THE SECOND GULF COAST REGIONAL CONFERENCE ON INDUSTRIAL HEALTH

OCTOBER 6-7, 1949
HOUSTON, TEXAS

"An Industrial Health Program Profits All: Management, Labor And The Community"

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Gulf Coast Regional Conference
on Industrial Health,
The second Gulf Coast Regional
Conference on Industrial Health,
October 6-7, 1949, Houston, Texas.

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HOUSTON, TEXAS, FRIDAY, OCTOBER 7, 1949
THE HOUSTON POST

SECTION 3
• Sports
• Local

Tamed Atom Brings Problems, Industrial Health Parley Told

A whole field of new health problems has been opened by the taming of atomic energy, Dr James H. Sterner, consultant to the Atomic Energy Commission, told members of the Gulf Coast Regional Conference on Industrial Health at a banquet Thursday night in the Rice Hotel.

"It is very likely that atomic reactors will be adopted as practical sources of power in the not too distant future. One of the major problems is in the medical field, controlling radiation exposure," he said.

DOCTOR STERNER'S speech was the last of four on the opening day of the conference.

Friday the conference will speed its work, operating two programs at once. A symposium on industrial wastes and stream pollution will cover a subject of high interest to the Houston area.

Resolutions will be voted on at a business session.

Doctor Sterner told some of the present applications of atomic energy and their danger.

Radio-cobalt is being substituted for radium in industrial radiography. One advantage is the cost. Another is that the cobalt can be fabricated into the desired shape before being irradiated.

Metal bars can be coated with radium or polonium as anti-static devices in paper-folding machines and other devices.

X-RAYS AND OTHER sources of beta radiation can be used to measure the thickness of films of paper or steel and to keep a machine regulated.

"Already a number of serious X-ray burns have resulted from improper and careless use of such equipment," Dr Sterner said.

Manfred Bowditch, director of health and safety for the Lead Industries Association, New York, NY, gave the keynote talk. Mr Bowditch said he believes he is the first industrial hygienist employed by any company in the United States. He started in 1925 with the General Electric Company.

"Industry as a whole has hardly more than begun to appreciate the profit potentialities of comprehensive health programs," he said.

"All too few industrial medical ... are really health-minded. sponsible. I think it may in all honesty be said that, as far as undergraduate teaching of industrial or occupational subjects is concerned, it is in most cases lamentably inadequate," Mr Bowditch said.

HE CRITICIZED management for failing in many cases to pay enough to obtain the best doctors and labor for lack of interest in health programs in the past. But he added:

"That labor is now ready to join in advancing the cause of health and safety in industry is evidenced by the Washington meetings now being held in an effort to establish a permanent conference for that purpose, with representatives of the American Federation of Labor, Congress of Industrial Organizations, National Association of Manufacturers, United States Chamber of Commerce and American Medical Association participating."

Dr Allan J. Fleming, assistant medical director of E. I. du Pont de Nemours and Company, Wilmington, Del, described two instances of detective work which was necessary to trace two chemical hazards in Du Pont plants.

In the first case, something was causing the workers' eyes to become cloudy, so that they could not see well enough to drive home. A new process for synthesis of ethylene glycol was being used. With the help of the plant force, chemists from the research staff and guinea pigs, the troublesome substance was shortly isolated. Dimethyl diglycollate was the culprit. Fortunately its effects did not linger.

IN AN ARTIFICIAL leather plant, some of the employes developed a severe skin irritation. After several months, the cause was found to be the reaction of a certain impurity with the liquid soap the workers used to wash up.

Dr Allen D. Brandt, industrial hygiene engineer for the Bethlehem Steel Company, Bethlehem, Pa, described methods of controlling hazardous fumes, gases, smoke and dust in plant operations.

More than 200 were on hand for the conference opening.

John C. Flanagan, Chamber of Commerce public health committee chairman, welcomed the group and listed the sponsors. These include Mr Flanagan's committee, the State Health Department, Baylor College of ... American Medical Association; American Society of Safety Engineers, Gulf Coast Chapter; American Association of Industrial Nurses, Houston Branch, Industrial Hygiene Foundation of America, Inc, and the Texas Manufacturers Association.

Friday's program will open at 9 AM with Dr Carl A. Nau of the University of Texas presiding. The symposium on industrial wastes and stream pollution will start at the same time with David F. Smallhorst of the Bureau of Sanitary Engineering, State Health Department, presiding.

The Texas branch of the American Association of Industrial Nurses will also be on hand and will have an organizational luncheon at noon.

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Stream Pollution To Be Discussed At Health Meet

Atomic Energy Expert Describes Possible Power Sources.

Two day-long programs will close the second annual Gulf Coast regional conference on industrial health today in the Rice Hotel, where the city health department may pick up some valuable information on controlling pollution and wastes in the city's bayous.

One of the programs is an industrial wastes and stream pollution symposium, which began at 9 a.m.

Dr. Fred K. Laurentz, city health officer, said he and members of his staff will attend the symposium.

"We might gain some very valuable information in the symposium on how to keep our bayous from being breeding grounds of disease," Doctor Laurentz said.

The other program will deal with various subjects on industry and the health of employes.

Dr. James H. Sterner, consultant to the Atomic Energy Commission, Thursday night at a banquet, spoke on the whole field of new health problems that has been opened by the taming of atomic energy.

"It is very likely," Doctor Sterner said, "that atomic reactors will be adopted as practical sources of power in the not too distant future, and one of the major problems is in the medical field controlling radiation exposure.

"Already a number of serious X-ray burns have resulted from improper and careless use of industrial equipment connected with atomic energy."

Other speakers Thursday included Allen D. Brandt, industrial hygiene engineer for the Bethlehem Steel Company of Bethlehem, Pa., who spoke on "Control of Environmental Industrial Health Hazards;" Dr. Allan J. Fleming, assistant medical director of the E. I. du Pont de Nemours & Co. of Wilmington, Del., who spoke on "Teamwork in the Solution of Industrial Medical Problems" and Manfred Bowditch, director of health and safety for the Lead Industries Association of New York City, who spoke on "Industrial Health Programs Pay Dividends."

At the Industrial Wastes and Stream Pollution Symposium the speakers will include Burnell Waldrep, assistant attorney general; V. M. Ehlers, national president of the Federation of Sewage Association; W. A. Moggio, research engineer for the National Council for Stream Improvement; M. B. Ettinger, scientist officer for the United States Public Health Service, and G. R. Herzik, Jr., chief engineer for the Texas State Department of Health.

The symposium will close with a round table forum by the panel of speakers and a summation of the highlights.

OCTOBER 6-7, 1949

CONTENTS

DEDICATION 1

CONFERENCE COMMITTEE 2

"WELCOME" - JOHN C. FLANAGAN 6

"INDUSTRIAL HEALTH PROGRAMS PAY DIVIDENTS", KEYNOTE ADDRESS

MANFRED BOWDITCH 8

"TEAMWORK IN THE SOLUTION OF INDUSTRIAL MEDICAL PROBLEMS",

ALLAN J. FLEMING, M.D. 13

"CONTROL OF ENVIRONMENTAL INDUSTRIAL HEALTH HAZARDS",

ALLEN D. BRANDT, Sc. D. 20

CONFERENCE BANQUET - "INDUSTRIAL MEDICINE IN AN ATOMIC ERA",

JAMES H. STERNER, M. D. 28

"THE EMPLOYERS LIABILITY FOR OCCUPATIONAL DISEASES",

J. DEWEY DORSETT 35

"SOME HEALTH ASPECTS OF ARSENIC IN INDUSTRY",

SHERMAN S. PINTO, M.D. 40

"THE ROLE OF THE NURSE IN THE INDUSTRIAL HEALTH PROGRAM",

F. RUTH KAHL 44

INDUSTRIAL CONFERENCE PANEL LUNCHEON, "INDUSTRY'S ROLE IN EMPLOYEE HEALTH",

BRIGADIER GENERAL JAMES STEVENS SIMMONS, USA, (RET.), DEAN,

HARVARD SCHOOL OF PUBLIC HEALTH 48

"THE PROBLEM OF THE AGING EMPLOYEE",

HARDY A. KEMP, M.D. 52

"RELATIONSHIP OF OCCUPATION TO HEALTH"

T. M. FRANK, M.D. 55

"THE SAFE HANDLING OF CHEMICALS IN INDUSTRY AND IN THE HOME"

D. D. IRISH, M.D. 59

"MANAGEMENT'S RESPONSIBILITY FOR PREPAID MEDICAL AND HOSPITAL PLANS",

ROSS GARRETT 64

"PUBLIC HEALTH ASPECTS OF ATMOSPHERIC POLLUTION",

GEORGE D. CLAYTON 67

"TEXAS LAWS AND REGULATIONS CONCERNING INDUSTRIAL WASTES AND STREAM POLLUTION"

BURNELL WALDREP 73

"INDUSTRY AND POLLUTION - ABATEMENT IN THE OHIO RIVER VALLEY",

EDWARD J. CLEARY 78

"SERVICES AVAILABLE TO INDUSTRY THROUGH THE UNITED STATES PUBLIC HEALTH SERVICE AND PUBLIC LAW 845",

RICHARD F. POSTON 84

"IN-PLANT INDUSTRIAL WASTES" STUDIES

W. A. MOGGIO 88

"ANALYTICAL PROCEDURES ADAPTABLE TO INDUSTRIAL WASTES' STUDIES"

M. B. ETTINGER 104

"POLICIES AND STANDARDS OF THE TEXAS STATE DEPARTMENT OF HEALTH REGARDING INDUSTRIAL WASTES",

G. R. HERZIK, JR. 110

WASTES SYMPOSIUM LUNCHEON - "THE FEDERATION'S INDUSTRIAL WASTES' ACTIVITIES AND RESEARCH",

V. M. EHLERS 114

RESULUTIONS 122

1949 REGISTRATION LIST 123

TO

TEXAS STATE DEPARTMENT OF HEALTH

THE BAYLOR UNIVERSITY, COLLEGE OF MEDICINE

THE AMERICAN MEDICAL ASSOCIATION, INDUSTRIAL HEALTH SECTION

TEXAS MANUFACTURERS ASSOCIATION

AMERICAN SOCIETY OF SAFETY ENGINEERS, GULF COAST CHAPTER

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

AMERICAN ASSOCIATION OF INDUSTRIAL NURSES, HOUSTON BRANCH

FOR THEIR SPLENDID COOPERATION, LEADERSHIP AND DETERMINATION TO MAKE THE SECOND GULF COAST REGIONAL CONFERENCE ON INDUSTRIAL HEALTH A CONTINUING SUCCESS.

SECOND GULF COAST REGIONAL CONFERENCE

ON INDUSTRIAL HEALTH

OCT. 6-7, 1949

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CONFERENCE WELCOME
TO ALL DELEGATES
BY
JOHN C. FLANAGAN, CHAIRMAN OF THE PUBLIC HEALTH COMMITTEE
AND VICE PRESIDENT AND GENERAL MANAGER, UNITED GAS CORPORATION

Ladies and Gentlemen:

It is my pleasure to open officially the Second Gulf Coast Regional Conference on Industrial Health. On behalf of the eight sponsoring agencies I extend to all of you a cordial welcome.

In opening the first Conference last year the Chairman expressed the hope that it would not be the last Industrial Health Conference held in this city. The success of that Conference and your presence here today justifies the prediction that these Conferences will be held annually in the future, with greater and greater attendance and with continually expanding influence in the field of Industrial Health, not only in the Gulf Coast territory but nationally, and perhaps internationally.

It will be my privilege to introduce the Chairman for the afternoon, but doing so I would like to take a few minutes to pay a well earned tribute to some of those who have worked long and hard to make this Conference a success. I am sorry that time will not permit me to mention all who deserve personal recognition.

The Texas State Department of Health, under the leadership of Dr. George W. Cox, has made a material contribution. Dr. Cox could not be here but we are fortunate in having Mr. V. M. Ehlers who deserves special mention for organizing the Industrial Wastes and Stream Pollution Symposium. We want to express our thanks also to Mr. Ehlers' associates, Mr. Fred Venable and Mr. Martin Wukasch.

To Baylor University, College of Medicine, we are especially indebted, not only for the help given in connection with this Conference but because without its cooperation and the use of its facilities, the First Industrial Health Conference would probably not have been held.

We are sure that Dr. Kemp and his associates at Baylor are gratified that the Conference has grown to the extent that Baylor's facilities are not able to accommodate the gathering this year.

The American Medical Association, Industrial Health Section, and especially the Harris County Medical Association, deserves special recognition for the fine work they are doing in promoting all types of health programs. Dr. Denton Kerr, president of the Harris County Medical Society, and Dr. W. H. Hamrick, a member of that Society, have done especially fine work in promoting this Industrial Health Conference.

The American Society of Safety Engineers, Gulf Coast Chapter, has a membership of 125 active workers. These men know the value of good health in industry and they are continuously active in promoting all health programs in this area. Mr. David Wood, past president, and Mr. Edgar C. Stokely, president of the Chapter, have done yoeman service in organizing the Conference.

The American Association of Industrial Nurses, Houston Branch, has actively assisted in the preparation for the Conference and to them we are indebted for having with us Miss Ruth Kahl, one of our speakers. We are especially grateful to Mrs. Antoinette Erwin, Chairman of the Houston Branch, and to Miss Jeannette Bartholomew, an active member.

The Industrial Hygiene Foundation of America, Inc., contributed to the promotion of the Conference by publicizing it in the Industrial Hygiene Newsletter and acting as a co-sponsor.

The Texas Manufacturers Association has rendered great service in promoting the Conference among its large membership. Mr. Clyde L. Jones, Director of Chapter and Field Activities for the Association, has been a valued and enthusiastic worker for the Conference.

The Public Health Committee of the Houston Chamber of Commerce was instrumental in organizing the first Conference and has been quite active in working up the program and in handling many of the pre-conference details for our present meeting. Many of those already named are members and active workers of the Public Health Committee.

I would like to pay special tribute to Mr. James W. Hammond, Chairman of the Industrial Health Conference Committee. Mr. Hammond is a member of the Humble Oil and Refining Company's Medical Department, although I suspect that for the past sixty days they have seen very little of him. The entire Conference program has been worked out under Mr. Hammond's directions, ably assisted by Mr. Rex L. Tidwell, in charge of Arrangements and Registration, and Mr. Otto Paganini in charge of Exhibits.

Without an efficient secretary no Conference of this type could be organized and we were especially fortunate in having the services of Mr. W. B. Black, Jr. of the Houston Chamber of Commerce. Mr. Black has worked night and day for the past two months and it would be difficult to measure the value of his services.

Finally we acknowledge our indebtedness to the distinguished men and women who will appear on the Conference program. The fact that they are willing to leave their homes and their business to appear on this program is the best indication of its importance and the finest hope for its contribution to Industrial Health.

Now it is my pleasure to introduce the Chairman for the afternoon. Dr. Kemp is so well known to most of you that it would be "gilding the lily" for me to enumerate even part of his degrees, his awards for scientific research and the important assignments he has filled since he graduated from St. Louis University in 1926. He has been associated with Baylor Medical College since 1948 where he has served as Professor of Preventive Medicine and Chairman Department Public Health and Preventive Medicine, and Director of Graduate Studies, Baylor University Graduate School Affiliated Hospitals. He is an active member of the Public Health Committee of the Houston Chamber of Commerce.

I am proud to present my fellow citizen, Dr. Hardy A. Kemp.

Dr. Hardy A. Kemp, Presiding

"INDUSTRIAL HEALTH PROGRAMS PAY DIVIDENDS"

Manfred Bowditch
Director of Health and Safety
Lead Industries Association
New York City

October 6

I trust that you will not be disappointed when I tell you that I have not come here for the purpose of citing statistics on the costs of industrial health programs, the extent of ill-health in industry or the dollar savings that may be affected through the impingement of such programs on this aggregate of ill-health. Sufficient reasons for not doing this are to me three basic facts. The first of these is that, although a goodly number of such cost estimates have been published, among them the quite recent and useful one of the New Jersey Department of Health, it is still true that, because of the variables inherent in the problem, each program is in great degree a law unto itself in the matter of cost. The second is that we have no worthwhile statistics on the extent or cost of ill-health in industry, let alone the costs of those physical and mental conditions which, while perhaps not so recognized, are anything but conducive to sound morale. And, in my opinion, we will never have such statistics, even as to those diseases properly designated as occupational, until they are made reportable by law as are tuberculosis and other communicable maladies. To point up this second fact, let me tell you of a little incident. The president of one of the member companies of our association had remarked to me that I should secure from our members reports of all their lead cases. When I broached this to the medical director of another of our companies, a far-flung and admirably operated organization, he came back with, "How can you get them when I can't get them myself?" My third and final fact is the quite obvious one that, with so frail a foundation as to costs, any thesis that I might seek to build in terms of dollar savings would have little validity.

So there will be no statistics. This does not mean, however, that I cannot express to you the most sincere conviction that any industrial health program, soundly conceived and administered in the light of the real needs of the company and its workers, will pay dividends quite as real as, if less tangible than, those which go out to the stockholders. I have that conviction and I hope to make clear to you why I have it.

But before I undertake this exposition, I ask your indulgence in one or two digressions. Firstly, as is the wont of us old gaffers, I would like to reminisce a bit. When I entered the employ of the Medical Department of the General Electric Company at Lynn, Massachusetts, in 1925, I became, so far as I have ever been able to determine, the first industrial hygienist ever to be employed on a full-time basis by an industry in this country. Honesty compels me to add that, being no tread-fearing angel, I undertook this work knowing next to nothing about industry and even less about hygiene. I was actually hard put to it to know how to describe myself, for industrial hygienists, now so numerous that they have their national and local associations and can hold regional meetings such as this one, were then very rare birds indeed. Yet despite these handicaps, it was almost no time before I was aware of two heart-warming satisfactions. I knew that

I was doing something definitely worth the effort, and there was apparent evidence that what I was doing was improving morale.

If there are amongst us here any younger hygienists who sometimes feel that they are a bit behind the eight ball or are not wholly convinced that their efforts are appreciated, a couple of illustrations of what I have just said may have the germs of helpful suggestion. On thus finding myself a neophytic atom in the G. E. colossus, I got myself a little notebook and started wandering through the works, looking for situations that seemed to call for correction from some viewpoint of health. Having satisfied myself as to the proper corrective, I would approach the man in charge and ask him to have the change made. The answer was almost invariably "Why sure." and the date was noted in my little book. When a month had gone by without visible change in the situation, Mr. Doe would be reminded that on such and such a date he had promised to do this or that. Sometimes a second month would elapse, with a second reminder, this time citing two dates, and after enough of this had gone on, I was gratified to learn that it was being said around the plant that, if you told that so-and-so Bowditch that you would do something, you might as well do it, as he would plague the daylights out of you until you did. And then one day a woman worker turned up in the dispensary complaining of back pain. I went to her work station and found that she was one of a group who were winding tape insulation onto quite sizeable coils. And I also noted that, though she was inches taller than any of her mates, the jig at which she worked was at the same height above the bench as all the rest. No appreciable gray matter nor cost were involved in raising the jig to a proper height, or in suggesting a less arduous method of winding, but it was good to learn that the pain had disappeared, and better yet to have this worker say to me one day "You don't know what it means to know that somebody in the plant cares about such things." Is there any one of us here who does not share my conviction that such simply accomplished improvements pay dividends out of all proportion to their cost?

Yet with this conviction of mine goes another, that industry as a whole has hardly more than begun to appreciate the profit potentialities of comprehensive health programs. Indeed, if this were not so, there would be little occasion for a paper such as this. So let us try to determine why health work in industry has lagged so far behind the industrial revolution itself, for only by so doing may we hope to stimulate it to more rapid growth. This cannot but involve some criticism of the several parties to the problem, in which I assure you that I mean to be entirely fair.

First of all, it is axiomatic that a health program in industry must be under medical guidance, for neither the hygienist nor the nurse is adequate to the situation alone. Such guidance, one might think, should be easy to secure, for there are now many full-time doctors in industry, many more who serve industry on a part-time basis, and still others available as consultants in industrial areas. Why, then, is it not more common? One reason, I believe, is that the concept of industrial medicine as little more than traumatic surgery is still regretably persistent. I subscribed when she said it many years ago to Dr. Alice Hamilton's dictum that the company employing a thousand workers should have a full-time doctor, and I still subscribe to it, with perhaps the more modern proviso that it be a half-time doctor and a part- or full-time hygienist or nurse. And I will go a step further and say that if this doctor or team of medical workers charged with responsibility for the health of a thousand industrially employed men and women do not find their time more than fully occupied, some change in personnel is indicated.

In short, it is my considered opinion that all too few industrial medical men are really health-minded. For this we must hold the medical schools at least in part responsible. I do not pretend to know too much about medical education, but I have taught in two of our leading schools of medicine, have informed myself of the instruction given at a number of others, and think it may in all honesty be said that, as far as undergraduate teaching of industrial or occupational subjects is concerned, it is in most cases quite lamentably inadequate. When we turn to postgraduate courses in industrial hygiene and medicine, the picture is somewhat brighter, yet even here, to judge by reports of enrolment at three well-known schools that came to me only the other day, it is none too rosy.

The old reliable law of supply and demand seems to be working here. What incentive is there to the young and aspiring M.D. to spend years of his youth and large amounts of his none-too-ready cash in perfecting himself for work which may well be rewarded, despite his competence, with earnings far less than he could gain in private practice? This question brings us to the steps of industry itself, and it is up these steps that we must pass in seeking to bring about the enlightenment that will have to come before anything approaching universally adequate health programs are attained in our manufacturing establishments. What are the major difficulties here? One, I believe, is continuance in some management quarters of the old idea that medical service is a necessary evil, to be secured at the lowest possible cost. If Dr. Jones will do the job for five hundred dollars less than Dr. Brown, Dr. Jones is obviously the man for the job. Another is the inability of the front office, which is used to laying down the law to its production departments, to conceive of dealing with its medical department in any other way. Yet most doctors who are really worth their salt are pretty independent critters and have no intention of being told by a mere layman how they should conduct their work. It is my firm belief that, if the managers of all our larger industries, in seeking medical and health service, would raise their sights in terms of professional ability, salary and that intangible called personality, to the level achieved by some that I could mention, and having done so, would give their doctors full front office backing but otherwise leave them alone, the professions, the schools, the workers and the corporations themselves would all be infinitely the gainers.

Labor, in the past, has had relatively little to say about health programs in industry, but this situation is changing. With the increased participation of the workers themselves in the solution of their own hygienic problems, it is to be hoped that there will come an ever clearer realization that, when health is mixed with politics, the former is invariably the loser.

Having been a state-employed industrial health worker for fifteen years, and therefore perhaps knowing whereof I speak, I venture to suggest that, despite their obvious importance and accomplishments in the development of industrial hygiene services, somewhat the same hope might be expressed with regard to the governmental agencies. All of us are, I am sure, painfully aware of the prolonged jurisdictional wrangling that has marred the record on both federal and state levels, and all of us who have the cause of industrial health at heart must be glad of the apparent lessening of this quite indefensible bickering.

I seem to have managed to throw quite a few bricks. Now, with your permission, I would like to pin on some well-merited posies in each of the above categories, for in at least partial compensation for the over-all lag which I am perhaps too prone to deplore, there have been many truly remarkable advances, for which due credit should be given.

Among the industrial physicians there are of course a goodly number who constitute the true leaven of the loaf. It was Dr. John J. Wittmer of New York's Consolidated Edison Company who said recently:

> "It is certainly the responsibility of industry to see to it that 'manpower' receives such care and consideration as is appropriate to its position in the scheme of our industrial economy. I can't conceive of a plant manager in this day and age, ordering, installing and operating mechanical equipment without (1) determining exactly what was required of the equipment, (2) securing the best equipment for his needs, (3) having it installed by competent mechanics, and (4) establishing an operations maintenance program to insure optimum efficiency and useful life.
>
> "Is there any moral or practical reason why we should do less for the individual, without whom the equipment could not have existed, let alone be operated?"

And another doctor, whom I am not at liberty to name, wrote me not long ago about two lead cases, saying of one that he "was annealing steel wires in lead baths, but in addition drinking leaded water out of his own faucets in a country home." To say that such etiological detective work is a credit to the profession seems to me but the faintest sort of praise.

I need not be told of the extreme difficulties faced by the medical schools in seeking to fit industrial medical instruction into an ever more crowded curriculum, and I am aware of the success that has met these efforts in some quarters. Confining mention to examples of medical school activity within the State of Texas, the industrial hygiene research laboratory being established by Dr. Nau at Galveston bids fair to be a most valuable addition to a group of institutions of which we have all too few, and the privilege of learning at first hand from Dr. Kemp of his plans for the future of industrial medical teaching at Baylor has added not a little to the interest of my first visit to Houston.

As to the industries, I have already indicated that there are those whose sights in terms of medical and health service are at a commendably high level. Since so revolutionary a change could not have come about without the sanction of an enlightened management, it seems appropriate to mention here the transfer last winter of the Socony-Vacuum Oil Company's human relations activities from its industrial relations department to its medical department, the purpose being to permit the traditionally confidential doctor-patient relationship to aid in solving personal problems adversely affecting the work of the company's employees. And as an example of excellent yet economical co-operative health activity for the benefit of industry at large, I would like to cite the fact that the smaller companies may secure the benefits of membership in the Industrial Hygiene Foundation of America for as little as fifty dollars a year.

That labor is now ready to join with management and medicine in advancing the cause of health and safety in industry on a truly sound basis is evidenced by the Washington meetings being held in an effort to establish a permanent conference for that purpose, with representatives of the American Federation of Labor, The Congress of Industrial Organizations, the National Association of Manufacturers, the U. S. Chamber of Commerce and the American Medical Association participating. Judging from what one of the medical members of this group has told me, the labor approach to the problem is on a high plane.

It seems most unlikely that the recently created National Advisory Committee on Industrial Health, with ten distinguished members, can fail to notably benefit the Federal Government's industrial hygiene activities. Among the state and local units, of which there are fifty-eight in all, it can hardly be expected that all will operate at the same high level of efficiency. Many are, however, doing excellent work, and I consider it a duty of my present position to bring about cordial and mutually profitable relations between these agencies and our member companies wherever possible. I have been particularly impressed by the Kentucky industrial health services survey now being conducted by Mr. W. W. Stalker, director of the division in that state.

I hope that, despite the rather rambling nature of my remarks, I have succeeded in making evident my conviction that industrial health programs do pay dividends. I realize, however, that, having now been engaged in the promotion of industrial health for nearly twenty-five years, I may be suspected of some little prejudice in its favor. It therefore seems appropriate that I should quote, in conclusion, from two of the men who pay for these programs, for if they are for them, as the executive heads of outstanding industrial organizations, it must be for reasons far more practical than mere prejudice. I quote first from an address by Mr. William B. Given, president of the American Brake Shoe Company, who said at a meeting of the Industrial Hygiene Foundation,

> "How effectively or how badly a Medical Department functions should be one of the many useful yardsticks for directors when they are wondering whether the company needs a new head. After all, the most important part directors have to play in management is promptly removing the senior officer when over-all he is found not up to his job - yes, and without wasting time about it.
>
> "By the same token, with today's competition for the most intelligent and efficient workers, stockholders cannot long afford directors who do not realize the importance of top health and safety conditions in their company's plants, nor managements which do not spend whatever money is necessary to give plant people the maximum of health and safety assurance."

And finally from Mr. Andrew Fletcher, president of the St. Joseph Lead Company, who on a similar occasion spoke as follows:

> "Good health is the most important asset in life. I know of no company that has improved working and living conditions of its employees that has not obtained satisfactory returns in dollars as well as in human happiness."

"TEAMWORK IN THE SOLUTION OF INDUSTRIAL MEDICAL PROBLEMS"

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The Industrial Physician often finds himself in a position analogous to that of the young doctor starting practice in an isolated community where he has the dubious distinction of being the only physician in the locality. The young medic soon finds himself confronted with a variety of problems, a few of which he is ill-equipped to handle. Unlike the young practitioner, the industrial physician is usually unable to find the answer to his problems in medical literature and unless he be one of those rare individuals with a knowledge of Chemistry, Physics and Engineering, he must rely on help from the toxicologist, chemist and industrial engineer, if he is to find an answer to some of the medical problems occurring at his plant. This is particularly true in the chemical industry, for many of the compounds are new and little or no information exists concerning their toxicity or physiological action. Until such information is forthcoming, it is essential that rigid medical control be exercised if we are to practice preventive medicine in industry.

If asked to define the difference between an industrial physician and any other physician, I think we could safely say that close co-operation with other professions is a characteristic of the physician in industry. Unless teamwork exists between the Medical, Safety, Laboratory and Industrial Engineering groups in any plant, the solution of an industrial medical problem will usually be unsatisfactory, expensive, and long drawn-out.

This afternoon I would like to mention two incidents which occurred in our plants, both of which were serious from a production as well as a medical viewpoint, and both of which were solved by the combined efforts of several groups.

The first of these incidents occurred at one of our plants shortly after the introduction of a new process for the Synthesis of ethylene glycol. During the first month of operation, it became necessary to filter material from an acid heel tank (See Slide 1) in an open filter. The operator attending this operation noticed that after a couple of hours, his vision became cloudy and he saw objects as through a fog. Shortly afterward, repairmen working on pump E (Slide 1) developed the same condition, as also did several operators who were exposed to a mist sprayed into the room from a leaky gasket in the ester train heel. Operators exposed to the mist for a few minutes only suffered no ill effects. The leaky gasket was repaired and the room washed down by operators wearing masks. It was observed that in spite of washing, a white film remained on the equipment. When washing down was completed the operators removed their masks and about two hours later developed foggy vision. Similar fogging of the vision developed in operators who first entered the building after the washing down process was completed.

The fogging of the vision was due to the development of cloudiness of the cornea. The cloudiness was unaccompanied by any symtoms or signs of eye irritation, but interfered with vision to such an extent that those affected could not drive their cars home from the plant.

As might be expected a mild wave of hysteria swept the plant. Fortunately the "eye fog" as it was soon called, subsided in 24 to 48 hours, leaving the cornea undamaged.

Although the possibility of shutting down the plant was discussed, no such action was taken, but as investigation was immediately started to determine the compound responsible for the "eye fog", where the compound was formed, and the mechanisms of its action on the eye. This investigation was shared by members of the plant, chemists from the research laboratory of the department concerned, and members of the Haskell Laboratory staff. Due to intensive efforts on the part of all concerned, isolation and identification of the offending compound was completed in a few days.

Step one was to find where the offending compound was being formed in the process, for it was known that the initial raw materials and the final product had no such effect on the eye. Samples were obtained from various stages in the process and these were tested by instilling suitably neutralized drops into one eye of a guinea pig using the other as control. Samples obtained from various parts of the operation represented by the shaded portion in Slide 1 produced fogging of the cornea in guinea pigs within 3 to 4 hours. When water was added to material from the acid heel (M), an oily substance settled out which was soluble in ethyl alcohol. Tests with the water soluble fraction produced "eye fog" in 2 to 3 hours, while tests with the oily (alcohol soluble) portion were negative. Various fractions of the acid heel (M) were then tested and it was found that distillation cuts between 97° to 105° c. at 0.5 Hg pressure and 105° to 134° c. at 1 mm Hg pressure, gave positive teste for "eye fog". Finally a crystalline material was separated from the fraction coming off at 90° c. at 0.5 mm Hg pressure, the separation being made at low temperatures in ether. A 1% aqueous solution of this crystalline material when installed into the conjunctival sac of a guinea pig produced a definite "eye fog" in one hour, and a half percent solution produced "eye fog" in 3 to 3 1/2 hours.

This crystalline material was identified as dimethyl diglycollate and a laboratory prepared sample of dimethyl diglycollate in a 1% aquous solution produced "eye fog" in one hour and a 0.1% solution produced "eye fog" in 4 1/2 hours.

To reproduce conditions as they existed at the plant, air was forced through a flask containing acid heel material and thence into a bell jar in which two guinea pigs were placed. The guinea pigs developed typical "eye fog" within 4 hours. When crystals of dimethyl diglycollate were substituted for the acid heel material, the guinea pigs developed marked "eye fog" in one hour.

There are several interesting features associated with the production of "eye fog" which bear mentioning. The condition is produced without any gross signs of irritation to the conjunctiva or the eye lids. It is unaccompanied by lacrimation or photophobia and it clears up within 24 to 48 hours without leaving any residual damage. This reaction differs entirely from that produced by dimethyl sulphate, which in dilutions of 1 in 300 produces marked irritation of the conjunctiva, accompanied by lacrimation and photophobia. The corneal cloudiness produced by dimethyl sulphate affects the surface cells of the cornea immediately and the condition does not clear up for three to four weeks or even longer.

In contrast to this, the corneal cloudiness produced by dimethyl diglycollate appears without the loss of light reflection from the corneal surface indicating that the surface cells have been affected slightly or not at all. Slide 2 shows a section through the normal cornea of one eye (Fig. 3) from a guinea pig and also a section through the fogged cornea of the other eye (Fig. 4) from the same guinea pig. The anterior epithelium in each of these sections is placed in juxtaposition and it may be noted how the epithelium in the cornea treated with the dimethyl diglycollate has become thickened. The cells are markedly swollen and their outline indistinct. The epithelial layer is decidedly oedematous, the oedema being most marked in the cells nearest Bowman's membrane. The reason for this being that the cells in this area are actively growing and more easily affected than the cells nearer the surface. The surface cells tend to lose their functional activity and act more as an inert protective layer just as the dry cells on the surface of the skin act as a protective layer.

The mechanism of action of the dimethyl diglycollate then is to produce an oedema of the cells in the anterior epithelium of the cornea so as to render this layer translucent to light instead of transparent. This action appears to be specific for dimethyl (and diethyl) diglycollate and seems to be linked up in the remarkable solubility of these compounds in both water and animal fats. Compounds with solubility characteristics such as these probably affect the surface tension of the epithelial cells of the cornea altering it in such a way as to permit absorption of excess fluid by the cells.

The rapid solution of the "eye fog" problem was made possible by having a quick means of testing suspected compounds by means of their action on the cornea of guinea pigs. The development of "eye fog" could be followed by observing the eye with an ophthalmoscope, and as a result the medical laboratory was able to inform the chemical laboratory within one to three hours whether a given sample contained the eye fogging agent or not. As a matter of fact the chemists were so intensely interested they were usually on hand to observe the effects first hand before returning to the chemical laboratory to follow fresh leads.

The second incident I wish to mention occurred in a plant manufacturing artificial leather and concerns an outbreak of dermatitis. According to the Bureau of Useless Statistics, sixty-seven out of every hundred physicians are habitual readers of detective fiction. If this startling bit of information is correct, many physicians in industry should have plenty of scope for their amateur detective talents since a search for the cause of a dermatitis outbreak is sometimes difficult, it is always interesting and often leads the physician into fields far removed from medicine.

The history of the outbreak briefly is as follows:

The first case of dermatitis developed in May, 1943, in a man operating a vinylite coating machine. This man had been operating the machine for about a month. The process consists of applying a jelly-like mixture of the vinylite resins dissolved in a solvent to cloth. The cloth then passes through a series of drying ovens where the solvent, chiefly methyl ethyl ketone is removed and later recovered. The dry coated fabric is then wound up on rolls.

The dermatitis in this individual was slow in responding to treatment, and it became necessary to remove the man from his regular job. It was soon discovered that he could not work in areas where there were solvent vapors without breaking out.

Nothing noteworthy developed between May and August except for a complaint by the men during the last week of July that the cleaning solvent (a mixture of ethyl acetate, ethyl alcohol and a small amount of methyl ethyl ketone) was stinging their hands. Early in August four new cases of dermatitis developed in coating department employees. The eruption appeared first as tiny blisters on the hands, arms, face and neck. The blisters developed into breaks in the skin and became red, raw, raised patches that itched unbearably, especially in a warm atmosphere. During August the man who had first developed dermatitis was deemed well enough to return to his regular job, but was assigned to pyroxylin coated fabrics rather than vinylite coated fabrics. Within two days his rash returned with such violence he had to be removed. (The vinylite coating operation and the pyroxylin coating operations are in the same area so that solvent vapors from the former could readily be inhaled by the man.) No new cases occurred during September but during October six new ones developed (Slide 3) and there was a sudden increase in November and December, the reason for which will be discussed later. The number of new cases fell off rapidly in January and February 1944, and no new cases developed subsequently. As you will note in Slide (3), 31 of the 39 cases occurred in the coating or finishing area and 26 occurred in the coating room. It was necessary to remove or transfer 12 men from their regular jobs. Fifteen of the men required treatment for 10 days or over and at least 9 of these men required treatment for 60 days or over.

