.

The boiler inspectors of states and insurance companies deserve much credit for the maintenance of safety over the entire life of a boiler. A thorough periodic inspection by a man who knows what to look for and has the authority to recommend improvements or, in extreme cases, condemn, is the best assurance against accidents falling in this group.

The line of demarcation between failures produced by faulty design and those caused by breakdown in metal is none too distinct. Often the latter is blamed for trouble actually originated by the former. So-called "caustic embrittlement" is an example. Destruction of the metal will happen and has happened in highly stressed points of boiler drums which are exposed to concentrated causticity. A few years ago it became quite the fad to label every crack found in riveted seams of boiler drums as caustic embrittlement. The real trouble was often not a matter

of chemistry at all. It was simply metal stressed beyond its elastic limit.

The tremendous force exerted by large diameter rivets while shrinking after they were hot formed compressed the metal under rivet heads to a point where its grain structure was destroyed. Cracks developed and would have developed whether there was caustic concentration or not. These cases of failures belong in the second group. They are the result of error in design.

A well designed and constructed boiler unit can only be as safe as the operating personnel permit it to be. Thorough training, clear understanding of the why and wherefore of various operations in the boiler room, knowledge of the design of the boiler and its idiosyncracies must precede placing the operator in charge of the boiler, but the most competent man is helpless in preventing trouble if the design of the equipment contains dangerous features.

Cooperation of operator and designer, in the light of the practical experience accumulated by both, and clear common sense analysis of every design detail before it leaves the drafting board helps to reduce accidents caused by faulty design. Thorough periodic inspections by the men of state and insurance companies are the best protection against accidents caused by gradual disintegration of the boiler metal. The inspectors are trained to look for and find points of potential trouble.

Use of competent operators, experienced designers and manufacturers and persistent adherence to a sensible inspection and maintenance program are three factors of equal importance for safe steam boiler operation as are the procedures prescribed in the printed manuals and in the examination papers of boiler operator licensing boards.

workers. Some of these may be listed as follows:

1. **Eye examinations.** Comprehensive tests can be performed to screen out those individuals with a variety of serious visual defects. It is hardly necessary to stress the value resulting from the correction of visual defects found by routine eye examinations.

2. **Dental Hygiene.** Dental examinations disclose unhealthy conditions in the mouth. We know that neglected dental conditions can affect the general health of an individual. The extent of neglect found in the examination of large numbers of workers is surprising.

3. **Mass Chest X-ray Programs.** Tuberculosis is still one of our worst killers. We cannot hope to bring this disease under control unless we find the active cases and prevent the spread of the disease to non-infected individuals.

4. **Venereal Disease Control Programs.** Infectious gases must be found and properly treated to prevent the spread of the disease.

Venereal diseases should not be a bar to employment unless in an infectious stage. The employer who thus unnecessarily discriminates against workers with non-infectious venereal diseases is not only interfering with the control of those diseases but is also creating bad labor relations which may never be erased.

5. **Immunization Programs.** Unfortunately comparatively few industries have inaugurated programs for immunizing against some of the contagious diseases—such as small pox, diphtheria and typhoid. When adults develop these so-called childhood diseases, they may be extremely serious and become epidemic in nature.

First-Aid, Nursing and Medical Services

Every industry, down to the smallest should have adequate first-aid facilities administered by someone trained for that purpose. Industries from 250 or more employees should have an adequately equipped first-aid dispensary preferably under the supervision of a graduate registered nurse—in a full-time or part-time capacity, depending upon the size of the plant and the hazards of the jobs.

Part-time nursing can be obtained either through the local visiting nursing association, if your city has one, or by 3 or 4 smaller plants hiring one nurse to spend certain hours each day in each plant, depending on the needs and the number of workers to be served. The cost of this part-time nursing service is proportioned by the participating plants, according to the hours spent in each one.

The larger the plant, the greater is the need for one or more full-time nurses. The industrial nurse is no longer just a finger wrapper—she is the key person in an industrial health program. Show me the plant where top management is not only sold on the nursing service but also takes a personal interest in the nursing program and I will show you a plant with good labor relations, less turnover and less absenteeism. The effect of those conditions on production costs is obvious.

A plant dispensary with one or more nurses on the staff can perform the most efficient health service when a physician is in direct charge of that department. The trained medical personnel are becoming available—many of our larger medical colleges are teaching industrial medicine to the students or providing post-graduate courses for those wishing to enter this type of practice. There is every indication that this trend in providing medical services for industrial establishments will increase in scope to include more plants, particularly the smaller ones on a part-time basis.

