Gulf Coast Regional Conference
on Industrial Health,
Fourth annual Gulf Coast
Regional Conference on Industrial
Health, September 27-29, 1951.

FOURTH ANNUAL

REGIONAL CONFERENCE
ON
INDUSTRIAL HEALTH

September 27-29, 1951

HOUSTON, TEXAS

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Creating Public Interest In

D HEALTH FOR INDUSTRY IN THE GREAT SOUTHWEST

DEDICATED

TO

THE PUBLIC HEALTH COMMITTEE, HOUSTON CHAMBER OF COMMERCE
TEXAS STATE DEPARTMENT OF HEALTH
THE BAYLOR UNIVERSITY, COLLEGE OF MEDICINE
AMERICAN SOCIETY OF SAFETY ENGINEERS, GULF COAST CHAPTER
AMERICAN ASSOCIATION OF INDUSTRIAL NURSES-HOUSTON BRANCH
TEXAS MANUFACTURERS ASSOCIATION
HEALTH DEPARTMENT, CITY OF HOUSTON
THE UNIVERSITY OF TEXAS, MEDICAL BRANCH
HARRIS COUNTY MEDICINE SOCIETY, INDUSTRIAL HEALTH SECTION
HARRIS COUNTY HEALTH UNIT
AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, TEXAS SECTION
NATIONAL ASSOCIATION OF SANITARIANS

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

FOURTH ANNUAL GULF COAST REGIONAL CONFERENCE
ON INDUSTRIAL HEALTH
SEPTEMBER 27-29,1951

ORGANIZATION

DR. DENTON KERR, CHAIRMAN, PUBLIC HEALTH COMMITTEE, HOUSTON CHAMBER OF COMMERCE
JAMES W. HAMMOND, I.H., HUMBLE OIL & REFINING COMPANY
DAVID M. WOOD, LIBERTY MUTUAL INSURANCE COMPANY
JOHN R. FRAKER, SECRETARY
MRS. ESPERANZA CASTELLANOS, RECORDING SECRETARY

INDUSTRIAL HEALTH CONFERENCE
COMMITTEE

DAVID M. WOOD, CHAIRMAN
JAMES W. HAMMOND, VICE CHAIRMAN

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Robert L. Allinson, I. H., Dow Chemical Company
Fred E. Gray, Diamond Alkali Company
Fred Randall, Carbide & Carbon Chemical Corporation
Boyd Nash, Houston Lighting & Power Company
Otto Paganini, Harris County Health Unit

PUBLICITY

Leonardo S. Patillo, Houston Chamber of Commerce

II. PROGRAM

(1) Public Health Aspects of Civilian Defense

Dr. George D. Broyles, Jr.

(2) Industrial Waste

Albert H. Halff, Sanitary Engineer
A. J. Krell, Office of Price Stabilization

(3) Industrial Hygiene

James W. Hammond, I. H., Humble Oil & Refining Company

(4) Industrial Medicine

Dr. W. H. Hamrick, Feagin Clinic
Dr. Ralph Liles, Drs. Rollins & Liles
Dr. W. M. Palm, The Houston Clinic

(5) Industrial Nurses

Jeannette Bartholomew, R.N., The Texas Company
Carrie J. Konrad, R.N., Texas Graduate Nurses Ass'n Dist. 9
Jane Weaver, Liberty Mutual Insurance Company

III. ARRANGEMENTS

Dr. Denton Kerr, American Ass'n of Physicians & Surgeons
Paul E. Buehner, Houston Chamber of Commerce

IV. ENTERTAINMENT & WELCOME

Dr. Hardy A. Kemp, Baylor University College of Medicine

V. BOOTH EXHIBIT

Geo. J. Gruber, Mine Safety Appliances Company

VI. REGISTRATION

A. Blieden, "Sanitation"

CONTENTS

Friday September 28, 1951 Cont'd.

CONFERENCE WELCOME
TO ALL DELEGATES
BY
DR. DENTON KERR, CHAIRMAN OF THE PUBLIC HEALTH COMMITTEE
AND PRESIDENT OF THE AMERICAN ASSOCIATION OF PHYSICIANS AND SURGEONS

Mr. Chairman, Members of the Assembly and Honored Guests: To all of you I extend a very warm and cordial welcome. I say this on behalf of the most efficient, most loyal and the hardest working committee with which I have had the privilege to work.

The Chamber of Commerce, the various health groups and many other organisations both civic and industrial have worked long hours getting this program together. We are extremely proud of our accomplishments because we have here a group of America's most successful and most talented speakers who are unselfish enough to come here on their own time and at their own expense to bring us important facts which are most essential to the health and welfare of an industrial area such as ours. The unselfish attitude of these great people and their willingness to come here and help us improve the industrial health of this region characterize the American way of life.

Honored guests, we welcome you here to tell us about your successes and failures. You will help us avoid the pitfalls which you have found to be expensive and unseccessful. May you be privileged to return again and again under similar circumstances. May you never be forced to come with an edict or a decree from some central power telling us that we shall do it a certain way or suffer the consequences. We shall try hard to make your stay pleasant while here, and you must feel free to call upon us for anything you might need.

We welcome the industrial leaders here because with the exchange of ideas we believe you can learn methods by which you can extend to your employees more healthful working conditions at a profit to you.

Pleasant working conditions and proper recreational facilities during off hours make an employee more efficient and more enthusiastic and will certainly increase production in any plant.

We welcome the Junior Executives. We hope you can learn some rules of health that will prevent nervous jitters, stomach ulcers and heart attacks at the very time in life that you can become most useful to your organization as well as to your community. Almost daily we read of the untimely death of some young man whose training and experience have brought him to the point of greatest usefulness. Such losses are very difficult to replace. Most of you already know that active interest in a worth while community project provides far more relaxation than can be found in crowded smoke filled clubs. The way you utilize your off hours, your week ends and your vacations will have a great influence upon the future of your organization and the future of democracy. Most of you have reached your present position by long hours and hard work. For this you have my sincere admiration. But do not get so engrossed in your work that you forget your own health and ever lose contact with the world about you.

To the employees and all others present we extend a particular welcome. We hope you feel free to make helpful suggestions regarding these programs. Your attendance, your interest and your constructive criticisms are paramount to the success of this conference. With shorter hours and longer vacations your leisure time is abundant. The way you spend that time will have much to do with the future success of your organization, your family or yourself. Far too many people save up time for long week ends only to jump into the family car on Friday night, dash across a state or two, then fight their way back for duty Monday morning. Tired, worn out and in a poor frame of mind they face another week. These people rarely get ahead with their company. They rarely contribute anything to the community in which they live.

If only a small but carefully planned portion of this leisure time is spent learning something about your company, how to do your job better, how to handle the next job above you or how to be a better citizen, Your life would be happier and more successful. Tomorrow some of you will be stepping up to take over greater responsibilities. It is hoped that this conference will help prepare you both psychologically and physically for your new position.

As we enter this 4th annual Industrial Health Conference let us all rededicate ourselves to the task of making industry in this area more and more efficient. Let us rededicate ourselves to the task of making our health and living standards the pride of this community and the envy of the rest of the world.

* * *

KEYNOTE ADDRESS
Thursday, September 27,1951

MORNING SESSION

W. Marvin Hurley,Houston Chamber of Commerce, Presiding

"INDUSTRIAL MEDICINE - A CHALLENGE"

E. A. Irvin, M.D.
General Motors Corporation
Detroit, Michigan

Industrial medicine is face to face with a challenge! Today we are looking toward a new horizon which is much broader and beyond it may lie more possibilities than ever before anticipated. The highest authority in the entire field of medicine, the American Medical Association, has recognized that Industrial Medicine has attained the maturity of a recognized specialty. It has established a provisional specialty board --- the American Board of Occupational Medicine. This newly created board will have representatives from the Industrial Medical Association, the Council of Industrial Health of the AMA, and the Academy of Occupational Medicine. It is true this is only a provisional board and further approval must come from the advisory Board of the Specialties and the House of Delegates of the American Medical Association.

This forward step was not easily achieved. At times the road was rough and stormy, and almost seemed beyond the realm of possibility. While the present leaders in Industrial Medicine are certainly cognizant of the ever widening aspects of this phase of the profession, it was not entirely the product of their effort but much of the credit must go to the pioneers in the field of Industrial Medicine. It was their persistent effort, courage and inspirational leadership which gave our present leaders the spirit and enthusiasm to carry on --- carry on to the reality of recognition as a specialty. We recognize the important fact that Industrial Medicine is a team --- a great combination of Industrial physicians, nurses, hygienists and medical staff workers. This achievement and recognition would never have been possible without the combined effort and cooperation of all members of this team.

With every accomplishment come new and greater responsibilities which must be discharged if progress is to be continued. One of our first and most urgent responsibilities is to meet the requirements of our specialty as set forth by the Board of Occupational Medicine, which are:

1. To improve the quality of graduate education in the field of Occupational medicine;

2. To determine and set educational, moral, ethical and specialized standards or qualifications for licensed practitioners of medicine and surgery confining their practices to the field of occupational medicine;

3. To determine by written and oral examinations and otherwise which physicians possess such qualifications and adhere to such standards;

4. As a protection to the public and the medical profession to issue appropriate certifications to physicians so determined as possessing such qualifications and adhering to such standards; and

5. To do all things necessary to promote the advancement and betterment of the specialized medical practice embraced in the field of occupational medicine.

These principles are the underlying foundation for a sound industrial health program and regardless of personal opinions, attitudes or prejudices there can be no deviation from them if we hope to obtain uniform and adequate medical service. The quality of medicine and the service we render industry and the worker is the measure by which we will be judged. Therefore, we must make sure that every physician in industry understands his responsibilities in maintaining a high standard of service and the effect which his failure to do so will inevitably have on our long range objectives. Most of us are aware of the fact that a variety of different types of medical services have been established in industry. Some reflect a broad knowledge of the problem and are the result of forward thinking, extensive planning and study. Others indicate a lack of understanding of the basic principles upon which industrial medicine is founded. For example, I recently spoke with a physician in a plant employing approximately 12,000 people who said he didn't have enough work to keep him busy. He went on to say that because of this he had developed several time-consuming hobbies and, in addition, had handled more than one hundred obstetrical cases during a period of three years. I mention this only to emphasize my statement that the basic standards are not always thoroughly understood because we all know that to adequately serve 12,000 employes, it would require not only the full time of one physician but the full time of several assistants as well. This is one of many examples I could cite which prove the need for educational work in establishing a firm foundation for medical service in industry.

The American College of Surgeons has for many years conducted a program of evaluation of Medical Services in Industry. This includes the inspection and evaluation of the Medical Service from the standpoint of staff, facilities, records and the over-all program. The American College of Surgeons recognized that the Industrial Medical Association had grown in stature and was the most logical group to render this service to industry. In May of this year an agreement was reached between the two associations which transferred the program of Medical Services in Industry to the Industrial Medical Association. We of the IMA will attempt to carry on an effective evaluation program which will be of assistance to both Management and Industrial Physicians.

Generally speaking, management has come to look upon Industrial Medicine as an integral part of business. And, with the increase in cost of health and accident insurance, plus the ever increasing costs of retirement programs, they are becoming more and more aware of the true value of a well organized medical program. However, there is much additional work to be done in this direction.

In some instances, due to the lack of understanding on the part of management, facilities and staff are not adequate to carry on a sound program. There are also instances where the medical service is placed so low in the organizational structure that the physician does not have access to top management to define the need for and the results which can be expected with an adequate program. While this is a weak link in the organization, it is our responsibility to establish channels of direct contact with top management levels in order to inform them of their medical needs; and also to acquaint them with the tremendous contribution a sound medical program can make to a more efficient operation of a business. Frequently we encounter resistance from management based on the cost of establishing this service. It has been proven that a good medical service is a sound investment. I know of no commodity or service which industry buys at the same discount which is expected of the medical service.

Industrial Medicine places a challenge before the medical educators. If we are to continue to progress in the effort to which we have dedicated ourselves, we must have their cooperation and help. In many instances in the past, our educators have been reluctant to give recognition to the need of incorporating Industrial Medicine in the under-graduate years of medical school. There has also been delay in establishing satisfactory post-graduate training in this field. The failure to emphasize these two important phases of medical education was a factor in the delay of achieving recognition as a specialty. One might well ask why it has taken so long for the importance of this phase of medicine to be recognized by medical educators. For years the curriculum of medical schools has dealt primarily with the problem of curative medicine and has failed to give sufficient consideration to the fact that "patients work." They have not stressed sufficiently the effect of work and environment on health and disease. The men in training during the under-graduate years, internship and residency can profit tremendously, regardless of their chosen field, if they recognize the effect of work on health and disease. The factors of work and employability and the environmental factors associated with the patient's work may be extremely important in his recovery or the maintenance of his health. However, I wish to emphasize work not as a causative factor of disease but that physical exertion associated with it may aggravate or delay the recovery from certain diseases. For example, a physician frequently fails to recognize the problems which the patient may encounter between his home and his place of employment. Some patients must walk long distances to public transportation and, conceivably, could encounter several transfers which may at times subject them to long periods of waiting in bad weather. The patient may have a long walk from the point of exit of the transportation, and then it may be necessary for him to walk one or more flights of stairs to the locker room. All of these are important factors with certain types of diseases and must receive due consideration. A current study of the Cardiac Housewife has been most interesting. It has revealed the great amount of work the average housewife does in the routine duties about the home. Most physicians have never thought of the duties of a housewife as being particularly strenuous but this study has shown the great need for placing restrictions on the activities of the cardiac housewife and how helpful work-simplification may be in these cases. There is room for further studies to be made in this field. The time to impress the importance of this phase of medicine is during the time of training the physician in medical school or during the time of internship or residency. This type of training is the responsibility of the medical educators in this country. There is now a Committee on Medical Education of the Industrial Medical Association which is working on a suggested program for post-graduate training in the field of Industrial Medicine. This information will be made available to Medical Schools, teaching hospitals and industries with well established medical programs which may be used for training purposes.

When discussing this phase of medicine recently with a dean of one of our leading medical schools, he was amazed to learn that more than 85% of the people of this country are employed in plants with less than 500 employes. Why should this be important to medical educators? It means that approximately 85% of the employed people receive their industrial medical service from physicians in private practice. This emphasizes the importance of training all physicians to be aware of the problems associated with employability. It becomes even more important during a national emergency when all manpower must be used with maximum effectiveness. The effective use of manpower depends on job placement. The evaluation of an individual's physical capacity must be made by a physician. We must recognize that the ideal use of manpower is impossible due to human variances. We order machines, tools, jigs and fixtures to specifications and we expect these machines to perform to known limitations. We cannot, however, order manpower to specifications so we must utilize to the highest degree of efficiency the manpower which is available and, therefore, must be prepared to use all of the known means to determine man's probable success on a given job.

The true importance of employability is frequently underestimated. This was recently brought out very vividly to me when I was asked to give a lecture to the students of a medical school on the subject of employability. The preceding lecture was on the subject of Diphtheria. In my opening remarks I could not resist commenting on the fact that during the entire year of 1950 there was not a single case of diphtheria reported in the city of Detroit, however hundreds of thousands of people were employed. I think this is of great significance when we realize that one lecture hour was spent on the discussion of this rare disease and one hour given to the entire problem of employability. It might be of further interest to know that in one of our leading medical schools, more than 4,000 hours are devoted to lecture and laboratory work, but only 16 of these are devoted to Industrial Medicine. The medical schools, public health officers and the practicing physicians deserve tremendous credit for their accomplishments, however, if we are to progress and keep in step with changing times, we must also change our attitude towards the requirements of the curriculum of our present medical education. These changes must take place in the curriculum of the under-graduate medical years and the emphasis must be carried on during the post-graduate training.