An investigation into the cause of the dermatitis was begun in August 1943 and was shared by the plant physician, the plant control laboratory, and by representatives of the New York State Division of Industrial Hygiene. Later Dr. Louis Schwartz then Chief of the Dermatitis Section of the U. S. Public Health Service was consulted on the problem. For the sake of brevity I am going to outline the steps to be taken in investigating an outbreak of dermatitis and indicate the action that was taken in this particular one. (See Slide 4)

1. Fix clearly the locale and date of onset of the outbreak, whether it was gradual or rapid in development. Try to correlate the outbreak with changes in the manufacturing process, the substitutions or addition of new chemicals, or the possible inclusion of impurities formerly not present.

2. Obtain a list of the raw materials and chemicals used in the area and have the plant superintendent or someone qualified accompany you through the plant and explain each step of the process from the beginning to the end. Note the presence of gases or vapors in the atmosphere remembering that systemic absorption may play a part in the outbreak. Also note the method of handling materials and the cleanliness or lack of cleanliness of the operation and operators.

3. Examine all the men in the area as well as those affected and look for slight abnormalities that may be present around the hair folicles or sweat glands that might indicate the presence of irritation from a chemical. A complete examination will reveal the presence of any skin abnormalities some of which will undoubtedly not be of industrial origin.

4. After studying all the data available try and narrow down the list of possible chemical suspects to a few probable ones. It may be necessary to carry out patch tests to identify the offender. In which case it will be necessary to be sure the concentrations used will not irritate a normal skin if applied for 24 hours.

5. If the cause can be found, adequate steps are then taken to eliminate it from the picture if possible, or steps may be taken to prevent skin contact with the active compound.

1 - In this case the outbreak was gradual in onset, starting in May 1943 and reaching a peak in November and December of the same year. The causative agent was apparently centered in the vinylite process since thirty-one of the thirty nine cases occurred in the vinylite coating or finishing area. The coating process had been in operation about a year and a half although production had increased considerably in the few months preceding the outbreak.

2 - Although a report was prepared by the plant control laboratory in August listing the important compositions handled by the nine men who had developed dermatitis, no immediate use was made of this information since it was felt safe to continue using these ingredients on the basis of information obtained from the suppliers of the ingredients. However, six new cases developed in October and in November a protective hand cream was tried as a means of preventing the dermatitis. This proved ineffectual and the number of new cases jumped from the previous month's level of six to a new level of 14. This protective cream was much more alkaline than usual (Ph 10) due to a substitution of ingredients made necessary by war shortages. Subsequent investigation indicated the high alkalinity was probably responsible for the great increase in the number of cases during November and December. The rapid increase in the number of cases was a matter of concern to all and help was sought from various consultants.

Two isolated observations by the staff of the plant control laboratory turned out to be of prime importance and serve to emphasize our thesis that Team work is a very essential element in the solution of industrial medical problems, for these observations were the key to this particular one. Before the outbreak of dermatitis started, it had been observed that when operators in the vinylite process washed their hands with soap, a bright red color developed on the skin. A second pertinent observation was made in the laboratory during an investigation of the solvent recovery process.

In the distillation of recovered methyl ethyl ketone (the solvent used in the process), a fraction remained which proved to be biacetyl. The latter appeared to be building up slowly in the recovered methyl ethyl ketone as it was re-cycled in the coating process. It was shown that biacetyl plus protein plus alkali gives rise to a brilliant red color presumably due to the formation of xylo quinone (Slide 5).

Quinones are known to be highly irritant to the skin, causing erythema, papules and vesicles. R. Prosser White in his text on Industrial Dermatitis describes a brilliant red rash on his own arm as a result of contact with quinone. He did not remark on the possibility of part of the color being due to a dye formed in the skin.

After reviewing the data, it was apparent that the agent producing the dermatitis could act in either the liquid or vapor phase as dermatitis cases that had been removed from the process broke down again if exposed to vapors from the vinylite process. The agent appeared to be a sensitizer or else it was being absorbed in sufficient amount as to exceed the limits of tolerance of the body.

The possibility of biacetyl being the offender was tested in November when patch tests on a group of 15 persons from the supervisory and laboratory personnel were carried out by the plant physician. The results of the tests were as follows:

Liquid soap midly irritated all persons tested;

Granular soap midly irritate 7 out of 15.

Methyl ethyl ketone plus biacetyl followed by plant liquid soap caused a typical rash within 24 hours in one out of 15. Several others of the group showed a delayed reaction in 48 hours or more where the methyl ethyl ketone containing biacetyl had been applied.

Although a recommendation to remove biacetyl from the solvent was made in November 1943 this was not accomplished until the end of the first week in March of 1944 because of the quantity of solvent in storage and in circulation at the plant. In the meantime new cases continued to develop. A dermatologist was called in consultation in January 1944 and five of the men seen were approved to resume work in the coating department; in two days four of them had a recurrence and all five had to be taken out of the operation and kept out.

Both the workers and plant management became dissatisfied with the progress of the investigation and Dr. Louis Schwartz was consulted early in February of 1944. As a result of his survey and examination of the men, Dr. Schwartz agreed that methyl ethyl ketone or possibly the biacetyl in the recovered solvent was responsible for the outbreak. He recommended additional patch tests be performed with the following:

1 - Virgin methyl ethyl ketone.

2 - Methyl ethyl ketone as it comes through the recovery system.

3 - Methyl ethyl ketone to which 4% biacetyl had been added.

4 - Chemically pure biacetyl, and

5 - Methyl ethyl ketone from the solvent recovery that had been treated to remove biacetyl.

The results of these tests showed that biacetyl was the agent responsible for the dermatitis.

The following corrective measures were taken.

1 - Biacetyl was removed from the solvent.

2 - A neutral sulfonated oil (Ph 6) was substituted for the alkaline soap.

3 - Protective clothing was provided in certain cases and a bland lanolin cream used on the face and neck.

4 - Ventilation around the machines was improved and steps taken to stop unnecessary contamination of the atmosphere with solvent.

These corrective measures put an end to this outbreak of dermatitis.

In conclusion may I again emphasize the advantage of cooperation between various groups in a plant when a medical problem arises. In this instance the solution of the problem was not reached as rapidly as it should have been due in part to a failure to realize the serious nature of the dermatitis and in part to a failure to instigate corrective measures at the proper time.

In both instances cited the trouble was due to an impurity or by-product in the process. Even though the formation of these by-products could have been anticipated by the chemical group, Medical could not have foreseen the consequence due to a lack of information on the toxicity and physiological action of the by-products in question.

The health of the worker whether he be a laborer in a plant or a vice president in an office is the concern of the industrial physician. A good industrial health program is one based on preventive medicine. It is almost impossible to practice preventive medicine in a complex, chemical industry today unless the industrial physician, technical men, safety engineer and the toxicological laboratory work as a unit from the time a new process is conceived in the test tube until it becomes a full grown operation in a big plant.

cant effects on their well-being. These concentrations vary from material to material, - some being relatively very harmful and others being almost innocuous. Knowledge of the safe limits of the materials in question and how the amounts in the air can be measured is important to the engineer in addition to ways and means of reducing the concentrations.

Engineering measures for preventing the inhalation of excessively contaminated air have been discussed by many authors, and there are about as many different classifications of these methods as there are papers on the subject. The principles expounded, however, are always essentially the same. They may be divided conveniently into three main groups as follows, depending upon the avenue of approach:

1. Eliminating the sources of contamination or reducing the amount.
   a. Building and equipment design, alteration, and maintenance.
   b. Substitution of less -toxic materials.
   c. Process or operation changes.
   d. Housekeeping.

2. Prevention of contaminant dispersion.
   a. Segregation of hazardous processes.
   b. Enclosing the hazardous processes.
   c. Wet methods.
   d. Local exhaust ventilation.
   e. Equipment maintenance.
   f. Worker education.
   g. Housekeeping.

3. Protecting the worker.
   a. Equipment alteration.
   b. General ventilation.
   c. Respirators.
   d. Worker education.

The control of an atmospheric health hazard is rarely accomplished by a single measure; it usually involves the use of a combination of methods.

ELIMINATING THE SOURCE OF CONTAMINATION. Obviously, the most successful approach to the problem of industrial atmospheric sanitation lies in <u>the design or alteration of plant and equipment</u> so that the control features are engineered into the structure and machinery. Factories constructed without due consideration to keeping the air clean, and existing plants, preclude the most efficient use of engineering-control knowledge. Much control equipment, installed on "unprepared" machinery even if carefully planned, is makeshift at best and has all the features of the proverbial "sore thumb". Probably the most important single avenue to better atmospheric sanitation lies in the education of the industrial equipment and machinery manufacturers so that at least the basic elements of control equipment are included as an integral part of each machine which is known to produce or disperse dusts, fumes, smokes, mists, gases, or vapors. Some action in this connection is in progress, but the surface is only being scratched. Some new plants are being laid out with the atmospheric-sanitation problem in mind. Also a few industries which are undertaking industrial hygiene on a long-term basis are slowly mechanizing and modernizing their existing plants to increase production, eliminate arduous labor, and reduce atmos-

"CONTROL OF ENVIRONMENTAL INDUSTRIAL HEALTH HAZARDS"

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The health hazards in industry which, if uncontrolled, may cause occupational illnesses and discomfort, are many and varied. The more common ones may be divided conveniently into seven groups as follows:

1. Atmospheric contaminants (Dusts, fumes, mists, gases, vapors and smokes).
2. Heat, cold, high humidity and rapid temperature changes.
3. Radiant energy other than heat.
4. Faulty illumination.
5. Noise.
6. Unsanitary conditions.
7. Fatigue.

All of these factors are capable of control by sound engineering to such degree as to render them innocuous to the industrial worker. It follows then that engineering is the first line of defense in the control of ill health and discomfort in industry.

Fortunately for the engineering profession, the human being is a miraculous organism and can stand considerable mistreatment without showing illness or even discomfort. For this reason, noise, radiant energy, atmospheric contaminants, fatigue, etc., need not be completely eliminated, they need merely be controlled within certain limits. These limits have been fairly well defined for most of the factors included in the foregoing list, and serve as bench marks for the engineers.

Of the groups listed in the first paragraph, atmospheric contaminants constitute the most important one. Because of its importance and the keen interest taken by labor and management alike in it, the engineering control of industrial atmospheric sanitation will be discussed in detail. No further reference will be made to the other health hazards, not because they are unimportant, but because of time limitations.

ENGINEERING CONTROL OF ATMOSPHERIC CONTAMINANTS

The objective in controlling dusts, fumes, mists, smokes, gases and vapors is to prevent the amount in the air breathed by the workers from exceeding safe limits commonly called maximum allowable concentrations. They are not truly maximum allowable concentrations, but are the amounts which all but the unusually susceptible workers can endure day in and day out without producing signifipheric pollution. Fully as important as the original design of any piece of equipment is its maintenance. Deterioration, wear, corrosion, abrasion, and shock result in inefficient operation unless maintenance is good. In the smaller industry, maintenance is too frequently left to the user of the equipment. This is not a satisfactory procedure. All maintenance work should be made the responsibility of one man or one department.

A very effective method of control is the substitution of nontoxic for toxic materials. The application of this method is very limited in scope because of the basic requirements on which materials are usually selected. It should however, always receive due consideration since it is both effective and usually inexpensive. Yet, for this very reason, the engineer or chemist must guard against overdoing substitution. It is generally agreed that any material, be it ever so harmful, can be handled safely if properly engineered. This feeling has been verified in practice by the experience of the atomic-bomb plants and the military explosives manufacturing and loading plants. As substitution of less-toxic materials frequently runs counter to quality control in production it must be recommended with caution, particularly since other methods are available for the adequate control of hazards. Examples of successful substitution of less-toxic materials are the substitution of steel grit for sand in abrasive blasting; artificial abrasive grinding and polishing wheels for sandstone wheels; nonsilica parting compounds for siliceous compounds in foundries; petroleum naphtha or toluol for benzol in the lacquer, ink, and rubber cement industries; Stoddard solvent for carbon tetrachloride in dry cleaning (special equipment is usually required to comply with fire regulations); quartz-free or low-quartz minerals for sand under mine locomotives; and relatively insoluble lead compounds for lead oxide in paints and ceramic glazes.

A change in the process can sometimes be used to eliminate or control a health hazard. Such change frequently involves major changes in other parts of the production line, and this control measure is therefore very limited in scope. Examples are controlling the temperature and speed of chemical reactions so that the rate of mist, gas, or vapor production is decreased; welding, crimping, riveting, or otherwise joining to eliminate soldering operations; and changing from manual batch charging to machine and hopper charging.

More can be done by good housekeeping to eliminate sources of contamination, particularly dusts and fumes, than is commonly realized. In dusty industries or workrooms where dust is continuously settling on all surfaces which approach the horizontal, and collecting on vertical surfaces, good housekeeping in the form of vacuum cleaning, wet washing, and sometimes brushing prevents the material from being redispersed into the air. The amount of dustiness which is contributed to the air of dusty industries by the continual redissemination of the settled material is sometimes more than 50% of the total dust concentration. Yet this dust can be prevented from getting into the air very readily by constant cleaning. Painting the walls a light color, improving the illumination, and oiling or wetting the floors are effective in promoting good housekeeping. While good housekeeping alone is seldom sufficient to control existing hazards, experience has shown that the housekeeping in most plants is a good index of the industrial hygiene program.

PREVENTION OF CONTAMINANT DISPERSON. Many industries have operations which produce considerable atmospheric contamination but which require the immediat attention of only a relatively small number of workers. If located indiscriminately throughout the plant or if conducted at certain times, such operations may expose many other workers to a needless amount of atmospheric contamination. By segregating or isolating these operations, only those few workers engaged there will be exposed to the hazard, and they may be protected by means of respirators. Also the segregation or bunching of hazardous operations aids materially in the effective application of local exhaust ventilation or other control measures. The usefulness of this measure is so obvious that examples are scarcely needed. Blasting in mines at the end of the shift so that the gases and dusts will have settled or dissipated by the time the workers return, sweeping and cleaning at night when other workers are not on the job, shaking out foundry castings at night when most workers are off the job, and locating the plating or degreasing tanks in separate rooms are common examples.

Enclosing an operation might be considered an extreme form of isolation. The contaminant or contaminated air is prevented from reaching the breathing zone of any workers except in rare instance when one or two men may be exposed within the enclosure. It is superior to segregation or isolation since it acts nearer the source of contamination. In one instance the simple expedient of attaching a loose cover for the containers being filled to the end of a canvas discharge chute from a gyratory screen reduced the dust concentration in the screen room by well over 50%. In another instance a toxic and highly explosive material was transferred from 50- to 5-lb. containers in a complete enclosure. The large cans were mounted on a frame in the top of a home-made enclosing device, and after closing the door the contents were dropped into a hopper by rotating the handle. Measured quantities were then dropped into small cans through a dust-tight corrugated hose. Two slide gates served to close and open the top and bottom of the measuring device. Hence by closing the lower gate and opening the upper one the material from the hopper filled the section between the slides which served as the measuring device. By closing the upper slide and opening the lower one the measured quantity of material was charged into the small container. This arrangement reduced the atmospheric concentration of the toxic material from a harmful level to almost nothing. Process enclosure has been found particularly successful at abrasive-blasting operations, such as barrel and cabinet types of equipment which operate on the batch basis. The equipment is closed tight during the cleaning operation and is open only for charging and discharging after the abrasive blasting has been discontinued. This method of control does not find wide application except in conjunction with local exhaust ventillation which will be discussed later.

Wetting dust with water or other liquids is probably the oldest method of control. It was practiced in the pottery industry in Great Britain as early as 1713. Wet drilling and water sprays have been widely employed in mining operations in recent years. The use of water sprays in quarrying operations also has been reported recently. Substantial reductions in the dust concentration have been reported as wet-grinding operations, and as wet-drilling operations in mining, but even then the atmospheric concentrations were still greatly in excess of the maximum allowable concentration. The effectiveness of wet methods for dust control depends upon two factors—wetting the dust, and proper disposal of the wetted dust. Some dusts are hard to wet and unless wetted will not be captured. Even if the dust is wetted satisfactorily, it is necessary to collect and dispose of the wetted material before the liquid evaporates and the dust is again redispersed by air currents, walking, or blasting. In certain mines, for example, the dust from the wet-drilling operations settles out as the water flows away, and collects also as water droplets on the walls from where it is readily redispersed. Even though wetting of the dust must be recommended with discretion, it has been found an effective dust control aid in rock drilling, blasting, crushing, screening, materials transfer, foundry shakeout, core knockout, and abrasive blasting, and the addition of moisture to molding sand decreases greatly any amount of dust produced while making molds.

Local exhaust ventilation is probably the most important single method of preventing industrial atmospheric pollution. Yet the principles involved and the bases for adequate design are so poorly understood that a large percentage of the installations made in recent years are unsatisfactory or inefficient. The design of good local exhaust systems is a specialty requiring knowledge not normally possessed by any engineering group including ventilating engineers, unless they have received special training in this field. This is neither the time nor the place, however, to discuss the details of this most important subject; they have been covered adequately elsewhere. 1,2,3. Suffice it to mention briefly the method of operation and to cite a few examples of operations at which local exhaust systems are used.

Local exhaust systems function by removing the contaminant or grossly contaminated air as close as practicable to the point where it is released or generated. This is done by producing air currents in the area of contaminant escape of such direction and magnitude as to carry the highly contaminated air into the exhaust hood which is located as close as possible to, or around, the source of contamination. The more nearly the hood encloses the source of contamination, or the closer it can be located to the source of contamination, the smaller will be the required exhaust rate to capture the contaminant effectively. Hood shape and location are of the utmost importance and deserve considerable study and head-scratching on the part of the designer. In addition to the hood, a local exhaust system includes piping or ductwork, an exhauster (usually a centrifugal fan), and usually a collector. The contaminated air is moved through the piping to the collector and the filtered air is then discharged to the outside of the exhauster. The design of the hood and piping, and the selection of collectors and exhausters are complete studies in themselves and will not be covered here.

Examples of the satisfactory use of local exhaust systems are numerous. Some are welding; granite surfacing; pickling and plating tanks; wood working equipment; grinders; buffers and polishers; and spray painting booths.

Like all other types of equipment, that employed to control health hazards requires constant checking and maintenance. It should be included with other equipment in the cleaning and maintenance schedule. Dust collectors, fans and in many instances ductwork require periodic cleaning to obtain satisfactory operation. Bent hoods and leaky or damaged ductwork and enclosures should be repaired promptly. Blast gates and dampers, if used, should be locked in position, but even then they need constant watching to see that the setting is not altered by the workers and the balance of the system thereby disturbed. Only too frequently management invests substantial capital in good control equipment and then either through complacency or lack of understanding proceeds to forget all about it until faced with a case or epidemic of occupational illnesses. The answer, and the only way to protect their investment, is periodic checking and maintenance just as is done with production equipment.

Very few if any measures or installations for the control of atmospheric pollution are foolproof. Much depends on the attitude of the worker. A cooperative, interested, and well-trained worker can accomplish much with any control equipment, whereas the indifferent, lackadaisical, untrained worker produces the maximum amount of atmospheric contamination with any control device. The solution lies in the education of the worker. This is an unending task and becomes very discouraging if labor turnover is high. Nevertheless it is the key to the really successful operation of atmospheric sanitation equipment. As a rule the labor turnover will be much less if the working conditions are good. Therefore, proper education of the worker is the first step in a chain of events which lead to a satisfactory educational program. To be successful the education of the worker must begin the day he is employed. If he is permitted to begin his work without proper instruction in the performance of his tasks he will form faulty habits of operation which require much effort to undo. On the other hand the educational program must not cease as soon as the worker has been trained in the correct procedure of doing his job. It must be continued throughout his period of employment to keep him on his toes and to prevent him from falling into a faulty routine. Examples of what can be accomplished in atmospheric sanitation by worker education are unnecessary—they are quite obvious. Any operation (whether it be provided with control equipment or not) which produces or releases an atmospheric contaminant can be done, and should be done, in a manner which results in the escape of as little material as possible into the workroom air.

Good housekeeping will serve to prevent the dispersion of atmospheric contaminants. However, it is considerably more important in eliminating sources of contamination and was discussed previously in that connection.

PROTECTING THE WORKER. Most industrial machinery or equipment which produces or releases harmful contaminants can be engineered either in the original design or by alteration of existing installations to decrease the worker's exposure. In many instances, however, the reduction of exposure is not sufficient to eliminate the hazard, and other control measures are needed. Yet there are some operations where the principle may be applied to render the worker's exposure harmless. Examples are the use of mirrors and/or extensions on operating handles to permit the worker to stand clear of the escaping contaminant; arranging all hot processes so that the operator stands beside rather than above the process; and locating a fan diagonally to the rear and to the side of the worker to blow the relatively clean workroom air through his breathing zone and to carry the highly concentrated contaminant from the operation he is doing away from him, or locating the terminal of a supply duct between the operator and the source of contamination to blow the contaminated air away.

General ventilation is second in importance only to local exhaust ventilation. It is particularly well adapted to certain contaminants and to certain sources of contamination and is unsatisfactory for others. Unlike local exhaust ventilation, it does not prevent the contaminant from escaping into the general workroom air, it merely dilutes the contaminated air of a given room or building with sufficient clean air to keep the concentration of contaminant in the room air from building up to a harmful level. Like local exhaust ventilation, general ventilation is misused a great deal by people who do not understand the fundamental principles of contaminant control. Major sources of contamination, especially if near to workers, cannot be controlled effectively by general ventilation; the dilution rate required to effect a safe concentration in the workers' breathing zones is so great as to be prohibitive. Minor and scattered sources of relatively harmless contaminants, on the other hand, may be controlled effectively and economically by general ventilation.

The subject of atmospheric sanitation through general ventilation is a very large and complex one. For further information on it, the reader is referred to treatises on the subject of which there are many. 1,4,5

Respiratory protective devices have a distinct place in the field of occupational disease control. That they are a last line of defense can hardly be denied. Nevertheless, where they should be used, how they should be selected, and how they should be used and maintained is not understood adequately by some of the people whose responsibility it is to select them and supervise their use and care. Each and everyone assigned this responsibility should study some of the literature on this subject. 1,6,7,8 Examples of places where respirators may be used satisfactorily are spray painting; abrasive blasting; cutting metal coated with lead paints by means of oxyacetylene torches; welding; handling dusty materials, clean-out operations; shaking out operations in foundries; and housekeeping or other cleaning and sweeping.

The education of the worker for his protection is fully as important as to prevent the creation of unnecessary dust, fumes, mist, gases, or vapors. He must be told which contaminants are harmful and sold on the idea of avoiding the higher concentrations. Careful and continuous education is necessary to get workers in the habit of standing upwind of all operations which produce or release considerable material, such as spray painting, welding, cleanout and other maintenance operations, and handling bulk materials; also to keep his face as far from the point of operation as possible, or out of the line of throw or movement of the contaminant.

EXAMPLES OF RESULTS OBTAINED

In conclusion, I should like to cite one or two examples of the results achieved in decreasing occupational diseases through engineering. After all, "the proof of the pudding is in the eating."

In the gold mines of South Africa, dust concentrations averaged about 150 mg/m^3 before a program of control was begun and the reported incidence of miners phthisis was about 30%. About 7 years after the dust control program was started the atmospheric dust level had been reduced to about 5 mg/m^3. The incidence of miners phthisis began falling about 9 years after the dust control program was started and reached a level of about 2% approximately 7 years after the dust level had been reduced to 5 mg/m^3. In this instance, the incidence of illness had been reduced from about 30% to 2% by reducing the atmospheric dust content from 150 mg/m^3 to 5 mg/m^3. 9

An effective industrial hygiene program was launched in the Government-owned explosives manufacturing and loading plants late in 1942,—about one year after Pearl Harbor. The atmospheric concentrations of TNT were on the ascent at that time and continued to increase until about April 1943 when they began to decline, the decline continuing until the close of the war. Periodic medical reports from these plants show that the incidence of lost-time cases because of TNT poisoning, of mild TNT poisoning cases, and of medical transfers from TNT exposure parallel the atmospheric dust and fume levels very closely. The figures in this instance are somewhat as follows. The peak concentration of TNT was about 2.7 mg/m^3 in April 1943 and the peak incidences of lost-time, mild, and medical transfer cases were about 21, 640, and 450, respectively, in terms of cases per thousand man years of exposed employees. The peaks of the cases occurred about July 1943. By the end of 1944 the average atmospheric TNT concentration had been reduced to about 1.0 mg/m^3 and the corresponding incidences of TNT cases were 1, 80, and 85. 10 Engineering measures alone, of course, were not responsible for this entire reduction. The personal hygiene program, and the periodic medical examinations contributed substantially.

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Mr. J. Barry York, Master of Ceremonies, introduced the guest speaker of the Industrial Health Banquet, October 6, 7 P. M., at the Rice Hotel.

"INDUSTRIAL MEDICINE IN AN ATOMIC ERA"

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The linking of the concepts "Industrial Medicine" and "Atomic Energy", as in the subject of this talk, is most appropriate. From the very beginning, in visualizing the development of an atomic energy program, it was recognized that the protection of the health of the personnel must be a primary consideration, and an extremely difficult undertaking. There can be no doubt but that the successful accomplishment of the object of the Manhattan project - the atomic bomb - would not have been possible without the imaginative and resourceful efforts of the radiologists and physicists in controlling the radiation hazards. The further progress of atomic energy under the Atomic Energy Commission in expanding and improving the military applications, and we hope, of greater import for humanity, the development of non-military uses such as power, medical, and industrial purposes is predicated upon the continued, inseparable aid of industrial medicine. The effects are not in such a single direction, however, as the description thus far would imply. The broader aspects of industrial medicine - in presently and apparently unrelated fields - cannot help but feel the impact of atomic energy, and of the essential and closely-knit pattern of cooperation established for the research, production and health activities in this new endeavor.

The growth of industrial medicine to its well established place in our industrial structure does not, I am sure, need retelling. Even the more recent phase, of adapting it to the Atomic Energy Industry has been repeatedly and well described in papers by individuals who were associated with the earlier periods of its development, in the Smyth Report, and in the Semiannual Reports of the Atomic Energy Commission. The latest of these AEC Reports, the Sixth Semiannual Report, is the most comprehensive exposition of the relation of Atomic Energy to Biology and Medicine thus far recorded. We may profit, however, in the examination of those aspects of the relationship which may have a counterpart in our present or future industrial experience. In addition, we may consider what advances in atomic energy are likely, and what applications may be made to industrial processes in order to anticipate and control the hazards which are an inevitable consequence. The military applications of atomic energy, though of the greatest importance to us, will properly be a subject for presentation when civil defense information is ready for release.

Of the various phases of the industrial medical experience in the atomic energy industry, that dealing with the control of environmental hazards, commonly known as industrial hygiene, stands out strikingly. In fact, so prominent and so important was this program for preventing radiation injury that its identity with the term "industrial hygiene" was almost lost, and the new and highly technical personnel employed in evaluating and regulating radiation effects coined a new name for their discipline - "health physics". That such a distinction is arbitrary is readily seen in considering the physiological effects of uranium compounds. Here, with the insoluble uranium salts, the radiation effect upon the lung from retained uranium is the limiting factor in setting up a permissible exposure level, while with soluble uranium, the potential chemical injury to the kidney determines the maximum allowable concentration.

This emphasis upon the control of the environmental factors has obscured the other aspects of good industrial medical practice which have been an essential part of many of the operating units on the project. Notable among these was the early and continuing experimentation with psychiatry in solving problems of employees. Although most of the examples which will be used in this talk have been taken from the industrial hygiene - or health physics experiences, it should not be implied that this phase is the sole - or even the most important- activity in industrial medicine.

In studying the experiences, the results may be qualified as successes or failures - or much more commonly will defy such present classification. In this latter, and numerically greater category, must be placed the many cases where only time and continued careful investigation will permit a final classifying. In the majority of instances it will not be difficult to extrapolate from these atomic energy project experiences to those of other types of industry. The conditions will vary - the urgency of the early days of the Manhattan project will not characterize the peacetime industrial development. But this is somewhat balanced by the relatively generous funds available then for research and health controls.

Among the notable successes, that of the control of radiation is exemplary. With an exposure to quantities of radiation far greater than previously imagined possible, a control program was developed and applied so effectively that thousands of employees worked safely and comfortably in their daily routine. Lest those of us whose identity with industrial medicine antedates this atomic era be given credit by default, it should be emphasized that this accomplishment was largely due to individuals with little or no previous experience with industry. They were the radiologists and physicists, called in because of their special technical knowledge. On many occasions, when they were overwhelmed by the magnitude of the control program which was visualized as necessary, they sought the support and comfort of physicians who had experience with such industrial conditions. The fact stands out, however, that with the opportunity, many of our associates in other fields are capable of transformation into industrial physicians and industrial hygienists and may give a most creditable performance. We should not only welcome their contributions, but should encourage them to further our common interest.

So well was the job performed in estimating the hazard and in controlling the exposures to radiation that no single instance of radiation injury has occured in the routine performance of the job. The remarkably few cases where injurious effects were sustained happened as "accidents" through failure of protective equipment or errors in judgment. The experience at Hanford, the plutonium manufacturing plant with its great reactors, emphasizes the good record. In the past 50 years, the span of our knowledge of radioactivity, only a few pounds of radium have been isolated. Yet one of these piles - or reactors - generates radiation equivalent to hundreds of tons of radium. In 1945 the average exposure of all workers at Hanford was 0.9 of a roentgen; in 1948 it was only a third of this value. The average of the ten workmen with the greatest exposures in any one year was only 2 roentgens. This is only one seventh of the conservative annual permissible dose, that is, the amount of radiation which is considered safe yearly throughout the lifetime of an individual.

Such a record was not easily or cheaply arrived at. Ingenious, elaborate and expensive remote control equipment had to be devised and installed. A rigid program of monitoring every operation involving radiation and of every exposed individual had to be enforced. The results, however, are much greater than the mere saving of compensation awards. They are reflected in the confidence of the employee, in his security that he can do his job well and safely. It is difficult to define this in dollars and cents, but it is an unequivocal and real asset, repeatedly proved in industrial experience.

Not infrequently, we do not have as much information in approaching the evaluation and control of an environmental hazard as was the case with radiation. Then it is necessary to weigh the scanty information, arrive at as good an estimate as possible, - and apply a clinical program for detecting the earliest possible signs of injury, if any. The risk is greater, and particularly if long term effects cannot be predicted from the results of relatively high short term exposures, a considerable burden of exposed individuals may cumulate by the time the first injury is recognized. This procedure is not an acceptable substitute for a careful and exhaustive animal research program where such is possible. Sometimes, good fortune attends this method - as in the case of the uranium experience - but there are sufficient unfortuante examples in the annals of industrial experience to emphasize the dangers.

In the latter part of 1942, when it became apparent that many tons of uranium must be mined, refined, chemically processed, and machined, and the program begun immediately, the only information available concerning its toxicity were a few limited studies in animals. These indicated that uranium, particularly uranyl nitrate, was capable of producing severe injury to the tubules of the kidney. It was recognized that plant operations, involving hundreds or even thousands of individuals would have to be planned for, and that even though an animal research program was begun immediately, large numbers of employees would have been at work with the material for many months before the results of the experiments could be made available. Scanty and unconvincing information of the testimonial type revealed no injurious effects among the relatively few workmen employed in the handling of uranium for the preatomic age uses such as chemical reagents and pottery pigments. A hurried study of several hundred individuals in the pilot plant of the electromagnetic separation process at the University of California Radiation Laboratory did not indicate any harmful effects from appreciable uranium exposures of from a few weeks to over a year's duration.

With this limited background, plant operations were planned, and serial studies of the exposed personnel begun. At first, with operating procedures changing almost daily, and with the lag between such changes and the time required to modify or install new control equipment, the exposures were to concentrations higher than the initial "best guess" value. Later it was possible to reduce the exposures considerably below this original proposed limit. With so little information to help in establishing a criterion, the element of good fortune must have aided materially, for there has not been a single case of uranium intoxication. The few instances of severe pulmonary irritation following accidental inhalation of uranium hexaflouride, a highly volatile, markedly irritating compound, cannot properly be classed as "uranium poisoning".

It is interesting - and not unusual in industrial medical experience - that in one plant where the original emphasis was on the hazard from one material (in this case uranium), an unwanted by-product created the greater injury and the more difficult control problem. In the reaction producing uranium tetrachloride, phosgene was given off to the amount of several tons a day. Initially, the reaction was one of high temperatures and pressures, and the escape of this very toxic gas almost a daily occurrence. On one occasion a minor epidemic of pulmonary irritation occurred in a building some hundreds of feet away from the chemical area, when escaping phosgene,channelled in peculiarly favorable meteorological conditions, entered a fresh air intake to be distributed through the ventilation system. The solution to the phosgene problem came not from the Medical Department (unless the persistent and resented prodding by it could be interpreted as the major stimulus) but from the process improvement engineers who substituted a vapor phase - atmospheric pressure reaction for the earlier procedure. As sometimes happens, the substituted process turned out to be much more efficient, but no part of the saving was credited to the Medical Department budget!

The final example which is cited as worthy of study is not as pleasant as the radiation of uranium stories. In the past few years it has become a familiar one to many of you, but merits retelling, at least in part. It has to do with beryllium, a substance of value in nuclear energy studies since it emits neutrons when bombarded with alpha particles. Beryllium was processed prior to the war as an alloy material, as a coating for flurescent lamps, and as a special refractory substance, but the demands of the atomic energy program greatly increased production. Attention was focused on the problem when in 1943 workmen in plants processing beryllium developed pulmonary injury, a few cases fatal. Dermatitis among the workers was a disturbing but rarely serious finding. As the story evolved, and the number of fatal cases increased, there were perplexing factors, and many competent investigators were reluctant to accept beryllium as the important causative agent. In the first place, there was difficulty in relating the acute form of the pulmonary disease to the chronic form. The chronic disease developed frequently only after some years of exposure, and in certain cases, several years after the termination of exposure. The fact that only a small percent of the workmen in a given plant developed the disease did not seem to correlate with the degree of exposure nor with any identifiable physical characteristic. Finally, "neighborhood" cases of the disease were discovered, - people living in the community who did not work at the plant, and who resided some blocks distant from it. The concentrations of beryllium to which these "neighbor" cases responded were considerably below the average plant levels, and yet the majority of the workmen so exposed did not develop the disease. Experimental studies on animals were begun, and although pulmonary injury was produced, it lacked certain aspects of the process in man. Thus far, therapy has been symptomatic only, and not too successful.

It is just this sort of occurrence, where the consideration of the material would not reasonably suggest the kind or severity of the injury, and where limited animal studies would not anticipate the degree of physiological damage, that causes the industrial toxicologist to be most conservative in his evaluation of a new substance. With the introduction of new compounds in constantly increasing numbers and even with greatly expanded facilities for detecting the harmful properties, it is unlikely that all of the hazardous materials will be identified so as to prevent injury to the workmen exposed in their manufacture and use.

With the most efficient program, there will be some failures. Without such prior experimental investigation, there will be many unfortunate occurrences, - inexcusable in our present stage of industrial medical development. A most essential adjunct to the experimental studies is examination of exposed workers. This will permit the identification of untoward effects at the earliest, and so limit injury to other workmen. In such a program the ratio of negative examinations to positive ones will be very high, but the overall result will more than justify the method.

Thus far the discussion has dealt largely with the application of industrial medicine to the atomic energy industry. Let us examine some of the effects of the development of atomic energy on industrial medicine in general.

It is very likely that atomic reactors will be adapted as practical sources of power and in the not too distant future. There are, however, many obstacles to be overcome. One of the major problems is in the medical field, - that of controlling the radiation exposure, - not only to workmen employed on such a unit, but to the surrounding community from the inevitable radioactive waste products of the reactor operation. The investigation is proceding in several directions, with stationary and movable reactors, and "breeder" piles which may make the essential fuel more rapidly than they consume it. This research program will require more trained health protection personnel than are immediately available, but when reactors are more widely in use, far greater numbers of physicians and hygienists, with this specialized knowledge and training will be needed. A training program must be developed to meet this demand. Industrial physicians and industrial hygienists presently responsible for the care of the employees in the power industry must eventually extend their horizons to include this new sphere of activity.