Programs to Reduce Non-Industrial Disabilities

Employers now realize that non-industrial illnesses and accidents are their concern, that personal hygiene, living habits and social problems affecting the physical and mental fitness of an individual are definitely reflected in his ability to stay on the job and to perform his duties satisfactorily.

Unless these factors are taken into account in developing an industrial health program, the benefits to employer and employee will fall short of the mark. There are two principal activities through which industry can approach these problems—absentee studies and health education.

1. **Absenteeism.** Industries are urged to keep absentee records and to make a careful

appraisal of the findings. These statistics form the basis for a health educational program and for any reduction program. It is necessary to determine where, why, who and to what extent absences from work are occurring. If an occupational cause for absences is indicated, it should receive close attention. We know that ordinary illnesses account for several times more absences from work than do industrial and non-industrial accidents combined.

Absentee studies were conducted by our Industrial Hygiene Unit in several Wisconsin plants for a period of 5 years. In addition to the well known data, it was found that only 9 per cent of the employees accounted for half the cases of legitimate absences and half the work days lost, another 25 per cent accounted for the other half of the absences and the work days lost. In other words, 66 per cent of all employees had no absences and no days lost from work by reasons of illnesses or accidents. Certainly, in view of these findings, any attempt at a reduction program should first consider a very careful medical investigation of that small percentage of workers to determine why they were ill and absent more than the large majority of the plant employees.

2. **Health Education.** Health education has not experienced the same period of trial as has safety education. Only during the past few years have any serious efforts been directed toward making the public health conscious. As with safety education, health campaigns will prevent illnesses—but we have a right to expect an improvement in

the health status and a longer production life span as a reward for a continued and intensified health education program. If we were to devote as much energy and coordinated effort to a health campaign as we have to our safety campaign in the past, we should reap the same benefits.

Health educational programs for industrial workers are growing in scope and effectiveness. Educational material of various kinds is available in increasing quantities. Many agencies and organizations are developing pamphlets, posters, leaflets, films and radio programs. Industry should take advantage of this service and plan health educational programs along the same lines as their in-plant safety campaigns. The plant physicians and nurses are key personnel in such planning and administration.

The various phases of such an industrial health program may sound too big and too complex for the average establishment. The points discussed are merely high lights of adequate health coverage and in bare outline form at that. To those of you who may feel that this is something belonging only in the budget of the large corporation, let me say that more and more small industries are adopting the very services described and are doing a good job of it. An industrial health program can be just as comprehensive and as effective as you want to make it. Top management must be sold first. If you have qualified personnel plus the ambition to do the job, it will produce the same results for you that others have experienced.

New Challenges for the Industrial Hygienist

By EDWARD E. DART, M.D.

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This report is a summary of the progress that has been made in industrial hygiene during the last few years. In it is recounted knowledge which has made it possible to meet the ever-present and always-new challenge of making the factory a desirable place in which to spend a large portion of one's life.

There are two concepts which should attract any remarks on new industrial health challenges. The first is that a substance may appear as a new health prob-

lem and so much may be written as to fill all the journals, and yet the basic toxicological studies on the nature of this so-called new substance may have been carried out a half century before. Paradoxically, then, what is in reality old may often be thought of as new, either because it has come into wide spread usage or because it has become associated with processes wherein it had never previously been employed. Well known substances with new industrial application constitute a major prob-

portion of that which is new in industrial hygiene.

The second concept necessary for an understanding of what is new in industrial hygiene is that operations must be considered as a whole. We are all prone to think of specific entities, for instance the problems associated with the handling of lead. The unwary person may not realize that in a given operation the oxides of nitrogen may require more consideration than would fumes from burning lead or that associated arsenic may demand major control measures exceeding those used for the lead. In developing a philosophy of safety, it is necessary to think of the industry or process as a whole with multitudinous exposures. As an example aluminum is about as nearly non-toxic as any substance can be, but in aluminum foundries controls have been employed to prevent exposure to chlorine gas, aldehydes and silica. Salt tablets are provided to prevent untoward effects of high temperatures in aluminum casting operations; and the medical and safety departments are ever active in preventing dermatitis from coolants used in aluminum machining operations. In this manner, safety engineers, industrial hygienists and physicians view industry as a whole and meet the wide scope of industrial health challenges by awareness of many different situations.