There is a great need for research to establish better means and methods of evaluating an individual's capacity to perform work. There is also a great need for emphasis with practicing physicians and all men associated with teaching hospitals to utilize to the best advantage all of the present known means of evaluating the patient's ability to perform his work and to impress the patient with the importance of any restrictions placed upon his normal activities. All too frequently, a patient makes a satisfactory recovery from an acute episode only to delay his convalescence and interfere with the maintenance of his health because he has not been adequate;y advised in regard to his work capacity and what limitations he should place upon himself. The case of one of our supervisors illustrates this point very well. He had been under the care of one of our leading clinics for treatment of an anginal type of pain which was diagnosed as coronary insufficiency. When he returned from the clinic, he was questioned about any instructions which had been given him in regard to pursuing his normal duties. The patient had been informed that he could return to work but he should "take it easy for a while." Further inquiry brought out the fact that they had failed to question him regarding his work and it so happened that in spite of being a supervisor, his work was quite strenuous and required constant walking during the entire day. I point this out as an example to show that some of our finest clinics sometimes forget that patients work. How much work is involved when you "take it easy"? How long is "a while"?

In conclusion, I want to pay tribute to the fine work which is being done today in the field of Industrial Medicine. In spite of the introduction of many new processes in the manufacturing field, we have been successful in keeping the incidence of occupational disease at a low level. The physicians have not accomplished this alone. We have had the fine cooperation and assistance of the industrial hygienists and the help of the nurses, technicians and statisticians. We must give credit to the intelligent management who has been progressive enough to recognize its needs and establish good medical service.

Today industrial medicine stands on the threshold of a new era; an era of new and broader responsibilities; an era of real challenge; a challenge to industrial physicians, to medical students, to educators, and, in fact, to everyone engaged in the field of medicine. How well we meet this challenge will determine in great measure our future progress to be manifested in the future health and happiness of mankind.

May the Star of the Great State of Texas guide us to greater progress and leadership in Industrial Medicine as it has inspired success and leadership in so many other fields of endeavor.

* * *

B I O G R A P H Y

Earle Albert Irvin, M. D.

Birthplace - Linton, North Dakota - 1908

Received M. D. degree University of Michigan 1933.

Experience:

Active in Industrial Medicine since 1934

Special interests in: "Employability and Placement", "Human Relations in Industrial Medicine" and "Heart Disease in Relation to Employment".

Activities:

General Chairman of the 1952 Industrial Health Conference to be held in Cincinnati, Ohio, in April, 1952.

Member Medical Council of the Yale Centre for Alcohol Studies.

Medical Advisory Committee Detroit Curative Workshop.

Secretary - Health Committee of the Automotive and Machine Shop Section of the National Safety Council.

Member of Michigan State Medical Society Committees on Industrial Health and Guiding Board of Workmen's Compensation.

Charter Member Detroit Industrial Physicians Club.

Member Research Committee of the Michigan Heart Association.

Member of Special Committee of the American Heart Association dealing with Heart Disease in Relation to Employment.

Lecturer University of Michigan.

Past-President Michigan Association of Industrial Physicians and Surgeons.

President-Elect of Industrial Medical Association - 1951

Medical Director - Cadillac Motor Division, General Motors Corporation.

We are primarily interested in sound which is a form of vibration traveling in alternate waves of compression and rarefaction, propagated in an elastic medium usually air. It may vary in intensity (energy), frequency (cycles per second) and velocity (1087.4 feet per second at 0°C). These are all physical phenomena which can be measured readily. When picked up by the human hearing mechanism, however, other characteristics which are subjective in nature are attributed to these physical waves. This is because of psychic responses to this external stimulus.

The hearing organs are extremely sensitive to sound and at the same time are capable of covering a very wide range of sound pressures. For example, the smallest 1000 cycle sound which can be detected has a pressure of the order of magnitude of 0.0002 dynes per square centimeter (reference pressure). If one bears in mind that atmospheric pressure is 1,000,000 dynes per square centimeter it is possible to appreciate this sensitivity.

The decibel which is the term used to express sound pressures, is a ratio between the sound pressure being measured and a so-called standard reference level (0.0002 dynes per square centimeter at 1000 cycles).

The range in pressure between the faintest sound which can be heard (0 db) and the loudest noise which can be tolerated (130 db) is a factor of 10^{13}. In order to handle such a wide range on a useable scale it is necessary to use a logrithmetic relationship. It is important to understand that because of this relationship one does not add decibels to obtain a corresponding increase in sound pressure. Addition of decibels results in a multiplication of sound pressure. Thus, an increase in sound level of 6 decibels is equivalent to doubling the sound pressure. Conversely, it should be borne in mind in control work that a 50% reduction in sound pressure is actually only a reduction of 6 decibels.

A second and often neglected factor in industrial noise evaluation is frequency. This refers to the number of alternations or cycles per second which occur at any point in the path of a sound wave. The human ear can distinguish frequencies ranging from about 20 to 16,000 cycles per second. The low frequencies are the low tones. The auditory sensation produced by frequency (and intensity and composition) is pitch, which is commonly thought of as the tones of the musical scale. It is often difficult to define sharply the difference between a musical sound and noise. Junior's violin is a good illustration. Physically, however, a musical sound is made up of definite, narrow, related frequencies while a noise usually has a completely random distribution. It is a well-known fact that noises which contain a high proportion of high frequency energy affect the listener to a greater degree than do low frequency noises. This is true whether we are interested in damage to hearing, speech interference or just plain annoyance.

Another term which we often hear is loudness. This is the response of an individual to sound as related to its physical characteristics. It is influenced by intensity, frequency and composition of the sound. While we see more and more reference to the terms "phon" and "sone" to express this relationship,there

This type of noise, which is relatively rare in industry, may result from an explosion or concussion and in extreme cases may rupture the eardrums of persons in the vicinity. However, in cases where there are repeated exposure to this type of noise at levels which are not high enough to produce rupture there is evidence in the literature of both temporary and permanent hearing loss. Most common industrial exposures result from relatively low level noise (a few thousand dynes per square centimeter) which may be either intermittent or continuous. The result may be a temporary hearing loss which may persist for a matter of minutes or hours with subsequent complete recovery. Many of you have probably experienced this phenomenon. Repeated exposure to this type of noise over a period of many years may produce partial but permanent loss. In general, it may be stated that the greater the noise intensity the greater potential loss of hearing. It is important to bear in mind, however, that the frequency of the noise is a factor also. The over-all sound level values in decibels are not a true indication of the ability of a given noise to produce loss of hearing.

We have begun to hear and will find the pressure increasing for the establishment of so-called threashold limits for noise. From past experience in the field of industrial hygiene we know that someone will probably publish such a number stating that it is an engineering guide although only temporary. After this has been repeated in the literature a few times and the original reference lost we will find ourselves faced with a fait accompli. At the present time it is possible to find in the literature numbers ranging from 85 to 100 decibels as safe levels. These discrepancies are probably directly related to the fact that each of the individuals quoted was dealing with an entirely different type of noise. The only adequate levels for safety from noise exposure will be those which are related to frequency. We must be extremely careful to avoid being stampeded into premature establishment of noise tolerances.

There is no question but that certain types of noise in industry are of sufficient intensity and proper frequency distribution to produce loss of hearing. One of the serious problems with which we are faced is related to the fact that many people lose hearing acuity through other causes such as degeneration with age or as a result of infection. It is often difficult to distinguish hearing loss from these causes and that caused by trauma, thus in many noise industries preplacement and periodic audiograms of employees are the rule. An audiometric program of this type is obviously of benefit not only to management as a legal protection, but chiefly as a means of protection of individuals who are exposed to the noise. This type of program, however, must be carried out with extreme care, particularly in regard to the type of audiometry, the environment in which it is done, and the interpretation and use of the results. These data should not be obtained for the sole purpose of filling files as is sometimes done.

A second criterion against which noise data must be evaluated is interference with communication by speech. It may seem like stressing the obvious to point out that the ability to communicate by speech in industrial plants is vitally important to efficient plant operations. Interference with speech is not only annoying, but also makes it difficult to give instructions, to train new personnel and even to give warnings of danger. In spite of this obvious fact it is amazing how much noise in this category is tolerated in industrial plants today. We have encountered instances where, what is commonly referred to as "corridor training" is carried out. This simply means that the plant environment is so noisy that new personnel must be trained in conference rooms or some other place outside the working area. After a period of lectures and examinations of charts and general discussion, the new employee is then taken into the invironment where he is to work and permitted to try out the theory which he has learned. There are, of course, two distinct disadvantages of this technique. The employee is improperly trained and frequently men on whom considerable time has been spent decide after a relatively short exposure that there is just too much noise and quit. One plant in which we have been working has reported that one out of every three employees who leaves their company within the first 30 days of employment does so because of the noise.

Attempts have been made to evaluate this quality of noise. The term "Speech Interference Level", which is defined as a measure of interfering effects of noise on the ability of two people to converse, is being used more and more. This level will vary considerably with conditions. In a conference room, for example, where conversation must be understood at distances up to 10 feet or more in normal voices an over-all level of 50 decibels might be too noisy, whereas 80 decibels may be perfectly satisfactory in a shop where conversation can be carried on at one foot distance. It has been found that the most obnoxious frequencies from the standpoint of speech interference are the three octave bands 600-1200, 1200-2400 and 2400-4800 cycles per second. Speech interference levels are derived from the arithmetic average of sound levels in decibels in these three octave bands. Experimental work on a laboratory scale with human subjects has been used to establish speech interference levels at various distances for various voice levels. Actually these criteria are a bit stringent for normal plant conversation for they are based on the ability of the subjects to distinguish between closely similar words. It should be noted, however, that these levels are, in general, lower than those used to measure hearing safety.

The third criterion is related to the behavior of individuals in a noisy environment. This, of course, is an extremely complex field and one which is not susceptible to precise measurement. You are probably aware of the fact that the same sound may be annoying under some circumstances and unnoticed under others. This is not merely a matter of loudness. The individual, his state of mind and the nature of the environment as well as the character of the noise are the things which determine the reaction at a given time and place. Noises which are unexpected and startle or frighten the hearer; noises which are out of place; intermittent noises which have no relationship to the work habit; and reverberation producing a noise which cannot be localized by the hearer are all contributing factors to annoyance. Likewise, annoyance generally increases with loudness with all other factors equal and generally the higher the frequency the greater the annoyance. Some workers at Harvard during the war found that the reduction of high frequency components of noise in a bomber by acoustic treatment reduced annoyance to the point where the noise in the treated bomber could be 10 decibels more intense than that in an untreated bomber before they were considered to be equally annoying. Of course, noises which interfere with communication are annoying regardless of intensity or frequency.

Much has been written on the effects of noise on production and physical behavior but the evidence is extremely inconclusive.

CONTROL

The ultimate answer to all of this is a well-conceived noise abatement program. There are many possible approaches and at the present time each situation constitutes a separate research project. It is essential that the program be set up in a way that will provide the lowest possible cost per decibel gained. This can be accomplished only after a detailed study.

The fundamental approach is to control the noise at its source. Here again, the analogy to plant atmospheric contamination holds. It is much more difficult to control either after they are in the general plant area.

1. If a machine is transmitting vibration to a building structure because of improper mounting, the noise may travel for considerable distances through the building. In a recent experience, an over-all level of 102 decibels was found in an area where there were no operations. Octave band analyses of the noise and vibration studies on the floor and columns showed this to be coming from machines over 100 feet away. Air transmission was ruled out because of the inverse square law. Control of this type of problem is accomplished by vibration mounting of the machine. This is done by putting springs, or some resilient material like rubber, cork or felt between the machine and building structure. It should be carefully engineered, for the type of mounting used will depend on the weight of the machine and the kind of motion.

2. The best way to reduce noise in machinery is in its original design. We have seen airplanes, automobiles, refrigerators, street cars and even subway trains made more quiet. The techniques are available, only the incentive must be provided to carry them into the field of industrial machinery.

   Our big job is to do something about existing machines. In some instances a good maintenance and lubrication program helps considerably. A good axiom to remember is that "noise in machines means wear". This may spur management to strengthen their maintenance system.

   Vibration measurements on machine parts will often show which are the sources of the highest noise levels. No substantial gain can be made unless there is a systematic attack - reducing the highest noise sources first. One usually has several chances to accomplish reduction. The noise source itself frequently cannot be changed, but this is usually transmitted through the machine to a part (or parts) which acts as a loudspeaker. It may be possible to break the path by the use of vibration absorbing material or to change the character of the noise by changing the size or rigidity of the loudspeaker. If the frequency can be reduced, the loudness will be decreased.

3. Acoustical enclosure of individual machines may sometimes be successful, but the enclosure must be carefully designed. Even the smallest opening may nullify the value of the treatment. Choice of materials of construction and sound absorbent will also be important.

4. General acoustical treatment of factory spaces is not the answer to industrial noise control. The sound levels are usually too high to permit economical reduction to reasonable levels and the individual machine operator is not protected from his own machine. In general, the chief benefit of such treatment is a lessening of annoyance by reducing reverberation.

5. In many cases today personal protection is absolutely essential to protect exposed individuals from extremely high intensity noise sources. Ear plugs of many varieties are available commercially. Most of them provide 20 to 30 decibels attenuation in the higher frequency ranges. It has been our experience that when sound levels become high enough to produce discomfort there is little difficulty in persuading operating personnel to wear ear protection. However, in the range between 90 and 110 decibels it is somewhat more difficult to persuade employees that they should use such protective equipment when provided. This situation, however, is no different than that encountered in persuading men to wear any type of protection such as respirators, safety shoes and goggles. In addition to a program of education it is important that the ear protection provided give sufficient attenuation to protect the wearer; it must be comfortable; it must be either disposable or easily cleaned in order to prevent infection of the ear canal; where large numbers of persons are exposed, cost may also be important. Merely supplying ear plugs does not solve the problem. To provide protection they must fit properly and they must be worn.

It is easy to see from this rather sketchy resume that the industrial noise problem is both complex and fascinating. The principal weakness at the present moment is the lack of information, particularly on character of various kinds of industrial noise and their effects on exposed people. A vast number of studies of this problem, preferably correlated with audiometric studies on exposed individuals will, in no time, provide us with a reliable operating base for determining its extent. As for control, many of the principles are already well developed and are applicable to the industrial problem. Only by attaching the problem aggressively can we hope to find the answer. Industrial hygienists are particularly well equipped to face this problem and find the answer. If the past is any criterion I feel confident that we will accept the challenge.

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CHARLES R. WILLIAMS

Education - Graduate, Union College, Schnectady, N. Y. - 1929.

AM (1930); Ph.D. (1934) Harvard University in Geology (Major field - optical mineralogy).

Member - Sigma Xi - National honorary scientific society; Delta Omega - National Honorary Public Health Society; American Industrial Hygiene Association; American Acoustical Society.

Employment - Loss Prevention Department, Liberty Mutual Insurance Company, Boston - 1934 to present. Now Director of Applied Research - Loss Prevention Department.

Harvard University, School of Public Health - 1936 to present. Now Assistant Professor of Industrial Hygiene. Major subjects - determination of industrial dusts; health hazards from light metals; and prevention of radiation injury.

Consultant to several Atomic Energy Commission installations on matters of Industrial Hygiene.

Major interests at the present time are noise control, prevention of radiation injury and control of atmospheric pollution.

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LABOR MANAGEMENT AND INDUSTRIAL HEALTH
Thursday, September 27, 1951

AFTERNOON SESSION

Ralph Liles, M.D., Harris County Medical Society, Presiding

T. M. Frank, M. D., Medical Director
Pan American Refining Corporation, Texas City,Texas, Moderator

"LABOR'S EXPECTATIONS AND RESPONSIBILITIES IN AN INDUSTRIAL HEALTH PROGRAM"

Boris Shishkin, Economist
American Federation of Labor
Washington, D. C.

Twenty-five years ago I was driving a trailer truck on a 1400 mile route which ran through seven states. At that time neither the company for which I worked nor anybody else gave a hoot about the truck driver's health. Most likely the man behind the wheel would not have a glass eye - mainly because the jolting on the job would have been too hard for him to hang on to it for long.