Many phases of the reactor program - the study of new metals, of radiation effects on supporting materials, of heat transfer media which must meet presently untried temperatures, of shielding devices, of handling and disposing of unwanted fission products, - will require the cooperative efforts of research and production units outside of the central atomic energy plants, - and many of the industries which you represent will be called on to contribute. These problems will be your problems, and in many instances, the burden of finding a solution will fall directly upon your shoulders.

Another product of the atomic era has already become a part of your industrial or research experience. This is the use of radioisotopes. The varied uses thus far made in process control are only a beginning. They include such diverse application as the control of the proportion of an alloying element in the manufacture of special steels; the measurement of the wearing qualities of moving parts, such as piston rings, by tagging the wearing surface and determining the radioactivity in the lubricating oil; the rates and efficiencies of a fractionation column, as in the separation of petroleum fractions; the control of the deposition of a chemical coating on the surface of fabrics where the accuracy of a thin layer is essential.

The employment of these tagged elements in chemical and physical research is rapidly increasing, - and in the shipments of radioisotopes to industrial, university, and independent research institutions are now numbered in the hundreds. From the viewpoint of health protection, these laboratory applications are most important. The technical personnel involved, with their major interest focused on the results of the experiment, will need to be guided constantly and firmly in the safe handling of these highly dangerous radioactive substances. For example, serious or even fatal results have occurred from the absorption and retention in the body of long-lived alpha emitters such as radium in amounts as small as 1.5 to 2 micrograms - one twenty millionth of an ounce. A whole new discipline has been built up for the safe control of hazards in this new branch - radiochemistry, and this must be mastered and applied.

The use of radioisotopes in the attack on industrial toxicological problems has already yielded valuable results. For example,antedating the atomic energy program, radiophosphorus obtained from a cyclotron source was instrumental in proving an appreciable absorption through the intact palmar skin of triorthocresyl phosphate synthesized from the radioisotope. This had a very practical value in justifying an expenditure of some thousands of dollars to protect a group of employees who might have been subjected to a considerable and daily skin exposure. In this instance, without the use of the radioisotope, such clearly defined results would not have been possible.

Again, radioisotopes have been used to follow the transport, deposition and excretion of such elements as lead, beryllium, uranium, plutonium, and a variety of elemental forms for which our ordinary chemical analyses either lack specificity or acuity. The behavior of certain toxins is qualitatively different at varying levels of absorption, but because our analytical techniques frequently have been limited at the lower end of the range, our knowledge has been confined to effects at the higher concentrations.

A novel property of radioactive elements, of being able to produce a record on photographic film,permits their anatomical localization. These autoradiographic techniques have been successfully applied to the whole animal, the organ, or by microscopic methods to the cell, or even a specific part of a cell. Films which are sensitive to and distinguish various types and energies of radiation have added immeasurably to the value of this discriminating tool.

Many other applications of radiation have been and will be made. For example, radiocobalt can be made available at a fraction of the cost of radium, and may well substitute as a source in industrial radiography. Since the metal can be fabricated prior to irradiation without difficulty, special shapes and dimensions may be easily achieved. Unfortunately, the lower monetary value may lead to less responsible accounting for the equally hazardous radioactive sources.

Metal bars, upon which have been coated layers of radium or polonium have been introduced as anti-static devices. The radiation, produces intense ionization of the air, and the prevention of troublesome static effects by discharging the charged surfaces of such objects as papers and transparent sheetings, and so permitting them to stack properly. Recent investigations have indicated that there may be a considerably greater hazard from these devices than was first judged.

Xrays and sources of beta radiation are being used to measure and record the

17936

thicknesses of films of such diverse materials as paper and steel. The apparatus is adjusted so that slight variations in the density of the measured film will vary the amount of penetrating radiation which impinges upon a photocell. The response of the latter is indicated by a change in the current passing thru the cell and this suitably amplified may be recorded, or can be connected with automatic controls for regulating the film producing equipment. Radiography of industrial products to determine possible flaws is a standard procedure. The possibilities for injury to employees in this techinque are very real. Already a number of serious xray burns have resulted from improper and careless use of such equipment.

These few observations may help you to become oriented with respect to those phases of atomic energy which you may reasonably expect to meet in the near future. The patterns employed in solving industrial health problems in the atomic energy industry are no different than those in daily use in other industrial fields. The fact that the program for preventing radiation injury was developed largely in secret and then presented full-blown, that the subject matter of nuclear physics is involved and foreign to most of us, and that there was no immediate need for handling radiation problems outside of the atomic energy field - all of these factors have effectively deterred industrial physicians, industrial hygienists, and safety engineers from taking an active and serious interest in this type of industrial health problem. We are approaching a time, in fact we are already there for many of you, when further avoidance of these specialized health problems associated with atomic energy is no longer advisable or possible. The majority of the plants not involved in a full time capacity for the Atomic Energy Commission cannot afford a "health physicist" for the handling of their minor radiation problems. Neither, we should hasten to add, can they afford to assign the responsibility for these problems to individuals who have not acquired the necessary knowledge and training. The obvious and proper compromise is to give industrial physicians, hygienists, safety engineers, and nurses sufficient understanding and training to permit them to solve the type of problem which they will encounter, whether it be radiation, beryllium, or presently unknown materials.

We have cited some examples of the application of industrial medicine to atomic energy problems. The essential and inextricable character of this realtionship generally will be admitted. We have noted the extension of the products of atomic energy into more common industrial activities. We find, among industrial health and safety personnel, an increasing awareness of the problems but a considerable uncertainty as to the manner of solving them. The number of individuals properly trained to handle these specialized problems is inadequate, and for some time, at least the demand for such persons will greatly exceed the supply. The immediate and obvious solution is in further training of the industrial medical and safety forces now working in industry. It will be difficult to supply such training because of the widely varied needs. Nor will the job be easy for those of you who elect to enter this field. The situation must be met, however, if we are to safeguard the comfort, health, and lives of our industrial population.

Dr. Carl A. Nau, Presiding

"THE EMPLOYERS' LIABILITY FOR OCCUPATIONAL DISEASES"

J. Dewey Dorsett, General Manager
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New York City, N. Y.
October 7

The keynote speaker yesterday emphasized the value to industry of sound industrial hygiene programs. Some employers have approached this question by inquiring how much will it cost to institute such a program. At the same time, they may not have realized what the cost of not having such a program is, and whether they can afford to be without it. A substantial part of such cost is the amount an employer must pay to provide compensation to employees, or possibly to satisfy judgments in acrions at law, in case of impairment of health due to the employment. It is to the legal phases of this question that I am going to address my remarks.

In 1947 the Workmen's Compensation Law of the State of Texas was amended to provide compensation for occupational diseases listed in a schedule, the hazards of which are present in the state. Prior to that time, no compensation was payable for occupational diseases contracted in the employment unless the employee could show that the contraction of the disease constituted an accident. As far as liability for damages at law is concerned, the Texas courts have held that acceptance of the Workmen's Compensation Law by the employee constituted a waiver of the right to bring such an action at law against the employer.[1] In one decision the court went further and stated that there was no right of action at common law for occupational diseases.[2] The latter is the view held by some of the other state courts as well, but in many states today such right of action is recognized based either on common law principles or upon violation of some statutory duty.

Recovery of damages through an action at law being barred, numerous attempts, often successful, have been made to obtain compensation for disability due to a disease, which should properly be classed as occupational, on the ground that the same came within the provisions of the Texas Workmen's Compensation Law. This law does not specifically refer to injuries by accident or accidental injuries but the courts have so construed the act.[3] However, they have been quite liberal in determining what constitutes an accident. For example, in the case of Travelers Insurance Company vs. Noble,[4] we find compensation being awarded for lead poisoning. Emphasis in this decision was placed on the fact that on a specific day, when an air hose became disconnected, the claimant inhaled unusual amounts of powdered lead. It is very likely nonetheless that previous exposures at least contributed to his condition. Compensation has also been awarded for anthrax[5] and dermatitis,[6] but in all these cases the claimant attempted to attribute his condition to a specific event. To a large extent, the courts have followed the findings of juries in this respect, even though the question whether specific facts constitute an accident or a disease would seem to be a matter of law rather than one of fact.

On the other hand, we find compensation being denied for eczema and injury to the lungs allegedly due to exposure to cement dust over a period of two years.[7] Likewise, the court on appeal reversed the judgment below in favor of the claimant for TNT poisoning, on the ground that the lower court did not clearly explain to the jury the difference between an accidental injury and an occupational disease.[8]

Attempt has also been made to show that the injury was accidental because it was due to the negligence of the employer and was, therefore, unexpected. However, the courts finally rejected this theory and held that the right to compensation in such cases does not depend on the issue of negligence.[9] Since it is a fundamental principle of workmen's compensation that benefits are payable regardless of fault, it would have been most unfortunate if this issue had to be considered in every claim involving disease.

Incidentally, I have heard representatives of industry state that they were not particularly interested in occupational diseases since the hazards of such diseases were not present in their business. In one of the cases in which the issue of negligence was raised, claim was made for tuberculosis allegedly due to the inhalation of dust while unpacking boxes in the receiving room of a Woolworth store.[9] Likewise, in an Arkansas case, compensation was awarded to an elderly lady for dermatitis due to handling coins and carbon paper as a teller in a bank.[10]

It is to be hoped now that occupational diseases are specifically covered by the Workmen's Compensation Law, that a more realistic approach will prevail as to what constitutes an accidental injury as compared to an occupational disease.

I am glad to note that in providing compensation for occupational diseases, your Legislature has listed the compensable diseases in a schedule. This schedule is quite comprehensive covering poisoning by thirty-one different substances and also fourteen specific disease classifications. While I believe it is just as proper to provide compensation for occupational diseases as it is to provide compensation for accidental injuries, it is important that compensation be payable only for truly occupational diseases for which industry may reasonably be held responsible. One must be careful to avoid providing in fact broad health insurance under the guise of compensation for these diseases.

If you will permit me to digress a moment - this subject of health insurance about which we hear so much these days - mostly from Washington - brings to mind an editorial I recently saw in a magazine called "American Druggist". I think this subject is important enough to all of us to warrant its quotation. The editor states:

> "After five weeks in Great Britain, we came home with new reverence for the faith of mankind that created America.
>
> "It is our conclusion that there is no hope, peace of mind, or real security for anyone in the belief that 'The State is my Shepherd, I shall not want.' This is the real concept of the Welfare State and it has done something to the British spirit. Nothing, not even a free health service, is more important to a nation than the spirit of its people.
>
> "So far as the British Health Scheme is concerned, it is a major

expression of the Welfare State idea, and as a health scheme, it is very similar to the plan President Truman has proposed for this nation. It is too early to tell what it has accomplished for the health of the British people, but there are definite signs that it has done something to their faith in themselves. If this nation of ours should ever adopt the same kind of a scheme, we must be prepared to accept the same increases in taxes and government controls. But of much greater significance is the depressing effect upon the spirit of the people.

"The Britons want security, but we do not think they have found it in the socialist idea that 'The State is my Shepherd.' To the extent that any man accepts the doctrine that the State alone can bring him security and happiness, he will lose faith in himself. Nevertheless, we must recognize that that false concept has a mesmeric appeal.

"It is reassuring to know that America is founded upon radical faith in people, but we dare not be complacent. It is our immediate responsibility to see that no citizen is tempted to lose faith in himself. We must help and inspire each citizen to make himself a useful member of society, and thus achieve true security for himself and his family."

I have great faith in the American people. If it should be determined that some sort of legislation in this field is desirable, I am certain that the people of Texas will have the good sense to adopt a sound program fitted to their needs and will not look with favor upon a scheme run and imposed by the Federal Government. It is essential that voluntary plans which industry has put into effect to provide disability and health benefits be not thrown into a scrap heap for some untried scheme that cannot and will not do the job as well.

In some states compensation for occupational diseases has been provided by broad definitions or merely by including such diseases within the term accident or injury without definition. This has raised a number of problems, since it is difficult, if not impossible, to define that term in such a manner as to provide compensation for real occupational diseases and, at the same time, exclude ordinary diseases of life. Numerous attempts at such definition have been made and their very number is indicative of the failure to arrive at completely satisfactory language. In absence of a specific listing in a schedule, such as that in effect in Texas, neither the employee nor the employer knows defintely, except after extended litigation, whether or not a specific condition is compensable. In Massachusetts, for example, where the term "personal injury" only is used without reference to occupational disease or accident, it has been held that an infectious disease contracted by a hospital employee was not compensable.[11] Under your law such diseases are specifically covered. It required an amendment to the law in Massachusetts to cover such diseases, but this only disposed of one type of disease and did not provide a solution for other questions which may arise.

Occupational diseases differ from accidental injuries to such a degree that it is necessary that specific provisions be inserted to cover the particular problems which arise with respect to such diseases. In the case of an accident, there is usually an event which gives rise to the disability - a man falls off a ladder - he slips and breaks a leg. Often, there are witnesses and it is usually not difficult to determine just how the injury occurred. In the case of an occupational disease, however, no such occurence takes place. A relatively long period of exposure oftens precedes disability. The onset is gradual. There may be considerable doubt as to the cause of the claimant's disability, whether it is due to exposure in the employment or completely unconnected thereto. An employee develops a blood condition. Is it due to possible exposure to a solvent in the employment, or is the cause completely unrelated to the work? Since there is no specific event causing the disability, from what time must periods of limitation be run and when is the employer entitled to notice?Prompt notice is important. Adequate treatment promptly administered and possible removal from exposure may well prevent development of a serious condition. Special provisions on these points are necessary, and I am glad to see that the Texas law requires notice within thirty days of the distinct manifestation of the disease.

With respect to diagnosis, some states provide for the creation of Medical Boards to pass on controverted medical issues and to assist the administrators of the law when confronted with problems of this type. Specialized knowledge is necessary which is often lacking among general practitioners. While in two states provisions creating such Boards have been declared unconstitutional, these Boards have been very helpful where the provisions of the law are adequate and the Boards are composed of high caliber personnel.

I have made mention of the fact that occupational diseases are often of gradual contraction. This is particularly true of the so-called dust diseases, silicosis and asbestosis, both of which are listed in the Texas law. It usually takes many years for these diseases to develop to a degree sufficient to cause disability. Thus, when a law is first enacted making them compensable,an undue burden is apt to be placed on industries in which a dust hazard is present. Many employees are in a position to make claims based on exposure long prior to the effective date of the law during which no liability existed and no reserves were set aside. To avoid dangerous dislocation among such industries, a number of states have provided for graduated benefits for such diseases under which the amount of compensation depends upon the lapse of time after the effective date of the Act that the disability or death takes place. You have a similar provision in the Texas law, where compensation is limited to 20% of the maximum period where disability or death occurs during the first twelve months. This amount is increased by 20% each year until the maximum specified in the Workmen's Compensation Law proper is reached.

Another important question in connection with the dust diseases is what constitutes disability. I have heard medical men, specialists in this field, say that a person having silicosis is either able or unable to do his work and if the latter is true, then he is totally disabled. Thus, some states provide that no compensation shall be payable for partial disability from silicosis or asbestosis. Long before incapacity to work occurs, some fibrosis may be present in the lungs. During periods of high wages and good employment these men will continue at work and no serious problem is presented. Should an economic recession occur, however, the presence of this limited fibrosis, demonstrable by X-ray, may well result in the making of a claim. It would seem that in the case of silicosis or asbestosis compensation should be paid only if there is actual physical incapacity to work.

I have tried to outline at lease some of the major portions of the Texas law, relating to occupational diseases, and refer to some of the problems that arise in connection with this subject in general. More important, however, than compensation for these diseases is prevention. It is far better for an employee not to contract an occupational disease than it is to receive compensation after it is contracted. This is true not only with respect to the employee but from the viewpoint of industry as well. In addition to providing such compensation, industry must bear the expense of lost production, lost time in training a new man and other expenses which are entailed when the services of an able and trained employee are lost. The insurance industry has been among the most active in discovering occupational health hazards and helping industry overcome them. For many years the stock insurance companies individually and through the Association of Casualty and Surety Companies and its committees have studied in detail the various phases of the problem and their solution and have contributed substantially to the development of knowledge in this field. Recently, we have set up a unit in our Accident Prevention Department to collect the very latest information on occupational health hazards so that insurance companies and through them industry generally may be advised of the most recent developments in the field. Thus, in accordance with its established practice, insurance,in cooperation with industry, has exerted its efforts to protect the lives and property of the people of this country.

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"SOME HEALTH ASPECTS OF ARSENIC IN INDUSTRY"

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Most of the arsenic used in industry is first produced as arsenic trioxide, and annual production in the United States is now approximately 35,000 tons a year. Of this amount 75 precent is used in insecticides to combat insects with which this part of the country is quite familiar - the boll weevel, the coddling moth end the gypsy moth. Smaller amounts are used both in weed killers and in the glass industry, and only 0.3 percent is used in pharmaceutical preparations.

In the United States arsenic as such is seldom mined separately, but is produced as a by-product in the smelting of copper and lead. When ores or by-products containing these metals are smelted the arsenic goes off in the flue gases where, with other dusts, it is caught by electrostatic precipitators or filters as a particulate dust. Arsenic trioxide does not melt at atmospheric pressure but sublimes at a temperature of 218°C.

Flue dusts containing arsenic are then roasted in Godfrey roasters and the arsenic trioxide driven off. It is collected in what are known as arsenic kitchens. These kitchens are long brick rooms in which the hot gases containing arsenic fumes are circulated as they cool. The arsenic trioxide precipitates as a dust and settles on the floors of the rooms where it is then collected. At this point, the dusty product contains 96 to 100 percent arsenic trioxide.

Handling arsenic trioxide dust calls for highly specialized engineering skill. A very high percentage of the dust particles are large, and they have a tendency to pack together. This may quickly reduce the efficiency of a ventilation system unless constant effort is made to keep the system open.

MEDICAL EFFECTS OF ARSENIC

Arsenic trioxide dust becomes a medical problem when it is breathed into the lungs,or when it comes in direct contact with the skin.

First let us discuss the systemic effects of arsenic which has entered the body thru inhalation. We have never seen a case of systemic poisoning from inhaling arsenic dust nor have we talked to anyone who has seen an undoubted case; although theoretically such cases could occur.

One of the effects of breathing arsenic dust may be the production of a hole in the septum of the nose about one-half inch back from the nasal opening. This perforation is probably produced by the following mechanism: When air containing arsenic trioxide dust is inhaled, the particles of arsenic trioxide impinge on each side of the nasal septum. There the particles dissolve on the moist mucous membrane surface and produce a high local concentration of arsenious acid. This material is corrosive and produces a local area of mucous membrane necrosis. The blood supply for the cartilage of the nose comes directly from the overlying mucous membrane, and when that membrane is necrotic the underlying cartilage quickly dies. A piece of cartilage similar in size and shape to the area of necrotic membrane then drops out. The production of this hole is practically painless and causes no disability. If, however, known preventive measures are used, the condition can be prevented.

Arsenic trioxide dust on direct contact with the skin produces a dermatitis, particularly where there is any moisture, sweat, or friction. Commonest areas of dermatitis are on the face, conjunctiva, axillae and groin. On the face arsenic dust collects around the edge of the respirator facepiece and produces a dermatitis. The use of a stockinet covering for the facepiece is of little value in preventing dermatitis in this area. In warm weather when the face becomes moist with perspiration a facial dermatitis can be produced in one day. The application of various protective powders and ointments before putting on an approved respirator has not proved successful.

Of particular interest to this group are methods for preventing arsenical dermatitis. Men working in arsenic dust must wear clean clothes every day. This includes clean underwear, sox, and coveralls. When dressing for work in the morning a man should also apply calamine powder liberally to the skin which will be exposed; that is, part of the face, and back of the hands. Coveralls with an attached hood should be worn as the hood protects the scalp, ears and back of the neck. We have found that a respirator, made out of two pieces of sheet paper wadding laid between two pieces of muslin is superior to any of the approved types. This is made in triangular form and two ends of the triangle are tied at the back of the head. The top edge of this respirator comes just below the eyes, and the third angle of the triangle is put inside the collar of the coverall. Small pieces of cotton are then placed inside the respirator on each side of the nose. When the hood of the coverall is pulled into place there is little skin exposed except an area beside each eye. The eyes themselves can be protected by dust-right goggles. The type of goggle with a small well of water at the bottom of each lens is useful if fogging of the glass becomes a problem. Arsenic trioxide dust will cause conjunctivitis which is very resistant to ordinary medical treatment. The sheet wadding respirator has been tested against industrial arsenic trioxide dust and found to be 99 percent efficient.

Protection of the type described keeps arsenic dust out of the ears. If arsenic dust settles in the ears a man may develop quite a sore ear after taking a shower because water is likely to splash into the external auditory canal and moisten the arsenic powder.

A dozen men using the type of protection described worked seven years in arsenic dust in a hot semi-tropical climate without developing a perforated septum or having a disabling dermatitis.

For treatment of arsenical dermatitis and conjunctivitis many drugs have been recommended. Calamine lotion and an ointment containing sodium thiosulfate have been widely used in the past. Sodium thiosulfate intravenously has also been recommended. Since the war we have been using the new drug BAL with spectacular results. It may seem strange that a drug injected intramuscularly should affect a dermatitis or conjunctivitis caused by direct, external, contact but it does and is the treatment of choice.

There is one derivative of arsenic which I wish to call to your attention particularly because it is one of the most insidious poisons in industry. That substance is the gas, arsine. Arsine is produced most often in the pickling of metals when arsenic is present as an impurity in either the metal or the acid. It is also produced in the acid leaching of ores containing arsenic and can be formed by the action of water on metalic arsenides such as aluminum arsenide. This latter method of production occurs as an accident in tin smelting or in certain types of lead refining.

Arsine, according to the textbooks, has an odor resembling garlic. From actual experience we feel this odor is greatly over-stressed and no dependence should be placed on the odor as a warning measure. Around an industrial plant the odor is not noticeable nor distinctive. Arsine does not cause any distress when it is breathed nor does it cause eye irritation. The only way to guard against arsine is to have a high index of suspicion and test the atmosphere by chemical means if the presence of arsine is suspected. We like the use of a hand pump which draws air thru a piece of filter paper impregnated with silver nitrate. This method was developed by the British and we have found it both rapid and efficient.

When arsine is breathed, it is absorbed by the blood from the lungs. Part of the arsine in the blood attaches itself directly to the red blood cells and part is carried to all the organs of the body because it is simply dissolved in the blood serum.

The arsine which is attached to the red cells causes those cells to dissolve and free hemoglobin is liberated in the blood stream. This excess hemoglobin is excreted by the kidneys and will make the urine dark red in color. Some of the liberated hemoglobin will go to the liver but if there is more than the liver can handle it will be thrown back into the blood stream and may produce jaundice. The appearance of blood-red urine is usually the first and certainly the most dramatic sign of arsine exposure. There is no pain connected with this hemoglobinuria, and it has been our experience men are greatly upset mentally by the sudden appearance of blood-red urine. This may occur within three or four hours after arsine exposure. The arsine which is attached to the red cells apparently causes them to dissolve over a period of about four days and in this time extreme anemia may be produced unless the dissolved cells are replaced by blood transfusions. We have found no evidence that blood which is added by way of transfusions is dissolved by arsine which has been in the blood stream and has previously dissolved other red cells. This is important for it means there is a definite end to the problem of red cell destruction and no patient need die from anemia.

The arsine which is carried in solution in the blood serum to all the organs apparently is deposited in the various organs but produces little effect except on the heart. In the heart, changes are produced which can be readily shown on the electrocardiogram, and from our experience we believe the electrocardiographic changes are the most sensitive indication of arsine absorption. Four deaths from arsine which we have observed have all been due to failure of the heart muscle and we attribute the deaths to the direct poisoning of this muscle by arsine.

Chemical analysis and microscopic examination of the various organs of the body have not shown other significant damage due to arsine.

Damage to the kidneys may result from the excessive elimination of hemoglobin if large numbers of red cells are destroyed. The hemoglobin acts as a chemical irritant in the kidneys and produces a lower nephron nephrosis. In non-medical terms this means the little tubules of the kidneys become inflamed, the lining cells break loose and the tubule becomes blocked with precipitated hemoglobin. Complete failure of the kidneys will result and waste products of metabolism which are normally excreted in the urine will accumulate in the blood. This is a medical catastrophe and demands the most skillful treatment. Even so, 90 percent of these patients die.

In the treatment of arsenical dermatitis or conjunctivitis BAL is the drug of choice. It acts with amazing rapidity and is very specific. In arsine poisoning BAL seems to be of little value. It does not stop the destruction of red cells nor does it help the heart muscle which has been poisoned by arsine.

As industrial hygienists we are interested in the amount of arsenic which it is safe to have in the air, and the amount in the urine which indicates dangerous absorption. The maximum allowable concentration in air, which has been suggested by the Conference of Governmental Industrial Hygienists, has proved to be a safe level. However, the problem of determining the significance of urinary arsenic levels is quite complex. In the case of another heavy metal, namely lead, we anticipate trouble if the urinary excretion goes above a designated range. Arsenic in the urine may represent the end product of arsenic trioxide absorption, arsine gas absorption, or may have come from the metabolism of an organic arsenical compound such as is used in the treatment of syphilis. Each of these three classes of arsenic compounds has a different degree of toxicity and it is only when the original source of the urinary arsenic is known that the significance of its value can be determined. At the present time it is not justifiable to give an arbitrary figure for urinary arsenic which can be called a safe value and to infer that all values above that amount are unsafe.

The body has various mechanisms which enable it in time to eliminate all excess arsenic. These mechanisms require several weeks to rid the body of ordinary amounts of arsenic such as might be absorbed from industrial exposures. We have found no evidence of accumulation and storage of arsenic in the body such as may happen with a metal like lead. The presence of arsenic in hair or nails is not true storage since once it is deposited it cannot get back into the body.

In conclusion we should like to point out that the studies of acute arsenic poisoning have been both extensive and thorough. The clinical picture in such cases is well defined. In industry the problem is entirely different because exposure is characterized by chronicity and relatively low concentrations of the material. The systemic effects are almost non-existent, and disabling conditions of exposed parts of the body become predominant.

"THE ROLE OF THE NURSE IN THE INDUSTRIAL HEALTH PROGRAM"

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The title might lead one to infer that there is but one role of the nurse in the industrial health program. I'd like to suggest that the nurse's role is a highly individual matter dependent in the main upon her interest, her vision, and her ability. Was knowledge omitted in the list of determining factors? Well, if the interest is sufficiently great, additional knowledge can and will be acquired, other factors being equal. It must be admitted that the administration of the industrial health program and the interest, vision, and ability of other team mates also have a strong influence on the activities of the nurse but during this discussion we will consider the interest, vision, and ability of the nurse herself as of major importance in determining the place she will assume in a particular industrial health program.

Until recently there has been little, if any, special preparation for the field of industrial nursing and the greater number of nurses, as of physicians, have been prepared for care of patients, with thoughtful observation of symptoms, analysis, and interpretation of what has been observed. Interest in the patient and his welfare is the impelling motive back of such comprehensive care of the patient rather than something acquired during preparation.

In industry, the employee who suffers a minor injury or minor symptom of distress becomes a patient, temporarily, but thoughtful observation of the individual and careful analysis of the information he gives, will inevitably lead to consideration of how to prevent like injuries or similar illnesses.

The nurse in industry finds herself one of a company, large or small, of well people who assemble daily to do a job. She has a responsibility readily recognized for giving them care when they become "patients" because of an accident or illness. However, her interest leads her to learn about the particular industry with which she is associated. She wants to know what its purpose may be. It certainly is quite different from that of the hospital or doctor's office, or perhaps the county health department or public school, where she may have been employed previously.

Having learned the purpose of "her" industry, she wants to know how it is accomplished; What is the plan of organization within the plant; Perhaps it is a subsidiary of a large company far removed; How does that affect her daily work, or, should it affect her at all; What goes on in her plant day after day - from raw materials to finished product? It makes a facinating story since the engineer has made it quite understandable to her. But the accomplishment of the purpose of this industry depends largely on healthy, well-adjusted employees working on the job every day. Surely the nurse can make a real contribution toward that end. It is very evident though that she must do more - much more - than merely giving good care to the employee when he becomes a patient.

As a good listener and because she has given good nursing care when it was needed, the nurse learns of many things which may interfere with employees' full attention to their jobs. Minor complaints do not keep a man away from the plant perhaps, but they do interfere with his efficiency, and he should be referred to the plant physician for diagnosis and attention before the minor complaints become of major importance. Worry over the health of his wife or child may also distract his attention from his work and again, talking over the situation with the plant physician may enable him to understand what he should do and so clear his mind from such intense worry. The employee might hesitate to go to the physician unless the nurse prepared the way for him. She can lead the employee to see that while the plant cannot take care of the entire health problems of his family, the management is interested in him and the physician, as well as she, is glad to counsel with him. Other worries of an employee may indicate his need for assistance from one of the health or welfare agencies in the community. He may need to consult a dentist, or some of the special clinic facilities of the State such as orthopedic or cancer detection service may be needed, or perhaps old age assistance for the parents for whom he is responsible, is the solution for his need. The nurse, because of her interest, is a good listneer. Again, because of her interest, she learns, if she does not already know, the source for the help which he needs and explains the required procedure to him.

The physical examination program affords another opportunity for preventive work by the nurse. Her knowledge of particular jobs is next in importance to that of the physician. Proper placement of an employee is obviously important in maintaining productive work as well as in preventing accidents. The nurse in her tours throughout the plant observes the men at their work. Perhaps John X. has been recently transferred to a different job and she wonders if the new job is within his realm of physical capacities so she makes a mental note to discuss it with the physician. She may also notice some careless housekeeping or an employee not using his safety equipment. Her first reaction to the latter is - why does he not wear his goggles - how can I make him understand his need to wear them - and again, she reports her observations to the responsible individual. Some of her observations may be a topic for discussion at the next safety meeting - her object not to embarrass anyone over a specific incident but rather - how can they develop better teamwork for accident prevention - or for good housekeeping.

As a result of the physical examinations a number of employees will need follow-up in order that each will secure the correction or treatment advised. The nurse will counsel with the employee as needed to kindle and maintain his interest and assist him as may be indicated to make and carry out his plan for treatment.

Nurses, in their basic preparation, learn the importance of accurately recording all nursing care and treatments and of keeping the physician informed regarding developments during his absence. In addition, the nurse in industry is interested in the optimum health of the employees, and in the objectives of the industry itself. Therefore, she studies and analyzes both the individual employee records and her daily reports. She knows that the plant physician expects her to refer to him the employee who is having frequent minor accidents, frequent complaints of feeling ill, or frequent short absences for "illness". The physician may then diagnose and initiate treatment for the underlying cause thus preventing a more serious difficulty. Perhaps the difficulty may prove to be one to be handled by the personnel or public relations director rather than the physician, but the nurse and physician think first of the employee's health and rule out physical causes, or explain physical implications when referring him to personnel. Personality clashes within a department may be a factor. If not discovered and resolved, they may lead to a major accident as surely as will the disregard of safety regulations.

In reviewing the daily report, the nurse may find several cases of skin irritations from one department or a series of assorted complaints from another department. She points out these facts to the physician in charge. Perhaps the foreman from one of these departments has stopped by the medical department and has observed an undue proportion of the day's checks for treatments given, in the column bearing his department number. "Did something go wrong today - are you using a new material - perhaps you would like to talk with Dr. X. - , or, maybe you aren't feeling up to par yourself - how about it?" (Explain use of a check sheet for the daily report - large sheets of paper ruled and having each column indicate one department. The column at the extreme left indicates the type of complaint or treatment. A check is made in the proper square, for each service given by the nurse or physician). The concentration of checks in any column shows the department of employment where investigation may be indicated. Of course, some foremen are more interested in health protection than others - hence, the lack of any checks in a particular column may indicate that the nurse should become better acquainted with the foreman of that department and with the activities for which he is responsible. Is there need for health services for any one of the employees in that group? The daily report - check sheet is used to detect possible sources of early trouble.

The monthly and annual reports of the nursing service are also valuable tools of the nurse with vision. They afford an opportunity to summarize service given, to note accomplishments, and, particularly with the annual reports, to furnish evidence as to further activities which should be undertaken. We have said earlier that the nurse could contribute noticeably to the productive schedule through her efforts to keep health, well-adjusted employees on the job each day. The reports should give evidence of what has been accomplished, realizing, of course, that the nurse is not functioning as a solo artist but rather as a member of a team working with the physician, with the personnel director, the safety engineer, the foreman, and with the employees toward the objective. Accomplishments of a particular month or year may be contrasted with those of the previous year. Has there been less time lost due to illness and injuries? The statistical part of the report may be brief, as brief as is consistent with the facts to be shown. The narrative part will explain or clarify as indicated and add human interest. The monthly and annual reports interpret to management the services given while they may be likened to a view in the mirror plus a suggested forward look, for the nurse and physician.

The competent nurse then is greatly interested in the employee group and in the industry itself, since she has become a part of it. She finds many opportunities for being a real team mate. Her powers of observation, as well as her listening ability, result in a constant challenge to her to increase her knowledge, in order to keep abreast and able to meet her opportunities.

Active participation in the professional nursing organization becomes a must to her. I note that the luncheon meeting this noon is planned for the organization of the Gulf Coast Chapter of the American Association of Industrial Nurses. I am sure that this new organization will prove to be valuable. We should appreciate, however, that these same nurses have, for some time, been active in professional nursing organizations seeking to enlarge their knowledge and vision through this means.

Institutes, conferences, and extension courses may also be planned by these groups in cooperation with the university as a further means of keeping up to date in their information. Some industrial nurses have registered at the local junior college for such courses as English composition, or introductory courses in psychology, sociology, and economics and have found them to be very helpful.

During this discussion, I have endeavored to point out that the nurse's role in the industrial health program is largely dependent upon the interest, vision, and ability of each one of us. Through the nurse's interest in the industry itself, as well as in the employees, and as a good listener and an able observer, she can be an invaluable team mate working toward maximum efficiency thru optimum health of the employees. As her opportunities present challenges to her, she seeks and finds the means to increase her knowledge to better meet the opportunities for service.

Industrial Conference Panel Luncheon

W. H. Seymour, Presiding

"INDUSTRY'S ROLE IN EMPLOYEE HEALTH"

Brigadier General James Stevens Simmons, USA. (Ret.)
Dean, Harvard School of Public Health
Boston, Mass.

October 7

Mr. Chairman, Ladies and Gentlemen:

I thank you for inviting me to attend this Second Gulf Coast Regional Conference on Industrial Health. It is good to be here with such a distinguished group, all of whom are interested in public health; and a privilege to be back in Texas. I cannot claim the distinction of being a native Texan since I was born in another great State, North Carolina. However, I feel close to Texas because I lived here during the early period of my professional life. Thirty-three years ago, as a Lieutenant in the Medical Corps of the regular Army, I reported for duty at my first station which was at Camp Stuart on the Mexican Border near Fort Bliss, Texas.

My second Army station was also in Texas, at Fort Sam Houston, where I was Commanding Officer of the Southern Department Laboratories. In this position I followed a distinguished Texan, Dr. W. H. Moursund, who is now Dean of the Baylor University Medical School. During all of this early Army service, I ate your bread, shared the bounties of your State, and developed a deep feeling of affection and respect for your forthright ways of life.

Therefore, I come here today as a friend who would be proud to be called an adopted Texan.

I am especially glad to be able to attend this conference on industrial health. The fact that you are holding such a meeting shows that the people of Houston and of Texas, like Americans everywhere, have become sold on the fact that good health is a basic requirement for effective, productive living. It also indicates that you are ready to roll up your sleeves and work out practical methods by which more of our people can keep themselves fit to work and fit to live.

Since other speakers will discuss the detailed organization of health and medical programs to meet the needs of small industries, I should like to talk briefly about the challenging opportunities which are now available in the field of industrial health.