I. HEALTH CHALLENGES IN THE METALLURGY AND FABRICATION OF METALS

There are few newly discovered metals, although recently certain metals have been used on an appreciable scale in industry for the first time. Some of these metals that have come into prominence within the last few years will be discussed:

A. Beryllium

Beryllium is used to form alloys, especially with copper, aluminum and nickel. A small amount of beryllium imparts to the metal a considerable amount of fatigue resistance. This is especially true of the copper alloy. Injury from beryllium was reported in 1933 by Weber and Englehardt¹ who considered that the pathological conditions observed resulted from the presence of fluorides in the dust. In 1943, Hyshop² and his associates described experiments indicating that beryllium is relatively non-

toxic and that fatalities in animal experiments resulted from exposure to the acid radicals such as fluorides and sulfates rather than to beryllium per se. A predisposition to pneumonitis, one of the important findings in human experience, was however noted in animals exposed to only beryllium oxides. Although excellent data were presented in this paper, there was nothing to prove that this predisposition to pneumonitis was not a specific reaction rather than such as might occur from the inhalation of any dust. In 1945, Van Ordstrand and his associates³ reported the occurrence of dermatitis with chronic ulceration of the skin, inflammatory changes in the respiratory tract and pneumonitis in a group of 170 workers exposed to beryllium compounds who were observed over a three year period. These inflammatory changes probably result from the extreme hygroscopicity of these compounds which enables them to extract water from tissue. It was the opinion of these investigators that severe damage might be caused by factors other than acid salts. They did not however describe instances of disease in which the possibility of exposure to acid radicals was well ruled out. Gardner⁴ found that beryllium granuloma of the lung developed in animals from exposure to beryllium silicate.

Clinical and experimental investigations indicate that exposure to the acid salts of beryllium will produce serious consequences more readily than exposure to the less soluble non-acid compounds. Beryllium in itself apparently predisposes to pulmonary inflammation and granulomatous lesions. At any rate most exposures include those to the acid salts such as fluorides, oxyfluorides or sulfates, and control aimed at limiting the concentration of acid radicals, coupled with ordinary precautions to prevent the inhalation of beryllium dust, should provide ample safeguard for the health of workers.

B. Cadmium

Cadmium has been used extensively in recent years in electroplating, as a coating metal, and in alloys. It is used in bearing metals, electrical conductors, pigments, ceramics, engraving processes, cadmium vapor lamps, and as a rustproof coating in place of zinc. Toxic reactions from cadmium have developed as a result of drinking lemonade mixed in cadmium-lined con-

tainers,⁵ and safety must be considered when cadmium may be used as a lining for food containers. As an industrial problem cadmium must be thought of whenever the metal is heated sufficiently to give off fumes, as in welding.

By 1944, 59 cases of cadmium intoxication from inhalation had been reported since 1858.⁶ Cadmium fume is noteworthy because it is not immediately irritating or unpleasant, and a workman may easily inhale sufficient fume or dust to produce severe pulmonary injury without realizing that he is being harmed. The symptoms, which develop several hours after exposure, are irritation of the throat, headache, cough, and in some instances nausea with a constricted feeling in the chest and shortness of breath as the condition progresses. The most serious consequence of exposure to cadmium fume is a severe pulmonary edema and pneumonitis. Safeguards to completely protect those near the operation should be provided whenever it is necessary to weld or burn cadmium.

C. Indium

Indium is one of the rare metals, but its use is becoming more generalized. It is used particularly for electroplating on cadmium for airplane motor bearings or for bearings in other high speed internal combustion engines. In 1942, indium was investigated by McCord, Meek, Harrold and Heussner,⁷ who found the metal and its salts to have cutaneous irritant properties but demonstrated some toxicity with subcutaneous or intravenous injection. No injury from indium was found among indium platers in an airplane motor plant over a three year period.

D. Magnesium

Magnesium is a metal of importance to anyone responsible for safety because of its flammability. However, the necessary safeguards in respect to fire protection are well known. In 1942, McCord⁸ described the development of gas tumors resulting from the implantation of magnesium particles in the tissues of animals. Accordingly at the beginning of the war, physicians in plants in which magnesium was machined were alert for evidence of gas in the tissue of operators. One such case was reported.⁹ I have seen a similar patient in whom gas developed in the tissues of the hand and