A big interstate truck high balling along the highway carried a valuable cargo. Usually it has to meet a right schedule. The driver behind the wheel of that truck is responsible for the truck. He is responsible for the cargo. He is responsible for the schedule. And he has an even greater responsibility - than for meeting every safety hazard that may be lurking around the next curve or over the next hill.

When I went to the San Francisco Airport yesterday to fly down here to Houston, I saw a big outdoor sign cautioning the motorist to drive safely and to protect the lives of children. The sign was one of hundreds put up around California, not by a business firm, not by an insurance company, but by the Teamsters' Union.

At the American Federation of Labor Convention just concluded in San Francisco, our Workers' Education Bureau made a showing of eleven labor films released this year. Three of these dealt with industrial safety and one with industrial health problems.

A few weeks ago I attended an Institute Sponsored by one of our State Federations of Labor. A whole day was devoted to the discussion of Industrial Health and Welfare Programs.

We have made much progress. In some industries - in the garment trades, for example the International Ladies' garmen Workers' Union provided both the initiative and the major responsibility for improving health conditions on the job, assuring the availability of competent medical services in the shop, as well as for providing a union-supported medical care system for its members.

In many defense plants, our Unions, such as the International Association of Machinists for instance, have developed, by agreement with management, industrial health and safety programs in which labor is given a large and vital share of responsibility. For details, turn to any issue of the Machinist's weekly newspaper. You will realize that a tremendous educational job is being done in words, pictures and cartoons to make the workers conscious of the essential safety practices, industrial hygiene and preventive as well as curative medical care.

There are today hundreds of examples of excellent union-management cooperation programs in which health and safety work has brought labor, management and the medical staff on one team.

That is the way it should be. But, unfortunately such cases, although they are growing in numbers, are still the exception rather than the rule. The task ahead is all the more enormous because it involves not only the progress yet to be made, but the job of overcoming a great, and growing lag accumulated in the past.

America's machine technology has been moving ahead at a breath-taking pace. And it has left the human needs far behind. The problem of closing the resulting gap is too big for either management, labor or the medical profession to grapple with alone. It can only be solved by a concerted - a joint effort of all three.

But the sad fact is that the basis for a cooperative effort by labor, management and the medical profession is lacking in America today. In most cases, management is hiding behind its frosted glass curtain and claims that industrial health of the workers is the exclusive prerogative of management. The medical profession is hiding behind its white gause curtain and claims that industrial health of the workers is a problem for the medical technician alone.

Yet the object of industrial health and safety activities is the worker. It is the worker who needs the best possible protection against both the accident and the health hazards to which his work exposes him. It is the worker who has the work experience - not the supervisor nor the doctor. It is the worker, therefore who can make the most valuable contribution to the working out the best preventive and the remedial programs that meet the practical need. Too often the management view is: We pay for the safety devices, We pay the safety engineer, We pay the doctor and the nurse. It is therefore our problem. Yet labor does pay: the workers pay a fearful toll in their lives, their limbs and their health. In addition, workers must shoulder the incalculable economic burden that industrial accident and disease thrust upon them.

In 1945 at the peak of our country's mobilization effort in World War II, over 16,000 industrial workers were killed or lost their lives from fatal injuries on the job. Over 88,000 workers suffered permanent partial disablement in the same year.

This is the time to start the work necessary to meet the challenge of the new national emergency. This is the time to cut short the destructive jurisdictional disputes between State Health Units and Labor Departments which are plaguing many of our States.

This is the time to develop real teamwork of labor, management and the medical profession in shaping a broad industrial safety and health program.

Such a program calls for standards. It calls for education of workers and supervisors. It calls effective inspection and enforcement. And it calls for adequate compensation for the economic losses arising from health and safety hazards.

It is for us here in America to show the way; to show that we can do it; and to show that we can do it together.

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BRIEF BIOGRAPHY

BORIS SHISHKIN, Economist, American Federation of Labor; Secretary, A.F.of L. Housing Committee.

Born October 28, 1906. A. B. with honors, Columbia 1930; M. A. Columbia,1931. Fellow, Brookings Institution, 1932-33; Research Associate, Columbia University, 1932. Economist, American Federation of Labor since 1933; Secretary, A.F.of L. Housing Committee since 1939.

Labor Advisor, National Recovery Administration, 1933-35; Member, President's Committee on the Unemployment Census, 1937; Consultant, U. S. Housing Authority and Federal Public Housing Authority, 1937-1948; Consultant, Defense Housing Coordinator, 1941-42; Labor Advisor, Office of Production Management, 1941-42; Consultant to Chairman, War Production Board, 1942-46; Member, President's Committee on Fair Employment Practice, 1942-46; Member, President's Committee on Civil Rights, 1946-47; Director, European Labor Division, Economic Cooperation Administration, 1948-1950. Member, U. S. delegation, 1949 Plenary Session, Economic Commission for Europe; Member, U. S. delegation, International Labor Organization, Preliminary Conference on Migration, 1950; Member, U. S. delegation,three-powers' Conference of Experts on European Migration. President (1948-49) and Chairman of the Board, National Bureau of Economic Research.

Author "Institutional History of Banking in the U. S." "Labor Productivity".

Home: Seminary Hill, Alexandria, Va.

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LABOR MANAGEMENT AND INDUSTRIAL HEALTH
Thursday September 27, 1951

AFTERNOON SESSION

"MEDICINE'S REPLY"

Carl A. Nau, M. D.
Professor of Preventive Medicine
University of Texas Medical Branch
Galveston, Texas

It has been my assignment to reply to 3 speakers who preceded me and to prepare a preliminary written statement. Not knowing what these speakers would say, I have chosen to present a point of view which, in my opinion, should be given much thought in trying to evaluate the importance of a Medical Department and its staff to an industry.

Good administration has been defined as "getting things, with a purpose, done through people". Good industrial administration is "getting things done through industrial employees". If this is correct, then it would seem "good business" to keep these people in "good shape"--in good physioan, mental and moral health.

It has been shown repeatedly that the maintenance of our human assets increases production; produces better goods and at a lesser cost.

I wonder if these are all the benefits one can expect from an effective industrial health program. I believe not.

The maintenance of our human assets must also be directed toward increasing our workers' opportunities to achieve happiness.

In this country of ours (and in every democracy) we say we believe in the worth of the human individual--in the dignity of man. If the employee is to be a happy and productive employee in an industry, then he or she must feel that the employer believes in his--the employee's--worth as a living being; and interested in increasing not only his productivity but also his opportunities to achieve hapiness, satisfaction and success.

Some American industry does only what it has to do for its employees; some concerns itself with doing things for and to its employees; and then a smaller group concerns itself with doing things with its employees. The distinctions are self-evident and clearly delineate which industry believes in the dignity of man.

Hundreds of thousands of dollars are spent each year in the maintenance of equipment; in the prevention of accidents; in compensation costs--direct or indirect--for those who become injured or ill because of the nature of the job. I wonder if money spent to repair an injury or to cure an illness is great evidence of the belief in the dignity of man; or is it evidence more of a desire to get a productive worker back in production?

How much do we spend to maintain and improve (not repair) our human assets? Often, medical departments are set up solely to conserve human assets through repair. They are staffed with improperly trained, disinterested and/or inadequate personnel; with inadequate funds; and housed in poorly located and inadequate quarters with little and/or antiquated equipment. Often, too, top management forgets that the conservation and promotion of human assets is a function of all departments--and not of the Medical Department alone.

Every worker must feel that his work counts and that he is a necessary and important part of the plant. The basic ingredients of human dignity are pride and happiness.

Probably by now you wonder whether I have any intention of speaking of a Medical Department as such.

Let me say here, I believe it is this Department through which the worker can be convinced most readily that his company believes in "The Dignity and Worth of Man". The success here depends on how well the Department is staffed; how competent the personnel are; how adequately it is financed; and the attitudes of the physician, nurse, technicians and others who may comprise the staff. The Medical director must have a sincere and abiding faith in the worth of the employee--not so much in terms of profits to the company, but in terms of the "Dignity of Man". He must be well trained and competent in his profession--and industrial medicine is a specialty in its own rights--; must be able to obtain and retain the confidence of all of the personnel--worker and executive alike. He must be a "good listener" and a "practical and effective counselor", not only in matters of physical health but in other matters as well. He may have to counsel with queer and abnormal personalities; with "troubled" and "worried" minds; with individuals who have conflicts and complexes. Employees and executives alike must feel free to come to him and "talk things over." And he must be willing and able to analyze, appraise and advise. What I have said of the physician is equally true of the plant nurse.

The quarters for a Medical Department must be easily accessible to the worker, attractive, clean, well lighted and well ventilated.

When the employee leaves the Medical Department, he should feel that his company has spent time, effort and money to provide for him a service which will help him maintain and improve his health and increase his opportunities to achieve happiness.

Above all else, the employee should never be given an opportunity to feel that the Medical Department exists primarily for the benefit of management; to take care of accidental injury and occupational disease, so the worker can get back on the production line as quickly as possible; and/or to exclude people from jobs because of defects which the worker, unknowingly, considers insignificant.

To be most effective in building plant morale, in helping to promote the belief that management believes in the worth and dignity of man, the worker must feel free to visit the medical department; to ask for advice and to know that everything that transpires is in confidence between himself and his physician (not the company doctor).

Far too often the worker's concept of American justice, of American medicine, of a capitalistic philosophy, of a free enterprise is obtained from his experiences as an employee in a plant.

The personnel of a well and effectively operated industrial medical department can do much to promote good industrial relations, good human relations and to promote a feeling in the mind of the worker that he, the worker, is important, is necessary, and is wanted.

A good industrial medical department, through its personnel, can often guide, direct and counsel with an injured, sick or "troubled" worker and serve well in the maintenance and furtherance of good plant morale.

The key to a good industrial medical service is:

1. A well-qualified industrial physician.
2. Well qualified other personnel--nurse, technician, industrial hygienist, etc.
3. Complete autonomy in such matters as are generally considered to be confidential between physician and patient.
4. The confidence and support of management.
5. Adequate funds.

One could go on and speak of medical programs in industry, of potential occupational health hazards, and on plant sanitation--wash room, rest rooms, eating places, food, lighting, ventilation, etc. These will probably be referred to later. One could also outline the opportunities of a medical department in the field of health education, in curative and preventive medicine. These, too, will likely be discussed later.

In my opinion, the greatest contribution a medical department or a plant physician can make is in the field of human relations--a preservation for the worker of the philosophy of the dignity and worth of man as a living, human being.

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Brief Biography of Carl A. Nau, M. D.

Born: Yorktown, Texas, DeWitt County; Graduate of the University of Texas, Austin Texas, with a B. A. and an M. A. degree; Graduate of Rush Medical College, University of Chicago, M. D. degree; Formerly, Director, Division of Industrial Hygiene, Texas State Department of Health; Following this, Professor of Physiology and Preventive Medicine; Medical Branch; Now, Professor of Preventive Medicine and Occupational Medicine and Chairman of the Department of Preventive Medicine and Public Health, Medical Branch, University of Texas.

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INDUSTRIAL MEDICINE IN SMALL INDUSTRY
Friday September 28, 1951

MORNING SESSION

W. H. Hamrick, M.D., Harris County Medical Society, Houston, Texas, Presiding

"AN INSURANCE PROGRAM IN INDUSTRIAL HYGIENE"

Warren A. Cook
Director
Division of Industrial Hygiene and Engineering Research
ZURICH - AMERICAN INSURANCE COMPANIES
Chicago, Illinois

Most of the activity in occupational disease control being conducted by the insurance companies is incident to workmens' compensation or employers' liability coverage of occupational disease.

In connection with these coverages, the casualty insurance companies maintain staffs of safety engineers and a number of the companies also have industrial hygiene divisions. The safety engineer group have as their major activity the prevention of accidents but in addition are trained to note health hazards and to recommend control measures. Most of their work is conducted on the basis of general observation of the condition but such instruments as flammable vapor indicators, carbon monoxide and hydrogen sulfide indicators, and velometers for air velocity measurement are being utilized more extensively by them as a basis for judgment of the severity of the health hazard.

Many of the more experienced safety engineers have developed real capacity in this field and are extending well considered advice in the control of conditions inimical to health of workers.

Certain of the insurance companies have considered it desirable to go further in offering an industrial hygiene service to industry. With full appreciation of the contribution of the safety engineer, it is realized that there are many phases of conservation services with which he must be familiar. It is believed that industrial hygiene is of sufficient importance both to industrial concerns and to the casualty insurance company that an industrial hygiene division is required in order to handle adequately many of the industrial health problems being encountered today.

In such a case as the beryllium exposures which have been given much publicity over the last few years, the amounts of compounds of this material which will cause injury are so small that the most meticulous observer could regard a condition as satisfactory only to learn that cases of occupational disease were occurring. It requires analysis of air in the breathing area of the exposed persons to determine whether or not the condition is to be considered safe or whether certain of the operations are to be further controlled.

A complete insurance company program in industrial hygiene includes accordingly a well-trained staff of safety engineers in close contact with the industrial plants backed up by a technical industrial hygiene service. This allies itself closely with the interests of the industrial concern. It operates on the basis that practically all employers today are interested in operating their plants in a manner which will not adversely affect the health of their employe[es] But industry, whether large or small requires technical industrial hygiene services to accomplish this with economy and certainty.

The insurance company industrial hygienist is in position to know what types o[f] exposures cause occupational diseases. His company makes the payments when claims are presented. He also tends to have a broader base for evaluation of a condition as he usually is in contact with a number of similar situations in various plants and often in a number of dissimilar industries.

The hydrogensulfide hazard may be a problem in one department of one company with perhaps half-a-dozen men exposed. The insurance industrial hygienist may have encountered this toxic gas in viscose rayon manufacturing where continued exposure to moderate concentrations exist, in refineries where fatal cases of acute poisoning have occurred, in the oil production fields and in chemical plants utilizing the gas as a sulfiding agent. The industrial higienist learns much about the individual exposure under consideration from plant personnel in contact with the operation, but he brings to the problem an extensive backgrou[nd] which frequently is of assistance.

The method of operation of the insurance company industrial hygiene division is first to discuss the general situation with management. The safety engineer or plant management may have brought the industrial hygienist in to consider some specific problem. The operation is then observed and in some instances it can be stated that the condition is satisfactory in its present state or that the exposure appears to be excessive and control measures need be introduced.

In other instances it cannot be definitely stated that the condition is safe or hazardous until the extent of the exposure has been determined. This is usually accomplished through air analyses or analysis of the urine as a measure of exposure to the hazardous material. Other methods of evaluation may also be in order, such as chest x-ray or blood examination.

These determinations may be done by the insurance company industrial hygiene division, by the facilities of the industrial concern or by some other industrial hygiene service, depending on circumstances.

On the basis of the results, control measures, if found to be necessary, can be made with greater certainty of successful application.

Thus a complete insurance company program in industrial hygiene makes available to industry the coordinated services of an informed and experienced safety engineering staff together with a technical industrial hygiene unit comprised of specially trained personnel and adequate laboratory and field equipment. Such an organization has proven to be of substantial value to the insurance company and to the industrial concerns which it serves in handling the increasing number of situations involving industrial hygiene.

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Brief History of Warren Cook

"My personal history related to industrial hygiene includes graduation from Dartmouth College and graduate work in chemistry at Yale University, serving as Chief Industrial Hygienist of the Bureau of Industrial Hygiene, Connecticut State Department of Health prior to my present connection with the Zurich-American Insurance Companies since 1937.

Pertinent activities over past years include President of the American Industrial Hygiene Association; Chairman, Engineering Control Committee of the National Silicosis Conference; Chairman, Committee on Standard Methods of Analyses of industrial Atmospheric Contaminants of the American Public Health Association; Member, Medical Advisory Committee of the National Association of Manufacturers' Committee on Healthful Working Conditions; Member, Preventive Engineering Committee, Industrial Hygiene Foundation of America; Editor, American Industrial Hygiene Association Quarterly; Associate Editor, Journal of Industrial Hygiene & Toxicology.