The great strength of our country has grown out of the courage, intelligence and industry of its people. Within the short period of a century and a half our people have done a remarkable job in converting the rich natural resources of the American soil into an abundance of things that make life worthwhile. We are still a young, vigorous, pioneer nation. We are not afraid to work. We still retain the pride of accomplishment, and we have no use for the spineless philosophy of communism which robs the individual of his responsibilities and reduces him to the status of a government parasite. We Americans have demonstrated our strength not only in peace, but in war, and we are strong enough to face the future with courage. This fact was strikingly demonstrated during World War II when the application of modern methods of preventive medicine and public health made possible the conservation of fighting and industrial manpower.

If we are to protect this rich heritage and pass it on to our children's children, we must take steps now to further conserve the nation's manpower and increase its reserves of health and strength.

That this fact is well recognized is shown by the present intense and widespread interest in public health. This interest is reflected in the numeours health bills now being considered by the Congress. There is no disagreement about the need for better health, but there has been bitter controversy as to the manner in which it is to be provided. These conflicts appear to be largely political and to have arisen in many cases through confusion of the main issue by politicians. The simple truth of the matter is that we need to conserve the health of our people and to raise its level to the highest possible point. We now have available the basic knowledge, the technical skills, and the tried methods with which this can be done, provided this knowledge is applied.

Industrial leaders are now in a position to make a real contribution to the health of the American people. Moreover, this contribution can be made with profit to management, to labor, and to stockholders, through increased productiveness, higher dividends, and better living conditions.

We are a nation of skilled workers, and large numbers of our citizens are grouped in industrial areas where they turn out the manufactured goods and products essential to our way of life. Over 60 million Americans are now gainfully employed in industry and in various business enterprises. The health of this productive segment of the population and their families is of primary importance because of the vital role which they now play, and will continue to play, in our national economy.

Much progress has already been made in improving the health of industrial workers. A number of industries maintain excellent services to provide medical care, and a few of the larger industries have comprehensive departments which are, in reality, comparable to the health departments of our great cities and states. Others still, with extensive overseas operations operate health programs which are truly international in scope.

On the other hand, there are still many industries, both large and small, in which the workers do not have adequate health protection. In many of these the lack of a medical or health program is reflected on the red side of the ledger - largely in terms of reduced efficiency and earnings.

Those of us concerned with public health believe that it is important to bring to the leaders of industry, both management and labor, a clearer picture of the advantages to be gained through providing adequate health coverage for all of the workers of the country. This cannot be done by the medical profession alone, nor by the medical specialty of public health. Something else must be added, and that is the informed, aggressive leadership on the part of industry itself.

Texas, with its tremendous expansion in all fields, - especially in the oil, chemical, and aviation industries, would appear to be a logical place to look for such vigorous, constructive leadership.

A few of the postgraduate schools of public health concerned with training in this field, including the one with which I am associated, are now offering courses for the special training of physicians in industrial health. It is our concept that the director of such a health program should have a special knowledge of occupational hazards, industrial health, sanitation, safety engineering, insurance compensation, placement examinations, labor relations, and industrial organization, as well as rehabilitation, the evaluation of workers' disabilities, and the assessment of medical needs of organizations. We believe that the director of a large industrial health organization should have a working knowledge of the modern developments in nutrition, epidemiology, biostatistics, mental health, health education, human ecology, and community health resources. He should be familiar with good administrative practice both in the field of public health and in its application to industry.

If we are to place our industrial economy on a sounder and more productive basis, the individual effectiveness of the worker must be improved. This does not necessarily mean that individuals should be fit enough to run a mile or box 15 rounds. It does mean, however, that the concept of health must be tied in with the worker's adjustment to his job, to his home life, to his community, and to off-the-job activities.

The remarkable progress which has been made thus far in lowering accident rates did not just happen. Machines, factory layouts, and the handling of materials were made safer by the cooperation of both management and safety experts trained in the principles of accident prevention. The next important step is to enlist the partnership of the physician trained in the techniques of industrial medicine and the biological sciences to reduce illness and injury.

More attention should be given to the design of equipment and working areas in terms of human limitations and capabilities. All too frequently equipment is designed at great effort and expense only to have the individual brought into the setting at the very end. Our experience with military equipment, such as tanks and airplanes, demonstrated many faults in this regard. An advance analysis of all possible human and design errors would no doubt result in a marked reduction of the accident rates in your factories.

The next step relates to the selective placement of workers in accord with their mental and physical capacities by means of pre-employment and interval examinations. To place a worker on a job for which he is temperamentally unsuited can only result in a high accident rate. To place a worker with heart disease on a job which requires heavy lifting can only accentuate his illness. To allow a man who is subject to fainting to operate a crane or work on a high scaffold can only result in disaster. Yet, think of the number of industrial concerns who do not observe these principles. Such a lag in observing recognized practices is comparable to not using immunizing procedures in an epidemic.

In the various fields which have been discussed, there are certain common denominators in regard to suitable programs which must be devised for a frontal attack for reducing illness and injuries. The most efficient mechanisms relate to careful and thorough periodic medical examinations, including x-ray and electrocardiographic and other laboratory procedures. By these means, it might be possible to discover early cases of diabetes, cancer, heart disease, and other serious ailments and prolong the useful lives of the older workers. The health facilities of your local community, the State, and the nation can be used effectively in achieving these ends. For example, your employees could utilize the visiting nurse services, tuberculosis and venereal disease clinics, maternal and infant welfare facilities, heart and arthritic clinics, and many others. Forward-looking industries, working closely with medical and safety advisors, have improved the worker's health and productivity on the job. Management need not consider such efforts as philanthropic ones, but as economic savings on their balance sheets.

This country is essentially an industrial one in which the health and productiveness of its population is basic for survival. Adequate industrial and community health services should be made available to every man, woman and child in this country - not because of any idealistic concept that has a parasitic right to demand health, but for the very practical reason that they are Americans, and their health is essential to the future strength and security of the nation.

Strong tides of popular interest in public health are now running through this country and the people are ready to take whatever steps may be required to relieve themselves and their children from the unnecessary burden of preventable illness, injury, and death. Health is sufficiently important to warrant calm, objective planning on a continuing basis by experts who represent the best available skill and judgment. This cannot be done without the encouragement of enlightened management in industry, and we look to you for leadership and support.

"THE PROBLEM OF THE AGING EMPLOYEE"

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It is a matter of general knowledge and common concern that our population is getting older. It has been reliably said that the number of individuals over 60 years of age is increasing five times as fast as our total population. This is a statement in relative values; it is more important to realize that well over twelve million of our people are beyond age 60 and that this group forms an increasing percentage of the working population of the country.

Realism, then, highlights the question, "What of the older worker?" Is a man worth employment beyond a certain age period? If so, how can he continue to be productive in his job?

Realism, again presents certain incontrovertible facts. In older age-groups, arthritis, heart trouble, kidney disease, the effects of poor nutrition, even obesity, become increasingly prevalent and go on progressively with little hope for cure and with only the possibility of slowing down the rate at which these changes are developing. Older people are no longer as strong muscularly as they were in their younger days. Their speed of reaction is slower, thus increasing the liability to accident where the nature of their work calls for speedy reflex action. Those who are injured require a longer time for recovery than younger people. The same is true where illness rather than accident is concerned.

Counter-balancing these liabilities, however, the record of the older employee, as a rule, is low in absenteeism; he is more loyal to his organization and takes a possessive pride in its accomplishments; for the most part he retains his increased skill and is not often involved in accidents; and, finally, his ability to make reliable decisions comes from an enhanced power of critical observation, itself derived from long years of experience.

To a very considerable degree, therefore, older employees are better employees, and since they are forming an increasingly large body in industry, industry may well concern itself with finding the best way to keep this group in productive employment.

The most important single item in this regard is first the understanding and then the adoption of a preventive rather than a curative philosophy where aging processes are concerned. None of us is 100 percent well, in the sense of being free from disease. Older people, as has been pointed out, are considerably less free from degenerative changes which tend to become progressive. The desideratum, therefore, must resolve itself into common-sense efforts to prevent these conditions from becoming entirely disabling by such means as will slow down these processes since they cannot, in most instances, be cured. And here the best, and indeed the only, tool is the use of in-plant medical personnel who know and understand just what, exactly, is going on in the plant, not only in the figurative sense of the word, but in a strictly literal sense as well, since, in a great majority of instances, successful accomplishment of this objective will come, purely and simply, from job adjustment, nothing else. The professor in his Ivory Tower, the best doctor in town in his walnut-paneled, air conditioned suite, both know that there is such a thing, but unless and until they know personally, for example, what it is to cast a fitting, to tend a forge, to run a crane, or even to distinguish between a number Two and a number Three scoop, no amount of pills or skills will take the place of knowing exactly the adjustment which may in many instances mean the difference between a continued life of productivity and a shortened and painful existence in employment.

Nor is it sufficient for either the doctor--or the management that hires them, as well--to send the old fellow back to the plant, after that long and futile trip to the consultant's office, bearing a note reading very much as follows, "Put this man on light duty. He has a bad heart." That, it is to be emphasized, is asking Mr. Foreman, Mr. Superintendent, Mr. Boss, or some other Mister to practice medicine, preventive medicine, for which he is not qualified, either by education or experience, nor licensed by state law.

How much cardiology does "Mister" know?

More, probably, than the professor, or the doctor, knows of the machine "Uncle Jim" has been tending, the loaded wheel-barrow he has been pushing, or the fumes he has been inhaling. At one time during the past war, I saw the Kaiser Shipyards operating with a labor force made up in a large measure with truants from all the cemeteries on the West Coast. I have a copy of the manual prepared by their medical department which, by means of a perfectly amazing set of formulae, made it possible for personnel managers from top-brass to straw-boss to slot almost any sort of a human being--or what was left of him--into a job and to do it without benefit of the medical. But that was war and doctors were not to be had--readily, at least.

Today, however, the increasing importance not only of the aging worker, but the importance of efficient production itself calls clearly and unmistakably for a doctor in over-alls, rubber boots, and a respirator, if necessary. Not the watch-around, but at least until he is personally acquainted, until he knows the score, knows who is pitching and indeed the entire line-up. "This man has a bad heart; give him light work" is not enough.

The right of the laboring man to work in a safe environment has been upheld in every court in the land and tribunals have been established to expedite decisions in matters of controversy where problems of this sort arise. We hear too little of it, but management has its rights as well. Basically, they stem from the right to produce efficiently, with honest profit to ownership on one hand, and with the intangible but tremendously important profit of providing a livelihood for Americans on the other. At the present moment, however, it does not seem readily apparent that there is agreement in industry at large that working, and thereby producing, at peak efficiency depends in a large part upon the development of a constructive, a positive health program in the working force, a program which not only protects the worker against accident and infection, but one that minimizes those aging processes which are all but inevitable, but which can be controlled in a large measure by job selection and job adjustment.

Too few of our industries support an in-plant medical program which includes examinations designed to disclose early remediable defects. Fewer still take the next step, that of sending the individual to properly selected specialist care, a sorting process, or triage, which is a specialty in itself, and a job of great responsibility both to the employee and the employer.

Labor and management working together have done still less toward bringing medical advice toward the solution of combinations of jobs or modification of job assignments where health itself is concerned. Even health counselling for the most part is relegated to laymen in personnel departments, or to the Safety Engineer which is better, certainly, under the circumstances. He indeed appreciates the importance of physical and mental health in production problems. Moreover, he makes an effort to learn and to do more and more about it. The enthusiasm for our recent course for local Safety Engineers, "The Structure and Function of the Human Body", bears this out.

All of this includes the aging worker and is included in the problem of the aging worker, since aging begins, chronologically, from the birthday itself and is increased in its processes from the beginnings of work itself, whatever its form.

What is missing?

The in-plant physician with a training in industrial medicine, be he full-time or only part-time.

Why is he missing?

Wherever there is a demand, sooner or later there will be a supply. Industry, both labor and management, has been reasonably content with the concept, "The best doctor in town is our doctor." Where interest has been sincere, mutual understanding has brought rich benefits. Too often interests have been divergent, or at least independent of ultimate objectives: the doctor seeks a cure of an established disease; labor wants compensation; management wants to pay off as speedily and as painlessly as possible. Has either ever given consideration to the need for physicians to specialize in industry, in all its broad scope and patterns, so that full appreciation for the problems of the "aging worker" will lead speedily to reasonable answers? Only recently has the demand been sufficiently insistent or visualized clearly enough for medical education to develop instructional programs designed to meet this need. Until industry demands that its medical officers be trained as specialists in industry, it will be utterly futile for a medical college to arrange such programs. They are expensive both to education and certainly to the physician himself, and there is little indication at present, that such training will gain preferment in appointments and assignments of graduated physicians, efforts of this sort will be entirely worthless. Only when industry as a whole, both labor and management, relinquishes the idea of the "best doctor in town", may we expect specialization in industry to occupy fully as important an area as any other form of medical specialization, and one which indeed will prove to be the most valuable of the medical specialties. Today, calls for the modern industrial physician are not too many and not too insistent. Perhaps those who need him do not know where or even how to call him, but until such time, the problem of the aging worker will remain more-or-less unsolved. The ultimate objectives of the "best doctor in town", labor itself and management are still far too much independent each of the other.

"RELATIONSHIP OF OCCUPATION TO HEALTH"

T. M. Frank, M.D., Medical Director
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Discussion of a subject referring to health requires a definition of health itself. This is difficult. Complete agreement is rare. For purposes of our present discussion, however, we might call health that state of well-being in which disease and disability do not intrude to alter one's plans or mode of living. Such a definition allows for the presence of infection, alterations of body function or structure and many other situations short of ideal, provided they do not hamper the individual, put a damper on his plans, worry or influence his morale. In short, it permits the presence of disease if the person can live as though it did not exist.

Many a person has gone through life with increasing loss of function of heart, liver, kidneys or other organs but by ignoring it, living a life full, complete, joyful, and unhampered. Autopsies frequently reveal not one but many diseases. Often the pathologist says it is not a wonder that the patient died, but amazing that he lived long enough to accummulate all these physical handicaps. And the friends testify that this individual went his way in perfect health, serenely unconscious of his deteriorating body, radiating cheerfulness. Who will say this one did not have health?

Although Virchow, the great pathologist, advanced medical sciences by his dictum that "all illness comes from alterations in body cells," that advance was made from superstition and abysmal ignorance in many cases. Since Virchow, the practitioners of healing have come to realize that he stated only part of the case.

As a rule, every patient presents an illness, a picture, a composite, a syndrome which is made up of at least two fractions: 1. Alterations in body structure and/or function, and 2. What the patient thinks of it. Often there is a third fraction - what the patient thinks of life in general. These fractions of the picture are seldom equal and the proportions vary from patient to patient, and in the same patient from time to time. Rarely the first fraction, that is the physical change, constitutes practically the whole picture. The patient is sick but unconcerned. More commonly fraction No. 2, the emotional reaction, is large, occasionally 100%. The patient is ill, cannot work, cannot enjoy life, seriously handicapped and yet no change from the normal in organ or function can be detected. Such is psychoneurosis, a common form of ill health.

It is remarkable how few people seem to realize the importance of the emotional reaction to body changes. People differ in their reaction to events. One of the great philosophers in rhyme, W. S. Gilbert, takes note of this in the <u>Yoemen of the Guard</u>. He is speaking of a lad making love to his lady. He says:

> "It may draw you a tear
> Or a box on the ear.
> You can never be sure till you try."

And if we differ in our reactions to other events, why shouldn't we differ in our reaction to illness?

And when the physical illness has been cured but the fear and worry, or perversely, the enjoyment of the attentions and concern of others persists, return to health is delayed and occasionally never attained.

We seem to forget the driver. A truck with the newest equipment, gas tank filled, completely loaded and ready to perform useful work, will remain idle until the driver takes charge. He can take it anywhere, work as long as he wishes. If he is a good driver, he can take even an old truck without paint, with squeaky body, doubtful brakes, worn tires, a dozen handicaps or potential difficulties and take it where others pronounce the job impossible.

Every person has a driver - his will, his intentions, his morale - call it what you wish, but a directing force within him which may succumb to minor difficulties, or ride triumphant over mountains. The worn out truck can be repaired, or rebuilt, or abandoned. The worn out body sometimes must be used as it is. But it is the driver who runs it in either case.

There is no intention to infer that illness is all mental. Diseases due to infection, malignancy, dietary deficiency, congenital malformations and anomalies and other recognized causes are not only real but very important. They are mentioned only in passing simply because they are so well known. It is our intention to stress the psychological or emotional factor only because it is not so widely known. These factors are all important in non-industrial life and, similarly, in industrial pursuits.

Doctors feel baffled often by the attitude displayed by some, that patients and diseases can be backed up in a slot or a groove in a machine, a few dials twisted, meters read, and then with a flourish of green and ruby lights the diagnosis, treatment and prognosis will issue from the machine on a little printed slip of paper and undoubtedly the fact will be tabulated on an adding machine built into the complex.

Patients are people. They can be angry, bored, worried, frightened, frustrated, resentful, ignorant, maladjusted, or conversely, the opposite of each of these. Nor must they be all or none. For instance, they can be happy about one thing, but worried about something else.

Then there are the normal compulsions of living - hunger. Many people work and keep well enough to work because that is the way to eat regularly. Sex - the demands of nature for a mate - and also care of children, furnish a driving force that tides many a person over a bout of illness. Ego - we all require a reasonable amount of approval and attention. Lack of approval has a decidedly bad effect on the moral and, hence, on the psychological factor of illness. Perhaps the commonest of all these emotional factors is fatigue. Fatigue of muscle is real. It is dependent on the accumulation of lactic acid in muscle. Yet very few of us know that kind of fatigue. Usually a person who is tired is disinterested, emotionally unchallenged, bored. Boredom looms as one of the greatest known causes contributory to illness and disability in ordinary life. Call it fatigue if you will but the emotional factor is large almost always.

These are some of the emotional factors that influence people and their accidents and illnesses.

Viewed against their background, let us now consider the relationship of occupation to health. First, there are the hazards inherent in the industry. Mechanical, such as falling objects, falls of persons, failing ropes and cables, et cetera. Chemical, from prime irritants such as acids and alkalies, and from noxious agents by dozens, including well-known poisons, such as arsenic, mercury and such; physical, from radiation and other exposures; biological, from a host of exposures,understood and not understood.

The hazards are very real and very important. In large measure they have been recognized and our safety engineers have done a fine job in providing devices to protect, eliminating hazards, analyzing accidents, preventing recurrences. To date, the biggest advances have been made in the physical field. Even bigger advances are in store, I sincerely believe, when progress is made in the psychological field of accident control and safety.

Safety is important but there are other facets to the jewel of health in its relationship to occupation.

Consider the psychological or emotional factors mentioned in relation to illness in general. These same things act in the accustomed way in the occupational field,only it seems to be usual to disregard this feature. An employee can be angry at his boss, his wife, or anyone else, and from this anger develop an illness or enlarge a small one into an illness of major proportion. He may resent favoritism, real or imagined, on the part of the boss. Frustration over years of work without advancement can prey upon a person's morale until illness takes its toll. All possible reactions to life, both favorable and unfavorable, can act upon the health of our industrial workers as much as on persons at home or self employed. Commonest of all the unfavorable reactions is boredom. A person who is assigned work that occupies only a small portion of his time or attention frequently falls victim to illness with symptoms out of proportion to the physical basis, and occasionally with no detectable basis whatever.

Let me remind you that there is no intention to slight infections and the other physical diseases. They must be recognized as of major importance, but because they are more generally recognized, the time alloted to this discussion has been invested in stressing the psychological aspects because I believe they have received insufficient recognition.

It is typical of human nature that things will get done, usually, if they are easy to do and not if they are hard. In our discussions of sick leave and disability this is not considered sufficiently. The easier we make it for people to be sick, the more of them will become so. The doctor is expected to say that a certain person is sick and that is that. Only sometimes it isn't so easy. Suppose you are a doctor and a patient comes in saying he has a pain. You will have to believe him. Suppose you are a patient and you tell a doctor you have a pain, but he shows in some way that he does not believe it. How long will you stay with that doctor? The thermometer registers fever, but so far there is no machine to prove or disprove pain. With sick leave (full salary for so many weeks), it is easy to be sick. And things that are easy get done.

Some persons believe it is management's responsibility to try to keep people well. For myself, I heartily disagree. I believe it may be to management's interest to keep people well, but not its responsibility. It is not possible for me to see how management could accept such a responsibility without taking another big step on the road to statism, socialism, paternalism, along which we have gone too far already.

What is the answer? I do not have it myself, but the first step, certainly is to recognize and describe our problem. Sickness and disability are often intangibles very much influenced by conditions at work, as well as at home. We would gain much by recognizing this and putting serious study and effort into attempts to solve this phase of our personnel problems.

S U M M A R Y

1. While I do not feel it is management's duty or responsibility to try to control health of its workers on a non-industrial basis, there may be situations where it is to management's interest to do so.

2. The present trend of laying increasing burdens of health insurance and pensions upon management makes the subject pertinent.

3. In facing the problem we must pay attention to physical illnesses, and in addition put greater stress on the psychological or emotional factors involved in illness and in every day living.

   Study of the latter point viewed in the light of working conditions, physical and personal, may pay big dividends.

Dr. J. M. DallaValle, Presiding

"THE SAFE HANDLING OF CHEMICALS IN INDUSTRY AND IN THE HOME"

D. D. Irish, M. D.
Biochemical Research Department
The Dow Chemical Company
Midland, Mich.

Gentlemen:

Chemical injuries are actually a small part of our total picture of accidental injuries. However, like other types of accidental injury they are unnecessary. In other words, we can do something about them. Your problem, like my own, is the responsibility for many people who may handle chemicals. Our problem is then largely one of inducing people to handle them safely. It is this problem of inducing other people to handle chemicals safely that is the heart of my topic today rather than the details of safe practice.

If we are to discuss 'chemical substances', we should consider what they are. We can certainly not rely upon the popular idea that a chemical is a 'dangerous stuff which stinks'. Broadly, everything we use is of a chemical nature. We are really dealing with practically any individual substance which may be used in industry or in the home. But, you may say, we are of course interested only in hazardous substances. Let us then consider what a hazardous substance is. In general, the term poison conjures up lurid visions of witches' brew and black magic. In such matters we must realize that we are dealing more often with emotional thinking than with rational thinking.

Let me give you my own definition of the term poison: 'A poison is too much'. Now I assure you I am not being facetious, I am very earnest in this definition. Let me illustrate by describing a very simple experiment which time does not allow me to perform for you. We are frequently asked, 'Is this substance a poison or is it not a poison?' If we were to ask the individual what he means, he would simply say, "Why give it to an animal, and if he dies it is poison, if he doesn't, it is not'. Let us then perform a simple experiment by taking 4 mice and giving them each by mouth one of 4 different substances. Those substances which kill the animal we will classify as deadly poison and those from which the animals show no discomfort, we will classify as entirely harmless. When two of the animals die we examine the record and find that they received the two deadly poisons, table salt and baking soda. The other two animals who lived happily and contented were given the innocuous substances known as strychnine and white arsenic. Now there is no trick or magic to this experiment, it is just a matter of amounts. We gave the animals more table salt and baking soda than we gave of strychnine and white arsenic. This is not a matter of a substance being a poison or not a poison, but it is a matter of whether or not the substance gets into the animal body in excessive amounts. You can readily kill an animal by an excessive amount of table salt or baking soda, but there is no reason in the world why you should. In the same way, we can readily kill an animal with an excessive amount of strychnine or white arsenic or nearly any other material, but there is no reason why we should. We realize of course that the smaller the toxic dose the easier it is to get a toxic amount and the more careful must be the handling precautions.

A chemical substance is not of malicious intent. It will not, with malice of forethought, reach out and bite us. It has consistent and definable properties. If we ignore these properties and misuse the substance, we can expect trouble. We see that we ourselves, in our own acts, contribute an essential part of the pattern leading to injury. Therefore, with more knowledge, and less disregard for the knowledge we have, we can eliminate to a large degree, the hazards of misuse.

There are three basic modes of contact to be considered in the practical problem of handling a substance. The breathing of an air dispersion (dust, vapor, mist, etc.) contact on the skin or eyes (with either irritation or absorption), and entrance by mouth. The practical hazard of breathing air dispersions is not determined solely by the toxic concentration. The ease of obtaining a toxic concentration is just as important, and this depends not only on the physical properties of the substance but also on the circumstances of use. Whatever the mode of contact and entry to the body, the ease with which excessive amounts may be contacted is more important than the toxicity alone. In other words, the toxicity is not a measure of the Practical Hazard.

The 'practical hazard' is determined by the Physical, Chemical, and Physiological properties of a substance plus the circumstances of use. The subject of interest to us is actually the Practical Hazards of our contemplated use.

So far I have emphasized the toxic hazard. We should never forget the fire hazard. It has been by all means more damaging to life and property. As a friend of mine expressed it in a general discussion on hazards warnings, 'We will blow more people through the window with CS_2 than we will ever poison with it in spite of the fact that it is a highly toxic substance'.

In one way we are a step farther ahead in considering fire hazards than we are with toxic hazards. Most people are more realistic and less emotional in considering a fire hazard. We are in general more cognizant of the fact that something can be done about them. However, be it fire hazard or toxic hazard, the basic fault is in misuse.

It is obvious then, that our problem is one of eliminating misuse. In order to do this, we must recognize what constitutes misuse of any particular substance and we must define what is proper use. Even after we have this information, it is necessary that we disseminate this information to the individuals who may handle the substance and convince them to apply safe handling practice.

While there are certain basic similarities between the problems in industry and the problems in the home, there are also certain differences which make it desirable to consider each one separately. Let us then turn our attention first to our industries. In considering industries please remember that the agricultural industries are our most important industries, and should not be neglected by those people whose responsibility it is to concern themselves with industrial health and public health.

If you are faced with a decision in regard to the design and operation of a process entirely new to your organization or area, you will probably want to investigate the known information as it appears in the literature. Let us then examine a typical case of a particular substance.

I quote in part from an abstract concerning the use of this particular substance we will call X - "Onychia Due to Handling 'X'". "All but two finger nails were affected in a woman" - working with X - "Some nails were stripped off, others were split and lifted from the bed. Granular tissue could be broken away when the nail plate was lifted." - - The condition cleared up when the woman stopped her work." - -

I quote in part from another abstract concerning the industry manufacturing 'X'. "Usually the disease begins with slight fever, chills and malaise. A localized infiltrated patch appears in the healthy skin, which in a few days develops the characteristic of an extremely painful boil, with lymphangitis and adenitis." - - "Laborers in the X manufacture usually present a squamous dermatitis between the fingers and on the back of the hands." - - "X causes gingivitis" - - "In extreme cases the teeth fall out."

In considering the facts presented by this abstract, you might readily consider that you would be faced with some serious health problems in operating such a plant. However, we note that the substance X is 'sugar'. This puts a rather different light on our interpretation of the fact. In analyzing our own thoughts, then, we realize that we may be as much affected by a somewhat emotional consideration by which we ignore the problem associated with a familiar substance and greatly overemphasize the problems associated with the use of a substance with which we are not familiar. This is not entirely unjustified because we have more reason to be confident of the information on a familiar substance. Too often, however, we find to our surprise that we have more information on a new substance than on some old familiar ones. Many of our older materials are accepted just because we are getting by.

We often observe in people handling chemicals a respect for a substance with a disagreeable character such as an odor although there are no serious hazards from its use. At the same time we see disregard for the hazards of a substance without disagreeable characteristics although verbal warning has been given of its potential health hazard. In a like manner a workman is often concerned over a small superficial irritation which is an obvious nuisance while apparently unconcerned over serious potential internal injury which may not be physically obvious to him at the moment.

In approaching the problem of a new process in industry, we obtain what information we can from the literature and from the toxicological laboratory as to the physiological effects of the substances. We also obtain as much detailed information as we can about the physical and chemical properties of the substances and the mechanics of the operations in a proposed plant for manufacturing or using these materials. From this information we should be able to put together a picture by which we can determine the possibilities of exposure in the operations and from the toxicological information determine whether or not these potential exposures represent a practical hazard. This is of course much simpler to state in a few sentences as I have stated it, than it is to accomplish in fact. The discussion of the details of working out this problem are beyond the time which we have available today. Let us assume that we have accomplished this survey, and have a pretty good comprehension of the problems which we may encounter and the means of safe handling of the material. How are we going to implement that in our industry so that we are successful in eliminating misuse and misoperation.

The first and most important step in our industry is to get our chemical engineers and designing engineers to recognize that the potential hazards involved in the manufacture and handling of the material are as much a part of the problem of design and operation of a plant as are the physical properties of the substance or, for that matter, the load on the structural members of his building. If we can get the designing engineer and the building engineer to take these factors into account in the original layout of his apparatus, we are making the most important step towards safe operation at a minimum cost.

The second main object to be obtained in the industry is to convince the operator that the proper use and handling of a material in his operations is just as important as the control of temperature and pressure in his process, or the productive output of his plant. When the operator accepts the health problems of his operation as part and parcel of the regular operating duties, then we have a good chance of eliminating injuries due to exposure to the substances in his process.

The final answer to our problems in industry comes from the success we have in putting across an understanding of the problems to the people in design and in operation. The attainment of the proper knowledge of the subject is just the beginning.

Please excuse me for a great over-simplification of the problem in industry. But as I want to leave these two main approaches with you, I do not want to go into further detail in discussing the industry's problem. The two factors, first, of accepting toxicological properties of a substance as a logical part of the problem of basic design; and secondly, of accepting problems of exposure as part of good operating technique, are fundamental to the elimination of health hazards in industry.

Now let us turn to the home. The greatest difference we have between the industry and the home is the fact that in industry supervision has some control over both the engineering of a process and the individuals in operation. In the home we have no direct control and very few channels for passing on information concerning the safe use of materials.

Recognizing the possibilities of over-simplification, I want to reduce the problem as it occurs in the home to the three factors that I feel are the greatest contribution to accidents with chemicals:

We will recognize that the label, containing the information on the proper use of a substance and any warnings as to certain misuses of the substance, is our most direct channel for informing the individual in the home. Our first great difficulty is the fact that people neither read the labels nor apply the information contained thereon. An attempt to get people to pay attention to the information contained on the package within which they receive the material would be a very great step forward in avoiding misuse of the material in the home.

Our second difficulty is created by improper storage. Mother brings home the groceries including a can of rat poison and dumps them all out on the kitchen shelf until she gets around to put them away. Meanwhile, little Johnny explores to see what he can find. All substances which are not to be eaten should be stored away from food stuffs and out of the reach of children.

The third major factor is of the greatest importance by far. I refer here to the tendency to transfer various substances to common containers around the house, such as a drinking glass or a pop bottle, which are then left readily available to children or other adults. This is probably the source of the greatest problem in handling substances in the home. Very much in the same category will fall the individual who purchases a small amount of material in the corner store and has it poured out into a pop bottle or other unlabeled, unidentifiable container, which he then proceeds to take home and leave where it is easily available to people who are not at all familiar with its content.

Let's examine but one result of such procedure. You will recognize immediately that it is not the most hazardous substance that causes the most difficulty in the home. Such a common material as kerosene which in itself is certainly not a highly toxic material, accounts for the vast majority of serious poisonings in children throughout the United States every year. Practically all of these cases are completely inexcusable in that mother or dad poured some kerosene into an ordinary drinking glass and then left it where a child could pick it up. This is certainly the commonest pattern. Kerosene is not singled out here as a toxic substance, actually, just the reverse. Nearly any other organic fluid under the same circumstances would represent just as much of a problem and many of them vastly more. Actually, kerosene emphasized my point that the toxicity of a substance is not by any means the impertant part of the problem. Kerosene is among the least toxic of the organic fluids with which we would be concerned in the home. The problem is that it is one of the commonest available in the home and probably the most carelessly handled.

Think of the almost unlimited number of common substances used around the home: washing compounds, household insecticides, agricultural chemicals, disinfectants, drycleaning materials, common solvents, natural gas, gasoline, turpentine, and many others. They vary in flammability and toxicity from potentially highly hazardous to almost innocuous, yet every one of them can be misused in some way. At the same time there is not one of them, no matter how hazardous it may be, that cannot be used with safety, if its properties are understood and it is handled with due consideration to its properties.

I could have given you a long dissertation on the detailed hazards of individual chemical substances and a tabulation of the various ways in which we could avoid difficulties. Practically all of this information has been published in some form. It appears in brief form on package labels and in more detail in the general literature. Much of this is already known to you. In analyzing the whole picture, it seems to me that, while this information is important, there is still the matter of convincing the people directly concerned to actually eliminate misuse. I have tried to discuss for you some of the more obvious angles of this problem we have of inducing people to apply some simple common sense to the handling of chemical substances in the industry and in the home.

We all recognize that it is possible with the proper knowledge and care, to handle practically any substance, no matter how toxic or flammable. We also recognize that we can misuse nearly any substance so that there may be hazard to the health of individuals concerned. Our aim is not to eliminate materials from our industries or from our home because they may be flammable or toxic, but our aim is to eliminate careless or ignorant misuse so that you and I and everyone else can enjoy all the advantages of the useful properties of these substances.

"MANAGEMENT'S RESPONSIBILITY FOR PREPAID MEDICAL AND HOSPITAL PLANS"

Ross Garrett
Ross Garrett and Associates
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At the American Hospital Association convention in 1948, Mr. Frank C. Rand, Chairman of the Board of the International Shoe Company, spoke on the subject--"The RESPONSIBILITY of American Industry to Health."

In discussing the RESPONSIBILITY of American industry to health, Mr. Rand stressed the fact that industry, working alone, would be unable to raise standards without the cooperation of hospitals, medical schools and the medical profession. Hospitals and the medical profession, he said, need to assume GREATER RESPONSIBILITY in the health-maintenance programs for industrial workers.

Mr. Rand said that industry could make its BEST CONTRIBUTION to the Nation's health by WORKING WITHIN THE FRAMEWORK of the NON-GOVERNMENTAL HOSPITAL SYSTEM. He explained that neither industry nor government should take FULL RESPONSIBILITY for the Nation's medical care; instead, he said, it should be a cooperative enterprise with final responsibility remaining with the individual.

It is interesting to note the repeated appearance of the word -- "RESPONSIBILITY" -- and to note further that all those who assume RESPONSIBILITY profess the need for assumption of comparable responsibility by the other segments involved in the SUM TOTAL RESPONSIBILITY.

While my subject today is not as all-inclusive as was Mr. Rand's, inasmuch as it is limited to only ONE predominant segment -- namely, RESPONSIBILITY for PREPAID MEDICAL AND HOSPITAL CARE PLANS-- I too wish to stress the fact that a sum is still the TOTAL of ALL ITS PARTS and that this is TRUE in the field of RESPONSIBILITY.

If the creator of the phrase -- "eternal vigilance is the price of liberty" -- were with us today, he could well adjust his statement to -- "eternal assumption of RESPONSIBILITY is the price of liberty."

With millions of the population already participating in non-governmental prepay medical and/or hospital plans--as of today, management's minimum possible RESPONSIBILITY can be said to begin with choosing to act AS THE COLLECTION AGENCY

. for NON-GOVERNMENTAL prepay medical and hospital plans

OR . for A GOVERNMENTAL prepay medical and hospital plan.

That choice in minimum RESPONSIBILITY remains as management's prerogative as of today. In England that choice has been removed from management of industry -- coincidentally, so have other choices of RESPONSIBILITY, demonstrating that liberty can readily be lost when management, with plenty of KNOW HOW does not KNOW WHERE, KNOW WHEN nor KNOW HOW MUCH to exercise established or unavoidable RESPONSIBILITIES during the era of choice.

The nation's expenditures for non-governmental hospitalization facilities have increased 140% since 1941 to a total of 1 1/2-billion dollars in 1948. Payments to physicians increased 100% since 1941 to total over 2-billion dollars in 1948. HOSPITAL ADMISSIONS ALONE INCREASED MORE THAN HALF A MILLION in 1948 OVER THE RECORD of nearly 16-million in 1947.

Cross-country need for hospital beds has grown by about 2/3 in 10 years, it is revealed. Most families live now in smaller quarters without facilities for sick care. Higher living costs have added to those unable to pay hospital bills in full.

Management's RESPONSIBILITY for establishment of a fiscal system to set aside monthly fixed or pre-determined amounts of money to create a reserve fund out of which to pay the COSTS of repairs and replacements to non-human machinery in the industrial plan is accepted as an important factor by most industries.