forearm, unaccompanied by febrile symptoms or other evidence of infection. The presence of gas was demonstrated both by crepitus on palpation and by distention of the fascial spaces as shown on roentgenographic examinations. The patient was a drill press operator who worked on magnesium castings. No injury more extensive than minor scratches on the hands was noted. He was removed from work on magnesium, and the gas disappeared only to return the day after he returned to his work with magnesium castings. The accumulation of gas in the tissue did not reoccur when he was removed permanently from the work with magnesium. Magnesium was never isolated from the tissue, so definite proof of liberation of gas in tissues from occupationally implanted magnesium is lacking but the possibility of such cannot be denied. This property of magnesium is of no great consequence; but rather it is interesting to medical people as a rarity. Magnesium is perhaps the classic example of a substance which is in itself practically harmless but which may have associated with it in numerous operations other hazards requiring control measures for the protection of health. Of importance are several potential exposures connected with magnesium foundry operations. Either molds and cores are sprayed with a fluoride or a substance such as fluoborate is incorporated with the sand in the core or mold. Therefore precaution in the form of ventilation and enforced personal cleanliness may be necessary. Of even more interest is the presence of sulfur gases in the work room. Sulfur dioxide is used for flushing cores and for maintaining a reducing atmosphere in heat-treat ovens. In addition, hydrogen sulfide and/or other sulfides are found in the core gas at shakeout operations resulting from the sulfur used as a flux for the molten metal. In general it may be said that procedures adequate to safeguard against a silica hazard and sufficient to maintain comfort with respect to sulfur dioxide and other sulfur gases will protect the workers from any dangerous exposure to hydrogen sulfide.

E. Osmium

Osmium is one of the rare metals and occurs naturally in combination with iridium. Because of its extreme hardness osmiridium is desirable as a compound for

fountain pen tips. Use for osmium compounds is found in the manufacture of electrical contacts and explosimeters. Osmium is also used as a catalyst. Metallic osmium is innocuous, but osmium tetroxide is formed on exposure of the metal to the air. As early as 1814, Berzelius¹⁰ noted the irritant properties of osmium oxide. The toxicological properties of osmium tetroxide were reported by Brunot in 1933.¹¹ By exposing himself to some of the vapor he noticed after ten minutes a metallic taste in the mouth, followed at 30 minutes by a smarting sensation in the eyes, and lacrimation. Later he felt a constriction in the chest and difficulty in breathing, and objects then appeared to be surrounded by halos. These findings were confirmed in cases of industrial exposure reported by McLaughlin.¹² These authors ascribed the halo observed around objects as possibly due to osmium crystals on the cornea.

F. Selenium

Selenium occurs as a contaminant in certain ores, especially copper. Until recently it was considered an unusable product. It now has become important because of its excellent property for rectifying alternating current. It is also used in the glass industry, in paints, and plastics and as an alloy metal for steel and copper. Selenium contamination of the soil causes "Blind Stagers" in cattle, a disease in which hoofs, horns and hair drop off. Absorption of selenium in human beings produces garlic-like odor in the breath and sweat. Lemley and Merryman¹³ found skin disorders of a non-specific type, marked disability, depression and inability to concentrate in patients suffering from chronic selenium poisoning. Armor and Pringle¹⁴ noted that when operators were exposed to fine dust anoxemia, catarrh and bleeding from the nose occurred. These authors stated that exposures should be kept at such a point that selenium would not be excreted in the urine. Hydrogen selenide requires careful control in industrial operations as a concentration of 0.005 mgm. per liter produces nasal and ocular irritation.¹⁵

G. Vanadium

Vanadium is rarely encountered in the pure state, but the different oxides (Hypovanadous oxide—VO or V_2O_3 , vanadium trioxide— V_2O_5 , hypovanadic oxide—VO,

or V_2O_4 and vanadium pentoxide— V_2O_5) are used to increase the hardness and malleability of steel and to increase resistance to corrosion. The pentoxide is used in some chemical oxidation processes as a catalyst in place of platinum, especially in the oxidation of naphthalene to phthalic anhydride. Here again is a health problem that can be solved by the use of proper safeguards to prevent dust or fume exposure before any harm has been done. Vanadium has no cumulative action in the body, and the acute and chronic symptoms are similar.¹⁶ These consist of increased blood pressure with constriction of the blood vessels (by direct action on arterial muscle or the vasometer endings) and constriction of the muscles of the bronchial system.¹⁷ A worthwhile discussion of industrial vanadium poisoning was presented by Symanski.¹⁸ The clinical signs are pallor of the skin, greenish black discoloration of the tongue, paroxysmal cough (rarely with hemoptosis), dyspnea, pain in the chest, palpitation with exertion, tremor of the fingers and arms, emphysematous type of chest, profuse bronchitis, bronchospasm, raised blood pressure with accentuated P2 sound, and reticulation on X-ray film of the lungs.

The health hazards associated with exposure to inorganic materials have been reviewed with a fairly extensive bibliography by Fairhall.¹⁹

II. HEALTH CHALLENGES IN THE PRODUCTION OF NUCLEAR ENERGY

Nuclear fission has presented one of the greatest challenges for industrial health protection of all time, and this challenge has been met so successfully that almost no permanent injury has resulted. Uranium was known to the toxicologist even before the days of the atom bomb and chain reactions. In 1854, LeConte²⁰ found that the absorption of small amounts of uranium over a long period produced hepatitis. MacNider,²¹ in experiments with dogs, found liver injury; and DeLaet²² reported four cases of poisoning in workers handling uranium salts.