At present, we are a member of the Special Hazards Committee of the Association of Casualty & Surety Companies, Chemical and Toxicological Committee of the Industrial Hygiene Foundation, representative of the American Society of Safety Engineers on the Toxic Dust and Gases Committee of the American Standards Association, Medical Advisory Committee of the Foundry Executives Group, Chicago Association of Commerce and Industry's Cleaner Air Committee; Associate Editor, Industrial Medicine and Surgery; author of technical and general papers on evaluation and engineering control phases of industrial hygiene and on maximum allowable concentrations of industrial atmospheric contaminants."

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INDUSTRIAL MEDICINE IN SMALL INDUSTRY
Friday September 28,1951

MORNING SESSION

"PLACEMENT OF AGED IN INDUSTRY"

J. F. McCahan, M. D.
Council on Industrial Health
American Medical Association
Chicago, Illinois

The currently increasing interest in the placement of the aged in industry stems mainly from two significant developments; first, the present national emergency, resulting in defense mobilization which necessitates a rapidly expanded workforce both military and civilian, and secondly, the realization and recognition of the fact that since 1900 there has been a consistent increase in the number of older persons, accompanied by decreases in the proportion of the younger age groups. It is evident, therefore, that our workforce is to be found among the older age groups. In the light of these facts, it would seem appropriate to briefly review some of the available information which will help orient us to the problems at hand. It is well that we recognize that we all have a personal moral and economic stake in this problem.

The Bureau of Employment Security of the Department of Labor says that the odds against a person 45 years old or over finding a new job are 6 to 1, even today when we are in a tight labor market. In 1948 the National Association of Manufacturers and the United States Chamber of Commerce conducted a survey of 279 companies, most of them large; two thirds reported that they refused to hire new applicants 45 years and over. Over 25% of the people in this country are 45 years or older. In 1950 a survey by the Bureau of Employment Security of 340,000 older workers and a large number of employers showed that discrimination in hiring because of age starts with women at age 35 and men at age 40 to 45.

There have been three significant trends during the past 50 years - increasing length of life, changing pattern of working lives, and length of working lives. In 1900 the average life expectancy was 49 years. Today it is 67 years. Every day almost 3,000 persons reach age 65. Persons retiring at age 65 now have an average of 13 years of life remaining, and half of them will live longer. The 1950 census showed that there were 12,300,000 persons 65 years of age and over, or about 1 out of every 12 persons. In 1900 the ratio was 1 out of every 25. In 1890 65% of all men over 65 were gainfully employed; in 1950 only 43%; and by 1975 a man of 20 will have 1 year of retirement for each 6 years of working life. The number of older women, 45 years and older, in our total workforce is also increasing from 12% in 1900 to 26% in 1950, according to figures released by the Women's Bureau of the United States Department of Labor.

The July 1951 Statistical Bulletin of the Metropolitan Life Insurance Company gave some very interesting information derived from Bureau of Census unpublished data regarding what the employed aged are doing. It was stated that "more than one fourth of the employed men at 65 and over are working in agriculture. Next in order are the (1) service industries, (2) trade and (3) manufacturing. The proportion of elderly men in manufacturing is considerably smaller than that for younger men, whereas for agriculture the reverse is true. This reflects the tendency for men in manufacturing to retire much earlier in life than men engaged in agricultural occupations. The majority of the employed women above 65 are in service industries."

Many organizations and groups, both private and governmental, are becoming interested in the problems of the older age group. The literature on this subject is voluminous, but unfortunately much of it is philosophical, with a corresponding paucity of factual data based on research studies.

The American Geriatrics Society has set up a National Advisory Committee on Industrial Employment of Older People. Its stated purposes are to assist industry, labor and industrial and private physicians in the preventive health maintenance of the working oldster, and in the procurement of additional workers for expanding defense plants. This group will advise and assist through lecture material, disability classification, techniques of evaluation of job demand vs. physical capacity, and therapeutic suggestions - all information distributed gratis.

The First International Gerontological Congress was held in Washington, D. C., in August, 1950. The resulting major conclusion was that the greatest lack was insufficient data. The Second International Gerontological Congress was held in St. Louis, Missouri on September 9-14, 1951, sponsored by the Federal Security Agency, as was the first meeting. The major purpose of this conference was to identify important problems in the field which can be attacked with currently available facilities, funds and knowledge. Major areas of discussion included: hygiene of aging, mental health, disease and disability, rehabilitation, institutional care, housing and living arrangements, health and employment, professional personnel and community planning.

Through conferences and meetings of this type it is hoped that stimulus and direction will be given to develop research projects that will afford us basic information which may in the future guide us in sound and realistic utilization of our older age groups.

Our experiences with the older workers during World War II offers convincing evidence that the properly placed oldster can produce effectively and efficiently with as good or better a health and safety record as his younger fellow workers. There are also reliable sources of information available through insurance companies and workmen's compensation commissions to prove the necessity for a well conceived and properly executed selection and placement program if we are to succeed in utilizing the full potential of the older worker. In industries where selective placement is combined with a health maintenance program that includes follow-up job adjustments, it has been found that the average percentage of accidents, as well as the average cost per accident is no greater among the older owrkers than is found among the younger group. However, in the absence of a placement program, or where the follow-up portion of the program is neglected, the older worker is found to have more accidents, and what is more important, they are much more costly. The reasons for this are quite obvious; if he is placed in a job that requires skills or reserve beyond his physical and mental potential, he is bound to be more accident prone; and when he is once injured, it will take longer for him to recover.

Aging is an insidious and continuous process which begins in the late teens and early twenties, not at age forty or forty-five. To understand and evaluate the aging process in relation to work ability and capacity, we must know the hereditary and environmental background of each individual. Then and then only will our selection and placement procedures be effective.

In considering the oldster for employment, minimal importance should be attached to his chronological age. What we really need to know is his anatomical age, his physiological age, his pathological age and his psychological age. There is a wide variation in the rate of the aging process, not only among individuals, but also among different parts of the same individual. Both the placement and the health maintenance examination should include stress tests which will give us an index of the physical and mental reserve of each individual. Some examples of stress tests now available are the Master's two-step test of cardiac reserve, the blood sugar tolerance test of pancreatic reserve, liver function tests, kidney function tests and various psychological tests to evaluate manual dexterity, aptitude and intelligence. Of course many of these tests are quite involved and do not lend themselves to practical use in the screening type of medical examination. There is great need for the development of simple stress tests that will measure ability and capacity and can be correlated with the job requirements.

Job analyses should be made by a team composed of the industrial physician, management, personnel, employment, safety, engineers and line supervision. Each type of work must be carefully studied so that the resulting job analyses will give accurate assessment of the physical and mental components that each job demands. When these analyses are reduced to concise, accurate and descriptive statements, a manual can be established which will make it relatively easy for the physician to assist management in matching the right man to the right job.

Placing the older worker in a job that is well within his capacity and ability will go a long way toward making him a healthy and safe worker, but we must not forget that he will have problems of adjustment which will relate to his home, community and industrial life which may seriously affect his work potential. It is here that well organized team work on the part of the industrial and personal physicians, industrial nurses, supervision, management, engineers, industrial psychologists, sociologists, cultural anthropologists, social economists and research workers in the natural and social sciences can bring to bear constructive influences on these complex problems in human relationships. Although there may be justification for sheltered employment for an occasional older worker, on the whole it is better for him and for industry if he is treated as a full fledged member of the work-force.

Our older people are not looking for special favors. All they ask for is a job suited to their abilities and capacities, friendly surroundings, and an adequate income to establish economic security and allow them to be contributing members to the life of the community. If we are to succeed in placing our aged workers in industry, we must engage the interest and cooperation of industrialists and the communities in the development of a program for the aging. The scope of this program should focus attention on the following major areas: alerting people to what older people can do and be; education for a long, happy and useful life; employment based on ability and capacity; adequate income; health and rehabilitation services; suitable living arrangements; personal services; counseling, home aids; satisfying and purposeful use of leisure time; to remain active participants in community life.

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Biographical Sketch
of
J. F. McCahan, M.D.

Birthplace: Redfield, New York, June 5, 1913.

Present Position: Assistant Secretary, Council on Industrial Health, American Medical Association, since January 1950.

Education: Syracuse University, Syracuse, N.Y.--1935, B.A.
Syracuse University College of Medicine, 1939, M.D.

Social History: Married: two children--ages 8 and 2 years.

Experience: First-aid attendant, Halcomb Works, Crucible Steel Corporation, Syracuse, N.Y., 1937-1939.
Highland Hospital, Rochester, N.Y.--two years rotating internship, 1939-1941
Staff Physician, Bausch and Lomb Optical Company, Rochester, N.Y., full-time, 1941-1942.
Medical Director, Bausch and Lomb Optical Company, Rochester, N.Y., full-time, 1942-1950.
Highland Hospital, Rochester, N.Y., staff junior surgeon, 1941--1950.
Genesee Hospital, Rochester, N.Y., courtesy staff, junior surgeon, 1943-1947.
Rochester General Hospital, Rochester, N.Y., staff member, Department of Industrial Medicine, 1947-1950.

Affiliations: Monroe County Medical Society--served on several committees between 1941-1950.
Rochester Academy of Medicine--served as member and chairman of membership and constitution committees between 1942-1950.
Rochester Pathological Society--President, 1950.
Health Council, Chamber of Commerce, Rochester, N.Y., President, 1945-1947.
Mental Health Association, Rochester, N.Y., member, 1943-1946.
Chicago Medical Society--member.
Illinois State Medical Association--member.
American Medical Association--member.
American Academy of Occupational Medicine--fellow.
Industrial Medical Association--fellow.
American Industrial Hygiene Association--member.

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INDUSTRIAL MEDICINE IN SMALL INDUSTRY
Friday September 28, 1951

MORNING SESSION

"REHABILITATION OF INJURED WORKERS IN SMALL PLANTS"

Edward C. Holmblad, M.D., F.A.C.S.
Managing Director
Industrial Medical Association
Chicago, Illinois

The importance of the problem of medical service to the employees of small plants becomes apparent when we realize that there are over fifteen million people employed in units of less than 500 employees. Approximately one-third of the workers in industry are employed in so-called small plant units, 85% in plants under 500 employees.

For a proper understanding of the rehabilitation of injured workers in small plants, we should make a comparative study of the medical and rehabilitative services of the smaller plants with those existing in larger plants at the present time.

Many of the larger plants have pioneered in the establishment of complete, competent and efficient medical departments. Not only have they found it desirable, but also profitable, to provide this type of medical care to their injured workers. The dangers of serious injuries are frequently more prevalent in larger plants such as the steel mills, large fabricating plants, locomotive works and ship yards. Therefore, their managements have provided safety engineers, safety committees and safety programs as well as industrial hygienists to help reduce these accident hazards and occupational disease exposures. They have found it advantageous to set up adequate supervision and check-up methods of the progress in the treatment of serious or prolonged cases of injury. Many have established their own rehabilitative departments with complete physical therapy and occupational therapy facilities. Competent specialized and trained personnel are charged with the responsibility of such a department. Most large plants realize the advantage of sending such personnel to post graduate courses, clinics, conferences and congresses. In addition, these medical departments have the advantage of regular specialist consulting services such as orthopedic and traumatic surgeons, neurologists, cardiologists, oculists, etc. They have found it advantageous to use these consulting services in their prolonged or problem cases. Frequently the larger plants have established personnel or casualty departments who carry on in the further rehabilitation by proper job placement and helping the injured workman to work back into the harness, gradually and safely.

Further, large plants realize the investment that has been made in training a workman for special work. They have departments for the settlement of injury claims, so that the employee can be continued at his regular or specialized job, avoiding the time and cost of training a new man for that job.

Now let us consider the medical services and rehabilitation of the injured worker in the small plant. Such plants are usually scattered all over the community, along convenient railroad or water terminal facilities and many in smaller cities and localities. In a very large percentage of these plants the medical service is selected from the nearest or most convenient physician and surgeon. Once in a while the proprietor of a small plant insists that the employee go to his own family physician, no matter what the doctor's type of practice or location. When sufficient injuries occur, the insurance companies covering the cost of workmen's compensation expense suggest a conference in the selection of the most desirable local treating surgeon. Frequently the doctor is a general practitioner who is only in his offices in the afternoon and evening, usually operating, visiting his hospital cases, or making residence calls in the meantime. Such offices are only occasionally equipped for xray service, and in the case of sprained ankles and wrists, xrays are deferred or the patient sent to the community hospital or to an xray laboratory. The rehabilitative or physical therapy equipment may consist of a heat lamp or short wave apparatus. Time consuming physical therapy treatments occupy space and time needed for private patients, and all too frequently when a plaster paris cast has been removed from a broken arm or leg, the patient is told to go home and soak the arm or leg in hot water and use it. There may be some patients who can rehabilitate themselves that way, but the percentage is small as most of them need help and guidance. Several years ago I saw an injured workman who had become a problem case because of a back injury. He had had treatments three times a week at the doctor's office for over two months. He stated the nurse in the doctor's office was usually busy, so he went in, turned on the heat lamp himself, took his own treatment for 20 or 30 minutes, and saw the attending doctor at weekly to ten day intervals. Fortunately this is not the usual practice, and I have seen many cases treated and rehabilitated excellently by the local and general practicioner. But these are the doctors who take the time to render individual treatment and aid their patients in loosening up stiffened, painful joints and muscles. Some time ago I saw a lady (L.R.) whose hand was caught in a press, with fractures only of the terminal phalanges. Dressings were discarded after the first three weeks, but physical therapy, massage, manipulation and muscle strengthening exercises were not started until three months later, - and then given only three times weekly. She had one of those stiff fingered, atrophic hands with flossy shiny skin. You have all seen this type of hand, with the fibrotic joints. You know how hard and painful it is to loosen up this type of hand, especially the metacarpo-phalangeal joints. One wonders how much better this situation might have been, had adequate rehabilitative physical therapy been started, say at the end of the second or third week.

The physician servicing the small plant, however, has certain advantages that can be made helpful in treating these injured employes. He has the advantage of seeing the patient personally each time and watching the progress from day to day. He may build up an excellent patient-physician relationship and understanding, approaching the private patient-physician status. Usually such patients have absolute confidence in the physician, and this is a most important factor in the rehabilitation of any injured worker. The doctor treating the small plant frequently knows the workers individually and he knows the plant management and foreman. He may also know the type of work available and the kind of jobs that lend themselves best to the rehabilitation of injured workers. We all recognize that regular purposeful remunerative work within the patient's capacity to do such work, constitutes one of the best rehabilitative measures we have. In the small plant the doctor can suggest to the management that he permit the patient to do light work, part-time, if not capable to work full time. Of course a great deal depends on the attitude of the management. I have heard managers say, - "If he can't do his regular work, I don't want him around, because I am paying for a regular full day's work". Such managers really prevent recovery of their injured workers.

There has been one very helpful influence in the rehabilitation of injured small plant workers and that is the supervisory and consulting services rendered by the covering insurance carriers. Most insurance companies are interested in seeing that their small plant injured employees are promptly rehabilitated. They realize that much money can be saved by reducing temporary total disability periods, and by reducing the extent of permanent disability.

The supervisory service checks the progress being made by the local treating surgeon so that when satisfactory progress is not made, or it appears that it may become a problem case, then the case can be seen and examined by a consultant who will study the problem, check up with recent xrays, and carry out whatever laboratory studies are necessary for the proper understanding of the patient's problem. If it is a head injury with delayed symptoms or a possible intervertebral disc problem, he may call in a neurological surgeon consultant. In this way the case gets worked up, studied, and referred for such rehabilitative treatment as may be indicated.