It might well be called management's RESPONSIBILITY for PREPAY PLANS TO MAINTAIN a state of health and well-being for the NON-HUMAN machinery of production. Enterprising management thus invented its own way of assuming RESPONSIBILITY to protect the initial investment of the stockholders of American industry --i.e.,

on the basis that a profitable investment
is not profitable if the initial investment
is depreciated without reserves for replacement
being set aside before paying a profit.

Let us now constructively explore management's RESPONSIBILITY with respect to the same type of system for maintaining well-being or repair of the HUMAN machinery involved in the sum total of industrial production methods.

FIRST and FOREMOST, let it be remembered that we have just demonstrated that management itself, WITH ITS OWN "KNOW-HOW", originated and developed the principle involved in prepayment plans..

SECOND, let it be remembered that applications of the principle to, and development of, PREPAY HOSPITAL PLANS--(called group hospitalization, and later Blue Cross)--was by men of management sitting as Members of Boards of Trustees and Directors of those plans, exercising their management-developed "KNOW-HOW" in behalf of the people in their communities, their own employees included.

Now, therefore, it may be logically said that management's RESPONSIBILITY for prepaid medical and hospital care is to EXERCISE VIGILANCE over its already-assumed responsibility.

Management should not rest content to act as a collection agency for prepay plan. Management can best assume its responsibility for prepay medical and hospital plans by simultaneously exercising its prerogative as management to consult with management of prepay plans - serve on Boards of Trustees of such plans - participate as members of advisory groups to such plans - CONTRIBUTE of THEIR "KNOW-HOW". Help solve the A-B-C sixty-four-dollar questions facing management of prepay plans:

A. PREPAID BY WHOM?
B. PREPAID FOR WHOM?
C. PREPAID THROUGH WHOM?

Management has the responsibility to participate in prepay-plan affairs -- to wield the KNOW-HOW of their OWN paint brushes and thus help paint the picture for the future of prepay medical and hospital organization and management.

Such management will carry out its responsibility in accordance with Mr. Bernard Baruch's so-aptly coined phrase -- "and, above all, we should keep in mind that the humanities come before the dollars. It may be trite to say it, but it should be said, again and again, that our first duty runs to man before business, but we must not forget that sometimes the two are inter-changeable."

"COOPERATION IS NOT A SENTIMENT -- IT IS AN ECONOMIC NECESSITY."

"PUBLIC HEALTH ASPECTS OF ATMOSPHERIC POLLUTION" 1/

George D. Clayton
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Washington, D. C.

Wherever human beings congregate there is atmospheric pollution. If we did nothing else but breathe, we would contribute to the contamination of the atmosphere....for the air which we exhale has been changed in composition from that which we inhaled. But our mode of living causes us to contaminate the atmosphere even more. Our modern civilization requires us, for example, to heat our homes and cook our foods; our industries, and our public transportation facilities all add to the general atmospheric pollution. We cannot even take our families out for a Sunday drive without aggravating the situation. I present these facts to you to indicate the universality of the problem as well as its complexity. In order to visualize its many facets, let us analyze two of the phases of the problem, namely, (1) effects, and (2) contaminants.

EFFECTS

The effects may be considered under the heading of (1) nuisance, (2) economics, (3) vegetation, (4) animals, and (5) health.

While this paper deals with the public health aspects of atmospheric pollution, these are not the only phases of the problem; and in many cases they are not the most significant. Therefore, brief mention is made of some of the other aspects in order to look at the health phase in relation to the problem as a whole.

Nuisance - The nuisance aspects of the atmospheric pollution problem are well knows. Obnoxious odors, loss of visibility, and the dirt of settled particulate matter have been experienced by practically everyone.

Economics - Another familiar effect of atmospheric pollution is discoloration of buildings, including stone, brick and painted surfaces. Blackened surfaces and encrustations of soot material frequently obliterate essential lines and decorations. They literally disfigure a building and seriously reduce its aesthetic and decorative value. More serious, however, is the corrosive action of acid gases on buildings. One of the effects of this reaction is the formation on stone surfaces of hard, impermeable skin which tends to blister and exfoliate. It has been reported that sheets of galvanized iron had a life span of 3-6 years in Pittsburgh as compared with 7-14 years in a smoke-free community; and that copper would last only 10-20 years in Pittsburgh, whereas it would be good indefinitely where there is relatively little atmospheric pollution. The effect is well known of certain acid gases on paint, as exemplified by the blackening of white lead base paint by hydrogen sulfide.

Vegetation - The civic beauty of a community is often reflected in the upkeep of its parks and the landscaping of its homes. The farms at its outskirts also are an essential part of a prosperous community. The effects of atmospheric pollution on vegetation are therefore an important consideration. A polluted atmosphere may injure plant life more than it harms animal life. The effects of polluted air are shown by stunting in growth, loss of vigor, reduction in crop yield and degradation of color. Sunlight is more directly essential to plant life than to other forms of life for the plant depends on the light falling on its leaves for the conversion of carbon dioxide to the carbohydrates that largely make up its substance. In other words, light is as essential to plants as carbon dioxide. On an annual basis the light reduction caused by pollution in the atmosphere may be up to 40 or 50 percent. Further loss is experienced by the plant because the coating of particulate matter that accumulates on its leaves makes it increasingly difficult for the life-giving rays of the sun to reach the leaf. This coating of particulate matter on the leaf surfaces also tends to choke the minute openings of the leaf through which the plant breathes. Particulate matter causes further damage to the living cells and destroys chlorophyll by holding the acid gases in the atmosphere in contact with the leaf. In many cases the leaves and tender plants are scorched beyond recovery. Further increase in acidity of the soil due to atmospheric pollution can adversely affect vegetation.

Animals - Evidence is available which indicates that animals are affected by atmospheric pollutants. The Donora investigation revealed that dogs manifested acute toxic effects during the prolonged smog conditions. There was some evidence to indicate that other species of animals were also affected.

Another effect that is not as dramatic but nevertheless important is that resulting from the ingestion of contaminated vegetation. Studies have indicated that although the concentration of a particular contaminant in the atmosphere might not be present in sufficient quantities to produce injurious results to livestock by inhalation, an accumulation or deposit of the contaminant on vegetation eaten by animals may result in lowering the vitality, stunting growth, and could eventually lead to death.

Health - For the purpose of this discussion, the problems of airborne disease of biological etiology, and airborne diseases of plant origin (such as allergies) will not be considered. The discussion will be limited to diseases caused by airborne dust, fume, and gas, - products of our civilization.

Since the thirteenth century, attempts have been made by various investigators to show the relationship between atmospheric pollutants and illness. The results of these investigations were either inconclusive or the claims could not withstand the close scrutiny of the medical profession. Therefore, the majority of the medical men looked upon atmospheric pollution primarily as a nuisance and not a health problem. As a result of the Donora episode, the question has again arisen, IS ATMOSPHERIC POLLUTION A HEALTH PROBLEM? To answer this question one must consider the problem from the viewpoint of both acute and chronic effects. For the acute phase, the answer is definitely in the affirmative. Our investigation into the Donora episode indicated that people dies and thousands became ill during the prolonged smog conditions.

It is not simple, however, to determine what the effects on the populace are of long-term exposure to atmospheric pollution. If these effects are to be ascertained, we must have answers to certain questions, such as:

1. What effects does atmospheric pollution have on persons with pre-existing maladies such as disease of the respiratory tract, heart disease, and possibly others?

2. What effect does atmospheric pollution have on elderly people who by the aging process naturally develop degenerative diseases of the lungs and heart?

3. What effect does atmospheric pollution have on children who have an increased respiratory rate as well as increased metabolism?

4. What effect does atmospheric pollution have in lowering the resistance of persons so as to predispose them to infectious diseases, particularly of the respiratory tract?

5. What effect does atmospheric pollution have on the mental health of individuals?

To answer these questions, it will be necessary to know more about the properties and effects of the contaminants themselves such as:

1. What concentration of contaminants is required to produce acute and chronic effects?

2. Does a combination of contaminants act individually? Is the effect additive, , or is the effect greater than the summation of the individual effects?

3. Under what meteorological conditions would contaminants increase to harmful concentrations?

These and many other questions must be answered before one can adequately evaluate the long term effects of atmospheric pollution on the health of the general population. Only general knowledge is presently available, such as the fact that atmospheric pollution does decrease the quantity of the germicidal rays of the sun and in this way may indirectly produce adverse effects. It is also known that irritating gases and large amounts of particulate matter present in the atmosphere may reach concentrations which would have an adverse effect. The extent of such injurious effects is not known.

Maximum allowable concentrations of many toxic substances have been established for protecting the health of workers in industrial plants. However, these concentrations have been established for the type of personnel normally employed in industry (aged 18-60 in relatively good health) during the course of an 8-hour day. Hence, the maximum allowable concentrations familiar to industrial hygienists throw little light on amounts that can be safely breathed 24 hours a day by the general population, including the very young and the aged, as well as persons with organic diseases and those with special sensitivity to respiratory irritants.

It is important to emphasize that information available on the toxicological effects of mixed irritant gases is meager and that data on possible enhanced action due to absorption of gases on particulate matter are limited.

To obtain the necessary data will require both laboratory and field work on an extensive and time consuming scale. Although these long-range studies are essential to the solution of the problem of atmospheric pollution, this does not mean that practical control procedures can not be carried forward in the meantime. It does mean, however, that careful thought and planning are necessary if orderly progress is to be made.

CONTAMINANTS

Before an intelligent evaluation can be made of the atmospheric pollution problem, information, even though general, must be obtained on the contaminants found in an industrial community. For present purposes of simplification, the contaminants may be divided into two groups: (1) gases and vapors and (2) particulate matter.

Probably the most common gas found in the atmosphere is sulfur dioxide. Some of the other gases found in various amounts are carbon monoxide, carbon dioxide, hydrogen sulfide, oxides of nitrogen, hydrofluoric acid, hydrochloric acid, ammonia, and organic solvents.

Particulate matter is a term applied to dusts, fumes, mists and fogs. The size of particulate matter plays an important part. Large particles settle readily near the source of discharge under normal weather conditions. These particles are seen daily on the floor, window sills, and porches. The smaller particles, less than a micron in size, remain suspended in the atmosphere for an extended period of time. They are the particles that reduce visibility, shut out sunlight, and adhere to the ceiling, walls, and draperies. They are also, unfortunately, the most difficult to collect by known control procedures. They also serve as nuclei for the condensation of moisture resulting in fog. The types of particulate matter commonly found in the atmosphere are sillica, sillicates, fly ash, carbon, and the oxides of the various metals. The type of particulate matter suspended in the atmosphere depends on the types of industries present.

Source - After classifying the contaminants found in the atmosphere, one next must consider the source or point of generation of these contaminants. Products of combustion, for example, emanate from such sources as manufacturing plants, homes, trains, boats, incinerators and brush fires. Industrial operations of virtually all types add to the general atmospheric pollution load, and automobile traffic, construction, and wind storms also contribute to the overall problem.

Methods of Control - After atmospheric contaminants have been studied, the sources determined, and toxicological information reviewed, the next question is "What can we do about it? The methods of control of various pollutants are many. The principles used are in the main: (1) substitution, (2) conversion, (3) collection, and (4) dilution. Let us consider these four principles to see how they apply in practice.

1. Substitution - This principle is well illustrated by the substitution of Diesel switch engines for coal-burning steam engines. Although substitution has a limited place in industrial operations, it may be used wherever practicable to effect a substantial reduction in atmospheric contamination. In the designing of a new plant where air pollution is a potential problem, this principle could be of primary importance.

2. Conversion - Conversion is a term applied to the process of converting, for example, an obnoxious substance to one that is not obnoxious. Thus, organic compounds are often disagreeably odoriferous and extremely annoying even in low concentrations. It is possible to convert such materials into substances which are not particularly objectionable by passing the offending materials through furnaces for conversion into a less objectionable substance.

3. Collection - There are many types of collectors on the market today, among which are mechanical filters, cyclones, electrostatic precipitators, scrubbers and ultrasonic equipment. Each problem in the collection of atmospheric contaminants must be considered as a separate entity, and the engineer must take into account many factors before making recommendations. In some instances, installations have paid for themselves by the recovery and subsequent reclaiming of collected substances. However, we must bear in mind that this cannot always be expected, and that the sole benefit derived will be a decrease in atmospheric pollution.

4. Dilution - Dilution is a very practical control measure. It is well known that a substance can be annoying, even harmful, in certain concentrations. Yet the same substance can be diluted to a point where it is no longer objectionable nor injurious to a person's health. This dilution depends on the vertical mixing, turbulences and dissipation by the wind; hence, the science of meteorology can play an important role in this method of control. For instance, if a plant were located in an area where prevailing winds disperse the contaminants away from the inhabitants, there would be no problem so far as the human element is concerned. It is probable in the future that many companies before they erect a plant will consider the meteorology of an area, in addition to the availability of raw material, labor, transportation, and other factors, before the erection of a plant.

In review, there are many known principles which may be applied to the control of atmospheric pollutantts. However, it is not meant to imply that the control of contaminants is a simple task. Much is yet to be learned about the control of small dust particles, particularly in the size range of less than one micron. Additional information is needed on the removal of small percentages of contaminants from relatively large streams of air. At the present time, the cost of controlling some atmospheric contaminants is prohibitive. It is, therefore, a challenge to the engineering profession to devise methods to increase the efficiency and economy of equipment for the collection of atmospheric contaminants.

ORDINANCE

The majority of the larger cities in the United States now have ordinances on smoke abatement and atmospheric pollution in general. In considering the adoption of an ordinance on atmospheric pollution the community should use ordinances from other cities only as a guide. The reason for this becomes obvious when you consider that no two cities are alike with respect to the various phases of atmospheric pollution problems.

Before an adequate ordinance can be adopted a thorough investigation into the problem is necessary. Consideration should be given to such factors as topography, and weather conditions, such as temperature inversions, wind directions and velocity, and humidity. The type, extent, and locations of industries must be evaluated. The type of fuel used in the community is also an important consideration.

Successful atmospheric pollution abatement practices have shown the need for an active civic support. The support of chambers of commerce, women's clubs and business and professional organizations is needed in molding public opinion for the abatement of atmospheric contaminants. Representatives of various industries, citizens groups, public officials, medical and engineering societies, should be represented on an advisory board to the atmospheric pollution department of the community.

SUMMARY

The problem of atmospheric pollution is much too complex to be covered in the brief time available, and only some of the highlights have been mentioned. It is a problem which is important to all of us - not only from the standpoint of its possible effects on us individually, but also as it affects our entire economy. The cooperative efforts of many groups will be required to obtain the basic information which is necessary if we are to develop a progressive atmospheric pollution program. Only by an intelligent, concerted approach to this problem can we hope to arrive at those reasonable conclusions which will permit industry the right of operation, and the community the right to have an atmosphere which is relatively free of atmospheric pollution.

INDUSTRIAL WASTES AND STREAM POLLUTION SYMPOSIUM

October 7, 1949
David F. Smallhorst, Presiding

"TEXAS LAWS AND REGULATIONS CONCERNING INDUSTRIAL WASTES AND STREAM POLLUTION"

Burnell Waldrep
Assistant Attorney General
Austin, Texas

The problem relating to industrial wastes and stream pollution has become more acute within recent years, arising primarily from the expansion of industry and the increased demands for water free from contamination. This is evidenced by the increased interest in legislation on this subject and the many activities in the field of conservation of water.

It is the right of every riparian owner to have the stream continue to flow through or by his premises in its natural condition of purity and free from any contamination or pollution such as would render it unfit for domestic purposes, manufacturing purposes, agricultural purposes, stock purposes or which would be destructive to fish life. A statute prohibiting the pollution of water courses by the inflow of salt water, oil and all other substances is a proper exercise of legislative power.

The Legislature has enacted various statutes which appear both in the civil statutes and the penal code condeming the pollution of streams and water courses in this State. Article 4444, V.C.S., after prohibiting the pollution of water courses or other public bodies of water, from which water is taken for the uses of farm livestock, drinking and domestic purposes, has provided therein for the institution of suit for injunction as follows:

> "Upon the conviction of any person for violating this law the Court or Judge thereof in such conviction shall issue a writ of injunction enjoining and restraining the person or corporation responsible for such pollution........
>
> "The State Board of Health shall enforce the provisions of this Article........."

Under the above quoted provisions, a conviction upon a criminal charge is not a prerequisite to the issuance of an injunction, nor is the District Judge deprived of jurisdiction to enjoin. Cardwell v. Austin, 168 S.W. 385 (Tex. Civ. App. 1914); Goldsmith & Powell v. State, 159 S.W. 2d 534 (Tex. Civ. App. 1942, error ref.). Article 4444 has been before the courts in several cases and has been declared constitutional.[1]

Article 698b, V.P.C., is in part as follows:

"Sec. 2. 'Pollute' is hereby defined to be the throwing, discharging or otherwise permitting to reach or to be introduced into any public body of surface water of this State any substance, material or thing in such quantity that the said water is thereby rendered unfit for one or more of the beneficial uses for which such water was fit or suitable prior to the introduction of such substance, material or thing, or is thereby rendered harmful to public health, game birds or game animals, fish or other edible aquatic animals, or endangers any wharf, or endangers or hinders the operation of any boat, or renders insanitary or unclean any bathing beach.

". . . . . .

"Sec. 5. Any person, firm, corporation, association, city, town or other political subdivision of this state, or any agent, officer, employee, or representative of any person, firm, corporation, association, town, city, or other political subdivision of this State who violates any provision of this Act shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined in a sum not less than One Hundred Dollars ($100), nor more than Two Hundred Dollars ($200); and each day that such a violation is committed shall constitute a separate offense. As amended Acts 1945, 49th Leg., p. 373, ch. 240,§1."

Jurisdiction of all matters relating to the protection of aquatic life is vested in the Game, Fish and Oyster Commission by statute. The disposal of industrial wastes is fast becoming a serious problem in the Gulf Coast area since aquatic life would be materially affected in the bays and Gulf by an unreasonable use of the water.

For a discussion of the penal statute see Myers v. State, 184, S. W. 2d 924(Tex. Crim. 1945); Stevenson v. State, 167 S.W. 2d 1027 (Tex. Crim. 1943); Bell v. State, 99 S.W.2d 940 (Tex. Crim. 1936); Jackson v. State, 93 S.W.2d 1141 (Tex. Crim. 1936).

Article 5351, V.C.S., prohibits the pollution of water in any development in water or on islands or river beds, giving the General Land Commissioner the power to forfeit or cancel the lease for failure to comply with rules or regulations adopted. Article 5366, requires that all development in the Gulf coast lands belonging to the State shall be conducted so as to prevent pollution charging the Game, Fish and Oyster Commission with the duty of enforcing the rules. Article 7577, V.C.S., provides a punishment for pollution of any person who shall deposit in any canal, lateral, reservoir or lake used for any purpose enumerated in this Act, the carcass of any dead animal, tin cans, discarded buckets or pails, garbage, ashes, bailing or barbed wire, earth, offal, or refuse of any character, or any other article which might pollute the water.

The ownership of the waters of natural streams is expressly declared by statute to be in the State of Texas. Article 7467, V.C.S., and Article 4026, V.C.S.

The Constitution of Texas designates rivers and streams as natural resources and invests the Legislature with their care. Tex. Const., Article XVI, Section 59a.

The State of Texas as a sovereign has the power to prevent pollution of water courses and public bodies of water within the State of Texas and the State has successfully exercised its power to enjoin the pollution of its water courses. In Texas Gulf Sulphur Co. v. State, 16 S.W.2d 408 (Tex. Civ. App. 1929), the State sued the Sulphur Company and others seeking to enjoin defendants from contaminating the waters of the San Bernard River by permitting waste water from sulphur wells and other harmful substances to escape into the stream. The temporary injunction was granted and upon appeal from that order, the Court of Civil Appeals affirmed the case. While the issue of the power of the State to sue was not raised, the Court, did, however, say that the San Bernard River being shown as a water course the injunction properly issued in favor of the State under the authority of Article 4444, V.C.S.

In the case of Goldsmith & Powell v. State, 159 S.W.2d 534 (Tex. Civ. App. 1942, error ref.), the Court stated that the pollution of a public water course is a public nuisance. City of Corsicana v. King, 3 S.W.2d 857 (Tex. Civ. App. 1928). The Goldsmith and Powell case was an appeal from an injunction restraining certain oil operators in the East Texas oil field from discharging salt water into the Neches River, wherein the Court affirmed the case, and stated:

> "In this case there has been a definite showing that a high degree of saline pollution has been attained in the waters of the River, that all aquatic life is extinct in the river, that near and adjacent lands are unfit for agricultural pursuits, and that there is a definite threat that the present condition will become worse as the production of salt water increases in the East Texas Field. It is evident that as the oil reserve in the field is depleted, the production of salt water will increase, finally resulting in ninety or one hundred percent salt water."

The case of Magnolia Petroleum Co., et al, v. State, 218 S.W.2d 855 (Tex. Civ. App. 1948, error ref. n.r.e.), was an appeal from a temporary injunction restraining certain oil operators in the Luling and Salt Flat oil fields from discharging salt water into the Guadalupe and San Marcos Rivers. The case was affirmed by the Court of Civil Appeals and the Supreme Court refused the application for writ of error, no reversible error. The Court stated:

> "Appellants having no lawful right to discharge or cause the discharge of any salt water into public waters used for domestic purposes, the order of the trial court was not too broad.
>
> " . . . . We are not dealing with imminent danger or threat of irreparable injury. We are confronted with actual and long continued pollution of public waters. Appellants say that the pollution will diminish as they take preventive measures. This is commendable, but it does not satisfy the law that there be no pollution and courts are not required to bide their time and wait until the parties see fit to discontinue their unlawful acts."

In the case of Continental Oil Co. v. City of Groesbeck, 95 S.W.2d 714 (Tex. Civ. App. 1936), a temporary injunction was issued restraining the oil company from polluting the city's water supply by the discharge of salt water and other obnoxious matters into the Navasota River. The Court, in affirming the issuance of the writ, said that the writ does not enjoin the appellant from doing anything that it has a lawful right to do, stating that it is unlawful in this State for anyone to pollute any water course or public body of water by the discharge of salt water therein where the water is used for domestic purposes.

The foregoing authorities would be equally as applicable to other industrial wastes and any unreasonable use of waters.

Pollution cases instituted by the State of Texas are as a general rule predicated upon three theories, such remedies being distinct and cumulative and as follows:

(1) The State has the power to abate a common law nuisance entirely aside from statute.

(2) An injunction may be granted under the authority of Article 4444, V.C.S.

(3) The State may prevent the pollution of public bodies of water, the property of the State, by invoking the penal statute, Article 698b, V.P.C.

An injunction will issue against defendant operators who are contributing to the pollution of public water courses, such pollution being a nuisance and a violation of the statutes without the necessity of pleading and proving negligence. However, the Texas Courts have repudiated the absolute liability doctrine of Rylands v. Fletcher, L.R. 3 H.L. 330 (1868), and the law in this State so far as damages to private property or bodies of water are concerned is that there can be no recovery of damages or injunctive relief without pleading and proving negligence on the part of the defendant operators. 4 Summers Oil and Gas, 25 Sec. 655, states:

> "Only in Texas is the liability of the oil operator made to depend upon his negligence. In that State his liability is absolute, if injury results from the pollution of the water course, the pollution of which is prohibited by statute. But if a landowner's crops are destroyed, his cattle poisoned and his farm converted into a worthless salt marsh by the flow of salt water and oil over the surface not in a natural water course, he cannot recover damages for the injuries suffered unless he alleges and proves specific acts of negligence by neighboring oil operators which caused them. If he fails in these requirements of pleading and proof, he is comforted only by the knowledge that the devastation was accomplished with due care."

In the case of Turner v. Big Lake Oil Company, 128 Tex. 155, 96 S.W.2d 221 (1936), plaintiffs sued the defendant oil operators to recover damages for pollution to "Garrison Draw" alleged to be a public water course and the plaintiffs also alleged the pollution of certain water holes on their land. It was alleged further that the defendants collected salt water and negligently permitted the dikes to break. The jury found for the plaintiff on all counts except that the defendants were not negligent. On appeal the plaintiff contended that it was unnecessary to show negligence since the pollution was prohibited by the Penal Code and their negligence per se. The Court of Civil Appeals affirmed the trial court holding that the water holes were clearly private property and that there could be no recovery without a showing of negligence. The Supreme Court affirmed this holding saying that plaintiffs must allege and prove some specific act of neglect or must allege and prove that the water polluted was a water course. The court fully discussed the rule of Rylands v. Fletcher and refused to apply it, but the Court did intimate that if a nuisance is created, proof of negligence is not necessary. See Nash and Windfohr v. Edens, 109 S.W.2d 496 (Tex. Civ. App. 1937, error dism.). Generally speaking, if the pollution constitutes a nuisance, proof of negligence is not a prerequisite to relief. 31 Tex. Jur. 421, Sec. 11; M.K.T. Ry. Co. of Texas v. Williams, 5 S.W.2d 575 (Tex. Civ. App. 1928, error dism.).

In analyzing the many situations contravening the pollution statutes, it might be well to determine the applicability of the statutes referred to in this discussion. There is a wide divergence of opinion among industry and others as to what constitutes pollution. Article 698b, V.P.C., refers to polluting substances which render water unfit for the beneficial uses to which adapted and it can be readily seen that any particular pollution problem becomes a fact question.

A riparian owner may not use the water of the stream so that the water is so corrupted and polluted so as to practically destroy or greatly impair its value to the lower riparian owners. What is a reasonable use is primarily a question of fact, but whether the undisputed facts and the necessary inferences therefrom establish an unreasonable use is a question of law. It is to be determined in view of all the facts and circumstances of the particular case.

A compound that would pollute one body of water may not pollute another and certain substances discharged in certain quantities in one stream might pollute the same whereas in another it would have no harmful effects. Therefore, it might be said that any substance placed in a stream of this State of a harmful nature may constitute pollution. There are no standards relating to polluted streams except the standards for drinking water. Section 422 of the Federal Standards for drinking water states that any water containing in excess of 250 parts per million in chlorides is not suitable for drinking water and this standard has been approved by the courts of this State. It should be noted in this connection that one who contributes to the creation of a nuisance by pollution may be enjoined even though his contribution is small and would not amount to a nuisance without the aid of the other contributors. Goldsmith and Powell, supra; State v. Smith, 40 N.W. 727 (Iowa Sup. 1891).

The subject matter herein has been dealt with generally in view of the time allotted and no particular phase of the pollution problem has been exhausted.

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"INDUSTRY AND POLLUTION-ABATEMENT IN THE OHIO RIVER VALLEY"

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Some people are saying that the pollution-abatement program in the Ohio River is destined to call a halt to all industrial expansion. This statement must be just as startling to you as it is to me. But that is exactly what I heard a few days ago from a delegation of industrial-promotion men who called upon the Commission.

It occurred to me, therefore, that it might be useful to relate what transpired at this meeting. In so doing I am hopeful that questions you have regarding the operations of the Ohio River Valley Water Sanitation Commission might be clarified.

First, I must give you a bit of background: Shortly after this Commission had been organized a major chemical concern, let's call it the "X" Company, sought a permit from one of the states in the valley to install a new plant. In its application the company furnished an analysis indicating that wastes from this plant would be large in volume, would contribute a substantial amount of hardness to the Ohio River, and for which there was no known method of disposal other than dilution. Obviously, here was a potential pollution situation of concern to more than one state. And with the Commission established, the matter was placed before the chief sanitary engineers of the states affected. This led to a study following which unanimous agreement was reached that a permit for this operation should be denied.

Backed with such support the health authorities in the state wherein the "X" company sought to locate, refused to sanction operation of the plant without adequate provisions for waste disposal. As a consequence the company decided it would look elsewhere for a site.

A lot of people had worked hard to attract this industry to consider the state. And you can be sure that they had a lot of questions to ask when the deal fell through because of pollution-abetement requirements. Thus it was that the state director of commerce and top representatives from the state Chamber of Commerce, a major railroad, and a power company, came to Cincinnati to talk over the situation.

First came this question: How does the Commission operate? That was an easy one to handle. The Commission is composed of representatives from eight states, which had signed a compact in June 1948, that pledged their "faithful cooperation in the control of future pollution and in abatement of existing pollution from the rivers, streams and waters in the Ohio River basin........"

The eight states are Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia and West Virginia. Each state is represented by three commissioners, appointed by the governor. In addition, there are three federal commissioners, appointed by the President of the United States, representing the Surgeon

General of the U. S. Public Health Service, the U. S. Army Engineers, and the Fish and Wildlife division of the Department of the Interior. The role of the commissioners is to determine policy for carrying out the provisions of the Compact.

One of these policies enunciates this principle: Objectives of the Commission will be accomplished whenever possible through the use of or through cooperation with the established regulatory agencies of the states. This means that Commission operations are designed to supplement rather than overlap those of existing state health departments or other state water-control agencies.

Thus, municipalities and industries will continue to deal directly with these agencies as they have in the past, regarding compliance with pollution abatement measures. However, coordination of individual state programs, the pooling of information and the direction of basin-wide activities are the functions of the Commission.

A good illustration of state and Commission relationships is provided in handling the case of Company "X". Here an upriver state was faced with the decision regarding a permit for discharge of a pollutional waste. The industry concerned made its representations to the state sanitary engineer. He, in turn, called upon the Commission to conduct a study of the effect of this waste downstream, to present these findings to the other state sanitary engineers and ask for their opinion. Since the conclusion was unanimous and the company accepted it, there seemed to be no further need for a public hearing or other Commission action on the matter.

That brought forth the second question: What about public hearings and the power of enforcement by the Commission? The answer to this was a little more involved.

Provision is made in the Compact for the conduct of two types of public hearing:

(1) Hearings are required in cases where the Commission may find it in the public interest to require a higher degree of treatment than the minimum prescribed in the Compact. This minimum, incidentally, is "substantially complete removal of settleable solids and the removal of not less than 45 per cent of the total suspended solids............" Since its establishment in June 1948, the Commission has conducted only one public hearing of this type. This was based on a finding that waters in the 22-mile stretch of the river known as the Cincinnati Pool called for greater removal of B.O.D. than would be afforded by primary treatment.

(2) A public hearing is also called for should the Commission find it necessary to issue an order through the appropriate courts for corrective measures upon any municipality or corporation.

It is the Commission's hope, of course, that it will achieve its objectives through persuasion and education. When and if this approach proves ineffective, appropriate legal compulsion can be initiated. This action is taken following the assent of a majority of the Commissioners from not less than a majority of the states, as well as the approval of a majority of the Commissioners from the state in which the order is to be issued. In terms of numbers this means that two commissioners from each of 5 states, or a total of 10, must agree; and in addition there must be included a favorable vote from 2 of the 3 commissioners from the state affected.

It is of more than passing interest to point out that this unusual power-of-enforcement clause captured the attention of delegates to the Academy of International Law at The Hague during a seminar this past summer. The Ohio River Valley Water Sanitation Compact was cited as having been "born with perhaps the strongest teeth of any American interstate organization, indeed stronger than any international organization........." And there was also this profound observation: "... the Commission's power to invoke the strong sanction of enforcement is the best guarantee that only rarely will it need to be exercised".

"This is all very fine", said the industrial delegation, "but why didn't you hold a public hearing in the case of Company "X"? The obvious answer, of course, was that the company accepted the state ruling and did not request a public hearing from the Commission. Incidentally, the Commission saw no gain to anyone in having the matter publicized in a hearing or through the press. This particular company was one of national standing. Any publicity focussing attention on the fact that it was seeking to operate a plant that would pollute or otherwise affect the water quality of a major river could hardly be construed by the company as contributing to its best interests.

While the Commission is fully aware of the power of aroused public opinion it does not propose to use such means to achieve its ends unless other efforts fail. Since the "X" company showed no desire or reason to air its case before the public, the Commission had no cause to feel otherwise.

All of which led to another question: "Why does the Commission involve itself with industrial wastes when its title would connote concern only with sanitation matters?

This was very significant. It had never occurred to me that certain people viewed industrial wastes as something quite apart from other wastes that contribute to the degradation of water quality. I'm sure the question relating to the Commission's concern with industrial wastes was asked in all sincerity because a remark was then made that nobody ever got sick drinking hard water. Why, therefore, should the Commission take a stand on the addition of hardness to a river?

This led to a discussion outlining the following view: It was not so much the additional hardness from Company "X" that would work a serious hardship. But it was the cumulative amounts of hardness from all the plants to be built in the future that could eventually create a severe economic burden on every user of river water. If Company "X" had been given permission to dump its wastes, then the same privilege would have to be accorded every other plant that sought it.

Emphasis was now shifted from health and sanitation aspects to a question on which industry could speak with unimpeachable authority. In fact, this was not a question; it was a statement, which said in effect: If the Commission enforced pollution abatement and forbid the discharge of wastes into streams it would put every industry in the Ohio River Basin at a competitive disadvantage with the rest of the country.

This statement was open to challenge in several respects. First, the Ohio Basin enjoys a special position with regard to raw materials, geographic location and labor supply that probably is not duplicated elsewhere. Second, the majority of the status in the Basin are signatories to the Compact and are operating or about to operate under similar pollution-abatement restrictions. Furthermore, adjacent states either have comparable legislation or are in the process of drafting more effective pollution-abatement laws. As a consequence, it did not appear at all likely that an industry could find a location where it might enjoy indiscriminate dumping of its wastes. Public opinion has advanced too far to countenance such conditions, as evidenced by strengthened antipollution measures in the states and the existance of federal legislation for this purpose.

Instead of a competitive disadvantage from pollution abatement, it was argued, industry stands to gain competitive benefits from stream-cleanup. There is hardly an industry that would not be in a better profit-making position if it could get better water at lower cost. Most industries are paying a substantial premium to have their present raw water supplies converted into a product suitable for their use. And the more polluted the source, the higher the premium. In fact, there is abundant evidence that one of industry's most critical problems today is to assure itself of an adequate and desirable supply of water. Anything, therefore, to insure this condition, such as pollution-abatement, would seem to favor industry rather than penalize it.

Furthermore, there is always the probability that under the compulsion to do something about its waste problem an industry may reclaim a by-product, or at the very least, make substantial reductions in the amount of waste.

There is nothing academic in this statement: Look what happened in the distillery industry. Waste recovery measures have resulted in the production of a cattle food that now commands more than $100 a ton. I don't know what the profit margin is but I can assure you that the distillery people are more than mildly enthusiastic a bout pollution abatement.

Another example, this time a steel company in the Ohio Valley. After years of opposition to the installation of works for the recovery of blast furnace flue-dust that had been dumped into the river, a plant was built at a cost of $516,000. In the very first year of operation this plant recovered enough ore dust not only to pay for its operation, but to yield, in addition, a net profit of $581.000!

And finally, this story told me by a chemical company executive. He said, confidentially, his firm was deeply indebted to a certain state health department because of a court order to abate pollution. When the plant chemists studied the problem they discovered that this particular waste was high in vitamin content. Today this plant has shifted its processing to extract vitamins and the material formerly produced has been relegated to the position of a by-product.

It is situations such as these that lead me to wonder if industry has been doing itself a great disservice by not giving more attention to what goes in and what comes out of its sewers. If one of our must powerful drugs can be extracted from a piece of moldy bread, you might let your imagination run riot with the potentialities in some of the things that now do nothing more than defile our streams.

And that brought us to the last question: If the Commission seeks to have industry take steps to install treatment works is it prepared to help and abet industries — particularly small ones — in seeking solutions for waste problems.

More than complete assurance could be given on this score. Already the Commission had embarked on such a program, although it has hardly been in operation more than a few months.

One of the problems to which it is directing immediate attention is phenol elimination — not only of major concern in the Ohio Valley but an industrial-waste problem of national significance. In this connection the Commission is acting in the role of directing and coordinating every resource that can be brought to bear on the problem. Thus far one of the major sanitary engineering research laboratories -- operated by private enterprise — has agreed to act as consultant and do certain laboratory work as a public service. Arrangements have been made with one of the nation's important steel companies for the installation of a pilot plant and to otherwise make available its resources to facilitate additional tests. Also associated in furthering these and related studies is the Cincinnati laboratory of the U. S. Public Health Service, along with the mobile laboratory of the Ohio State Department of Health.