Of more importance are the hazards associated with the production of atomic power.²³ In the process of nuclear fission radioactive gasses and dust are given off producing alpha, beta and gamma ray emissions. These radiations are well known and have been previously associated with X-ray

and radium. The new feature of exposure in relation to nuclear fission is the production of slow neutrons. Little has been published on the biological effects of slow neutrons, but apparently their action is similar to that of the beta and gamma radiations with injury to the blood-forming organs as one of the early reactions. Protection of health in such exposures requires the study of the employees, the use of instruments for detection of exposures, the employment of mechanical handling and processing and of barriers of distance and concrete to prevent exposures.

III. HEALTH CHALLENGES IN THE PLASTICS INDUSTRY

The development of plastics is one of the most rapid that has occurred; constantly new materials are introduced.

A. Resins

Fortunately most of the resins employed have little potency as systemic toxins. As skin sensitizers, the phenol-formaldehyde resins, the phenol-furfurals and the urea-formaldehyde and melamine-formaldehyde resins are of considerable importance.

B. Antioxidants

Many of the antioxidants and stabilizers are organo-metallic compounds which act as primary irritants to the skin. Some of the hydroquinone derivatives are of interest because of their interference with normal skin pigmentation and the consequent whitening of the skin.

C. Plasticizers

Plasticizers are added to increase the flexibility or decrease the brittleness of the material. A number of the plasticizers are skin sensitizers; still others may be important both as a cause of dermatitis and of systemic reaction. Perhaps the most important of the potential systemic reactors are the chlorinated diphenyls.

D. Solvents

However by far the greatest problem in the plastics industry is exposure to numerous solvents. These are for the most part alcohols, amides and amines, esters, ethers, glycols and their derivatives, halogenated hydrocarbons, aliphatic and aromatic hydrocarbons, ketones, nitriles, nitrocarbons and sulfur derivatives. Of these the chlorinated hydrocarbons, the aromatic hydrocar-

bons, carbon disulfide and to a lesser extent the nitrocarbons are all well known systemic toxins, and the usual precautions should be taken to prevent excessive exposure. It is of interest that the chances of exposure are sometimes less inherent in the manufacture of these products than in the use of plastics in later fabricating processes, due to the enclosure and mechanization of operations in the manufacture of the basic materials. In other instances, in which such safeguards cannot be provided, greater opportunity for exposure is attendant on the manufacture of the crude product. A high-light review of this subject may be found in the paper by Cranch.²⁴

IV. HEALTH CHALLENGES IN THE RUBBER INDUSTRY

The replacements of natural rubber by synthetic rubber has also created some new and challenging problems which have been fairly well worked out during the war but which may be new enough to many to warrant inclusion here. The most widely used synthetic rubber is Buna S, a copolymer of butadiene and styrene. Because of its resistance to petroleum products, there is also considerable demand for Buna N, a copolymer of butadiene and acrylonitrile.

Butadiene has little or no cumulative effect from repeated inhalation if the concentration is well below the explosive limit of 2.2%,²⁵ and it is only mildly narcotic in these concentrations. Styrene acts principally as an irritant of the lungs, mucous membranes and skin. Liver and kidney damage has been reported for excessive exposure. A maximum safe concentration of 200 p.p.m. has been advocated by Carpenter.²⁶ Acrylonitrile (vinyl cyanide) is an extremely toxic material—comparable to a molecular equivalent of cyanide²⁷ and in the new synthetic rubber plants great pains have been taken to prevent any harmful exposure to this substance.

The synthetic rubber industry has also presented new possibilities for exposure to solvents. Whereas gasoline and petroleum naphthas can be used to replace the more toxic solvents for use in the manufacture of natural rubber products, benzol and its homologues and chlorinated hydrocarbons are necessary to dissolve most of the synthetic rubber. Ethylene dichloride is perhaps the only satisfactory solvent for the

thoccol type of rubber. Neoprene, Buna N, and butyl rubber require cyclic or chlorinated hydrocarbons for solution. Buna S latex, like natural rubber latex, can be dissolved in petroleum naphthas. Safeguards consist of the usual enclosure of processes, ventilation and personal protective devices.