The next question is how can we best aid the injured worker in the small plant to get competent, adequate and the best possible rehabilitative service and treatment. I think this can be best accomplished by carrying on an educational program on rehabilitation among those persons charged with the responsibility of treatment of these workers. This first includes the small plant management, and secondly, the local treating surgeon. There is a very definite difference in the present day knowledge of rehabilitation and rehabilitative physical therapy treatments and their resultant values, when we discuss this situation with the small plant manager in contrast to the medical departments and managements of large plants. The small plant manager is so busy with other problems and details that he cannot devote adequate time to getting information about rehabilitation. It must be brought to him in other ways, served occasionally at his trade association meetings and dinners, or at luncheon club programs. The same situation is prevalent with the busy general practitioner or local surgeon. He is so busy that he cannot read the current periodicals or attend the special conferences or physical therapy association meetings. He probably goes to the national medical association meeting for two or three days once a year, and attends his county medical society program meetings perhaps once a month in winter time. These channels must be utilized to help give him the desired information.

There is a great deal of very valuable educational material going out from just such meetings as these Annual Gulf Coast Regional Conferences on Industrial Health. Those attending here are helping to spread this knowledge over a very diversified area.

The American Medical Association through the work and activities of its Council on Industrial Health, has done some very excellent work of giving the general practitioner knowledge and information about the specialty of industrial medicine and surgery. Each of these activities include some material about rehabilitative physical therapy. There are exhibits, moving pictures, clinics, charts and reprints available at the National and State Medical Society meetings. The information prepared by the Council on Physical Therapy has been most valuable.

The annual Congress on Industrial Health, sponsored by the American Medical Association Council on Industrial Health, has had instructive papers on rehabilitative problems.

The educational work of the INDUSTRIAL MEDICAL ASSOCIATION with its component societies, has contributed much to this field of rehabilitation during the past years, with its annual meetings and conferences at various localities throughout the country. The local industrial physicians and surgeons societies, as well as the State and County committees on industrial health, should be urged to include more instructive and educational papers on their regular programs dealing with rehabilitation of injured workers. Such knowledge reaches the local or general practitioner and thereby directly helps in the treatment of the injured worker from the small plant.

The meetings of the American Association of Industrial Nurses and the many local Industrial Nurses Associations, are doing some very excellent educational work in the field of rehabilitation. These nurses are important factors in seeing that patients from small plants are referred to competent rehabilitative physical therapy centers, if and when such treatments are indicated.

One of the larger insurance companies from Boston recently conducted a series of seminars in some of the larger cities throughout the country, each session lasting several days and being attended by several hundred physicians, many treating injured workers from small plants. Although these seminars dealt with the entire specialty of industrial medicine and surgery, yet a very definite part of each day was devoted to the rehabilitative treatment of injured workers.

One of the excellent developments in the medical services to small industries is the grouping of several small plants under the care of a competently trained industrial physician and surgeon. He usually has adequate treatment facilities and a well functioning rehabilitative physical therapy department.

I would like to discuss for a moment the use of the work "Light work" in connection with rehabilitation of injured workers. The term "light work" in sending the injured employee back to work, has been so frequently abused that to many foremen and plant managers it has become a distasteful expression, at least sub-consciously. Immediately they picture in their minds some employee who is trying to use his injury to get a soft job that will enable him to stall and give him special privileges. The foreman or plant manager may therefore be unconsciously antagonistic to a rehabilitative program when calling for "light work". If, on the other hand, these foremen and plant managers can be trained or instructed to recognize the importance of getting people back to work, and that work to their maximum capacity to do such work is really the final step of treatment, much will have been accomplished. I have found that the term "modified work" has been much more acceptable to everyone concerned. It satisfies the patient's desire for some consideration and gives the supervisor the opportunity to modify the worker's duties within reason and within his capacity to work.

I have found this term "modified work" a most practical way to describe the kind of work to which the injured is to be returned. You can give specific instructions if you please, describing exactly the kind of modified work that should be done, and both the employee and his boss will take more kindly to this terminology as it conveys the idea of the kind of work to be done. It can be changed from time to time to conform to the patient's work capacity.

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BIOGRAPHICAL SKETCH

Edward C. Holmblad, M. D., F.A.C.S., Managing Director and Treasurer of the Industrial Medical Association; Senior Attending Surgeon, St. Luke's Hospital, Chicago; Consultant in Industrial Medicine and Surgery; formerly Regional Chief Surgeon, Railway Express Agency, for numerous railroads, industries and insurance companies in the Chicago area from 1920 to 1946; author of numerous articles on industrial Health and the value of Industrial Medical Services.

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INDUSTRIAL MEDICINE IN SMALL INDUSTRY
Friday September 28, 1951

MORNING SESSION

"WHAT THE PHYSICIAN CAN DO FOR SMALL INDUSTRY"

Leonard Arling, M. D.
The Northwest Industrial Clinic
Minneapolis, Minnesota

Speaking for myself, I am offering my lifetime of service exclusively to the specialty of medical care of industry--principally small industry. This is not done in a spirit of self-sacrifice, but with the knowledge that such services are needed and offer a good professional life. The lack or absence of adequate industrial medical care in most small industry, today profers the greatest possibilities of service and rewards for service to the young doctor of medicine who will dedicate himself to its development. More doctors should devote full time to this specialty.

Industrial medical practice is desirable because it offers:

1) A challenge--that of providing services to scattered groups of people.

2) Ample returns for labors--which is really quite important.

3) Variety of medical and surgical work.

4) Pleasant practice in all but rare cases.

5) Service to the productive segment of our population--a service that is really needed.

6) Interest in the broad aspects of community life--I know of no other place in the practice of medicine where you can see the full gamut of community life as you can in industrial medicine.

7) Possibility of fairly regular hours of work.

8) Experience in management, education, labor problems, and public relations.

9) Satisfaction to the physician because he is performing a useful function for his fellow man, community, state, and nation.

What the individual doctor can offer small industry depends primarily upon his personal qualifications as a trained and competent doctor. His qualities for leadership, business ability, investigative insight or curiosity, professional manner, integrity, and sense of duty to his fellow man will add to or detract from his success. Correct location or availability of his services also is very important. With the help of state and local public health agencies, the individual physician can offer small industry a fairly complete industrial health service. His performance will vitally affect America's future industrial efficiency.

The greatest effectiveness of the industrial physician lies in his ability to apply present knowledge of corrective devices, preventive medicine, public health, and safety practices to the local industrial groups directly under his own care. Research projects should be conducted but they should be secondary to the practical application of what we already know. Some of the research then will become unnecessary.

Nothing is being done which cannot be done better. This is as true of industrial medicine as of other phases of human endeavor. The Industrial physician has a field which is ripe for improvement principally by the application and extension of knowledge already available to him.

From an over-all medical picture, the doctor should be able to provide a health program which is patterned to the needs of the individual plant for the improvement of its employees' health and general well-being. This requires a first hand intimate knowledge of the working conditions in all departments, that he knows the hazards and potential hazards of the machines, materials, and processes which are used and that he knows what corrections to make or how to go about securing the answers. He must act as advisor to management and counsellor to the employee, and must ever be impartial and honest in his decision when adjudicating their differences on medically related problems. This is one of his vital roles in industrial relations.

Administrative work of a plant medical program requires:

1) Establishment of medical policies and procedures. These should be stable and not haphazard or changing with the whims of the day.

2) Setting standards for physical examinations on various work requirements. This must include the program for the aged and the physically handicapped.

3) Development and maintenance of all medical records. This includes:

   a. Physical examinations and their follow-up

   b. Medical histories

   c. Departmental breakdown of plant-wide records and correction of hazards, thereby determining the effectiveness of the medical program.

   d. Special examinations such as vision surveys binocular testing devices--these are especially valuable in firms that do not have pre-employment and periodic examinations, or in highly clerical operations.

4) Handling the medical records of workmen's compensation. (Remember that the palest ink is better than the most retentive memory!!) All records are important.

It is extremely important that we avoid being morassed in the details of excessive or cumbersome records, in inefficient planning of each day's activities or in attempting to repair what should have been prevented. Any plant manager knows it is wiser to maintain the plant in good condition than to be forced to do expensive emergency repairs. The same applies to medical care in industry.

Prevention is the key of success of any industrial physician. PREVENTION includes any or all of the following:

1) Encourage practical application of preventive medicine with emphasis on the highly successful immunizations and vaccinations.

2) Industrial hygiene control of air pollutions, solvents, vapors, and general sanitation.

3) Proper pre-placement analysis of the employee's physical capacities to avoid aggravation and to get maximum employee-efficiency on the job.

4) Corrective glasses and goggles.

5) Periodic health and safety examinations.

6) General and specific safety precautions--safety shoes, gloves, aprons, et cetera, when indicated.

7) Dietary advice for cafeteria or home lunches.

8) Health Education in general.

Prompt and efficient care of all medical and surgical emergencies is required if the medical department is going to establish and keep the confidence of the plant personnel. Proper ambulance and hospital facilities as well as medical and surgical consultants should be available.

Major surgical and rehabilitation problems should be relatively rare if the proper pre-placement and periodic physical examinations plus safety training and practices are carried out. In our own experiences with more than three hundred firms at present, we have plants employing one thousand or more who have fewer total lost time accidents than other plants employing one hundred or less. Fortunately, there has been improvement in the latter.

The doctor should take an active part in the educational and publicity work which is directed at improving the hygienic standards of employees both at home and in the industrial environment. Health counselling of employees offers an excellent opportunity for presenting such advice to individuals who are most in need of that service. Much help in promoting educational work may be obtained from insurance companies, unions, and public health agencies.

Recreational programs for all employees should be encouraged. These may vary from vigorous sports to hobby shoes, cards, or chess playing. Hobbies should be encouraged on an individual basis as well as in groups.

The physician in industry should keep abreast of State and Federal legislation affecting workmen's compensation, group insurance, and medico-legal trends. He should be informed concerning demands for fringe benefits and other factors involving medical, surgical, and hospital care including disability retirement features. He is sometimes called upon to assist in working out local agreements between management and labor.

The physician must be responsible for the performance of nurses and first aid attendants under his supervision. He should provide standing orders for the guidance of personnel and have a first hand knowledge of their capabilities in handling the various medical and surgical emergencies. He must place proper limitations on dispensing commonly used drugs for headaches, colds, gastro-intestinal complaints, joint and muscular pains to prevent the dangers of their abuse. He should use his trained help, such as industrial nurses, to the full extent of their abilities to make follow-up of his plant medical program a success.

In some instances all the hourly-employees and most of the salaried employees of small industries are carefully examined and counselled regarding their health problems, but the top executives are neglected by their own choice or due to the doctor's timidity in dealing with the problem. As a result, the high production efficiency of the entire plant may be lost by one unhealthy individual who functions poorly at the policy-making or top business level of the organization. Very frequently the operation of a small industrial unit will depend entirely on the life or death, efficiency or inefficiency, of one man.

Certainly there is no better place for the industrial physician to practice his art and science than on the top executive and his immediate top supervision. A large corporation might be seriously hurt by the loss of a member of top management but the same loss in a small industry may bring about complete dissolution of the organization.

Physicians in small industry can represent their firms at local, regional, or national industrial medical meetings, i.e., if they make a conscientious effort to do so. No doctor can get to all meetings and it should not be necessary. However, no amount of reading takes the place of the stimulus derived from direct contact with our colleagues of similar interests, the viewing of exhibits, and the chance to obtain a few extra words of clarification directly from a certain speaker. Perhaps that is where the expression "Right out of the Horse's Mouth" came from.

Group practice in industrial medicine is distinctly advantageous in providing more comprehensive coverage and twenty-four-hour service. (I have had fifteen years experience in an industrial practice, eight years of which I was alone, and seven years in group practice. I have no desire to repeat the first eight years!!!). There were too many twenty-four hour working days.

Although this may not apply directly to my assigned subject matter, it does affect the doctor's performance.

Several common pitfalls of doctors doing work for small industry should be emphasized----

1) Frequently a young doctor wants a temporary job with an industrial plant until he can get started in a conventional type private practice. He gradually neglects the industrial practice until the employer dismisses him or he gives it up for sheer neglect.

   If the position was worthwhile for him to get started upon his career, it should be worthy of a definite part of his day in the future.

2) Another doctor may take a position as a plant physician at a reduced rate because he can get many private patients as a result of these contacts. This is always an unsatisfactory arrangement.

   The employees end up paying for part of the doctor's salary and the employer gets inadequate service.

3) Some physicians have a reduced fee to the insurance company and make it up on private fees. Others have a reduced fee to the individual and "soak the rich insurance company". Either procedure is unjust.

   Adopt a fair fee-for-service which is an approximate standard for the community and refuse to be a fee chiseler. The insurance company charges standard rates and the worker demands his standard hourly pay. The doctor should likewise charge a standard fee. (in industrial work).

The solution to good industrial medical practice requires that it be developed and kept on a sound financial basis. It should be just as attractive as the conventional private practice. The underpaid industrial physician is just as unhappy as the underpaid plant employee. Adequate salaries must be demanded to permit the industrial physician to maintain high standards of professional service.

Our experience with business leaders in industry has been most satisfactory. They want service for their employees with minimum time loss from their jobs. They want employees on jobs which will best use their abilities and minimize their disabilities. (A physical handicap which does not interfere with the job performance is not a disability on that job.) The employer wants good industrial relations. The proper medical service frequently is the answer to many of his problems. That service must be economically sound for the employer, for the doctor, and beneficial to the employee. If any of those three advantages are lacking it is a bad bargain.

Summary and Conclusions: The industrial physician working alone can give a reasonably adequate industrial medical service with the assistance of state or local industrial health units. His performance will depend upon his personal qualifications as a trained and competent doctor who understands this specialty.

Group practice of industrial medicine and surgery has distinct advantages in offering complete services and a twenty-four hour coverage.

Small industries can expect industrial physicians to provide the administrative, medical, surgical, and preventative services which are found in medical departments of large industries, but on scale proportionate to their relative size. However, it is more important for the physician to safeguard the health and efficiency of the top management in small industry than it is in large corporations whose ~~top~~ administration is supported by an eschelon of subordinates. Medical services in all industries must be established and maintained on a sound financial basis. They should have a planned budget.

As a word of warning to all of us as citizens.

A highly bureaucratic government which is seeking more votes and stronger labor support will strive for socialized medicine. We can expect more demands from labor for additional medical services, which, if not anticipated and supplied by management, will become a strong political issue. The manner in which management, labor, and the medical profession settle these differences may decide the future of private enterprise in America.

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BRIEF HISTORY OF LEONARD ARLING, M.D.

Graduate of the University of Minnesota Medical School -- M.D., 1936.
Married; 3 children
Began general practice of medicine in Minneapolis in 1936. Physician of Twin City Assembly Plant of Ford Motor Company since January 1937. Founded the Northwest Industrial Clinic in December, 1944--the first privately-owned, departmentalized clinic limited to industrial medicine and surgery in the United States. The Clinic now provides twenty-four hour service for approximately three hundred Minneapolis and St. Paul industries, which locally employ from twenty to three thousand men per firm. Services include: 1. Occupational traumatic surgery, 2. Ophthalmology, 3. Toxicology, 4. Pre-placement and periodic examinations of workers and executives, 5. Inplant or on-call services, 6. any special medical problems which may need study.

ACTIVITIES:

1. Chairman of Health Section of Industrial Committee of Minneapolis Chamber of Commerce. Captained one team in last spring's membership drive.
2. Member Hennepin County Medical Society.
3. Chairman of Committee on Industrial Health, Minnesota State Medical Association.
4. Member, American Medical Association
5. Counselor for District 11 of the Industrial Medical Association.
6. Member of Minnesota Governor's Advisory Committee on the Employment of the Physically Handicapped.
7. Regional Medical Consultant for the Railroad Retirement Board.
8. Served on Board of Messiah Lutheran Church as trustee.
9. Program chairman for Standish grade school P.T.A.
10. 32nd degree Mason, and member of Zuhrah Temple of the Shrine.
11. Chairman of Upper Midwest Health Conference, held in May, 1949, co-sponsored by Minneapolis Chamber of Commerce and the Hennepin County Medical Society.
12. Hobby most consistently enjoyed--photography. Has entered and occasionally won national and local contests. Served as president of Twin City Camera Club.