Here, then, is an example of how the Commission seeks to coordinate the resources, skills and interests of private industry and public agencies on problems of mutual interest. Other projects are now in the planning stage.

May I add that the Commission is not setting itself up as a research agency. It has neither the funds nor the personnel to operate laboratories. Furthermore, as a matter of policy, the Commission has gone on record to state that it does not propose to engage in laboratory research. It firmly believes that existing state, federal and other established centers of research are readily available and eminently qualified to carry on such work.

Furthermore, the Commission believes, and has evidence to show, that industries do not expect this Commission or any other regulatory body to provide solutions for their waste-disposal problems. But the Commission accepts the responsibility that it should inspire and coordinate all efforts that will aid industries and municipalities in furthering stream clean-up at reasonable cost and as quickly as possible.

The Commission is sympathetic to the special problems of the smaller industries, with their limited staffs and research skills. It will seek to develop cooperative ventures on waste disposal among similar types of industry, particularly in conjunction with existing trade organizations.

It is not amiss to point out that the very composition of the Commission membership assures industry an adequate opportunity to register its views. Industry has five able spokesmen on the board of commissioners. Other members include outstanding professional men representing the fields of public health, fish and wild-life conservation, engineering, the legal profession and the press. Thus in the formulation of policy and the promotion of remedial measures the Commission will enjoy the benefit of a wide variety of viewpoints.

It was on this note that the meeting came to a close. I feel safe in saying that the industrial delegation had a clearer picture of the Commission operations. And this led to some practical suggestions whereby their efforts and ours might be integrated in working on problems of mutual interest.

As for the Commission, the meeting provided one of the best opportunities it has had to tell its story. It is a story that will have to be told many times because the audience to be reached is a vast one that encompasses millions of people and thousands of industries.

More important than the story is the message that it brings. For the Ohio River Valley this message is one of great hope -- hope for prompt restoration of clean waters through the united efforts of the states, their people and their industries.

"SERVICES AVAILABLE TO INDUSTRY THROUGH USPHS AND PUBLIC LAW 845"

Richard F. Poston
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Dallas, Texas

Presented by:

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For the past thirty odd years the Public Health Service has been studying our country's water pollution problem. Originally we were concerned solely with the public health aspects of pollution. This concern was generally tied into the problems of water treatment for domestic water supplies. Industrial wastes containing phenols were studied extensively, as they presented a serious taste and odor problem. Early studies of corrosion indicated acid mine drainage as an injurious industrial waste. The gradual development of our concept of water pollution has expanded along with industrial progress until today we are concerned with such complex wastes as are produced by butadiene manufacture and the refinement of fissionable materials.

Today we do not think of water pollution as only a public health problem. It has become much broader, encompassing water pollution as it affects water use for domestic purposes, for industry, for fish and other aquatic life, for agriculture and for recreation. The goal of our water pollution control program is the restoration of our water resources to a condition compatible with the greatest public good.

All wastes will not require the same degree of treatment, nor will all streams be required to meet uniform standards. It is conceivable that different reaches of the same stream will have different standards.

We are not so naive as to think our streams and lakes can be returned to their primeval condition of pristine purity and we realize that considerable time will elapse before some of our streams can be put into even partially acceptable form.

As a natural resource, our streams and waters should be used and conserved for the maximum benefit of the majority of our citizens. In certain exceptional cases the use of a stream to receive untreated or only partly treated wastes may present its best use.

It has taken two hundred years to get our streams into their present condition — we do not expect, nor can we bring about, the necessary corrective changes overnight.

It should be made clear in the beginning that the primary responsibility for the abatement of industrial waste pollution lies with industry. (Although the Federal Government may provide technical assistance when feasible in the solution of problems), you may be sure the various stream pollution control agencies, Federal, State and Municipal, will look to each contributor of pollution, including industry, for the correction of its portion of the pollution.

Why the sudden interest in water pollution? It has not been sudden! It has been a gradual awakening to the fact that many of our streams have become foul, noisome sewers - that our fishing has been destroyed and that in many places we are dangerously short of additional supplies of acceptable water for domestic and industrial use. For years there has been agitation for Federal antipollution laws. Numerous bills were presented but, although the proponents were agreed in the broad over-all objectives, they could not agree on details. There were two schools of thought: one wanted the impossible, the immediate removal of all pollution from the streams; the other wanted the impractical, to let each polluter correct his condition as he saw fit. Finally, in the last session of the 80th Congress a compromise measure was passed which is known as Public Law 845 - or the Water Pollution Control Act.

This Act states that it is the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of the States in controlling water pollution, to support and aid technical research for devising and perfecting methods of treatment of industrial wastes which are not susceptible to known effective methods of treatment and to provide Federal technical services to State and interstate agencies and to industries. Among the other provisions of the Law are those which grant financial aid to States for the conduct of investigations, research, surveys and studies related to the prevention and control of water pollution caused by industrial wastes. This financial aid will supplement the funds heretofore made available by the States themselves for their water pollution control activities. It would appear that the States are now in a good position to carry out an effective program which has too often been hampered in the past by insufficient funds. Public Law 845 clearly recognizes the significance of the industrial waste problems in provisions calling for research, study, investigation and abatement of industrial waste pollution.

The Law contains a regulatory feature which is of interest. The pollution of interstate waters which endangers the health or welfare of persons in a State other than that in which the discharge originates, is declared to be a public nuisance and subject to abatement. Whenever the Surgeon General finds that any pollution declared to be a public nuisance is occurring, he shall give formal notification to the offender causing or contributing to such pollution. The notification shall specify a reasonable time in which to secure abatement of the pollution. If action calculated to secure abatement within the time specified is not commenced, additional action, culminating in a public hearing, will be taken.

The public hearing shall be before a Board appointed by the Federal Security Administrator, and it shall make recommendations concerning the measures, if any, which it finds to be reasonable and equitable to secure abatement. Again, after allowing a reasonable time for compliance with the Board's recommendation, the Federal Security Administrator may, with the consent of the water pollution control agency of the State or States in which the matter causing or contributing to the pollution is discharged, request the Attorney General to bring suit on behalf of the U.S. to secure abatement of the pollution.

The Court, giving due consideration to the practicability and to the physical and economic feasibility of securing abatement of any pollution proved, shall have jurisdiction to enter such judgement, and orders enforcing such judgement, as the public interests and equities of the case may require.

We do not think that it will be necessary to invoke the regulatory provisions of the Act very often, as we do not feel that industry can afford the adverse publicity which would accompany such action. We believe that industry is awakening to its responsibilities and that in the future it will take the initiative in clearing up pollution, if for no other reason than the good will that it will gain.

In passing, it might be well to mention that several amendments to the Act have been proposed which give industry financial aid in its efforts to control pollution. In general, these amendments would grant certain tax exemptions for funds expended on industrial waste treatment works.

To implement the Act, 10 River Basin Offices have been established. The area served by each office is not based upon political subdivisions but rather upon a drainage basin basis. In this section of the Country offices have been established in Dallas and Little Rock to serve an area comprising, in general, the states of Texas, Louisiana, Oklahoma, Arkansas, New Mexico and Arizona.

The offices are staffed with techincal personnel who are available for consultation upon request. The basin offices operate through officially designated State Water Pollution Control Agencies. In the case of Texas the State Department of Health has been designated as the State Agency.

The primary objective of the basin office is the development of a comprehensive program for the abatement of pollution of basin waters. Experience has shown that the planning of a program on a watershed basis or a sub watershed basis is more effective than a hit or miss trial and error attempt to secure correction of polluted stream conditions. The program will successively determine the sources of pollution, the water use, potential water requirements, the improvements needed to condition the water for these uses and, finally, a construction schedule.

The Public Health Service has for many years maintained a laboratory at Cincinnati that has accepted much of the leadership in developing water pollution control procedures.

Numerous field studies and considerable research has been made, including work on industrial wastes. Research and field studies required for the solution of specific area problems will continue and will emphasize work upon industrial wastes disposal problems. Cincinnati's activities will include the accumulation, review, and publication of available data concerning volumes, characteristics, and methods of treatment of wastes produced by various industries. Research will be made on analytical methods for industrial wastes and their components. Improved methods are needed for many new wastes.

Modification of standard tests to eliminate interference by wastes materials is also needed. And there is a need, too, for the refinement of existing test methods to provide greater utility and practical application. Studies of the effects of industrial wastes on waters used as sources of water supply will be made. Studies of toxic effects in aquatic environment as related to industrial wastes, chemical substances, and plankton will also be made. Additional data will be required before reasonable pollution standards can be formulated for many new wastes.

The control and abatement of industrial waste pollution will be an expensive proposition. Similar industries located on different watersheds will find that a different degree of treatment may be required to meet the water use expected of streams on which they are located. It is quite possible the customer will have to pay an increased price for his finished products because of the expense involved in industrial waste treatment.

The picture is, however, not totally dark. It is expected that in some cases valuable by-products will be recovered from industrial wastes. In some few cases the by-products may more than offset the cost of treatment. We believe that industry, by applying the same intensive research to the abatement of pollution and the recovery of waste materials as it has to the development of new processes, will come up with a pollution abatement program that is not only feasible but also economical.

The Water Pollution Control Act establishes in the Public Health Service a Water Pollution Control Advisory Board. The composition of this Board is interesting as it represents all of the interests that may be affected by Water Pollution Control Activities. Board members include an engineer who is an expert in sewage and industrial waste disposal; a person active in the field of wild life conservation; a representative of municipal government; a representative of State government; a representative of affected industry and representatives from the Departments of the Army, of Interior, of Agriculture and of the General Services Administration (formerly the Federal Works Agency). At present, industry's representative on the Board is L.A. Danse of General Motors Corporation. The engineering representative is N.T. Veach, Consulting Engineer of Kansas City. It is the duty of the Board to review the policies and program of the Public Health Service as undertaken under the authority of the Act and to make recommendations thereon to the Surgeon General.

In summary let me say that we have a big job ahead, an expensive job, a job which must be done if we are to progress further in the American way of life. Industry and Government at all levels have a responsibility in getting the job done. I think it will be done. The Public Health Service extends to industry such technical services as it has available.

"IN-PLANT INDUSTRIAL WASTES" STUDIES

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The subject of waste control in the pulp and paper industry has of necessity been confined, in this instance, to that of a single manufacturing process, the kraft process. The inclusion of other manufacturing processes would serve to lengthen and complicate this discussion. The kraft process was selected as a specific example since it is of greatest interest in the South, it being the predominant process in use in the South, both from the standpoint of number of mills and total tonnage. However, the principles involved are applicable to other processes used in the manufacture of pulp and paper.

Although the manufacture of pulp and paper are two separate operations, they are complementary and are treated together in the scope of this presentation. In general, the two operations are integrated, resulting in manufacturing installations where pulp wood enters the mill at one end and finished paper leaves the mill at the other end. The inclusion of bleach plant operations in the pulp mill is also considered typical of the present day operation in the manufacture of kraft paper.

The kraft process, sometimes referred to as the sulfate process, is an alkaline process. It depends upon the dissolving action of sodium hydroxide and/or sodium sulfide on the non-fibrous matter in wood. The products of the process vary according to the cooking conditions from dark brown, unbleachable fiber to a soft, easy bleaching fiber. Either bleached or unbleached papers made from kraft pulp range from a coarse, tough, rattly sheet to a soft, pliable, opaque paper depending on the cooking treatment and wood.

The raw materials for a pulp mill consist of pulp wood, which is chiefly one of the resinous woods, water, and chemicals such as salt cake (sodium sulfate), lime (calcium oxide), chlorine, hypochlorites and caustic soda (sodium hydroxide). Raw materials for a paper mill consist of the pulp fibers, water, sizing materials (starch, rosin, wax, alum), fillers (clay, talc, calcium and barium sulfates, titanium dioxide, zinc sulfide and calcium carbonate), and coloring matter (pigments and dyes).

In the procedure for making kraft pulp and paper, the pulp wood is first passed through large horizontal revolving drums, called barking drums, which remove the bark from the log. Following this, the log is passed through chippers which break the pulp wood into chips. These chips are screened in order to attain uniformly sized chips. Oversize chips are rechipped to proper size and undersize chips and slivers are discarded, and may be used as fuel.

The wood chips are placed in storage bins from which they are conveyed to the digesters. The digesters are usually stationary, vertical, unlined steel vessels of about 4,000 cubic feet capacity which are directly or indirectly heated and are equipped for recirculation of the cooking liquor. A weighed quantity of wood chips is added to the digester. The cooking liquor, called white liquor, is then added to the digester along with some black liquor to make up to the desired volume. When the digester is filled it is sealed off and the cooking cycle is begun. The cooking operation may take up to about five hours. At the end of the cooking period, the pulp and black liquor formed during the cook is blown into a diffuser or cyclone separator preparatory to washing the pulp.

The two most common devices for washing pulp are diffusers and vacuum washers. Diffusers are simply vertical steel tanks with false bottoms in which the pulp and black liquor are placed and washed first with dilute black liquor and later with clean hot water. They are usually operated in pairs with the dilute liquor from the first diffusers being used to wash the pulp in the second diffuser. The excess dilute wash waters are usually wasted to the sewers. Vacuum washers (brown stock washers) are horizontal vacuum filters, operated in a series of two or more, with two or more effects on each washer. The pulp and black liquor from the digesters are fed in at one end of the installation while fresh water is fed in at the opposite end resulting in what is called countercurrent washing. This type of washing system is the preferred method and has several advantages over diffusers. This system permits more efficient washing of the pulp and the recovery of a more concentrated black liquor from the washing operations. It is usually operated as a closed system and no dilute black liquor or wash water is wasted to the sewers. The washed pulp flows to a brown stock chest from where it is put through various refining operations such as screens, knotters, rifflers, Jordans, deckers, etc. The refined fibers are then pumped to the bleach plant or to the paper mill.

The bleach plant operations usually consist of a chlorination stage using chlorine gas, caustic extraction using sodium hydroxide and a bleaching stage in which hypochlorite is used. Washing operations follow each of the above stages. The bleached fibers are then pumped to the paper mill.

Returning to the end of the pulp washing operations, the black liquor drained from the fiber following the cook, plus the black liquor from the washing operations, is placed in black liquor storage tanks. This material is fed into black liquor evaporators which consist of a variable number of evaporators in series, with steam under pressure being fed into the first evaporator body and a vacuum maintained on the last evaporator body. Following evaporation, black liquor soap (tallol) is skimmed off the concentrated liquor and the liquor is further concentrated to a solid content of about 60% in a disc, cascade or spray type evaporator. This concentrated liquor plus any added salt cake is then fed into the recovery furnace and burned with or without the use of added fuel. The gases from the combustion are usually passed through an electrostatic precipitator to recover the vaporized chemicals. The smelt from the combustion furnace is dissolved in water forming green liquor. The green liquor is clarified and the dregs are discarded. Hydrated lime is added to the green liquor and the resultant white liquor is clarified and stored for use again in the digesters. The mud (calcium carbonate) from the white liquor clarifier is dewatered and sent to the lime kiln for burning and recovery of the lime.

The paper mill operations consist of taking the fiber produced by the pulp mill either bleached or unbleached, further refining it and converting it to paper or paperboard. In so doing various materials may be added to the fiber such as sizing materials, fillers and coloring matter. The fiber is converted to paper or paperboard on cylinder machines or fourdrinier screens, followed by pressing, drying and calendaring.

The preceding general description of the kraft pulp and paper operations is subject to many variations, both in equipment and operation, at individual mills. However, even from this general outline of the process, what may appear to be a simple operation of converting wood into fibers and the fibers into a sheet of paper is in reality a highly integrated and complicated series of operations. At least ten unit operations are involved in this manufacturing process including, disintegration, mechanical separation and filtration, evaporation, diffusion, drying, heat transfer, combustion, flow of fluids, adsorption and absorption. As a result there are many sources of wastes of major and minor importance.

The existence of the kraft pulping process is entirely dependent upon the recovery and reuse of the chemicals used in cooking the pulp wood. Without the recovery of these materials the cost of kraft paper would be prohibitive. Since the existence of the process is based on this recovery of materials, the efficiency of this operation is of utmost importance. In addition to the economic importance, the recovery process has a direct bearing upon the amount of waste material discharged and the resulting pollution created by this waste. By increasing the efficiency of the recovery operation the waste discharge and pollution problem is proportionately decreased. This factor should not be overlooked or minimized and expenditures for equipment to increase chemical recovery may equally be considered as expenditures for pollution abatement in the same sense that expenditures for by-product recovery are considered expenditures for pollution abatement.

Definitions

In order to clarify the meaning of some of the terms used and to be used in this presentation it would be best to define those which are peculiar to the manufacture of kraft pulp and paper.

Salt Cake is the common name for sodium sulfate, which is the material used to prepare the cooking liquor.

Green Liquor 1, 2, is the name applied to liquor made by dissolving the recovered chemicals in water and weak liquor preparatory to causticizing.

Black Liquor 1, 2, is the name applied to liquors recovered from the digesters, up to the point of their incineration in the recovery plant. For purposes of waste control the term dilute black liquor is used to indicate highly dilute forms of black liquors which are obtained from pulp washing operations in diffusers or deckers and other forms of dilution, which are usually discharged to sewers as a waste.

White Water 2, 3, is the water from paper machines, pulp grinders and other operations which do not load the water with impurities which entirely prevent its use. It would not include any waste liquors or washings from pulp mills, or the spent bleach and washings from bleaching operations. It is water that has previously been used to convey pulp through the system and has been extracted from the final product for further use. The name comes from its color, which is due to the particles of fiber, resins and oils which it contains.

Bleach Plant wastes are those liquid wastes originating in the bleach plant from washing operations following chlorination, caustic extraction and bleaching operations.

Organization and Personnel

One of the most important factors in the success of a plant waste survey is that the top management of the company should wholehartedly support the program. Only with their backing will it be possible to properly carry on a waste control study, followed later by the implementation of recommendations based on the study, for decreasing the quantity and strength of the waste waters. Further, all department heads and even foremen should be informed about the program so that they will know what the aims of the program are. Their cooperation and assistance will be needed many times and if they are kept informed of the over-all picture, they will exhibit more interest and take a more active part. For example, the assistance of the engineering department will be needed in the design and installation of flow measuring devices. The laboratory can assist in the collection and analysis of waste water samples. They also can furnish, from their control records, invaluable data on the manufacturing process. Other individual departments can cooperate and assist in sample collection and compositing, particularly during off hours. Following the survey, the experience and assistance of the operating department heads will prove invaluable, should changes and adjustments be found necessary to decrease or eliminate wastes.

The problem of planning, executing and interpreting the results of a waste control program should be made the full time job, and sole job, of at least one properly qualified person. He may be a sanitary engineer, chemist, or chemical engineer. Usually, it will be one of the latter two, since few mills employ sanitary engineers as a regular part of their mill personnel. However, management may desire to employ a sanitary engineer especially for this type of job. Whoever is designated for this job should have access to the mill management in order to expedite the program as well as have the necessary authority to get what he needs. He should be furnished with enough trained and untrained personnel, either full or part time, to assist him in the collection and analysis of waste samples and for any necessary supervisory work.

Technical personnel assigned as assistants to the engineer in charge of the program should be trained in appropriate phases of chemistry, biology, and engineering and should be thoroughly familiar with the mechanics and chemistry of the manufacturing process. It is preferable to have people who have a background of training and experience in the field of pollution abatement. However, initiative, sound judgement, and a good technical training and background may be substituted for the specialized knowledge of pollution abatement. Intelligent nontechnical personnel may be assigned many of the field and laboratory activities if they are given the proper training and guidance on the job.

Physical Plant Survey

A knowledge of the lay-out of the plant is mandatory. Drawings and plans should be available to the survey engineer. These plans should include the structures, roads and utilities, particularly the plant sewers as well as air, steam, gas, water and power. In addition to the physical layout and services of the plant he should have information concerning the surrounding terrain, such as topographic maps, and all available flow data and analyses of any water body into which the mill waste is being discharged. Further, an investigation should be made concerning any proposed changes in flow, character and projected future downstream uses of the water body receiving tha waste flow. Changes in flow may be brought about by installation of dams for power projects, flood control or wildlife conservation purposes. Changes in downstream usage of water in a stream may be brought about by plans for municipalities to use the water for domestic uses, or, at the other extreme, to cease using it for domestic supplies. The same may be true in the case of water used for industrial purposes. A thorough knowledge of any future developments of this nature is necessary in order that a final decision may be reached concerning the degree of pollution abatement and waste treatment necessary. Knowledge of these matters will also assist management in establishing a policy concerning any changes which will have a direct effect upon the mill. It is not always possible to procure reliable data and information on future plans for dam construction and stream uses. Therefore, any such information must be carefully weighed and decisions made with caution.

Manufacturing Process Survey

Preparation of flow sheets of the manufacturing process is the first step in becoming familiar with the details of the process used in the manufacture of pulp and paper. Generally, these flow sheets are already available but may be in need of revision and correction. Flow sheets showing in detail the location of each piece of equipment in the processing chain, the point of entry of raw materials and chemicals, the flow of the product in the process of manufacture and by-product recovery can be prepared with the aid of existing flow sheets plus the help of the various departments concerned in the manufacture of the process. Quantities of materials used are designated on the flow sheet and are expressed as quantities per unit of finished product. In pulp and paper mills, the unit quantity of finished product is usually one ton of pulp or paper. Plant records will be the source of the quantities of raw materials used and quantities per ton of product are calculated from these figures.

The raw materials used in the manufacture of kraft pulp and paper include pulp wood, sodium sulfate, lime and water. In addition to these, depending on the type of pulp and paper manufactured, are chlorine, caustic soda, hypochlorites, fillers, sizing and coloring matter.

The pulp woods used in the kraft process are the coniferous woods. The quantities of wood used in various mills varies, depending on the capacity of the mill and the yield of pulp, which is dependent on the type of wood and the cooking operation. For southern pine wood, the pulp yield is approximately 50% on the bone dry basis, 3, or for every two tons of dry wood one ton of pulp is produced. The quantities of salt cake (sodium sulfate), lime and water used vary at individual mills, depending on the efficiency of the recovery operations and the quantity of water reused. Salt cake losses may be as high as 300 pounds per ton of product. In modern efficiently operated mills salt cake losses may be less than 100 pounds per ton of product. Losses in salt cake are sustained in pulp washing, evaporator and recovery furnace, and in causticizing and mud-washing operations.

The classification of water as a raw material in kraft pulp and paper manufacture is a natural one since pulp and paper manufacture is as dependent on a sufficient quantity of acceptable quality water as it is dependent on quantity and quality of pulp wood. In addition to its uses in the preparations of the cooking liquor and washing operations, one of its major functions is its use as a carrier for the wood fibers throughout the entire pulp and paper manufacturing operation. Large quantities of water are used, resulting in large quantities of waste waters. In spite of the great strides made recently in the reuse of waters throughout the manufacturing operations, large quantities are still discharged to the sewers because they no longer meet the water quality requirements for use in the process. These large quantities of water, no longer fit for use because of impurities, creates the difficult pollution abatement problem faced by the kraft industry. Mills discharging as much as 25 million gallons of waste waters per day are not unknown in the South. Treatment of such large quantities of water to remove oxygen-consuming impurities is by no means an inexpensive undertaking. Calculated figures of maximum quantities of water used (no reuse) in the kraft process, excluding bleaching operations are estimated at 115,000 gallons per ton of wood pulp 4,. However, based on actual mill data, with reuse of pulp and paper mill white water, for a mill making bleached stock, fresh water consumption should be from 30,000 to 45,000 gallons per ton of pulp 5,. In spite of the obvious savings made in both fiber and water recovery by reusing white waters in mills, there is a limit to the amount of recirculation because of the cumulative effect of impurities which the recycled water picks up. Limits of recommended water quality 3, 6, for good mill practice are reached and fresh water must be taken into the system as the undersirable water is discharged to sewers.

A knowledge of the chemical changes taking place and by-products produced during the manufacturing operation is of assistance to the survey engineer. From these reactions he should be able to formulate an idea of the type and quantity of the waste products discarded. This knowledge may form the basis for recovery of further by-products, but more important, it will serve as a basis for the analytical work to be performed on the mill waste for waste control practice, waste utilization and waste treatment. This information is also of value in any research. work that may be done to determine the pollutional characteristics and toxicity limits of any material which may be found in the mill waste. Usually, this information concerning reaction products which are discarded is available without the need of long and involved analytical procedures and it may be found in various text and reference volumes and in the publication literature of the field.

Pine wood is approximately 50% cellulose, 30% lignin, 15% carbohydrates, 3.5% resins and fats, and the remainder is protein and other minor compounds. The cooking liquor (white liquor) is made up chiefly of mixtures of sodium hydroxide sodium carbonate and sodium sulfide with small quantities of sodium sulfate, thiosulfate, and sulfite. During the cook the reactions in the digester are essentially hydrolysis of the lignin and carbohydrates, resulting in salts which are soluble in water or an excess of alkali. Fats and resins are saponified and are dissolved or carried as suspensions in the liquor. Sulfur is disposed of by reaction with lignin and by the formation of volatile organic substance. Wood alcohol is formed from the hydrolysis of lignin. Sodium salts of formic, acetic and lactic acids are formed by oxidation of sugars. Tannins and proteins are dissolved after release from the wood during cooking. During the cooking cycle, digester relief gases yield paying quantities of turpentine. The crude oil that floats on the water condensate consists of 50-90% turpentine and 10-20% pine oil. The remainder is dimethyl sulfide, methyl mercaptan with some methanol, acetone and ketones. The water condensate, containing disselved quantities of the above, is discharged to sewers.

In bleaching operations chlorine forms chlorinated compounds with the lignin in the fiber. These chlorinated lignin compounds are soluble in alkaline solution and are washed out of the fiber in this manner. Hypochlorites oxidize lignin to soluble products in bleaching operations.

Black liquor contains the sodium salts of resin and fatty acids (crude sulfate soap) which tend to separate on cooling and concentration of the black liquor. This material is skimmed from the concentrated black liquor and treated with acid to form tall oil. Tall oil is a black, sticky, viscous liquid containing resin and fatty acids in varying proportions, plus some phytosterols. The resin acids are abietic and its isomers and the fatty acids are mainly oleic and linolenic with a little linoleic and stearic.

Following the removal of the crude sulfate soap by skimming from the black liquor, the greatest portion of the organic matter remaining is in the form of lignin and lignin compounds. Disregarding the sodium compounds in the black liquor, which have recovery value, the ligneous material has considerable recovery value in the form of fuel. This is taken advantage of in the operation of the recovery furnace operation.

Plant Waste Survey

One of the best ways to determine the origin, quantity and characteristics of individual process wastes in a plant is to undertake the preparation of an accurate flow diagram of waste flows. This diagram should also show the quantity of water used, both fresh water and reuse water, in the manufacturing process. The water supply-waste water diagram may be incorporated into the manufacturing process flow sheet or be prepared as a separate drawing. All the sewers may be located from the drawings of the physical plant layout. However, it is wise to make an actual physical inspection of the plant to locate all the sewers since oftentimes the plant layout drawings may not be up to date in that respect. Although the quantities of water used are usually metered and available to the survey engineer, the waste flows are generally not measured and may simply be estimates based on the incoming measured water supply. Therefore, it will be necessary, once the sources of waste are found, to install measuring devices.

In a highly integrated manufacturing process, as the pulp and paper process, with its numerous unit processes, using large quantities of water at many different points, the origin of waste waters is manifold. Throughout the entire process, particularly from the point where the pulp leaves the digester to the paper machine, water is continually added and removed from the pulp for various reasons, such as for washing, refining, bleaching and transporting the pulp. Each time water is removed from pulp it extracts some impurities from the fiber. This continual addition and removal of water may be likened to a continuous washing operation, with greater quantities of impurities removed from the fiber initially, making chemical recovery economically feasible, and lesser quantities of impurities removed finally, making the chemical recovery economically unfeasible.

Pulp and paper mills discharge into water bodies wastes which may be classified as to their main pollutional characteristics as:

1. Dissolved oxygen-consuming types:
   a. Through biological activity. Organic wastes such as those derived from pulp washing operations, which contain extracted lignins, sugars, cellulose, and domestic sewage.
   b. Through chemical activity. Organic and inorganic wastes such as mercaptans and sulfides.
2. Toxic types:
   a. Organic and inorganic wastes such as fatty and resin acid soaps, sulfides and mercaptans.

3. Inert type:
   a. Organic and inorganic wastes such as fibers, lime mud, and green liquor dregs.

Some of the wastes may be classified in more than one category. However, with the latest type mill equipment, improved recovery efficiencies and treatment and reuse of white waters, the only wastes of pollutional importance are those consuming dissolved oxygen in the stream through biological activity.

The wastes in a pulp and paper mill vary in both strength and volume with some of high strength and low volume and vice versa. Origin of pulp and paper mill wastes may be tabulated as follows:

Pulp Mill Wastes

1. Barking drums
   a. Pulp wood washings
2. Digesters
   a. Condensate from digester relief gases
3. Knotters
   a. Knots, impregnated with black liquor, discharged to sewer
4. Washers
   a. Diffuser tail washings
   b. Decker and vacuum filter seal pit water
5. Evaporators
   a. Barometric and jet condenser waters containing condensable and dissolvaved vapors
6. Liquor Room
   a. Green liquor dregs
7. Bleach plant
   a. Wash waters following chlorination, caustic extraction and hypochlorite stages
8. Miscellaneous
   a. Spills and leakage from black liquor storage tanks
   b. Leakage from black liquor pumps and lines

Paper Mill Wastes

1. Paper machines
   a. White water from fourdrinier and cylinder machines

The wastes of greatest pollutional importance in pulp and paper mills are washer wastes, black liquor evaporator condenser waters, bleach plant wastes and paper machine wastes. These wastes control the characteristics of the total waste from a pulp and paper mill by virtue of their strength and volumes. Other individual wastes may be of greater strength but the volumes are so small that they have little or no detectable effect on the characteristics of the total mill waste. Approximate flow figures and B.O.D. values of wastes for modern plant practice are as follows:

	Gallons per ton of pulp	ppm B.O.D.
Pulp mill (diffusers, no bleaching)	7,000 - 10,000	300-500
Pulp mill (vacuum washers, no bleaching)	7,000 - 10,000	150-300

Bleachery	30,000 - 40,000	70-120
Paper mill	2,500 - 5,000	20-60

The paper mill and pulp mill flow figures above pertain to mills which take maximum advantage of white water recirculation.

In order to determine the total quantity of oxygen-consuming and/or toxic material that is discharged into a stream, it is necessary to determine the volume and strength of the wastes. Volumes of wastes are determined by measuring the actual waste, as it is discharged from the unit operation, by some suitable measuring device. In cases where the waste cannot be measured directly it will be necessary to estimate the flow. The choice of measuring devices will depend entirely on the individual situation and the ingenuity of the survey engineer. Obviously, no one or two methods will fit every situation since there is such a diversity of sewerage installations in different mills and even in the same mill. There are numerous devices available for the measurement of flows, among which are rectangular, triangular, and broad-crested weirs, Venturi flumes, nozzles, orifices, etc. Designs, characteristics and application of these various measuring devices may be found in hydraulics handbooks 7, and texts. Continuous recording devices and totalizers are available for these devices and should be used if at all possible. The flow in sewers from certain unit operations may fluctuate considerably, thus readings taken at fixed intervals may lead to erroneous flow figures.

To determine the pollutional strength of wastes it is necessary to analyze samples of the waste. The results of chemical analyses of waste samples are no more reliable than the accuracy used in collecting the waste sample for analyses. The analysis of the samples collected have a direct bearing on determining the characteristics of the waste flows in a plant. Sampling techniques should be sound since the corrective measures to be taken in waste control and treatment will be based on the analytical results of the samples. These corrective measures oftentimes will involve the investment of large sums of money and, if the sampling techniques are faulty, the investment may be a total loss insofar as achieving the results it was meant for.

The two general types of samples are the grab sample and the composite sample. The single grab sample is usually unreliable and interpretation of data from these samples should be made with extreme caution. Single grab samples may be considered reliable only if the polluting characteristics of a particular waste remains constant at all times. Instances of this type of sewered waste are rare in manufacturing processes. Multiple grab samples collected at frequent, regularly spaced intervals and analyzed individually will yield reliable data on the fluctuations in the quality of waste. Samples of this nature will bring out the extremes in the qualitative character of the waste, and can be of great value in the design and construction of waste control and treatment facilities, so that the facilities may provide adequate treatment under the worst existing conditions. Correlation of reliable flow data with the results of multiple grab samples will yield accurate information on the over-all waste picture in a plant.

Of a similar nature as multiple grab samples are short period composite samples. These samples consist of measured portions of waste, proportioned to the rate of flow at the time of collection, which are collected manually or mechanically and put into one container. The mechanically collected samples are naturally more representative than the manually collected ones, since they are collected continuously while manually collected samples can only be collected at fixed time intervals. The collection and analysis of short period composite samples (for example, 2 hours) would yield information of the same nature as multiple grab samples. However, the customary composite sample is collected over a period of 8, 12, or 24 hours and if properly collected, stored and analyzed will yield reliable data in the case of most plant wastes. Statistical analysis of sampling data will be of assistance in estimating average conditions and normal variations, determining the reliability of the collected data, and estimating the number of necessary samples 8,.

Accurate interpretation and evaluation of sampling data can only be made if the manufacturing process activities are known at the time of sampling. If major unit operations are closed down or being operated under abnormal conditions the interpretations and analyses of the data must take this fact into consideration, since the character of the wastes will undoubtedly be effected under these conditions. Therefore, it behooves the survey engineer to keep well informed on the manufacturing operations.

Various types of sampling equipment are available for both continuous and spot sampling and the literature and texts contain many references to such devices. In cases where oxygen-consuming wastes are to be composited, refrigerated samplers should be used. Rotating scoop or cup and time-cycle-operated automatic samplers may be purchased 9, 10, 11, or constructed in the plant.

The analytical tests usually applied to waste effluents of a pulp and paper mill are: 1, pH, alkalinity and/or acidity, 2, dissolved oxygen, 3, B.O.D., 4, sulfides and mercaptans, 5, resin soaps, 6, solids (dissolved and suspended, volatile and fixed, 7, color, 8, sulfates, 9, toxicity to aquatic life.

The B.O.D. determination, in spite of its shortcomings for certain industrial wastes, has been successfully applied to the kraft mill wastes 12, and it is used as the primary measuring stick of kraft mill waste pollution. The resin, mercaptan and sulfide determinations are made solely as a check on mill operations and recovery processes. An extensive survey 13, has shown that though the minimum lethal concentration of these substances to fish may be exceeded in the mill sewer the concentration, when discharged into a stream, falls far below the minimum lethal concentration even with minimum dilution ratios. Sulfate determinations are made as a check on salt cake losses, which are indicative of the dilute black liquor losses to the sewers.

Whenever applicable the analytical determinations are performed by the procedures contained in Standard Methods For The Examination Of Water And Sewage, 9th Edition. Some slight modifications are necessary in order to fit these determinations to industrial wastes. Special determinations have been developed for sulfides, mercaptans, and resin soaps determinations 14, and for the determination of toxicity to aquatic life 15, 16, 17.

Research and Development

A waste control and waste disposal survey is incomplete without research and development work to determine the best means for solving the waste problem. The best procedure to follow in initiating this type of work is to review the prior art and prepare an extensive and organized bibliography. The bibliography should not only consist of waste disposal practices of the particular industry under study, but also of similar or related industries since the waste disposal practices in another industry may be applicable to the one under study. In addition to waste disposal practices an investigation of process literature should be included to determine the possibilities of waste control by process changes and by-product recovery as described above. This bibliography of prior art should serve as a guide and not as the final word as to whether a waste abatement problem has a solution.

Laboratory research experiments should consist of preliminary investigations which are well organized along basic lines of attack, but are unencumbered with refinements. These experiments will generally indicate the mode of attack which may yield a successful solution. Following this, the method which shows the greatest possibilities is then investigated in detail by designing experiments to show the influence of the many variables in the method.

Pilot plant studies are used to test the practicability and economics of proposed procedures under plant conditions. It is unwise and frequently costly as well to attempt to translate laboratory findings directly into full scale facilities. This is particularly so in the case where investments for waste control are large, where a new treatment process is being used or even when an old process is being adapted to new and different types of wastes.