V. HEALTH CHALLENGES TO THE INSECTICIDE INDUSTRY

Until recently the armamentarium of the insecticide industry has consisted mostly of calcium and lead arsenates, nicotine, rotenone, pyrethrum, dinitro products, fluorosilicates, sulfur and copper compounds, and lime-sulfur mixtures. More recently has been added DDT (1-trichloro-2, 2-bis (p-chlorophenyl ethane), its close relative DDD or TDE (1, 1-dichloro-2, 2-bis (p-chlorophenyl ethane), the chlorinated benzenes, and hexaethyl tetraphosphate. Extensive usage of DDT by the Army²² has shown that DDT is relatively non-toxic to humans and that absorption of the dry powder through the skin is negligible. On the basis of animal experiments and observations of human subjects, Cameron and Burgess²³ concluded that there was a wide margin of safety in the use of DDT as an insecticide. They stated that only gross carelessness would cause exposures great enough to produce toxic effects when spray concentrations were not maintained in excess of 0.5%. These investigators found that although absorption through the skin may result from exposure to preparations of DDT in fat solvents, absorption of the dry powder does not occur. Illness has however been reported both in this country and in England, and precautions should be taken to prevent excessive exposure, especially to preparations of DDT in solvent. Symptoms consist of pains in the extremities, irritability, fatigue, paresthesia, uneasiness. Inducement is an important laboratory finding²⁴ (One death has been reported.)

Hexaethyl tetraphosphate is effective against a number of insects, red spiders, citrus mites, aphids and flies at dilutions of from 0.25% to less than 0.025%. Approximately 0.2 ml. per kg. is lethal to rats when applied to the skin and 0.005 ml. per kg. when administered orally, according to data provided by the manufacturer. This chemical is said to be readily hydrolyzed in water thus minimizing the likelihood of toxic re-

actions from eating fruit or vegetables covered with residual from spraying.

VI. HEALTH CHALLENGES IN WORK REQUIRING HAND POLISHING OF METAL

In the airplane industry, where the light metals are used extensively, a new problem developed which challenged doctors, engineers and safety personnel. Hand burring and polishing of castings with high speed rotary tools was carried out on a large scale. Investigations in this country²⁵ have indicated that a somewhat different condition results from exposure to vibration produced by these tools when the rates were in excess of 10,000 per minute as compared to most of the previous industrial exposures in which the rates of vibration were below 4,000 per minute.

The solution of the problem was found in the rather general applicability of wet sand tumbling, thus making at least partial elimination of the process possible. Investigation of insulating materials to determine those most effective in eliminating vibration are under investigation so that where such tools are necessary they can be used safely. Other measures used in meeting the challenge were elimination of exposure to cold, pre-employment examinations and frequent follow-up examinations with removal from exposure to vibration of all subjects whose symptoms were not transient.

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Some Considerations in Design of Exhaust Systems

By W. C. L. HEMEON

Industrial Hygiene Foundation

Costs are intimately related to the success of a plant improvement program. Major, individual, cost savings may spell the difference between rapid accomplishment of a broad plant improvement program and slow accomplishment of a narrow one, especially in plants where the project costs exceed the departmental or plant budget.

Economy in such matters as ventilating systems does not mean inadequate control of serious superior engineering.

It is relatively simple to design exhaust systems with extreme factors of safety, in which all possible and many impossible sources of contamination are included in the system, and at excessively large air-flow rates.

1. If the cost estimate based on such a design is so great that it is tabled by the management, then that is faulty engineering.

2. If such a system is constructed and results in such a high loss of heat in winter that the capacity of the existing boiler plant is exceeded—that is poor engineering.

3. If an excessive exhaust rate interferes with the normal functioning (or most advantageous functioning) of the process to which it is applied, that, too, is bad engineering.

The relatively undeveloped character of this branch of engineering, poses the problem of how exhaust systems and industrial ventilation systems generally, could be most advantageously purchased.

1. A favored procedure consists in requesting competing equipment manufacturers not only to quote prices on a system, but also to indicate the design of the system. This procedure is advantageous only if one can select bidders who have had extensive experience with the problem. The disadvantages are obvious where one or more of those selected do not thoroughly understand the problem. More important still, no two bidders will have the same ideas on an appropriate design. The costs quoted, therefore, will not be based on the same end result. One, then, is in a quandary as to whether to accept the lowest bid which may result in an inadequate system or the highest bid which may be wasteful and not successful.

2. A second common method especially in larger companies is to assign the whole problem to a staff engineer. He may be a machine designer or a general plant engineer. If he has had no experience in this field, the results may be sad. It is too frequently assumed that any staff engineer should be equipped to handle such designs.

3. A third method is to assign the whole problem to a local installation contractor, a procedure which is similar to the first one mentioned and subject to the same disadvantages.

The best answer to the question of how to purchase exhaust systems I have already implied. The system should be engineered, and specifications produced therefrom.

The average person will picture the process of engineering to involve preparation of detailed blueprints of a system layout. That isn't necessary, and would render the procedure an impractical one for most of the smaller exhaust systems installed for industry. Furthermore, most of the simple, smaller systems are commonly installed now without any drafting work at all.