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INDUSTRIAL MEDICINE IN SMALL INDUSTRY
Friday September 28, 1951

12:00 NOON

Hardy A. Kemp, M.D.
Baylor University College of Medicine, Houston, Texas
P r e s i d i n g

"EXHAUSTION IN THE YOUNG BUSINESS EXECUTIVE"
Diagnosis and Treatment

Sidney A. Portis, B.S., M.D.
Associate Clinical Professor of Medicine
University of Illinois (Rush)
Chicago, Illinois

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The Journal of the American Medical Association

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Industry has come to recognize that the toll of death and disability in the management group is excessive. This is evidenced by the report of the Labor Economic Section of General Motors Corporation in 1944[1] that 189 men in that corporation's management group had died in the preceding five years. Realizing that the health maintenance program for the supervisory group had proved inadequate, the corporation set up a program of diagnostic health examinations to prevent this catastrophic loss. The Life Extension Institute reported that of 1,000 holders of life insurance policies in amounts of $25,000 or over who had received extensive examinations since Jan. 1, 1938, of whom 81 per cent were more than 40 years of age, 79 per cent were found to have physical impairments (18.5 per cent of which were high blood pressure and 22 per cent abnormalities of the heart). More recently, Franco[2] reported that periodic health examinations uncovered major medical disease in 25 per cent of executives examined. In FORTUNE[3] for June 1950, there was an article, "Why Executives Drop Dead." It quoted from a report of the Life Extension Examiners of New York that 60 per cent of the executive group examined had conditions requiring a physician's attention, the larger part of them of a cardiovascular nature. In view of the foregoing surveys and others, we should like to present our observations, which may shed light on some disabling factors that, if permitted to go unrecognized, may produce morbidity and mortality of a degree similar to that already reported.

Exhaustion in executives has not been stressed by other investigators in surveys previously published. We became especially interested in this phase of a pa-

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1. Lutz, E. F.: Conserving the Health of Management, Occup. Med. 2: 599-605 (Dec.) 1946.
2. Franco, S. C.: Periodic Health Examination of Executives, Indust. Med. 19: 213-219 (May) 1950.
3. Why Executives Drop Dead, Fortune 41: 88-91 (June) 1950.

tient's complaint through our studies on fatigue states as related to a disturbance in carbohydrate metabolism. For many years we have seen young business executives in their early forties or fifties who became utterly exhausted. These executives had many disorders interfering with their efficiency. Apparently they started out in their jobs with all the zest and enthusiasm and ambition to reach a goal which would give them prestige, affluence and security. Most of them were college trained, and many had graduate education preparing them for their life work. Why did men with such drives manifest disabilities at an age at which they should have been most productive? Why did these men live under tension which not only affected them but projected their emotions on employees under their supervision? Why were some departments in industry more productive than others engaged in similar lines of work? Physicians must furnish answers to all these questions if the health and welfare of executives are to be preserved and if the harmony and safety of their employees are to be guarded at all times.

We therefore undertook a comparative study of the last 50 business executives under the age of 50 who consulted us as patients and of a similar group of executives who were referred to us by corporations for prophylactic examinations.

GROUP OF PATIENTS

The group of executive patients was studied by careful history taking, physical examination and thorough laboratory and roentgenologic investigation to evaluate the clinical picture. It is interesting to note that in 60 per cent (fig. 1) of this group fatigue was one of the outstanding complaints. The evaluation of this complaint is complex, because it is largely subjective and must be evaluated on an individual basis. Heretofore there has not been an objective measurement of this symptom.

In 43.3 per cent (fig. 1) of the fatigued group we found a more rapid disappearance of the sugar from the blood as measured by the three hour intravenous dextrose tolerance test (table 1, fig. 2); in other words, these patients had relative hypoglycemia.

The clinical significance of this has been stressed in previous communications.[4] In 58 per cent of the entire group of executive patients, the third hour blood sugar level was below the initial level, determined during fasting. In some instances there was a drop of 30 to 40 mg. per 100 cc., while in others the drop was between 5 and 15 mg. One severely fatigued executive showed a fasting level of 87 mg. per 100 cc., and at the third hour his blood sugar level had dropped to 44 mg. This relative hypoglycemia has been shown in previous studies to be an effect of overstimulation of the islet cells of the pancreas, mediated by the parasympathetic nervous system via the vagi. Blocking of the vagus nerves with atropine sulfate throughout the 24 hour period has resulted in the

4. Portis, S. A., and Zitman, I. H.: A Mechanism of Fatigue in Neuropsychiatric Patients, J. A. M. A. 121: 569 (Feb.20) 1943. Alexander, F., and Portis, S. A.: A Psychosomatic Study of Hypoglycaemic Fatigue, Psychosom. Med. 6: 191 (July) 1944. Portis, S. A.: The Medical Treatment of Psychosomatic Disturbances, J. A. M. A. 126: 413 (Oct. 14) 1944; Life Situations, Emotions and Hyperinsulinism, ibid. 142: 1281-1286 (April 22) 1950.

elimination of this drop in blood sugar values. Several patients who have had a vagectomy for treatment of peptic ulcer have shown restoration of the intravenous dextrose tolerance curve to near normal. If the autonomic nervous system is involved in this distrubance of function, as these observations suggest, the origin of the disturbance must be in the emotional centers of the central nervous system. The brain is highly susceptible to changes in nutrition. The most important food that the brain uses is sugar. Our studies in fatigue states reveal that when an inadequate amount of dextrose circulates in the blood, the brain does not function properly, the patient becomes high-strung and easily fatigued and the body does not maintain its competence. A more or less constant feature in the life situation of the tired young business executives treated was a loss of zest, loss of enthusiasm and boredom and antipathy for their jobs, business superiors and associates.

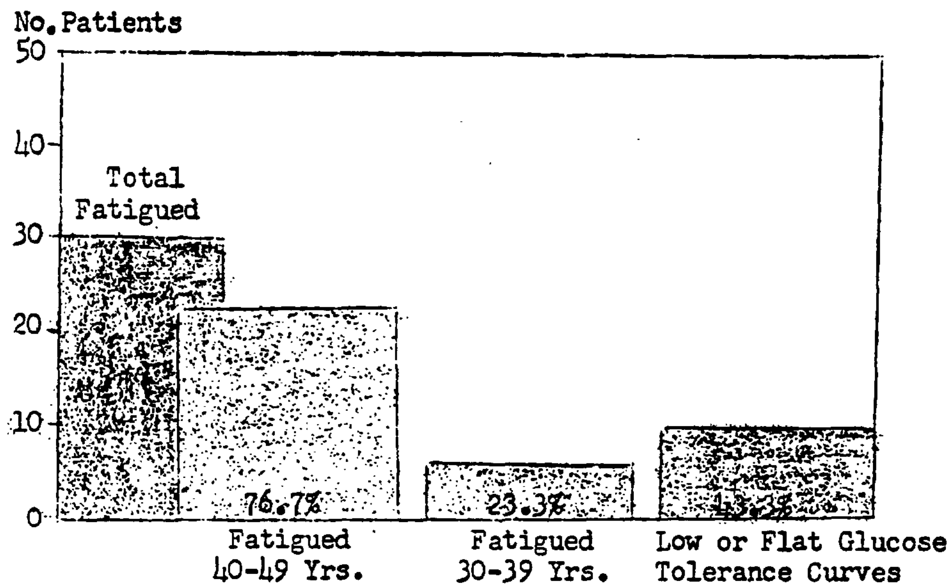

Fig. 1. - Incidence of fatigue in the 50-patient executive group.

Psychological studies have revealed that executives with somatic symptoms are as a rule dependent men whose insecurities and feelings of inferiority are great. Their drives to succeed are a reaction to their intense fears of being inadequate, which are expressed as insatiable ambition, producing somatic symptoms in the gastrointestinal, cardiovascular, respiratory and neuromuscular systems. The executives' interpersonal relations appear adequate on the surface, as far as their business associates are concerned. However, their reaction to their families is frequently hostile, so that their wives and children as a rule are injured. Frenzy and repressed aggression, frequently on an unconscious basis, are present in most such persons, though they manifest strong defenses, against expressing their psychological weaknesses. Their capacity for getting pleasure out of life is limited.

Another significant characteristic of the executive's thinking is a fear of failure. Even though the executive can look back with some pride on his accomplishments, there is always apprehension or fear that all will not be the same tomorrow. The fear is not so much of loss of material things as of loss of pride. These psychosomatic manifestations are well illustrated by the following report of an executive patient.

TABLE 1. - Mean of Blood Sugar Tolerance in 43.3 per Cent of the Fatigued Group

Time of Test	Blood Sugar Levels, Mg./100 Cc.
Fasting	73.6
½ hr.	118.8
1 hr.	74.8
2 hr.	61.2
3 hr.	56.4

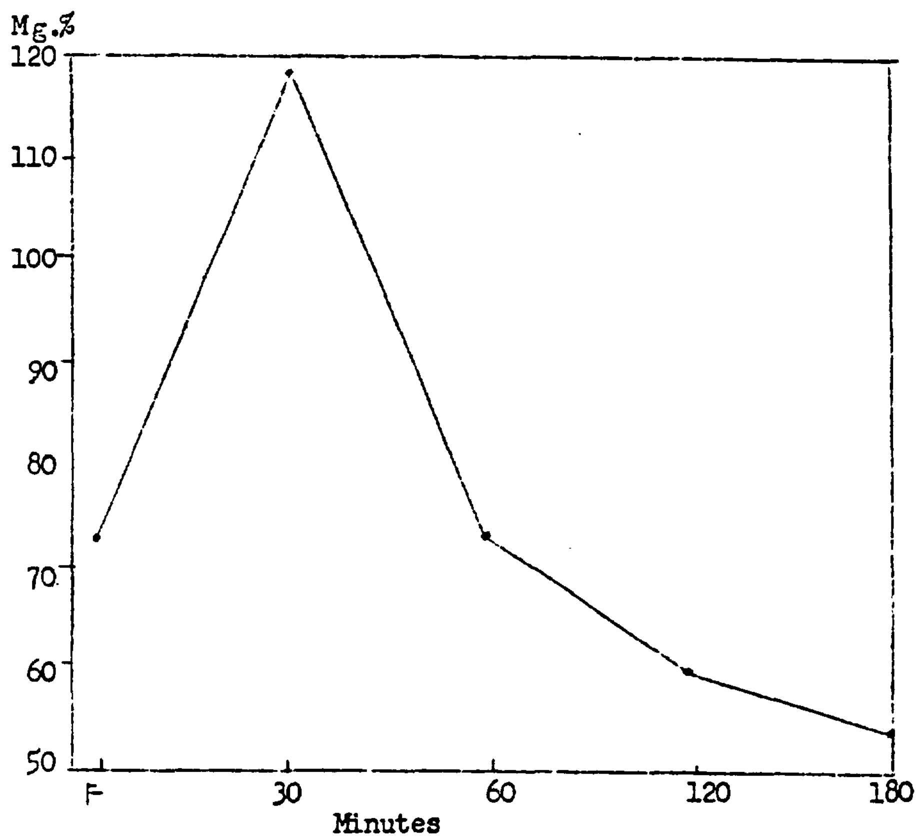

Fig. 2. - Intravenous dextrose tolerance test of the fatigued group. Average of curves of 43.3 per cent of fatigued patients.

REPORT OF CASE

A business executive, 37 years of age, had felt well until nine days prior to consultation, when at 3:30 p.m., as he was walking through the factory, he suddenly felt light-headed, began to perspire and noticed quickening of his heartbeat. His legs felt weak and he had to sit down. The company physician found his systolic blood pressure at that time to be 110. He was taken to the hospital, where an electrocardiogram and blood count were within normal limits. He remained in the hospital only one hour. However, after that time he continued to feel weak and tired; he became light-headed when up and around but felt normal when lying down. It tired him to walk one block, but he experienced no shortness of breath. He stated that on the day preceding the onset of these symptoms he thought he had overexerted himself. His muscles ached and felt dull, as though they were tired, and he noticed a peculiar sensation over the middle anterior part of the chest. This sensation disappeared almost entirely, yet walking a half block still brought on a "chocked-up" feeling.

Physical examination revealed nothing of clinical significance. Except for the intravenous dextrose tolerance test (fig. 3), thorough laboratory and roentgenologic studies gave normal results. The dextrose tolerance curve, however, resembled the so-called "flat curve" which we had previously observed in fatigue

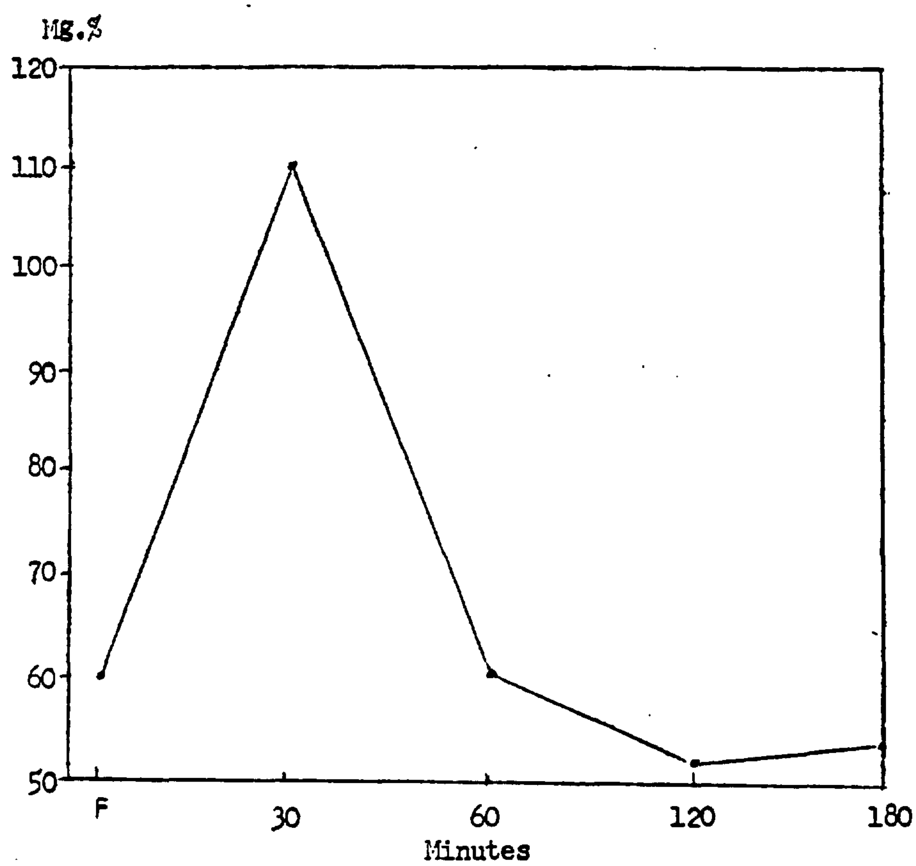

Fig. 3. - Intravenous dextrose tolerance test of patient aged 37.

patients. This "flat curve" is characterized by a lower than normal level at the half-hour determination and failure of the blood sugar to return to the fasting level in three hours.

Because we were interested in discovering what precipitated the acute condition which had persisted for nine days, we inquired into the psychological factors which might have brought about the breakdown. We found that the patient was employed by a concern which had decided shortly after the war that a plant in a small town would be better suited than their current plant to their specifications and purposes. They moved their key employees into a small community, built homes for them and set them to work. For the first few years of operation of this plant, operations went at top speed and with the smoothness of a fine watch. However, after four or five years the management found that efficiency in the plant was lowered. There had been no change in the capabilities of the executives; they were still young and still able to do a job, but they now were becoming tired, befuddled and irritable. The chief executive, at the age of 37, had noticed that in the early midportion of the afternoon he experienced acute fatigue. He began to suffer from precordial distress; he resorted to chain smoking and felt exhausted when he came home at the end of the day. His wife was struggling along with three children and no diversification in her day's work. When she would have liked a break in the monotony of her domestic life, she found that her young husband was content to sit around and recover from the fatigue of his daily efforts in the plant. This furnished a desirable escape mechanism for him. The situation was aggravated by lack of adequate social outlets, since the couple could not become too closely associated with the younger executives because of the danger that such personal relations would be detrimental to efficiency in business.