Research and development studies should be designed to yield information as to the practicability of waste elimination or change in waste characteristics by means of waste recovery and utilization or process and operational changes. Further, it should yield information on the possibilities of waste treatment and the means whereby this is accomplished, either through segregation of wastes, mixing of wastes or the diversion of waste waters, with or without preliminary treatment to domestic sewage disposal plants.

Since adequate pollution abatement and waste treatment usually involve large expenditures, the plant program, abatement and treatment procedures should be selected with regard to the protection of such an investment. Selection of abatement procedures should be based on a consideration of increases in pollution due to population and industrial expansion, increase of emphasis on sanitation and public health and greater interest on the part of the public in the use of waters for recreational purposes. The probability of more highly restrictive requirements of the future should serve to emphasize the tentative status of existing stream standards and requirements. The treatment procedures and installation facilities should be selected on the basis that they shall provide adequate treatment 100 per cent of the time. Facilities which require by-pass of untreated wastes in emergencies or plant shutdowns are a poor inventment and serve only to void the accomplishments of previous periods of satisfactory operation. Treatment and abatement equipment should also be selected on the basis of suitability to expansion and alteration necessitated by any plant expansion or process change.

Waste Reduction

After collection, analysis, and interpretation of the data collected during the waste survey the survey engineer must formulate a plan of attack designed to reduce and eliminate, if possible, the pollution problem. The initial emphasis should be placed on waste reduction in the plant itself rather than on waste treatment since it is usually more economical. The institution of good housekeeping methods in a plant will often contribute materially to a pollution abatement program. By good housekeeping is meant the elimination of careless operating techniques by individual employees and departments, proper maintenance and prompt repair of equipment and general plant cleanliness. Spillage of liquors, foam and fiber leaks in pumps, piping and storage facilities should be kept at a minimum. These substances find their way into sewers, usually accompanied by large quantities of wash water used to clean the floors. Small quantities of materials like black liquor will materially increase the strength of wastes. Every gallon of black liquor spilled from a digester, which has a B. O. D. of about 30,000 ppm, will make when diluted, 300 gallons of a waste having a B.O.D. of 100 ppm. As black liquor is concentrated in the evaporation process its B.O.D. becomes greater and spillage of this material is even worse. This applies to other materials as well, including the toxic substances.

Another mode of attack on the problem of waste control is in changes in the manufacturing process or process equipment. The possibilities of waste reduction in the former are usually limited since the quality of the manufactured product usually controls the manufacturing process. Radical improvements in waste control may sometimes be made by complete process changes such as a change from sulfite to sulfate pulping or a change from calcium base to magnesium or ammonia base in sulfite pulping. However, some small improvement may be obtained, even in the kraft process, by some small changes in the manufacturing process which would have no harmful effect on the quality of the product.

Closely associated with process changes are changes in process equipment. Such changes in equipment would not alter the basic manufacturing process but would be an improvement both from the standpoint of product quality and waste quality and even possibly from an economic standpoint. In the kraft industry the improved pulp washing operations brought about by counter-current vacuum pulp washers has resulted in less black liquor being wasted to the sewers since these washers operate in a closed system, thereby eliminating any sewered wash waters. Increased black liquor evaporator capacity has also made possible a reduced amount of black liquor reaching the sewer. With increased capacity, weaker black liquor waters are being evaporated instead of sewered. The economics of black liquor evaporation are based on the cost of salt cake replacement. However, it may well pay the manufacturer to take a small loss on his evaporation operation in order to keep the black liquor out of the sewer. If it were allowed to go to the sewer, for the sake of economic evaporator operation, the cost of treatment to remedy the pollutional effects of the black liquor may cost more than the cost of evaporation and recovery of this same material. Foam traps and breakers are other types of equipment which will cut sewer losses.

Another piece of equipment widely used in pulp and paper mills is the save-all. The primary objective of save-alls is the reclamation of pulp fiber from white water. Reclamation of this fiber from white water serves to keep it out of the sewers. Removal of fibers from sewered wastes is a major step in pollution abatement. Fibers discharged into streams may form sludge banks, thereby decreasing the aquatic life by its blanketing effect of stream bottoms, as well as decreasing stream dissolved oxygen through the decomposition of the fibers, which are almost pure cellulose. Many different types 2, of save-alls are available, each having different degrees of recovery efficiencies, among which are the wire cylinder, felt, sedimentation, vacuum filter, and flotation types.

Closely associated with fiber recovery, water supply, and the use of save-alls is the reuse of white waters in a pulp and paper mill. White water from deckers, cylinder and fourdrinier machines is recirculated and reused in various mill -

processes. It may be recirculated after being passed through save-alls to recover the fiber it contains or it may be recirculated without fiber recovery. At first glance this may seem to be the answer to the problem of eliminating large quantities of waste waters containing dissolved and suspended impurities from the sewers by recirculation in a closed system. The fact that these white waters contain impurities which would constantly be augmented with additional impurities, places severe limitations on the amount of proposed recirculation and closing of the system. Waters used for washing and other purposes in a mill must meet certain quality standards 18, and if these standards cannot be met, the water is unsatisfactory for use. Recirculation systems which are closed too tightly 19, may lead to troubles such as bacterial sliming, excess retained heat, reduced machine speeds and production, excessive foaming, reduced paper quality (strength, color appearance, cleanliness and brightness), sizing difficulties and increased corrosion of equipment. Nevertheless, a system may be closed to the extent that it is not injurious to product or operation and, at the same time, is beneficial from the waste reduction standpoint.

Perhaps one of the most frequently publicized methods of waste control in an industry is through by-product recovery. Unfortunately, this disproportionate amount of publicity is extremely misleading to the layman. Actually, the specific instances are numerous where this method of waste control, diminution, or elimination may be or has been successsfully applied, but it adds up to just a small fraction of the solution of the over-all problem. By-product recovery is a tempting undertaking in the search for the solution of stream pollution problems and, though it has been successful, the field is limited. In addition to economic limitations, there is always the possibility that the waste from the by-product recovery operation may be worse than the original waste, which would only serve to aggravate the waste disposal problem. The industry is indeed fortunate that can solve its pollution problems entirely or in part by this means and benefit by it financially as well. Though this situation is rare, by-product recovery operations have their place in the plan for waste control. Economically marginal or uneconomical by-product recovery operations may be financially successful ventures when balanced against the additional cost of waste treatment incurred by the presence of some recoverable materials left in the waste waters. Here again is an instance where small economic losses in manufacturing operations may be written off as waste treatment and pollution abatement costs.

Waste Treatment

The treatment of kraft mill wastes is a problem which has long plagued the manufacturers. Much time, money, and effort have been expended by individuals and mills in an effort to find a solution, but with little success. Some measure of success has been achieved by the ponding or storage of these wastes. The ponding of wastes serves several purposes. It permits the holding of these wastes until adequate stream flows are available to provide the necessary dilution which prevents nuisance conditions. This is called controlled dilution and has the disadvantage of requiring large storage facilities, careful control of waste release and the possibility of inadequate stream flows. Ponding has also been utilized as a means of lowering the B.O.D. of the waste, thus permitting a continual discharge at any stream flow following a more or less short holding period. This method has had several successful instances on plant scale operation, one using the total mill waste 20, and another utilizing a method of waste segregation 21,. The mechanics of this method have been investigated 22, establishing it as a method of biological treatment which is subject to control and improvement.

The search for a treatment process for kraft mill wastes is being carried on at various mills and at Louisiana State University under sponsorship of the National Council For Stream Improvement. A biological treatment process, developed at Louisiana State University which is now ready for the pilot plant stage shows promise of success. A chemical treatment process, now in the pilot plant stage at one of the southern kraft mills also shows promise of success.

The preceding paragraphs have been an attempt to illustrate the fundamental principles involved in a waste control study of any industry, using the kraft pulp and paper industry as an example. The choice of the kraft industry as an illustration was not based on the fact that this industry is a typical one but rather that it is the industry whose industrial waste problems are most familiar to the author.

The organization designated to investigate and develop proper waste control facilities applies the same basic principles whether it be a one-man waste survey in a small plant, or multi-group organization operating in several plants of a large company or on an industry-wide basis. However, the planning and execution of a plant waste control survey and placing into effect the various recommendations of this group must be made so as to fit into the company policy and administration patterns, necessitating cooperation and consultation with other company departments 23, such as Research and Development, Engineering, Medical, Public Relations, Legal, Operating and Salvage and Reclamation Departments or their equivalents.

Although the actual instances cited to illustrate basic concepts in this presentation were drawn from the kraft process, this same type of information in most industries would be available from the respective trade or industry association 24,. Apparently, most industries are attacking the problem of pollution abatement through the activities of industry associations. With a properly planned, directed, and staffed organization, this approach appears to accomplish the greatest amount of good with the least waste of time, effort, and money. However, there are many notable exceptions to this industry association trend, even in industries having such associations, where individual concerns are undertaking their own pollution abatement programs.

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"ANALYTICAL PROCEDURES
ADAPTABLE TO INDUSTRIAL WASTES' STUDIES"

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In this discussion of the analysis of industrial wastes, consideration will be given to the over-all problems involved. There will be no elaboration of the details of any particular sampling, compositing or analytical procedure, or programming of the approach to any specific problem. Essentially, this discussion will be concerned with the logic and reasoning behind the selection and application of analyses for evaluation of the sanitary importance of a particular waste.

The analytical procedures which may be applied to industrial wastes can be divided roughly into three categories:

1. The general sanitary criteria developed for the measurement and control of sewage treatment processes.

2. Procedures established as an integral part of stream standards.

3. Chemical procedures especially designed to fit a particular industrial waste.

In addition to these tests, an industrial waste may require special biological examination such as:

1. Biological assay for toxicity to aquatic life, particularly studies of the toxicity of a waste to fish, or the food organisms which make fish life possible.

2. Biological assay designed to evaluate the possible deleterious effect of a waste on sewage disposal processes or stream purification.

Such specialized biological assay is important, but this discussion will of necessity be limited to consideration of the first grouping of tests presented.

As background for elaboration of the testing of industrial wastes, it would be well to make some classification of industrial wastes. One of the many possible classification schemes is presented in Table 1. The classification presented is to some extent arranged on the basis of the appropriate analytical approach. The relationship of the grouping presented to suitable analytical techniques will develop as this discussion proceeds.

Applicability of the General Sanitary Criteria to the Evaluation of Industrial Wastes

The term, "general sanitary criteria", has been devised to designate the long established parameters so generally used in the control of sewage treatment processes and as measures of the sanitary condition of streams. These include biochemical oxigen demand B.O.D., oxygen consumed, nitrogen in various forms, the various determinations of solids and volatile matter, and alkalinity or acidity along with pH, temperature, dissolved oxygen, etc.

In general, these values will adequately describe the sanitary significance of food processing wastes Group IV-b and will, with minor modification serve to characterize the wastes listed in Group IV-a.

Frequently, the relationship of the B.O.D. test to the oxygen consumed value is not appreciated. It might be well to point out that these two values are complementary. In general, neither determination can be substituted for the other. The B.O.D. test is essentially a biological assay. It measures the amount of material in a medium which can be oxidized by biochemical agencies under stipulated conditions. On the other hand, the oxygen consumed test is a strickly chemical oxidation carried out under rigidly specified conditions.

There are a number of oxygen consumed tests which are in use. Many more have been proposed. A group of these tests is now undergoing evaluation by a Standard Methods committee of the Federation of Sewage Works Association. Without exception, every oxygen consumed test is a chemical oxidation made according to a fixed procedure.

Occasionally an enthusiastic chemist, after devising a new or improved oxygen consumed method, decides that his procedure gives the same information as is yielded by a B.O.D. test. Such a result seems most unlikely. In order for an O.C. (Oxigen Consumed) test to be the equivalent of a B.O.D. test, it must show nearly perfect correlation with the B.O.D. test.

Recently Moore, et al, 1, in evaluating an oxygen consumed procedure, studied the oxidation of a group of representative chemical compounds. This sort of work would represent one phase of the demonstration that an O.C. test is the equivalent of a B.O.D. test. With data such as are described above, it would be necessary to establish that all compounds chemically oxidized are also biologically oxidized and that no compound is chemically attacked which is not also biologically oxidized. The development of an O.C. test having such characteristics does not seem probable.

As an example, acetates and saturated straight chain fatty acids show a high degree of resistance to chemical oxidation, yet they are readily oxidized by microorganisms. On the other hand, cellulose, to cite one example, is most resistant to microorganisms in aerobic systems, yet it readily undergoes chemical oxidation. With these two common materials as criteria, any of the O.C. tests proposed to date can be classified as definitely not the equivalent of a B.O.D. test.

However, because there is frequently some correlation between an O.C. test and the B.O.D. test, the O.C. test has a definite sphere of usefulness. The advantages of the O.C. test may be delineated as follows:

1. It can be used to secure results rapidly.
   a. In some cases it may serve as a guide in selecting appropriate dilutions for B.O.D. tests.
2. It may be used as an index on wastes containing toxic materials which cannot

be satisfactorily examined by the B.O.D. test.

3. In some cases, where equipment and necessary material for the B.O.D. test are not available, the use of an O.C. test may be necessary.

4. On certain chemical wastes, the O.C. test is perhaps the best parameter available to measure the amount of material being discharged.

The general sanitary criteria frequently are not well adapted to characterizing a waste. It would obviously be useless to run B.O.D., nitrogen values or the like on most of the mineral wastes listed in Group "A", Table I. These materials can best be evaluated in terms of pH, acidity or alkalinity, solids and the determination of definite mineral constituents.

A group of determinations or examinations which may be arbitrarily applied to industrial wastes are those procedures which are stipulated as an integral part of stream standards. When definite limits for the amounts or concentrations of certain materials which may be discharged are established, it is a practical administrative measure to specify in detail the means which shall be used to determine whether a waste conforms to the established standard. Further, the procedure specified actually becomes a definitive part of the standard. For instance, it would be possible to debate at great length regarding what constitutes "oil" in a waste. However, when a procedure for the determination of oil is adopted as part of a standard, the procedure so adopted serves as a clear definition of oil. For the purpose of interpreting the standard, oil is that material which is measured as oil by the procedure stipulated.

In reaching agreement on methods designed to become a part of stream standards, a perplexing problem frecuently occurs. This is the difficulty which arises in trying to make a practical compromise between those methods or procedures which most closely approach technical perfection, and methods which can be carried out at reasonable cost. It is obviously undesirable to stipulate any method which the parties concerned cannot afford to use, either because of an excessive requirement in the way of man hours and laboratory space per determination, or because very expensive and highly specialized equipment is required.

In the tentative concentrations listed by the International Joint Commission as "Objectives for Boundary Waters Quality Control" 2, definite limits were established for the amount of certain materials which might be discharged. Many of the techniques prescribed for interpretation of the "Objectives" represent not the best procedure available, but the best procedure which it was deemed feasible to specify.

Under this heading of arbitrary procedures, as an example, the International Joint Commission 3, tentatively prescribed methods for phenolic material, pH, iron, and oil, as part of their "Objectives for Boundary Waters Quality Control". While some of these are determinations which have been designated as the general sanitary criteria, they assume a definite identity as part of a quality standard for wastes.

Finally, it is necessary to select or develop analyses designed to best characterize a particular waste. There are no inclusive simple rules which may be laid down for choosing the right group of analytical determinations to use. The experience, judgment, and "know-how" of the personnel involved must be used to the fullest extent.

Before undertaking the examination of most industrial wastes, the goal or purpose of the examination should be clearly established. Thus, one series of determinations might be pertinent if a given waste is suspected of causing taste and odor difficulties, a second group would be applicable if the waste is being considered as a possible contributor to a serious oxygen sag, and a third group of determinations might best be used if the waste is believed to be a source of toxic metals or cyanides.

The value of the establishment of objectives in connection with the analyses of industrial wastes cannot be over emphasized. Once the objectives of the examination are thoroughly understood, the analyses have a definite goal. It is then possible to lay out a compact analytical program which will secure the significant data. Also, it is easy to avoid making an expensive collection of irrelevant determinations.

For example, the significant chemical criteria in the case of a metal plating waste believed to have killed fish are likely to be cyanide, toxic metals and possibly acidity or alkalinity. In the case of a milk processing plant being gaged as a stream load factor, the general sanitary criteria will evaluate the waste. In the case of a waste being considered as a source of phenolic materials, and as a factor in a stream oxygen sag, phenol, O.C. and B.O.D. along with some other specialized tests may be sufficient. The Fluoride determination, which is rarely applied to industrial wastes, would be a key determination in the examination of fluorination wastes, or processes involving the use of hydrofluoric acid.

In the case of the examples cited, the proper analytical approach has been fairly obvious. This is not always the situation. There is no substitute for experience in designing a procedure for the examination of industrial wastes in connection with a particular situation.

After the objectives of the examination of an industrial waste are fixed, it must be recognized that the task which remains is likely to be a research problem of some magnitude. Analytical methods have an unfortunate tendency to break down when applied to industrial wastes. This is especially true when it is desired to determine a definite component of the waste. When one particular material is involved, it is frequently advisable to take steps to see if the procedure used actually did work.

Suppose it is desired to determine the amount of cyanide present in a given waste sample. First, the method to be used is selected and the determination carried out. Then, as a check on the efficiency of the applied method, a definite amount of cyanide is added to the waste, and a second cyanide determination is made. Unless the difference in the two values obtained is approximately equal to the amount of cyanide added, there is good reason to doubt the method used.

For instance, if 1, analytical results indicate 100 p.p.m. of cyanide to be present in a given waste and 2, 100 p.p.m. of cyanide are added to a portion of the waste and the fortified portion is analysed, using the previously applied procedure, the value obtained should be about 200 p.p.m. In the situation just cited, if the second cyanide determination had shown 120 p.p.m. of cyanide present, there would be every reason to reconsider the applicability of the technique used. No analytical method can ever be considered satisfactory unless it will consistently show recovery of a very high percentage of an added amount of the material which it is desired to determine.

No attempt will be made to describe means for determining the presence of materials which give a positive interference with an analytical method applied to an industrial waste. Such a discussion is beyond the scope of this paper. However, one point cannot be over emphasized - - - continued skeptical evaluation of analytical procedures is a "must" if reliable results are to be obtained.

SUMMARY

1. The regular laboratory procedures which may be applied to industrial wastes consist of:

   a. The general sanitary procedures.
   b. Procedures established as an integral part of standards.
   c. Procedures specifically designed to gain desired information concerning a particular waste.

2. The successful application of analytical techniques to industrial wastes requires:

   a. Establishment of the purpose to be served by the information to be obtained.
   b. Careful specification of the determinations to be made and the procedures to be followed.
   c. Repeated examinations of the efficiency of analytical procedures to insure that the analytical values are reliable.

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TABLE I

Types of Industrial Wastes

A. Wastes Principally Mineral In Nature

   1. Brine Wastes
   2. Mine drainage
   3. Waste slurries
   4. Mineral washing slurries and suspensions
   5. Pickle liquor wastes
   6. Plating wastes
   7. Miscellaneous wastes from inorganic chemical manufacture

B. Wastes that Contain Principally Organic Materials

I. Hydrocarbon Wastes

1. Oil wells
2. Petroleum refineries
3. Styrene manufacturing plants
4. Copolymer rubber plants
5. Butadiene manufacturing plants
6. Natural rubber processing or reclaiming
7. Gasoline filling stations, bulk stations, garages, etc.

II. Miscellaneous Organic Chemical Wastes

8. Munitions plants such as T.N.T. tetryl and ammonium picrate manufacture
9. Pharmaceuticals (Synthetic)
10. Synthetic fiber plants such as viscose or nylon
11. Organic chemical manufacture

III. Phenolic Wastes

12. Gas plants
13. By-product coke plants
14. Chemical plants
15. Synthetic resin plants (phenol resins)
16. Tar, road oil and creosoting plants
17. Wood distillation plants
18. Dye manufacturing plants

IV. Biological Wastes

a. Wastes from processing biological materials and/or from biological processes

19. Tanneries
20. Pharmaceuticals (Antibiotics, Biologicals)
21. Alcohol Industries (Breweries and Distilleries)
22. Miscellaneous fermentation industries
23. Glue and gelatin plants
24. Wool scouring
25. Textile manufacture
26. Paper manufacture, particularly sulfite pulp and kraft mills
27. Laundry wastes

b. Food processing wastes

28. Cannaries
29. Meat packing
30. Milk and dairy products plants
31. Corn products plants
32. Beet sugar plants
33. Cane sugar plants
34. Fish processing plants
35. Other food processing and dehydration plants

"POLICIES AND STANDARDS OF THE TEXAS STATE DEPARTMENT OF HEALTH REGARDING INDUSTRIAL WASTES"

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From the early days of Texas history, Texans have been water conscious. In fact, in one of the many anecdotes dealing with the extremes of the State, the remark is made that Texas has more streams and less water than any place in the world. While the accuracy of this statement is undoubtedly questionable, the fact remains that the water situation in Texas is far from satisfactory. Much emphasis is now being placed on water conservation, which subject appears to be increasing in importance with the passing of each year.

In the era prior to the war between the states, the subject of stream pollution in Texas appeared to be of small consequence. Texas was emphatically a state without industry, and the agricultural pursuits of that day and time hardly contributed to the problem of industrial pollution. Domestic pollution, likewise, was of small consideration, since the day of community sewerage systems had not yet arrived, and remained to be developed some years in the future. As the frontiers progressed beyond Texas and communal living with its attendant problems became a reality in the State, the subject of stream pollution then became a topic of frequent conversation. The seriousness of the problem began to be realized about the turn of the century; however, it was not until thirteen years later that public concern finally prompted the Legislature to provide by law for the prevention of further activity destined to contribute to the gradual, but none the less definite, deterioration of Texas streams.

Consequently, at that time there was passed an Anti-Stream Pollution Law very similar to the present Article 4444, VCS., and a sanitary inspector was appointed several years later by the Governor to enforce its provisions. It is interesting to note in passing that the present State Sanitary Engineer received this appointment, and while no longer appointed by the Governor, has continued in the service of the State since his original appointment. The present stream pollution abatement facilities of the Texas State Health Department could hardly be foreseen in the humble beginning of the lone inspector provided in 1915.

In the meanwhile, other stream pollution laws have been passed and repealed and passed again, until at the present time there are two laws of major significance regarding anti-stream pollution activity in Texas. These are Article 4444, a Civil Statute enforcible by injunction, and Article 698-b, a Penal Statue enforceable by a suitable penalty. However, it is appropriate to point out that Article 4477-1, VCS., while concerning itself with many phases of environmental sanitation, requires that plans and specifications for construction of sewerage systems be approved by the State Health Department before commencement of the work. On some occasions the existing laws have been criticized as being inoperable. While it is admitted that perfection still remains to be achieved, it might be said in defense of Texas laws that there are many persons likewise critical of the enforcibility of any of the various states' anti-pollution laws. Also to the credit of the early Texas lawmakers is the fact that the State laws have been tried in the courts and have been held to be constitutional. The balancing of equities, punitive action against city officials, and the impracticability of injunctions against the operation of a sewerage system, all provide for practical considerations that make legal action against a municipality difficult. On the other hand, punitive action against an industry lends itself to more practical consideration, since the loss of funds through the payment of fines is more significant than in the case of a municipality.

Legal action against the pollution of streams has been undertaken only on extremely infrequent occasions by the Texas State Department of Health. However, it is of interest and significance to note that when litigation was undertaken, it was against industry, principally because of the previously explained limitations. Consequently, it has been concluded that the most practical approach to the prevention of stream pollution is based principally on the premise that public education should receive first consideration. Proponents of this belief point with pride to the improvement that has been realized through the years, while opponents point with equal derision to the harm that has been done while education has been achieving its results in its slow methodical fashion.

The status of enforcement at the present time remains unchanged in any major degree from what it has been in the past. Surveys continue to be made, reports are prepared, hearings are held, warnings are given to those involved, and as a last recourse court action is undertaken. To a great extent this will no doubt continue to be the course of action followed in the future, since time has proved this to be a very practical procedure. It has been found that if the sources of pollution can be located, corrections can frequently be secured by soliciting the cooperation of those concerned. However, to assume that this approach would be effective in all cases would be highly idealistic, and there can be no argument against the desirability of having adequate laws to bolster a cooperative program. In any group in society there will be found some recalcitrants who understand only the harsh word. Fortunately for those engaged in enforcing anti-pollution measures, these constitute a very small minority; and, therefore, the educational approach is still very effective.

It has been shown, however, that the patience of the public, which has been long suffering in the past, is becoming shorter each day. This of course, detracts from the effectiveness of public education as an antipollution tool, and when public demand for action is of such magnitude that it represents the desires of the majority, they can rest assured that the legal facilities of the State will be utilized to protect the purity of its water resources.

The impatience of the public with the delay involved in affecting the abatement of stream pollution by the use of public education is shown by the recent passage of the Federal Water Pollution Control Act, otherwise known as Public Law 845. It might be of interest, however, to note at this point that the Federal law specifically deals with industrial waste, which would imply that as far as the National Congress is concerned, the primary potential hazard appears to be from the waste produced by industries. This might be explained on the basis of industrial wastes generally being more troublesome to handle than domestic wastes, and further substantiates the need for research on industrial waste treatment. However, the Federal Government recognized the advisability of states handling their own problems insofar as possible, by designating them as the primary enforcement agency and making it possible for the Federal Government to become involved only when the State failed to act. Even then, Federal legal action can be taken only at the invitation of the State. In the case of Texas, the State Health Department has been designated as the Agency to deal with the Federal Government in these matters.

While the State and the Federal Government have cooperated for many years in health programs, and it appears that the future of the joint anti-pollution program is indeed bright, industry no doubt will sometimes approach only the Federal agency, soliciting advice from them regarding their pollution problems. While the State is glad to see this display of interest on the part of industry, it should be remembered that the Federal Government is not in a position to interpret or enforce the State statutes, and it would, therefore, appear expedient for industry to clear these matters through the State agency. While the State and Federal laws are not necessarily in conflict, a clean bill of health from the Federal agency would not confer immunity upon an industry from the provisions of State laws.

In spite of the fact that the State Health Department is charged with the enforcement of the State's anti-pollution laws, the role of a critic who can suggest no solution to the condition he criticizes is an unpopular one, even for the State Health Department. Therefore, to obviate being placed in this position, it is necessary that a certain amount of research be done to study the problems which yet remain unsolved. One of the principal problems facing the State is the disposal of waste from the citrus and canning industries. This problem has not yet been satisfactorily solved and is being studied at the present time, as it has been for some years in the past. The possibility that sewage lakes or lagoons might furnish an economical and suitable method of sewage disposal appears so promising that this is being studied in detail, although several years' work has already been done in this field. Some of the disposal problems of industry have been solved, as may be illustrated by the use of reinjection walls for salt water from oil wells. However, there are many more yet untouched, and the State Health Department will welcome suggestions and requests from industry as to future problems worthy of attention.

While a full-blown technical discussion of stream standards could furnish the basis for much discussion, the provisions of the Anti-Stream Pollution Law allow practically no flexibility. Since the laws in effect provide for an unchanged condition of the receiving water course, the single standard to be established could be summarized by the phrase "complete treatment". While this would not apply, of course, to water affected by tides except where recreational, shellfish growing, or other public health considerations were evident, the fact remains that the Legislative Bodies of Texas desire the unpolluted condition of the streams to remain unchanged in their passage through the various communities on their way to the Gulf.

It may be recalled that about ten years ago an attempt was made to have passed a stream pollution law that would allow for the Texas State Health Department to determine the degree of treatment required for each stream. While cognizant of the difficulties involved, the State Health Department joined with those interested in this proposal in an attempt to have it receive favorable consideration, but its reception by those concerned with its passage is best illustrated by pointing out that it failed to pass out of the sub-committee, much less reach the floor of the House of Representatives.

However, this is frequently the fate of many stream pollution bills and was the ultimate disposition of a bill introduced into the last session of the Legislature, which had the sponsorship and sanction of some representatives of industry. While the intent of this proposed law was good and it was patterned after laws of other states where anti-stream pollution activity appears to be quite progressive, the proposed law repealed all existing laws and contained a section that excused from compliance those who were financially unable to do anything or those having a waste for which a satisfactory method of treatment was not known. While such a provision is understandable from the point of view of some of those against whom the law was directed, any thinking representative of an industry located on a stream will realize that the condition of the stream affects them as much as it does those farther down the stream.

In the way of a compliment, it might be interjected into this discussion that, generally speaking, industry has realized this and has been most cooperative in aiding in the enforcement of anti-stream pollution measures. In passing, it might be added that this proposed law provided for a separate Board for stream pollution control. While it is desirable to have a Board composed of representatives of all phases of anti-stream pollution activity it must be realized that unless a single agency or individual is given sufficient authority by law, the activity of the Board can stagnate. It appears that the State Health Department is the best equipped at the present time, of any single State agency, to continue the fight to maintain the purity of the State streams. They have the proper personnel, as well as equipment, and have been doing this type of work for many years.

Nevertheless, it might be repeated that because of the provisions of the existing law, the Texas State Health Department does not attempt to classify streams nor do they attempt to establish flexible standards, inasmuch as they would all ultimately have to involve the principle of complete treatment. However, in practice, some discretion can be used in those cases where a waste does not reach a stream or where a waste is discharged into water affected by the tides.

There is no question regarding the desirability of cooperation with industry and solving their waste disposal problems. They are wanted in this State, and it would behoove the regulatory bodies to be considerate of their problems. No doubt it will be found that the past record substantiates this belief, and those concerned may rest assured that such will be the reaction of the State Health Department in the future.

Wastes Symposium Luncheon

R. B. Kahle, Presiding

"THE FEDERATION'S INDUSTRIAL WASTES' ACTIVITIES AND RESEARCH"

V. M. Ehlers, C.E.
National President
Federation of Sewage Association
Director, Bureau of Sanitary Engineering
Texas State Department of Health
Austin, Texas

The Federation of Sewage Works Association, although still a youthful organization, has developed over a five year period from an active and corporate membership of 2,630 to approximately 5,000. It very keenly feels its responsibility of stimulating and studying the industrial waste pollution problems which today confront industry and affect the health and economy of all people. This interest and responsibility is definitely stated as the first objective in its Constitution as follows:

"The objects of this Federation shall be: The advancement of fundamental and practical knowledge concerning the nature, collection, treatment and disposal of sewage and industrial wastes."

One of the means by which the Federation endeavors to advance its objectives is by devoting about one-third of the space in the SEWAGE WORKS JOURNAL to industrial waste matters and emphasizing this important subject by allocating at least a third of the time on technical programs of the annual meetings. Of course, Member Associations are encouraged to expand their services in this direction.

Our Research Committee includes industrial waste literature in the annual review published in the JOURNAL; and also has a special sub-committee engaged in the study of toxic industrial wastes, which study includes the determination of all wastes which would be toxic in any way in sewage treatment plants and in streams; and the study also attempts to determine the concentration levels at which such toxic wastes are dangerous or objectionable. As soon as feasible the Committee plans to develop a standard method for the determination of toxicity.

Our Committee on Standard Methods of Sewage and Industrial Waste Analysis is vitally interested in and is giving considerable attention to the industrial wastes which are being studied under the Research Grant made by the Division of Research Grants and Fellowships of the National Institute of Health, the current grant being in the amount of $48,700: The project being conducted at Purdue University is a study of all methods for the quantitative determination of metals in industrial wastes. The laboratory at Ohio State University is engaged in the study of methods applicable to special industrial wastes, such as those deriving from synthetic rubber manufacture, detergents, soy bean processing and those containing phenols and phenolic resins. Four other laboratories throughout the Country are making studies under this Research Grant.

It is highly desirable that research be undertaken to develop economical treatment of wastes and useful by-products.

The following listing of suggestive projects indicates only a few of the needs for further studies:

1. Effects of industrial wastes on natural watercourses, including interference with natural purification, damage to aquatic life, and relation to sources of water supply.

2. Cause of industrial wastes creating bad odors in otherwise healthy fish and water supplies.

3. Study of the toxicity of various chemical constituents in water to (a) man, (b) aquatic life, and (c) cows and other animals.

4. Development of improved processes for treatment of industrial wastes, e.g. – synthetic rubber, meat packing, munitions, cannery, sugar refinery, and silk wastes (possible by-product recovery).

5. Effectiveness of C_4Cl_6 for grease separation (Hexachlorobutidine).

6. Anaerobic sludge digestion at very high temperature 180°F plus.

7. Significance of newer industrial wastes and their constituents.

8. Methods of de-ionizing wastes.

9. Study of basic factors involved in land disposal of sewage which would effect design factors.

10. Study and evaluation of the basic forces at work in stream pollution and sewage treatment; the functions of organisms, enzymes, and catalysts in the decay and transformation of organic matter.

11. Deodorants for sewage and industrial wastes.

12. The role of Sphaerotilis in treatment of carbonaceous wastes.

13. Bacteriological and chemical methods of destroying toxins.

14. Studies to develop a more accurate method for the determination of nitrate in polluted water and sewage effluents in the presence of ammonia and nitrate.

15. The development of very sensitive quantitative methods for the determination of each of the following constituents in polluted water:

    (A) Styrene and styrene polymers.
    (B) Butadiene and waste products of butadiene manufacture.
    (C) Tertiary butyl catechol.

16. The development of the proper neutralization, dilution and seeding teachnique for B.O.D. studies on various industrial wastes to ensure reproducible results in the carbonaceous stage.

17. A study of the course of biochemical oxidation of various industrial wastes.

18. A study of the effect of acid mine drainage and pickle liquors on the B.O.D. reaction.

19. A study of the treatment of combined wastes from butadiene, styrene and copolymer plants in the synthetic rubber industry.

20. The development of a method for the treatment and disposal of the large volumes of wastes produced in the manufacture of alpha T.N.T.

21. A study of the effect of various industrial wastes on the biological secondary sewage treatment processes.

22. A study to determine the effectiveness of the iodic acid method for oxygen consumed in measuring sewage and industrial waste treatment plant efficiencies.

23. Development of by-products from various domestic sewage or industrial waste sludges.

24. Development of treated methods suitable for strawboard wastes.

Although the problems confronting industry and all other participating agencies seem insurmountable at times, actually a great deal has already been accomplished in the research field and many projects are under way; therefore, it does not seem amiss to name here a few of the projects relating to sewage and industrial wastes which are now under way:

1. Woods Hole Oceanographic Institution, Woods Hole, Massachusetts; Bostwick H. Ketchum, Director: "The Viability of Enteric Bacteria in Sea Water and the Factors Controlling the Fate of Sewage After Discharge in the Sea."

2. North Texas State College, Denton, Texas; J. K. G. Silvey, Chairman, Science Division: "The Role of Actinomycetes in the Production of Tastes and Odors in Water and their Relationship to Algae and Under-Water Vegetation".

3. University of Texas Medical Branch, Galveston, Texas; O. H. Connell, Associate Professor of Sanitary Chemistry; "Effect of Temperature and pH upon the course of Reactions of Chlorine with Ammonia and Amino Groups Encountered in Sewage".

4. New Jersey Agricultural Experimental Station, Rutgers University, New Brunswick, New Jersey; Willem Rudolfs, Chief, Division of Sanitation: "Mechanism of Anaerobic Digestion of Sewage Solids and Industrial Wastes".

5. Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey; Willem Rudolfs, Chairman, Department of Sanitation: "Survival of Tubercle Bacilli in Sewage Treatment Processes, Stream, and Water Supplies".

6. Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey; Willem Rudolfs, "Oxidation of Soluble Organic Wastes by Activated Sludge, Dispersed Growth and Sand Filtration".

7. Rensselaer Polytechnic Institute, Troy, New York; E. J. Kilcawley, Professor of Sanitary Engineering and Soil Mechanics, "A Study of the Interaction of Sewage and Soil Based on the Hydraulic, Physical and Biochemical Changes Occurring in Model Earth Filters".

8. University of Florida, Gainesville, Florida; Wilson T. Calaway, Assistant Professor of Sanitary Sciences; "Biology and Ecology of Sewage Treatment processes".

9. Southwest Research Institute, San Antonio, Texas; Dr. Harold Vagtborg, Director: "Factors Involved in the Secondary Treatment of Sewage and Industrial Wastes by Lagooning".

10. University of Florida, Gainesville, Florida; John E. Kiker, Jr., Associate Professor of Public Health Engineering: "A Fundamental Study of the Disinfection of Sewage".