Let us see what fundamentals need to be incorporated into such specifications.

The mechanical layout of exhaust systems is not a fundamental problem. The locations of process equipment contributing visible dust (or other obvious contaminant) are apparent and layout is therefore merely a question of running ducts from each source to a central main duct, thence to the exterior of the building. Any first class sheet metal contractor knows the principles of duct construction as to gage, multi-section elbows, radius of turn, 45°-30° T's, tapering enlargements, etc.

Hood

The important fundamental is in the design of exhaust hoods, and the success of the system depends on it. Although the aerodynamic characteristics of suction openings are quite simple, the process characteristics affecting the selection of a correct velocity are too complicated for a brief treatment.

For my present purpose it is sufficient to point out that the hood should, and can readily, be described in the form of specifications and thus define concisely the requirements of the process.* For example, the following:

*Hood is the point or points of an exhaust system where air enters, whose function is to entrain (at least in part) the contaminant. It is completely described by "cubic feet per minute," shape, and location.

"A flaring hood shall be constructed and installed—(describe the location)—having face dimensions of 38 inches horizontally, and 10 inches vertically, and shall be arranged to exhaust laterally at a rate of not less than 1500 c.f.m." Simple sketches of hoods are often desirable.

Similarly, the size of branch duct should be specified, depending on the nature of the contaminant being exhausted.

Other pertinent specifications respecting balance of air-flow between branches, loca-

tion of discharge duct and general construction specifications would be included.

Exhaust Locations

The most important factor in the design of exhaust systems for some problems is in the definite identification of exact sources of contaminant. In the common problem, sources of dust, fume or vapor are obvious, i.e., where visible dust is generated.

Where a series of processes or machines produce small amounts of a toxic substance, the offending concentrations may be invisible and all sources not apparent. Before intelligent design can be started this information must be had. The services of a good industrial hygienist are invaluable, in fact often imperative, for this purpose. He must not merely measure general air concentrations, but identify exact sources and estimate relative importance of each. Opinions must be supported by proof.

Economics of a Problem

Let's consider a factory ventilation problem that involves several dust sources, control of which will cost a considerable sum. Assume, in this hypothetical case (1) that all sources have been established, and (2) an estimate has been made of the relative amounts of contamination produced by each. If, furthermore (3) the cost for exhausting or otherwise controlling each location has been estimated, we have all the ingredients for a nice problem, which will illustrate very useful economic thinking—which means engineering thinking.

I have prepared the table below to syn-

bolize such a ventilation problem. We have the picture of a problem in which inclusion of item B in the control system would only eliminate one per cent of the total contaminant at a cost of 20 per cent of the project. Item C accounts for 50 per cent of the problem at a cost of only two per cent of total.

Depending on the specific nature of the problem, we might decide to include control for items C, D, E for control of 92 per cent of total contaminant and a cost of 27 per cent of maximum; or we might include A, also; and in still other circumstances control of item C alone might be perfectly satisfactory, for a cost of only 2 per cent and control of 50 per cent.

Circumstances justifying the latter might be where it is a temporary process and where economic considerations are of top importance and where workers would not be injured after 50 per cent improvement.

Realizing I might be misunderstood to be advocating economy at the expense of good conditions, I wish to emphasize that the purpose of the discussion is to suggest a method of thinking, i.e., engineering thinking. It is part of a practical philosophy that recognizes when perfection must be fought for and when lesser objectives are more suited to the strategy of plant improvement.

More About Good Engineering

We frequently complain that dust collectors are commonly placed in a dark inaccessible corner and are forgotten immediately afterward—do not receive maintenance attention accorded to direct production machines. The complaint is often justified.

But a system requiring excessive maintenance cannot be said to be well-engineered. Dust collection systems that must be cleared of accumulations in the horizontal ducts every few weeks are not good systems.

Systems whose ducts are constantly being battered and dented are not well-engineered, nor are dust collectors whose hoppers get hammered concave.

Perhaps the most frequent complaint by plant operating men is that workmen refuse to use safety or ventilating appliances, such as movable hoods, or swinging covers. No one questions the thoughtlessness of humans—the workmen. It has constantly to be combatted. That is a major year-in-, year-out task of the safety man.

But, I think we too frequently shift blame to workmen when it is the fault of inadequate engineering. If we design a device requiring the conscious cooperation of work-

men—requiring the acquisition of a new habit to accompany the production habits—let us admit that it is an imperfect solution—that we are placing a new habit burden on the worker. That having been realized one may then resolve to continue studying it for eventual development of a more nearly perfect solution.