Analysis of this executive's life situations showed him to have the aggressive, dependent type of personality commonly seen among executives. The patient's mother had died when he was 9 years of age, and he had been passed from one relative to another until his father remarried two years later. He had been a football player and had subsequently married, had three children and become successful, rising to be executive director of a plant employing 400 workers. The onset of his complaint coincided with the development of a fatigue syndrome in his wife, who was distinctly bored and unhappy with life in a small town and who complained bitterly of the lack of social and intellectual diversion.

What does all this add up to? On the one hand, the business of the plant was conducted more efficiently and production costs were lower than in its previous location. On the other hand, at the end of five years its top executives were distinctly bored and tired and sooner or later became inefficient. Of course management and business must get a fair return on their capital investments or they will not be able to enlarge, modernize or expand their plants. But business should realize that highly developed, highly skilled workers must have some chance for diversion in their life outside the plant. This may mean that management may not profitably locate plants in areas where the labor market is good if the price they have to pay is a breakdown in the efficiency of their top executives.

SURVEY OF CORPORATIONS

For comparison with the group of executive patients, we studied 55 executives under the age of 50 who were referred to us by corporations for prophylactic examination. These were subjected to a routine check-up consisting of a careful history of any complaints, previous illnesses, the last time a complete medical examination was made and any facts pertinent to an accurate inventory of any patient. A complete physical examination was made, and deviations from normal were noted. This was supported by the following laboratory tests: Urine and stool analyses, complete serologic study, blood counts with differential, electrocardiogram, 2 meter roentgenogram of the chest to determine the exact size of the heart and condition of the lungs and determination of the basal metabolic rate. After the completion of this routine investigation,each person was interviewed at length, and a life survey was made for pertinent facts leading up to the present job situation. This included questions on early childhood, family environment, education, jobs previously held and reasons for leaving, marital status, home life, home environment, frequency and length of vacations, use of leisure hours, avocation and present position. The study included the subject's relations to superiors, equals and those for whose productivity he was responsible, the number of employees under his supervision and his attitude toward these employees.

Emotional Status. - We were particularly interested in evaluating emotional status in the relationships of the subject's everyday life. Early childhood patterns of many of these persons were found to be factors in the later development of insecurities, which were prevalent and which interfered with their efficiency.

The average businessman, if he is in apparently good health, does not go to a physician of his own volition. Twenty-eight of 55 of the executives included in this study had not had a physical examination within the preceding two years. The predominant reason appears to be that everyone thinks his or her organs are superior, although he knows less about the workings of the human body than he does about an automobile. He does not take into consideration the fact that, although one can get new parts for an automobile, no new parts have been developed for the human machine at the present writing. The intelligent person who has an automobile will take that machine into a service station every one or two thousand miles to have it oiled, greased and checked, but he does not give equivalent care to his own body.

It is apparent that industry has a real stake in the management group, in which it has made a large investment. Moreover, the efficiency of workers is definitely related to the physical and emotional stability of their immediate superiors. Yet how many corporations and companies insist on periodic medical examinations for their executives? Review of the literature reveals that only a small percentage of corporations insist on and provide facilities for periodic medical examinations of their management group.

The executive who knows his job well should be able to work with the ease and precision of a well oiled machine. But the executive who has the ability and is disturbed by some emotional factor finds his efficiency definitely impaired and usually resorts to artificial stimulants to whip up his system; thereby he drives his body beyond the limits of its factors of safety. In the human body the factors of safety are no different from those of steel, wood or any other structural material. A certain load can be tolerated, but beyond the limits of stress the compensatory machanism no longer functions and the body begins to show wear and tear. A man aged 40 or 50 therefore may find himself in the physiological group of men aged 60 or 70.

Physical Observations. - This survey revealed that 29.1 per cent (fig. 4) of the group had hypertension and 27.4 per cent obesity; electrocardiograms were abnormal in 12.7 per cent and on the borderline in 10.9 per cent. Of the whole group, only 5.4 per cent were considered entirely normal, without any physical defects. These figures compared favorably with those of Lutz,[5] who reported abnormality in 82 per cent of his group of executives. Our survey revealed two important facts: first, the lack of adequate medical study prior to this study, and second, the high incidence of asymptomatic organic disease. Lutz[5] reported also that in 41 of 55 patients with diseases of the cardiovascular system there were no symptoms. Fatigue in our referred group was noted in 10.9 per cent as contrasted with 60 per cent in the patient group. Similar surveys in the literature have not emphasized the factor of fatigue.

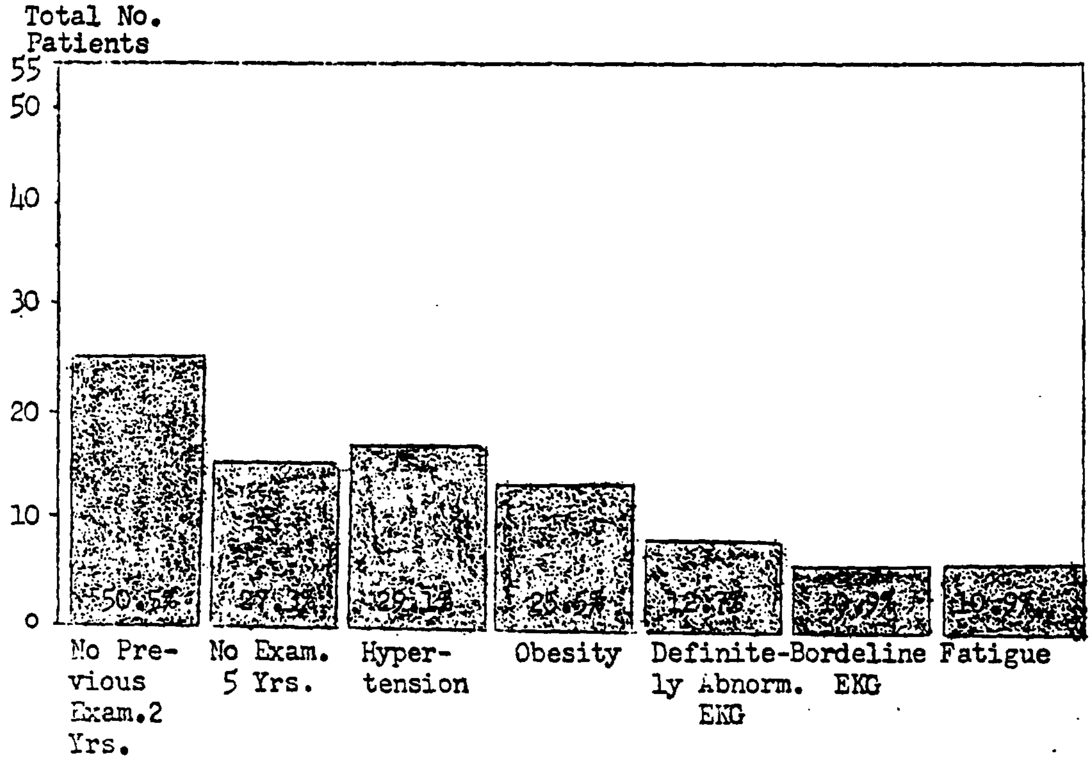

Fig. 4. - Prophylactic corporation survey.

ETIOLOGICAL FACTORS

It is our observation that the person whose occupation is largely sedentary and primarily mental usually does not have good eating habits. Many an executive will rush to work without an adequate breakfast, although he is in a field of endeavor in which food is of paramount importance because he is using his brain constantly. Breakfast is one of the most important meals of the day because in the morning most persons have fasted for 12 or 14 hours and because physiologi-

5. Lutz, E. F.: Health Examination of Industrial Executives, Indust. Med. 17: 65-69(Feb.) 1948.

Since the manifestation of fatigue is in part a psychosomatic problem, one wonders whether affected executives should be treated by psychiatrists or whether their problems may be superficial enough to be handled by their personal physician. If the physician is well enough informed on psychiatric problems, he may point out to the patient the factors which produce the disability, but if the emotional picture is complex and the patient is exceedingly disturbed, a dynamically oriented psychiatrist should be consulted. Many business

TABLE 2. - Suggested Diet for Fatigued Executive

<u>Foods to include daily:</u>

Cereal and bread	Whole grain or enriched, four servings or more.
Meat, poultry or fish	Two servings or more.
Eggs	At least three a week.
Vegetables	At least two servings a day; one serving or more should be of a green or yellow vegetable.
Potatoes	One serving or more.
Fruits	At least two servings; one serving should be of citrus fruit or melon; the syrup of canned fruits should be avoided.
Milk	One pint or more.
Water	Six to eight glasses, which may include coffee and tea.
Desserts	Fruit as specified, simple puddings, fruit gelatine, simple cakes (sponge or pound cake without icing), simple cookies.
Fats	As needed and desired.

<u>Foods to avoid:</u>

Sugar, candy, pie, pastries, jelly, honey, jam, syrup, alcoholic and carbonated beverages.

<u>Sample Menu</u>

Breakfast	Luncheon	Dinner
Orange juice	Tomato juice	Chicken broth, rice
Oatmeal	Broiled lake trout	Broiled lamb chops
Poached egg	Asparagus	Baked potato
Toast	Combination salad with dressing	Julienne carrots
Butter	Bread	Perfection salad
Coffee	Fruit cup	Bread
No sugar	Tea or coffee	Butter
	No sugar	Baked custard
		Tea or coffe
		No sugar

10 a.m. Milk, 6 oz. 3 p.m. Milk, 6 oz.

Bedtime Milk, 6 oz.; crackers, cereal or toast; fruit.

NOTE: The patient may smoke after meals but never on an empty stomach.

organizations now hire psychologists as either personnel advisors or industrial psychologists. This is a good form of industrial hygiene.

SUMMARY

Fifty business executives under 50 years of age who sought medical care for various reasons and 55 similar subjects referred by their employers for routine check-up have been compared as to physical condition, laboratory observations, roentgenologic evidence of abnormality and emotional status.

Fatigue was one of the outstanding complaints in the group of patients studied. It is often related to a disturbance of carbohydrate metabolism and to faulty dietary habits.

Life situations play an important role leading to exhaustion in executives. A dietary and pharmacologic approach to the therapy of exhaustion has been suggested. The role of alcohol and tobacco has been discussed.

CONCLUSIONS

We present evidence to show that executives do become exhausted. Frequently organic disease may progress unnoticed. The stress and strain of superimposed emotional factors on well balanced organic defects give rise to symptoms which cause the patient to seek medical care.

Industry should insist on periodic health examinations of executive personnel, since asymptomatic organic illness often is disclosed by prophylactic examination. Management also must recognize the need for psychological and psychiatric counseling in guarding the well-being of its executive talent for long term efficiency.

Physicians must approach the problem of disturbed physiological balance with sympathy and understanding. Fatigued patients should not be dismissed with a diagnosis of "functional disease." If the common sense of the family physician of the past is combined with the scientific knowledge of today's laboratory trained physician, it may help to solve some of the problems which confront industry.

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INDUSTRIAL HYGIENE
Friday, September 28, 1951

MORNING SESSION

A. W. Breeland, Lone Star Gas Company, Dallas, Texas, Presiding

"INDUSTRIAL HEALTH PROBLEMS IN THE RUBBER INDUSTRY"

William E. McCormick
The B. F. Goodrich Company
Akron, Ohio

The American rubber industry is complex and diversified. Its raw materials and products come from, and are used by, many parts of the world. Many of its processes require the use of potentially hazardous materials. Recent years have seen many changes in this industry. One of the most significant of these has been the development of American-made rubbers from domestic raw materials. In 1941 essentially all of the 787,000 long tons of rubber consumed in the U.S.A. were imported natural crude. In 1950, nearly half of the 1,258,000 long tons used came from domestic synthetic production. Many types of American-made rubber are commercially available, but GR-S (Government Rubber-Styrene) is the chief product. Others are butyl, nitrile types, neoprene, and thiokol. In the production of all of them certain health hazards exist. In the processing of them, as well as of natural crude, similar problems arise. A discussion of those relevant to GR-S production, and GR-S and natural crude processing, follows.

I. GR-S Manufacture:

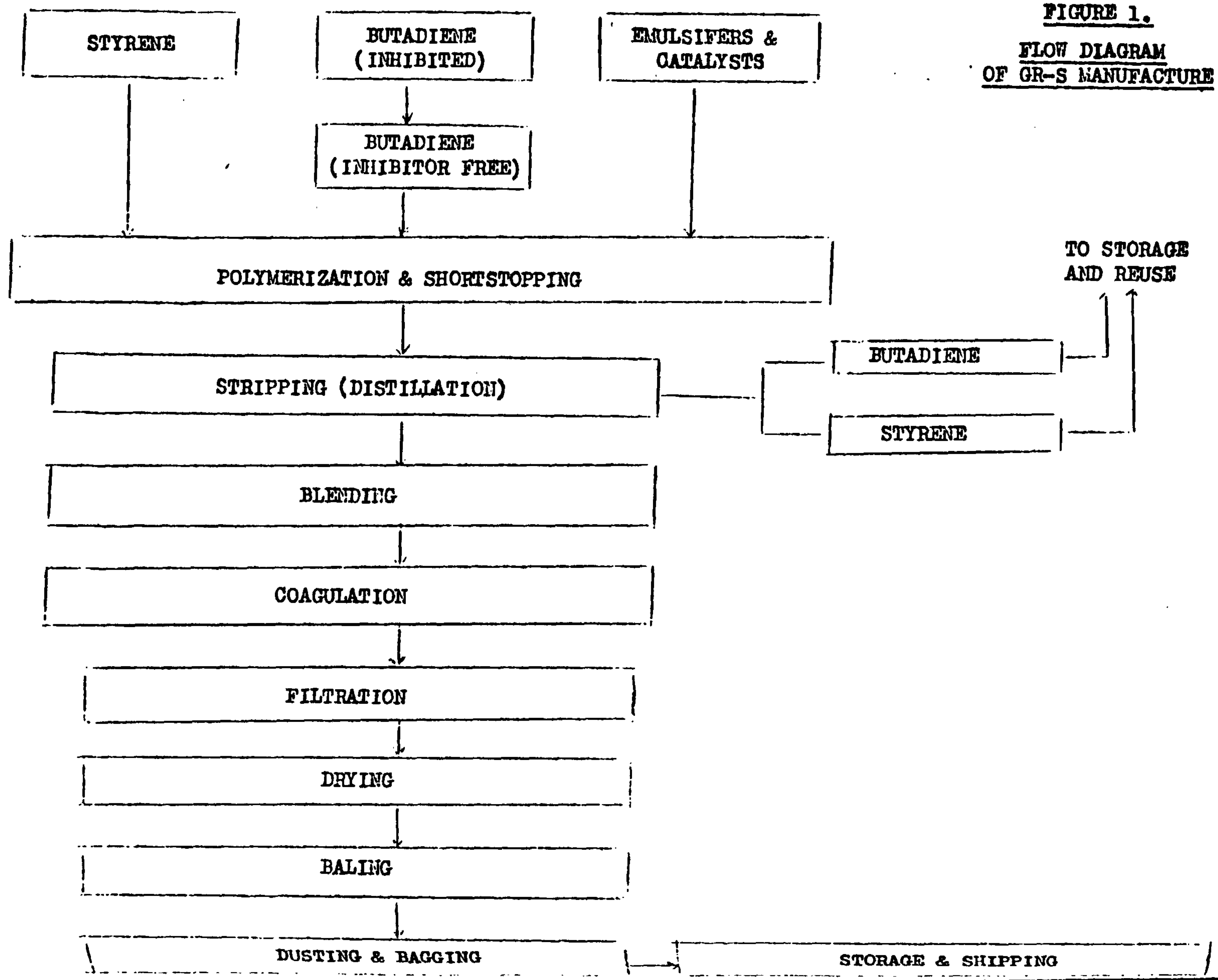
The manufacture of GR-S rubber consists of copolymerizing two compounds, butadiene and styrene, to form a finely dispersed latex. This is then subsequently coagulated, filtered, dried and baled for processing operations. Various types of GR-S are produced, depending upon the physical properties desired in the final product. This variation requires the use of different operating temperatures and pressures, different butadiene - styrene ratios, various catalysts, modifiers, polymerization accelerators, and anti-oxidants. A flow diagram of the general process is shown in Figure 1.