11. Massachusetts Institute of Technology, Boston, Massachusetts; Dr. Arthur T. Ippen: "Fundamental Research on Methods of Air Dispersion to Secure Greater Efficiency in the Solution of Oxygen from the Air Supplied in the Activated Sludge Process for Sewage and Industrial Waste Treatment".

12. Federation of Sewage Works Associations, Champaign, Illinois; W.D.Hatfield, Chairman, FSWA Standard Methods Committee, Decatur, Illinois: "Administration, Supervision and Coordination of RG-2140 to 2146 on Development of New and Improved Methods of Analysis of Sewage Industrial Wastes, and Other Polluted Water".

13. Purdue Research Foundation, Purdue University, Lafayette, Indiana; M. G. Mellon, Professor of Analytical Chemistry: "Development of Reliable Methods for Determination of Metals in Water and Sewage".

14. Rutgers University, New Brunswick, New Jersey; Willem Rudolfs, Chairman, Department of Sanitation, N. J. Agricultural Experiment Station: "Studies on Direct Methods for Determination of B.O.D. and the Effects of Industrial Wastes on its Determination".

15. New York Department of Health, Albany, New York; F. Wellington Gilcreas, Assistant Director: "Study of Standard Methods for the Chemical Examination of Sewage (grease, nitrogen compounds and other specific tests which may be assigned)".

16. The Ohio State University, Columbus, Ohio; L. K. Herndon, Assistant Director, Professor of Chemical Engineering: "Development of New and Improved Methods for Quantitative Detection of Specific Organic Components in Industrial Wastes".

17. Texas College of Mines and Metallurgy - El Paso Department of Water and Sewerage - El Paso City-County Health Unit; El Paso, Texas; Anton Berkman, Investigator: "The Study of the Sanitary Hazards of Polluted Irrigation Water, Its Effects Upon Soils and Related Public Health Problems."

Many industrial concerns are undertaking their own pollution abatement programs, not depending entirely upon their industry associations for guidance. A complete list would include: General Motors, Atlantic Refining, Ford, DuPont, American Viscose and American Cyanamid.

Studies and research projects underway by industrial associations would include the following:

BREWING INDUSTRY: The United States Brewers Foundation, Inc. is financing a project at Purdue University for utilization and disposal of brewery wastes. A method was reported for reducing dissolved solids and B.O.D. of press liquors by inoculation with bakers' yeast, with a concurrent increase in yeast. Also attention has been given to the utilization of spent hops by composting for use as fertilizer.

CANNING INDUSTRY: Fruit and Vegetable Canning: The National Canners Association has made several important contributions through its Scientific Research Committee conducted by the Sanitation Department of the Associations' Research Laboratories, which advocates independent research, cooperative research, advisory consultation services to individual canners, and an educational program for industry. Much literature has been distributed by this organization. Present plans include cooperative research projects with Purdue University, the Wisconsin State Board of Health and at least one other agency on treatment for apple cannery wastes, modifications of the standard B.O.D. determination and methods of preserving samples for B.O.D. determination. Tri-State Packers Association, Inc., a member association is showing interest in stream pollution. Also the state associations of canners in Wisconsin, California, Indiana, Minnesota and New York have been active in this research.

Citrus Fruit Canning: The Florida Citrus Commission (included here as an industrial organization) is concerned with shipping, packing or marketing. The Commission plans to conduct comprehensive study and research, preferably at the University of Florida, to determine all possible new and further uses for citrus fruits and conversion of same. Further, independent and cooperative research with the United States Citrus Products Station at Winter Haven, Florida, has been conducted and was productive of several practical contributions. Some of the so-called waste products after processing make excellent cattle feed, citrus molasses and feed yeast production from press liquors are also promising. Further, a study of anaerobic fermentation is under way.

Fish Canning: The California Fish Canners Association, Inc., has rendered certain member companies a unique service by acting as the medium through which a cooperative abatement project was actually constructed. The Harbor Water and Sewer Committee has for its objective the design and construction of those installations necessary to effect waste disposal and eliminate contaminated water. The Committee is presently cooperating with the California Legislature in preparation of waste control and disposal legislation.

CHEMICAL MANUFACTURING INDUSTRY: The Manufacturing Chemists' Association of the United States is undertaking the task of assisting member companies in the solution of waste prevention and disposal problems. A standing Stream Pollution Abatement Committee specifically aims to acquaint industry with the nature of stream pollution, to provide opportunity for exchange of technical information on waste treatment, to direct attention to the possibilities of production process changes to reduce pollution, to encourage cooperation of the pollution regulatory bodies, to assist companies in organizing for sound and effective abatement programs, and to keep industry posted on present laws and trends in pollution control legislation and regulation. The program contemplates strengthening liaison with other organizations concerned with the problem and the encouragement of institutional research fellowships.

DAIRY INDUSTRY: The following seven segments of the dairy industry have joined forces to solve their problems of waste disposal which, of course, are related under the title of the Task Committee on Dairy Waste Disposal: National Cheese Institute, American Butter Institute, Evaporated Milk Association, International Association of Ice Cream Manufacturers, American Dry Milk Institute, Dairy Industry Supply Association and the Milk Industry Foundation. The aims of this organization are to minimize wastes by education and studies in equipment design, studies of economical methods of waste utilization, education on importance of measurement and analysis of plant wastes and collection, evaluation and dissemination of information on waste treatment and its economics. Full cooperation with the activities of state pollution control agencies is contemplated in the attainment of these objectives. Michigan State College is installing a pilot plant at a milk processing station for the purpose of several studies. A three-year study of the destruction of milk solids is under way at the Eastern Regional Research Laboratory, at Philadelphia.

ELECTROPLATING INDUSTRY: The American Electroplaters' Society, an educational organization, was established for the advancement of the science of electroplating and has established a fellowship at Yale University to study the composition, volumes and effects on streams' aquatic life and sewage treatment plants of electroplating and related wastes. An attempt will be made to determine methods of recovery of valuable constituents as well as methods of treatment and disposal of residual wastes. Cyanide wastes are to be given the first detailed attention, followed by copper, chromium, etc. Also it is planned to investigate limits of tolerance of these toxic wastes in receiving streams.

GAS INDUSTRY: Although the widespread distribution of natural gas has relegated most manufactured gas plants to the limbo of emergency standby service, and by the same token eliminated gas plant wastes disposal as a pollution factor, the American Gas Association has in the past issued much valuable literature which is still fine reference material and the Association is marking time now, although prepared to act in the event of any demand for revival of its original program.

MEAT PACKING INDUSTRY: The American Meat Institute has taken no formal action in its waste disposal problems; and inquiries from packers are handled on an individual basis by the Institute's Director of Packing-house Practice and Research. It appears that the attention being given this grave stream pollution problem caused by the meat processing industries is not nearly commensurate with the importance of the issue.

PETROLEUM INDUSTRY: The American Petroleum Institute's growth has evolved into three committees on waste disposal: The Committee on Disposal of Marketing Wastes, which has published a most satisfactory code of practice; the Committee on Disposal of Production Wastes, which has hit a snag due to the variability of conditions in the twenty-two oil-producing states, and as a consequence since 1941 has been functioning only in an advisory capacity; and the Committee on Disposal of Refinery Wastes, which has made three commendable contributions as evidence by its Report: (a) "Waste Water Containing Oil", at present the best known guide for handling oily wastes; (b) "Waste Gases, Vapors, Sludges and Dusts"; and (c) "Waste Water Containing Selutes". At Ohio State University and Pennsylvania State College, the Institute is studying methods of measuring toxicity of industrial wastes to bacteria and plankton; and a new research project involving studies of factors governing the gravity separation of oil from waste water is being considered.

The Pennsylvania Crude Oil Association has recently undertaken representation of oil producers in that State in discussions with the State Sanitary Water Board on the subject of development of practical requirements for waste disposal incident to the drilling and operation of oil wells.

PULP AND PAPER INDUSTRY: In intensity, vigor and scope of its stream pollution abatement program, the activities of the National Council for Stream Improvement (of the Pulp, Paper and Paperboard Industries), Inc. has forged far ahead of any other. The organization was created solely for the purpose of conducting an integrated national program for the abatement of stream pollution resulting from pulp and paper production. The Council is at present sponsoring cooperative research as follows: Virginia Polytechnic Institute (semi-chemical wastes), Mellon Institute of Industrial Research (bleachery wastes and inter-industry problems), Purdue University (strawboard wastes), Rutgers University (white water problems), University of Michigan and Kalamazoo College (de-inking wastes), Institute of Paper Chemistry (aquatic biology problems), Manhattan College (stream analalysis), Louisiana State University (kraft mill wastes), Oregon State College (yeast production and aquatic biology). Arrangements are being negociated with Syracuse University for sulfite waste liquor studies. The Sulphite Pulp Manufacturers' Research League, Inc. has for its objective the economic development of practicable methods for eliminating spent sulfite liquor as a factor in stream pollution. A plant scale installation for Torulopsis yeast production is being engineered. The League plans to refine the Torulopsis yeast process, supplement the process with a view toward improved pollution abatement efficiency and search for alternate methods where yeast production is not applicable.

STEEL INDUSTRY: The objectives of the American Iron and Steel Institute are to study and develop the technical aspects of processes for the treatment and disposal of all industrial wastes of the steel industry and also to cooperate with federal and state authorities in their efforts to arrive at a feasible degree of purity in receiving lakes and streams. For years the Institute Committee has sponsored a research fellowship at the Mellon Institute of Industrial Research.

TANNING INDUSTRY: The Tannery Waste Dispesal Committee of Pennsylvania is composed of representative Pennsylvania tanners and members of the State Sanitary Water Board for study of pollution control. The Tanners Council of America is the trade association of the industry. The American Leather Chemists Association is a technical society of specialized interest, which correlates information on treatment procedures and renders advisory assistance to members of the association in the solution of individual problems.

TEXTILE INDUSTRY: The Textile Foundation, Inc. undertakes to aid its constituency in problems of waste disposal. Under a research fellowship at the University of North Carolina in 1932 four technical papers evolved. At the request of the Foundation, the Advisory Committee on Textile Waste Treatment made a survey of the literature and actual waste disposal practice. In cooperation with the University of North Carolina and under guidance of the advisory committee with Dr. H. G. Baity as General Adviser, the Foundation published the bulletin, "Textile Waste Recovery and Treatment", which report is still the outstanding treatise on textile waste treatment and disposal. The Institute of Textile Technology is a non-profit membership corporation designed to train technicians at the graduate level for work in the textile industry. It is equipped to conduct broad research and is authorized to grant advanced academic degrees. Bio-

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WINE INDUSTRY: The Wine Institute is a service organization for California wineries. The Winery Residues Disposal Committee of this Institute considers all proposals for handling residues and recommends those deserving special attention by research. A search is now being made for recoverable by-products from grape pomace (seeds, skins, pulp and short-stem fibers).

The Federation of Sewage Works Associations also advocates wholeheartedly a liaison service to bring together all interests concerned with stream pollution and utilization and disposal of industrial wastes toward the end of mutual understanding, agreement on policy and unity of action.

We feel that one of the principal attributes of the Federation is its attraction to every individual or agency that is interested in preventing or abating stream pollution. We wish to keep it a neutral meeting ground for representatives of industries, governmental pollution control agencies, municipal authorities, research authorities and technical specialists in design and operation of waste treatment and disposal works. We hope that all professional and administrative personnel will use our services to give expression to their points of view and integrate their skills toward a common objective — the prevention of stream pollution and the establishing of benefits for all agencies concerned.

If the Federation's principal interest seems to be devoted to municipal sewage collection, treatment and disposal, we would like for it to be remembered that we feel this is one of the chief advantages offered to industry. And it certainly is an advantage for industries to be able to dispose of their wastes by discharge into public sewers. And better still, if, by ardent research, methods are determined by which waste products from industrial plants may be utilized in the manufacture or processing of other useful materials, a long step forward will have been made and untold benefits derived which will assist in stabilizing the economy of the Nation; and the Federation will be fulfilling its objectives as set forth at the beginning of this paper.

The experiment that was initiated by the Harris County Commissioners Court based on their new concept in its pollution control has already paid big dividents, and I predict will be ultimately proclaimed as one of the outstanding innovations in this field in the future.

I wish to pay tribute to Judge Perry and his associates for this farsighted activity.

I pray for the creation of a county or regional sanitary district with no discrimination against small or large cities, industry or agricultural or recreational interests.

SECOND GULF COAST REGIONAL CONFERENCE ON INDUSTRIAL HEALTH
REPORT OF RESOLUTIONS COMMITTEE

John C. Flanagan, Chairman
Public Health Committee
Vice-President and General Manager
United Gas Corporation
Houston

Resolutions Committee offers the following:

1st: Vote of sincere thanks be extended particularly to the Committee on Public Health of the Houston Chamber of Commerce, its Chairman, Mr. John Flanagan, and its Secretary, Mr. William Black, and the Program Chairman, Mr. James Hammond for originating, developing, executing such a well-conceived and well-planned program as this one which itself marks the Second Regional Conference on Industrial Health here on the Gulf Coast, and one which places proper and unmistakable emphasis on an important part of the future of this increasingly important region.

The Resolutions Committee offers as well a resolution of thanks to all the other organizations which have contributed so generously to the promotion and execution of this program. Their work is deeply appreciated.

2nd: Whereas, the interest at this meeting is real and definitive; and, whereas, the tremendous importance of industry, growing industry, in the Gulf Coast Region calls for the most serious sort of study, review, and exchange of ideas, to the end that good, prior planning will obviate mistakes costly to health, life, and investment. The Resolutions Committee, therefore, offers a resolution that the Gulf Coast Regional Conference be continued as an annual affair.

3rd: Whereas, the interest of the public is best served by the public itself; and, whereas, one of the major interests of the great City of Houston is now that of industry; and, whereas, there exists at this time a duly constituted standing committee on Public Health in the Houston Chamber of Commerce, a committee which concerns itself not only with the public health of Houston, but with that of the Gulf Coast Region as well, be it resolved that the sponsorship of this annual conference be continued by the Houston Chamber of Commerce with the same support and encouragement now supplied by National, State and local health and safety engineering organizations.

4th: Whereas, it is understood that the Harris County Medical Society, in connection with other interested groups in this area, is contemplating extending an invitation to the American Association of Industrial Physicians and Surgeons to hold their 1952 annual convention in Houston; and, whereas, it is the opinion of the Resolutions Committee that the presence of this annual convention in this area would serve and stimulate interest in the field of industrial health and safety.

BE IT RESOLVED, that the sponsors of this Conference agree to support and assist in every way possible toward the obtaining for this area of the aforementioned convention.

1949 SECOND GULF COAST REGIONAL CONFERENCE
O N
INDUSTRIAL HEALTH

REGISTRATIONS

Allinson, R. L.	Dow Chemical Company	Freeport
Armstrong, Wallace F.	Ethyl Corporation	Baton Rouge, La.
Austin, T. S.	Hartford Accident & Indemity Co.	Houston
Axelrad, B. A.	Freeport Sulphur Company	Freeport
Bailey, J. E.	Freeport Sulphur Company	Freeport
Baird, Harry S.	Sun Oil Company	Dallas
Baird, Dr. V. C.	Humble Oil & Refining Co.	Houston
Baker, George M.	Texas Employers Insurance Assn.	Houston
Ball, H. K.	Ethyl Corporation	Tulsa, Oklahoma
Barrett, R. L.	Assn. Plumbing Contractors of Houston and Harris County	Houston
Bartholomew, Jeannette	The Texas Company	Houston
Battle, Gilbert	The Champion Paper & Fibre Co.	Pasadena
Baugh, Thelma C., R. N.	160 Ashburn	Houston
Beasley, R. S.	Lone Star Steel Company	Lone Star, Texas
Bennett, Hazel V.	Sheffield Steel Corporation	Houston
Berry, Clyde M., Ph.D.	Esso Standard Oil Company	New York City
Bethel. M. B.	Dow Chemical Company	Freeport
Bibee, T. R.	Gulf Oil Corporation	Houston
Blackwell, Belle	Houston Public Schools	Houston
Blaschke, Lester	Corpus Christi-Nueces Co. Health Unit	Corpus Christi
Blieden, A.	"Sanitation", 6602 Stearns	Houston
Bliss, Stan	Davis Emergency Equipment Co.	Newark, N. J.
Bock, Roy C. A., M.D.	Ethyl Corporation	Baton Rouge, La.
Boddie, Charles	PanAm Refining Corporation	Texas City
Boner, Emerson Q.	Rubber Reserve	Houston
Boone, Chas. B..	Gulf Oil Corporation	Houston
Bowditch, Manfred	Lead Industries Association	New York City
Brady, S. O.	Humble Oil & Refining Co.	Houston
Brainard, Paul	Emsco Derrick & Equipment Co.	Houston
Brandon, Dr. Sylvan	929 Medical Arts Building	Houston
Brandt, Allen D.	Bethlehem Steel Company	Bethlehem, Pa.
Brandt, P. L.	PamAm Refining Corporation	Texas City
Briney, Mrs. Mildred, R.N.	Petrol Refining Co., Inc.	Texas City
Brock, M.	Gulf Oil Corporation	Houston
Brooke, Maxey	Alamo Refining Company	Sweeny, Texas
Brown, L. H.	Eastern States Petroleum Co.	Houston
Bryan, A. C.	City of Houston	Houston
Buck, Frances	U. S. Public Health Service	Dallas
Cadigan, Charles H.	Eastern States Petroleum Co.	Houston
Caranach, A. E.	Gulf Oil Corporation	Port Arthur
Carlisle, O. T.	Carbide & Carbon Chemicals Corp.	Texas City
Carter, Will T.	Texas Employers' Insurance Assn.	Houston

Cernosek, Amalie	National Biscuit Company	Houston
Chalmers, J. S., M.D.	Bethlehem Supply Company	Tulsa, Okla.
Christensen, Rigmor	Magnolia Petroleum Company	Beaumont
Clayton, George D.	U. S. Public Health Service	Washington, D.C.
Cleary, Edward J.	Ohio River Valley Water San. Com.	Cincinnati, Ohio
Compton, E. D.	The General Tire & Rubber Co.	Baytown
Connell, C. H.	Univer. of Texas - Medical Branch	Galveston
Coogle, Dr. C. P.	2220 Maroneal Street	Houston
Crum, C. L.	Fidelity Casualty Co. of N. Y.	Houston
Daeschner, Mrs. Pearl	Eastern States Pet. Co., Inc.	Houston
Dale, Jr., R. H.	Southwest Steel Products	Houston
DallaValle, Dr. J. M.	Ga. Institute of Technology	Atlanta, Georgia
Daniels, Mrs. Mary Tom	Houston Lighting & Power Co.	Houston
Dashel, R. W. Rucks	Diamond Alkali Company	Pasadena
Davidson, Tom H.	Humble Oil & Refining Co.	Baytown
Davies, Kieffer, M. D.	Phillips Petroleum Company	Bartsville, Okla.
Davies, S. Benson	Texas Employers' Insurance Assn.	Galveston
Davis, Miss Mavis	St. Joseph School of Nursing	Houston
Dadisman, W. Ray	Maryland Casualty Company	Houston
Delaune, R, H.	Dow Chemical Company	Freeport
Denholm, Dr. John S.	Esso Standard Oil Company	New York City
Dent, Marshall	PanAm Refining Corporation	Texas City
Dernehl, Dr. C. U.	Carbide & Carbon Chemicals Corp.	Texas City
DeVore, Dr. Neal M.	923 Medical Arts Building	Houston
Dickson, D. B.	Department of Health	Fort Worth
Diserens, Alton H.	State Health Department	Austin
Dodd, Miss L. P.	Humble Oil & Refining Company	Tyler
Dooley, Allan B.	The Texas Company	New York City
Dorsett, J. Dewey	Assn. Casualty & Surety Cos.	New York City
Dowling, R. F.	Huey and Philp Hardware Co.	Houston
Downs, Jr., Major F. H.	HQ Fourth Army	Ft. Sam Houston
Dunne, Larry	Corpus Christi-Nueces Co. Health Unit	Corpus Christi
Durham, Mrs. Ludy, R.N.	Peden Iron and Steel Company	Houston
Dymond, Arthur L.	Aluminum Co. of America	Port Lavaca
Edge, Groneck	Humble Oil & Refining Co.	Baytown
Edwards, Wm. Lee	Boy Scouts of America	Houston
Ehlers, V. M.	State Health Department	Austin
Elm, Roy	The General Tire & Rubber Co.	Baytown
Emden, Louis	Gulf Oil Corporation	Houston
Erwin, Antoinette G.	Mosher Steel Company	Houston
Estes, Douglas S.	Petrol Refining Co., Inc.	Texas City
Ettinger, M. B.	U. S. Public Health Service	Cincinnati, Ohio
Farragut, L. D., M.D.	Harris County Health Unit	Houston
Fearey, M. E.	Rohm & Haas Company	Pasadena
Fetzer, Dr. Lewis Wm.	612 Southwestern Life Bldg.	Dallas
Fields, J. S.	Phillips Chemical Company	Bartsville, Okla.
Fitzgerald, Jr., C. L.	Maintenance Engineering Corp.	Houston
Flanagan, J. C.	United Gas Corporation	Houston
Fleming, Allan J., M.D.	E. I. du Pont de Nemours & Co.	Wilmington, Del.

Flukinger, Stanley P.	Second National Bank Bldg.	Houston
Forsgard, Jr., Sam M.	Texas Employers' Insurance Assn.	Houston
Folkland, Audrey	Magnolia Petroleum Company	Beaumont
Folse, Parker C.	Magnolia Petroleum Company	Houston
Frank, T. M., M.D.	PanAm Refining Company	Texas City
Freeman, William I.	State Health Department	Houston
Friedrichs, C. C.	Wallace & Tiernan Company, Inc.	Houston
Furley, W. E.	Wyatt Metal & Boiler Works	Houston
Gaenslen, George R.	State Department of Health	San Antonio
Gans, Mrs. Beulah	James Bute Company	Houston
Gapetus, N. A. A.	Jefferson Chemical Company	Port Neches
Garrett, Ross	Ross Garrett and Associates	Chicago, Illinois
Godwin, Damon D.	Texas Employers'Insurance Assn.	Houston
Goodgion, Mrs. May	Williamson-Dickie Mfg. Corp.	Fort Worth
Graham, H. R.	Goodyear Synthetic Rubber Corp.	Houston
Grossheim, L.	Shell Oil Company, Inc.	Houston
Grubbs, Jack	American Assn. Insurance Cos.	Houston
Haley, Harold D.	Royal Liverpool Insurance Co.	Houston
Hall, C. M.	Natural Gas Odorizing Co., Inc.	Houston
Hall, J. E.	Jefferson Chemical Company	Port Neches
Hammond, J. W.	Humble Oil & Refining Co.	Houston
Hamrick, W. H., M.D.	Harris County Medical Society	Houston
Hand, S. T.	Lykes Bros. Steamship Co., Inc.	Houston
Hansen, Eva, R.N.	E. I. du Pont de Nemours & Co.	La Porte
Harlan, Allie G.	Sheffield Steel Corporation	Houston
Harp, W. M.	Humble Oil & Refining Co.	Houston
Harrison, Cala G.	Chambers Co. W.C. & I.D. #1	Mt. Belview,Texas
Harrop, James	Humble Oil & Refining Co.	Baytown
Hartel, V. F.	Hartford Accident & Indemnity Co.	Houston
Harvill, Clyde	City of Houston - Water Dept.	Houston
Helmer, Arthur J.	J. Weingarten, Inc.	Houston
Hendon, Roy B.	Liberty Mutual Insurance Co.	Atlanta, Georgia
Hendrick, V. C.	Rohm & Haas Company	Pasadena
Hendricks, N. V.	Standard Oil Co. of New Jersey	New York City
Henry, J. S.	Gulf Oil Corporation	Houston
Herndon, Henry T.	Texas Employers' Ins. Assn.	Dallas
Herzik, Jr., G. R.	Texas State Dept. of Health	Austin
Hibbs, Edwin B.	State Health Department	Houston
Hicks, Douglas	Max H. Jacobs Agency	Houston
Hopkins, Mark C.	PanAm Refining Corp.	Texas City
Hudgins, James J.	Miss. State Board of Health	Jackson, Miss.
Hutchins, A. G.	Sinclair Refining Company	Houston
Irish, D. D., M.D.	The Dow Chemical Company	Midland, Michigan
Jacobi, R. I.	Sinclair Refining Company	Houston
Jenkins, Joe E.	Freese, Nichols & Turner	Houston
Jones, H. M.	Ford Motor Company	Dallas
Jones, J. Mack	J. N. Flood & Co. - Engineers	Waco, Texas
Jorgenson, Mrs. Sybil	Jefferson Chemical Company	Port Neches
Juneman, G. M.	Carbide & Carbon Chemicals Corp.	Texas City

Kahl, F. Ruth, R.N.	U. S. Public Health Service	Washington, D. C.
Kahle, R. B.	Eastern States Petroleum Co., Inc.	Houston
Kahle, Dr. Warren F,	Eastern States Petroleum Co., Inc.	Houston
Kassell, Dorothea E.	Sheffield Steel Corporation	Houston
Kellman, Dr. Seth W.	Chance Vought Aircraft	Dallas
Kemp, Dr. Hardy A.	Baylor Univ. College of Medicine	Galveston
Kent, Dr. B. M.	Humble Oil & Refining Co.	Houston
Kerr, J. C.	Magnolia Petroleum Company	Houston
King, Mary Lou	American Cancer Society	Houston
Kitchel, K. K.	The General Tire & Rubber Co.	Baytown
Koch, C. A.	Houston Lighting & Power Co.	Houston
Konrad, Carrie J.	Graduate Nurses' Assn.	Houston
Kroll, C. A.	The Dow Chemical Company	Freeport
Langham, Karl	American Zinc Co. of Illinois	Dumas, Texas
Langhorst, Karl F.	Employers' Mutuals	Houston
Laurentz, Fred K., M.D.	City Health Department	Houston
Lefton, I. M.	State Health Department	Houston
Lester, John W.	E. I. du Pont de Nemours & Co.	Orange
Lewis, Dr. B. M.	Dept. of Public Welfare	St. Louis, Mo.
Lewis, Miss Clara, R.N.	Sinclair Rubber Co., Inc.	Houston
Lewis, Mrs. Fannie B.	American Brake Shoe Company	Houston
Liles, Ralph, M.D.	Surgical & Medical Clinic	Houston
Lindsey, Ernest T.	Celanese Corp. of America	Bishop, Texas
Little, Leonard	United Gas Corporation	Houston
Littlefield, E. E.	Jefferson Chemical Company	Port Neches
McBride, R. B.	Carbide & Carbon Chemicals Corp.	Texas City
McCants, R. P.	United Gas Corporation	Houston
McDonald, Malory	Missouri Pacific Lines	Houston
McDouglas, Wm.	PanAm Refining Corporation	Texas City
McFarland, Dr. Ross A.	Harvard Society of Pub. Health	Boston, Mass.
McKee, John	Ford Motor Company	Dallas
McLean, Beatrice	Surgical & Medical Clinic	Houston
McMakin, L. E.	Sinclair Refining Company	Houston
McReynolds, R. J.	3832 Broadway	Houston
Macrini, Mrs. Jean	Monsanto Chemical Company	Texas City
Madigan, J. F.	The Texas Company	Houston
Mark, Joe B.	Sheffield Steel Corporation	Houston
Martin, Walter G.	State Health Department	Tyler
Masten, J. L.	Monsanto Chemical Company	Texas City
Mathewis, M. A.	Neptune Meter Company	Houston
Mathis, Oma	Hughes Tool Company	Houston
Mayfield, J. L.	Felix Paquin & Associates	Galveston
Metyko, Frank J.	608 Scanlan Building	Houston
Mills, Kerry E.	PanAm Refining Corporation	Texas City
Mims, Jack	Liberty Mutual Insurance Co.	Houston
Minkus, Dr. R. F.	E. I. du Pont de Nemours & Co.	Orange
Mobley, H. R.	City Health Department	Houston
Moggio, W. A.	Louisiana State University	Baton Rouge, La.
Montgomery, T. C.	Southern Pacific Lines	Houston
Moore, Dr. John T.	821 Medical Arts Building	Houston
Morris, H. E.	Monsanto Chemical Company	Texas City

Morrish, Fred	McEvoy Company	Houston
Murph, D. B.	Eagle-Picher Company of Texas	Dallas
Murphy, Wm. J.	Texas Employers' Insurance Assn.	Houston
Naschke, Al	American Assoc. Insurance Cos.	Houston
Nash, R. B.	Houston Lighting & Power Co.	Houston
Nau, Carl A.	University - Medical Branch	Galveston
Neal, Jack	University of Texas - Med. Branch	Galveston
Neveuz, Joe L.	Gulf Oil Corporation	Houston
Newman, Don	American Assoc. Insurance Cos.	Houston
Newman, Wm. A.	Ethyl Corporation	Houston
Niccolls, J. F.	Houstoun, Stevenson & Cummings	Houston
Norris, Jr., H. L.	The Dow Chemical Company	Freeport
Norris, Oleg M.	Southern Alkali Corporation	Corpus Christi
Norville, R. G.	Aluminum Company of America	Port Lavaca
Norwood, B. E.	Shell Oil Company, Inc.	Houston
Nosler, Richard F.	M. N. Dannenbaum Company	Houston
Opersteny, Edward	Texas Employers' Insurance Assn.	Houston
Ostrom, O. E.	Southwest Steel Products Company	Houston
Padgett, A. R.	Humble Oil & Refining Company	Houston
Paganini, Otto	Harris County Health Unit	Houston
Painter, Jr., J. H.	Harris Co. Pollution Survey	Houston
Parker, Miss A. V. (Nurse)	Houston Lighting & Power Co.	Houston
Payne, Dorothy B.	Sheffield Steel Corporation	Houston
Peters, Ola, R.N.	A. O. Smith Corporation	Houston
Pinto, Sherman S., M.D.	American Smelting & Refining Co.	Denver, Colorado
Pipkin, R. W.	Humble Oil & Refining Company	Baytown
Poole, Wm. L.	General Foods Corporation	Houston
Posey, Jesse	Shell Chemical Corporation	Houston
Poth, Edward W.	U. S. Air Force	San Antonio
Potter, A. D.	State Health Department	Austin
Powell, George B.	Mosher Steel Company	Houston
Preston, Allan H.	Houston Laboratories	Houston
Price, Robert E.	Gulf Oil Corporation	Port Arthur
Prior, A. H.	Emsco Derrick & Equipment Co.	Houston
Protzman, L.	Hartford Accident & Indemnity Co.	Houston
Rahn, R. L.	McEvoy Company	Houston
Raleigh, Mrs. Zena, R.N.	Humble Oil & Refining Company	Houston
Randall, F. A.	Carbide & Carbon Chemicals Corp.	Texas City
Rasmussen, Florence	Gulf Oil Corporation	Houston
Reeburgh, Jr.	Gulf Oil Corporation	Port Arthur
Regehr, John K., M.D.	Pine Bluff Arsenal	Pine Bluff, Ark.
Revelle, E. A.	Mathieson Chemical Corp.	Lake Charles, La.
Richey, Alvan E.	Industrial Scientific, Inc.	Houston
Riddle, Don	Gulf Oil Corporation	Houston
Roberson, Seth	Natural Gas Odorizing Co., Inc.	Houston
Roetman, E. T.	U. S. Public Health Service	Dallas
Rollins, Alma	Texas State Dept. of Health	Austin
Rowan, H. A.	Jefferson Chemical Company	Port Neches
Saffington, H. O.	Humble Oil & Refining Co.	Baytown

St. John, H. W.	Central Power & Light Co.	Corpus Christi
Saunders, John W.	Humble Oil & Refining Co.	Baytown
Saxon, Elmer G.	Shell Chemical Corporation	Houston
Schaefer, Charles A.	State Health Department	Houston
Seymour, W. H.	Liberty Mutual Insurance Cos.	Boston, Mass.
Shaffer, Sherman S.	Humble Oil & Refining Co.	Baytown
Shannon, G. T.	Humble Oil & Refining Co.	Baytown
Shaw, Miss Barbara (Nurse)	Houston Lighting & Power Co.	Houston
Shearon, Will H.	American Chemical Society	Houston
Shelley, P. G.	Dow Chemical Company	Freeport
Shigley, C. M.	The Dow Chemical Company	Freeport
Shrewsbury, C. L.	Southwest Research Institute	San Antonio
Siddall, C. L.	The Dow Chemical Company	Freeport
Simmons, Brig. Gen. J.S.	Harvard School of Public Health	Boston, Mass.
Simpson, Jr., A. D.	United Gas Corporation	Houston
Smallhorst, David F.	State Department of Health	Austin
Smith, Frank H.	Tennessee Gas Transmission Co.	Houston
Smith, H. D.	Goodyear Synthetic Corporation	Houston
Smith, Wm. E. R.	American Zinc Co. of Illinois	Dumas
Sorrels, J. H.	Texas A & M College	College Station
Stallings, W. B.	Monsanto Chemical Company	Texas City
Stalnaker, Dr. Paul R.	4715 Fannin Street	Houston
Stark, Glenna	Humble Oil & Refining Co.	Baytown
Stephens, Clyde T.	Superior Insurance Company	Sherman
Sterner, Dr. James H.	Eastman Kodak Company, Med. Dept.	Rochester, N. Y.
Stockton, L. E.	Emsco Derrick & Equipment Co.	Houston
Stokely, E. C.	Dow Chemical Company	Freeport
Strong, E. R.	Southwest Research Institute	San Antonio
Swasey, S. L.	The Champion Paper & Fibre Co.	Pasadena
Sylvester, John W.	Humble Oil & Refining Company	Baytown
Taylor, L. V.	American Can Company	New York City
Tennent, Mrs. T. H.	Women's Public Health Committee	Houston
Thompson, Jr., A. T.	State Health Department	Austin
Tidwell, Rex L.	Blue Cross Plan	Houston
Tomex, John A.	Texas Employers' Insurance Assn.	Houston
Tudor, T. Clifford	B. F. Goodrich Chemical Company	Port Neches
Tuma, Q. V.	The Texas Company	Houston
Turner, Herbert G.	United Gas Corporation	Houston
Vela, L. G.	Felix Paquin & Associates	Galveston
Venable, Fred S.	State Health Department	Austin
Viles, P. S.	Humble Oil & Refining Company	Houston
Vincent, D. M.	Phillips Chemical Company	Pasadena
Vogelpohl, K. E.	Southwest Steel Products Co.	Houston
Wagers, Otto	The Champion Paper & Fibre Co.	Pasadena
Walden, Pearl	State Board of Health	Jackson, Miss.
Waldrep, Burnell	Assistant Attorney General	Austin, Texas
Wardlow, W. B.	State Department of Health	Austin
Waring, R. P.	Houston Lighting & Power Co.	Houston
Warren, R. W.	Hartford Accident & Indemnity Co.	Houston
Weaver, Jane M., R.N.	Liberty Mutual Insurance Co.	Houston
Weiler, L. J.	Humble Oil & Refining Company	Baytown

Wettstein, Frank E.	Texas Employers' Insurance Assn.	Houston
Whalley, Anne M.	Sheffield Steel Corporation	Houston
White, Robert J.	Baroid Sales Division	Houston
White, William E.	Public Works Department	Houston
Wild, Mrs. Beulah Temple	Community Council	Houston
Willett, Kathryn	Gulf Oil Corporation	Houston
Williams, David F.	Champion Paper & Fibre Co.	Pasadena
Williams, Harvey B.	PanAm Refining Corporation	Texas City
Willis, A. B.	The Milwhite Company, Inc.	Houston
Wilson, J. A.	Gulf Oil Corporation	Houston
Wilson, James W.	State Health Department	Houston
Winder, Norman G.	Texas Vitrified Pipe Company	Dallas
Wood, David M.	Liberty Mutual Insurance Co.	Houston
Wood, Harold A., M.D.	Houston Public Schools	Houston
Woodley, James W.	Liberty Mutual Insurance Co.	Houston
Wright, E. R.	Dow Chemical Company	Freeport
Wynne, James D.	Liberty Mutual Insurance Co.	Dallas
Zentman, Angelika	12545 Market Street Road	Houston
Zucca, J. F.	Consolidated Western Steel Co.	Orange

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