The flexible metal hose exhaust for welding fumes so widely employed during the war is a good illustration of this. It required worker collaboration—therefore superhuman inspection, supervision and propaganda. It was a makeshift solution.

In fine, if a worker complains that an adjustment he is expected to make, several times daily, is too inconvenient, I suggest that we consider him to be right until proved wrong. Let us look first to the mechanical adequacy of the device, and look with unprejudiced view.

Over-Simplification

There is great temptation in a short talk to distill some fundamental truths for the benefit of one's listeners, to send them away with some nuggets—the form of simple statements about engineering air control. This is dangerous; it has resulted in the past in the spreading of some false notions.

This is illustrated, for example, by the following descriptive phrases, easily understood when out of context with broader design principles, i.e., that rate of air change is often a suitable basis for estimating the required ventilation of an occupied space. Thus we frequently see tabular values of air changes per hour required in various circumstances. I have gone into this subject elsewhere and shall not take the time to dissect the false reasoning, other than to state that it is without foundation as a mode of procedure.

Another favorite "distillation" is the frequently stated principle that solvent vapors

ECONOMICS OF A FACTORY VENTILATION PROBLEM

(Industrial Hygiene Foundation—Pittsburgh, Pa.)

Source of Contamination	Units of Contamination	% of Total	Relative Cost	% of Total Cost
A	5	7%	\$ 4	8%
B	1	1%	\$10	20%
C	40	50%	\$ 2	2%
D	10	15%	\$10	20%
E	20	27%	\$30	50%

are enough heavier than air that they sink to the floor or other low space and appropriate ventilation is therefore designed in the form of exhaust which terminate near low points. In this case, also, the idea is cited merely to illustrate our thesis. From the practical standpoint of design of industrial ventilation it is less than a half-truth, and leads to considerable economic waste

where it results in ventilation systems which fail in the task intended.

I have suggested that strong efforts be made to effect greater economies, and that this means superior engineering. The attitude of "all or nothing" is not always practical and there are situations where half a loaf of bread is a successful accomplishment.

Labor Management

WEDNESDAY MORNING SESSION

October 9, 1946

Presiding: JOHN W. GIBSON, Assistant Secretary of Labor.

The Viewpoint of the U. S. Department of Labor

By JOHN W. GIBSON

Assistant Secretary of Labor

I am very sorry that Mr. Verne Zimmer, Director of the Division of Labor Standards, U. S. Department of Labor, couldn't be here with all of his old friends this morning acting as chairman of this important meeting. I know you will all join with me in wishing him a speedy recovery.

This morning, we have a very important subject to discuss, and we have some very intelligent and able people on this panel to present their points of view, on what, in America today, is perhaps one of our most controversial questions, the broad question of relations between labor and management, whether in the field of collective bargaining and safety, or where ever their relationship happens to meet.

In this meeting hall, filled as it is this morning, I feel compelled to say a few words to you that I am sure Verne Zimmer would have liked to have said to you, and then I will present my part in the program, following which we will hear from other members of the panel. Before we close the meeting, we will try to summarize the thinking of the panel and the audience on all important related questions.

The last labor-management safety session I attended here was in 1943. We had the same response in attendance at that meeting as we have here today, only we had a much smaller hall and couldn't get them all in.

The picture has changed some, but not a great deal. At that meeting we adopted an eight point program. The eight point program was again adopted in 1944, and I think in order to get this meeting off properly, it is only a very short program, that I will read those eight points, and from there we will resume our discussion.

Point 1, was a promotion of safety, which should be just as definite and objective of labor as wages and working conditions. Point 2, management should actively seek labor's cooperation. Point 3, education in what safety means, should be stressed by management and labor to the end that the attack on unsafe conditions and practices, can be instituted at the job level through full knowledge by every worker of the principles of safety.

Point 4, the cooperation of workers must be sought without detracting in any way from the necessity for expert and professional safety guidance in the plant. Point 5, plant safety committees should always function in full coordination with and under the official sponsorship of the plant safety department. Point 6, the basic responsibility for safety and the safety program, is that of management. Labor recognizes that its cooperative effort must be dovetailed into management's structure with recognition of the authority of management, that runs concurrently with its basic responsibility.

Point 7, the physical condition of the plant, with respect to cleanliness, sanitation, and general housekeeping, is an essential factor in any safety program. Point 8, it is our opinion, and we request the president of the National Safety Council to communicate to the heads of organized labor that we feel full cooperation of organized labor is desired with the National Safety Council in order to put across the best safety program that we can.

That was the extent of the principles adopted twice by groups similar to this one.

I know that Mr. Zimmer was thinking of discussing this morning the trend in the