Butadiene:

The butadiene used for GR-S manufacture is the 1,3 isomer, with the formula $CH_2:CH.CH:CH_2$. It is a gas which liquifies at -4.4°C. It is highly inflammable, with an explosive range of 2.0 - 11.5 percent in air (1). Because of these physical characteristics, storage and transportation are accomplished under pressure and insulation. Upon its arrival at a GR-S plant, it is handled in a closed system. Necessary precautions must be taken to insure against the possibility of fire and explosion wherever it is used. Butadiene tends to spontaneously form explosive peroxides upon ageing. Hence an inhibitor such as tertiary butyl catechol, must be incorporated into the commercially produced product(2).

FIGURE 1.

FLOW DIAGRAM OF GR-S MANUFACTURE



The health hazards of butadiene are mild. It has a narcotic effect at high concentrations, but has little if any cumulative action(3). Atmospheric concentrations up to at least 1000 p.p.m. can be tolerated for prolonged periods of time without ill effects.

Styrene

Styrene, $C_6H_5.CH:CH_2$ is a liquid, boiling at 145°C. Its limits of inflammability are 1.1 per cent (29.3°C.) to 6.1 per cent (65.2°C.)(4). As in the case of butadiene, rigid precautions are necessary to protect against fire. Physiologically, styrene does not produce the serious effects of the closely related aromatic hydrocarbon, benzene. No significant changes have been found in laboratory animals exposed to vapor concentrations of 650 p.p.m. up to six months(5) but subjective symptoms in humans have been found(3) after several hours exposure to 800 p.p.m. The vapors become quite irritating above 400 p.p.m. It is therefore desirable to maintain workroom atmospheres below 200 p.p.m.

Minor Components:

A large number of substances are used in more or less minor quantities for GR-S manufacturing. Among these are the various catalysts, emulsifiers, polymerization accelerators, short stopping agents, anti-oxidants, and dusting materials. Fortunately very few of these substances in their specific use present health problems. Exceptions are dinitrochlorobenzene, sodium sulfide, and EFED (triphenyl phosphite).

Dinitrochlorobenzene is a hazardous compound. It is a severe sensitizer and elaborate precautions must be taken to prevent skin contact. If it does occur accidentally, immediate removal from the skin is necessary. In addition to its dermatitis producing potentialities, it is also systemically toxic. The degree of this, however, is not fully established, but is believed to be more severe than nitrobenzene(6). In the industrial use of this compound, the dermatitis hazard is by far the more important, and because of its severity, more or less controls the systemic hazard automatically.

During the coagulation of the latex, sulfuric acid is used. If sodium sulfide is present, hydrogen sulfide is produced. The high degree of toxicity of this compound is well known. The manufacturing operations at which this evolution occurs are essentially open, and most of them require the installation of process ventilation to satisfactorily control this hazard.

EFED is a relatively new compound industrially. Little is known regarding its toxicity. However, upon hydrolysis phenol is one of the products. This, together with EFED, may be present in the workroom air around the coagulation, filtering, and drying areas in sufficient amounts to require the use of process ventilation.

II. Processing Operations:

A large rubber industry in its processing of crude rubber into finished prodducts uses a tremendous variety and quantity of different materials. An attempt has been made to list these (Figure 2). This listing is obviously intended to be typical of the industry and is not complete for any one manufacturer. Professional industrial health personnel will recognize here many materials with well known physiologically characteristics, as well as many about which little or nothing is known. It is because of the use of this vast array of substances, as well as the constant introduction of new ones, that industrial hygiene in the rubber industry is a necessity.

It obviously is impossible to discuss in detail the health hazards of any great number of these materials. Many of course, are relatively innocuous and require no discussion. Others present numerous problems. From the standpoints of severity of hazard, number of personnel exposed, and quantity of material used, the solvents as a class are of major importance. These I shall attempt to discuss briefly. It should be realized that in addition to the various systemic problems associated with the use of these solvents, there is always the problem of dermatitis. This in many cases is the more difficult of the two to control.

Aromatic Hydrocarbons:

Benzol, toluol, and xylol (the names for the commercial grades of benzene, toluene, and xylene) are used quite extensively as solvents for rubber cements and for tackifying purposes. By far the most important of the three from the standpoint of hazards to health is bensol, although the other two are not without danger. The literature contains a large amount of information on the physiologically effects of these materials, some of which is conflicting, to say the least. The chemical formulas of the three compounds are C_6H_6, $C_6H_5.CH_3$, and $C_6H_5(CH_3)_2$. The commercial grades of each contain as impurities minor percentages of each of the other two, and xylol contains all three of the xylene isomers (meta, ortho, para). Their boiling points are 80.2°C., 110.4°C., and 138°C. - 144°C. respectively. All are inflammable, with quite low explosive levels, and with flash points of -12°C., 4°C., and 18° - 20°C., respectively.

Acute poisonings rarely result from these solvents, but chronic poisoning is a real probability. This is characterized chiefly by a damage to the blood forming processes, and may be permanently injurious or fatal. The symptomatology and treatment has been adequately discussed previously[7] and will not be repeated here. The working environment of the employee must be so controlled that excessive exposure to any of these solvents will not occur. Suggested maximum vapor concentrations are 50 p.p.m. for benzol and 200 p.p.m. for toluol and xylol. In addition, the personnel so exposed should be examined regularly, with a complete blood count made at two - three month intervals. Any abnormal trend in one or more of the blood values should indicate the need for possible removal of the individual from exposure and correction of operating procedures.

Petroleum Hydrocarbons (Distillates):

Members of this group of solvents which find common usage in the rubber industry are gasoline (unleaded), hexane, heptane, and kerosene. Hexane and heptane

FIGURE 2.

COMPONENTS USED IN THE MANUFACTURE OF RUBBER PRODUCTS

RUBBER

1. AMERICAN MADE
   - GR-I
   - GR-S ("HOT" AND "COLD")
   - GR-S LATEX
   - HYCAR PA
   - NITRILES
   - NEOPRENE
   - THIOKOL
2. NATURAL
   - FINE PARA
   - GUAYULE
   - NATURAL LATEX
   - PALE CREPE
   - RIBBED SMOKED SHEETS
3. RECLAIM
   - INNER TUBE (NATURAL BUTYL)
   - MECHANICAL BLEND (BLACK, LIGHT)
   - NO. 1 PEEL
   - NO. 2 PEEL
   - PURE GUM
   - WHOLE TIRE

TEXTILES

CHAFERS (PRIMARILY COTTON)
HOSE AND BLET DUCKS (RAYON, COTTON, NYLON)
LINERS (PRIMARILY COTTON)
TIRE CORD (RAYON, COTTON, NYLON)

VULCANIZING AGENTS

ETHYL TUADS (TETRAETHYLTHIURAM DISULFIDE)
METHYL TUADS (TETRAMETHYLTHIURAM DISULFIDE)
SELENAC (SELENIUM DIETHYLDITHIOCARBAMATE)
SELENIUM
SULFUR
TELLURAC (TELLURIUM DIETHYLDITHIOCARBAMATE)
TELLURIUM
TETRAMETHYLTHIURAM MONOSULFIDE

ACTIVATORS

BARAK (DIBUTYL AMMONIUM OLEATE)
CALCIUM HYDROXIDE
LITHARGE
MAGNESIUM OXIDE
M.O.D.X. (MIXED ORGANIC AND INORGANIC ACETATES)
PARA-AMINO PHENOL
POLYAC (POLYDINITROSOBENZENE)
SODIUM ACETATE
STEARIC ACID
TRIETHANOLAMINE

RETARDERS

ANTISCORCH ESSEN (PHTHALIC ANHYDRIDE)
BENZOIC ACID
DELAC J – DIPHENYL NITROSO AMINE
VULTROL – DIPHENYL NITROSO AMINE
PHTHALIC ANHYDRIDE
SALICYLIC ACID
TRICHLORO MELAMINE

FIGURE 2.

COMPONENTS USED IN THE MANUFACTURE OF RUBBER PRODUCTS CONT'D.

SOLVENTS

ACETONE
AMYL ACETATE
BENZOL
BUTYL ACETATE
BUTYL ALCOHOL
CARBON TETRACHLORIDE
ETHYL ACETATE
ETHYL ALCOHOL
ETHYLENE DICHLORIDE
GASOLINE (UNLEADED)
HEPTANE
HEXANE
ISOPROPYL ACETATE
ISOPROPYL ALCOHOL
KEROSENE
METHYL ALCOHOL
METHYL ETHYL KETONE
METHYL ISOBUTYL KETONE
MONOCHLOROBENZENE
PROPYLENE DICHLORIDE
TOLUOL
TRICHLOROETHYLENE
XYLOL

STIFFENERS & ANTI SOFTENERS

GLUE
SHELLAC

COLOR PIGMENTS

ALUMINUM POWDER
ANTIMONY SULFIDE
BENZIDINE ORANGE
BENZIDINE YELLOW
CADMIUM LITHOPONE
CADMIUM SELENIDE
CADMIUM SULFIDE
CHROME GREEN
LEAD CHROMATE
MONASTRAL GREEN
PERMANENT GREEN
PERMANENT ORANGE
PERMANENT RED
RED IRON OXIDE
RED LITHOL TONER
RUBBER GREEN
TITANIUM DIOXIDE
ULTRAMARINE BLUE
YELLOW IRON OXIDE

INERT FILLERS

CALCIUM SILICATE
CORK
GROUND WHITING
HARD CLAY
PRECIPITATED WHITING
SOFT CLAY

FIGURE 2.

COMPONENTS USED IN THE MANUFACTURE OF RUBBER PRODUCTS CONT'D.

ACCELERATORS

ALDEHYDE AMMONIA (AMMONIA-ACETALDEHYDE CONDENSATION PRODUCT)
ALTAX (BENZOTHIAZYL DISULFIDE)
BUTYL EIGHT
BUTYL ZIMATE (ZINC DIBUTYLDITHIOCARBAMATE)
CAPTAX (MERCAPTOBENZOTHIAZOLE)
DIBENZO GMF (P,P' DIBENZOYL QUINONEDIOXIME)
DIORTHO TOLYL GUANADINE
DIPHENYL GUANADINE
ERIE (BIS 4,5 DIMETHYL-THIAZYLDISULFIDE)
ETHYL TUADS (PETRAETHYLTHIURAM DISULFIDE)
ETHYL ZIMATE (ZINC DIETHYLDITHIOCARBAMATE)
ETHYLAC (2-BENZOTHIAZYL-N,N-DIETHYL THIOCARBAMYL SULFIDE)
GMF (P-QUINONEDIOXIME)
GUANTAL (DIPHENYL GUANIDINE PHTHALATE)
HEPTEEN, HEPTEEN BASE (HEPTALDEHYDE-ANILINE CONDENSATION PRODUCT)
HEXA (HEXAMETHYLENE TETRAMINE)
LEDATE (LEAD DIMETHYLDITHIOCARBAMATE)
MERCAPTOTHIAZOLINE
METHYL TUADS, MONEX, THIONEX (TETRAMETHYLTHIURAM DISULFIDE)
METHYL ZIMATE (ZINC DIMETHYL)
METHYLENE PARA TOLUIDINE
NA-22 ACCELERATOR (2-MERCAPTOIMIDAZOLINE)
PARA NITROSODIMETHYLANILINE
POLYAC
POTASSIUM PENTAMETHYLENE DITHIOCARBAMATE
PULLMAN (BUTYRALDEHYDE-ANILINE CONDENSATION PRODUCT)

ACCELERATORS CONT'D.

SAFEX (2,4-DINITROPHENYL DIMETHYL-THIOCARBAMATE)
SANTOCURE (BENZOTHIAZYL-2-MONOCYCLOHEXYL-SULFANAMIDE)
SPDX (LEAD DITHIOCARBAMATE)
TETRONE (CIPENTAMETHYLENE THIURAM TETRASULFIDE)
TEXAS (MIXED MERCAPTO ALKYL THIAZOLE)
THIOCARBANILIDE
TRIMENE, TRIMENE BASE (FORMALDEHYDE-MONETHYLAMINE CONDENSATION PRODUCT)
ZBX (ZINC BUTYL ZANTHATE)

FATTY ACIDS

COTTONSEED FATTY ACID
FATTY ACID ESTER
LAURIC ACID
LOW ACID PALM OIL
STEARIC ACID
WOOL GREASE

REINFORCING FILLERS

BARYTES, BLANC FIXE
CHANNEL CARBON BLACKS (VARIOUS TYPES)
FURNACE CARBON BLACKS (VARIOUS TYPES)
LITHOPONE
PRECIPITATED OR FUMED SILICA ("WHITE CARBON BLACK")
ZINC OXIDE

FIGURE 2.

COMPONENTS USED IN THE MANUFACTURE OF RUBBER PRODUCTS CONT'D.

ANTI-OXIDANTS OR AGE RESISTORS

AGERITE ALBA (MONOBENZYL ETHER OF HYDROQUINONE)
AGERITE POWDER (PHENYL BETA NAPHTHYLAMINE)
AGERITE RESIN (POLYMERIZED ALDOL ALPHA NAPHTHYL-AMINE)
AGERITE RESIN D (POLYMERIZED TRIMETHYL DIHYDRO-QUINOLINE
AGERITE WHITE (DI-BETA NAPHTHYL PARA PHENYLENE-DIAMINE)
BLE (A KETONE-AMINE REACTION PRODUCT)
FLECTOL B (CONDENSATION PRODUCT OF ACETONE AND ANILINE
FLECTOL H (CONDENSATION PRODUCT OF ACETONE AND ANILINE)
FLECTOL WHITE (1,1-DI PARA HYDROXYPHENYL CYCLO-HEXANE)
HOBOKEN (DIPHENYL PARA PHENYLENE DIAMINE)
ISO PROPOSY DIPHENYLAMINE
NEOZONE D (PHENYL BETA NAPHTHYLAMINE)
PBNA (PHENYL BETA NAPHTHYLAMINE)
SANTOFLEX B (CONDENSATION PRODUCT OF P-AMINO-DIPHENYL AND ACETONE)
STALITE (MONO AND DIHEPTYL DIAMINES)

DUSTING MATERIALS

CORN STARCH
MICA
POTATO STARCH
SOAPSTONE
TALC
ZINC STEARATE

PLASTICIZERS & SOFTENERS

ASPHALTUM OIL
BARDOL
BLACK PETROLEUM
COAL TAR BASE OIL
DIBUTYL PHTHALATE
DIPENTENE
EXTENDING RESIN
FACTICE
HYDROGENATED ROSIN
MINERAL RUBBER
PARAFFIN BASE OIL
PARAFFIN WAX
PARAFLUX
PINE TAR
SOFT ASPHALT
SOFT COAL TAR
SOFT CUMAR
STABELITE
SYNCERA WAX
TERGUM
TRICRESYL PHOSPHATE
R.P.A. #3 (XYLYL MERCAPTAN IN INERT OIL)

WETTING AGENTS

ALPHASOL OT
AQUAREX D
NACCONOL
ORVUS PASTE
TERGITOL #7
TURKEY RED OIL

FIGURE 2.

COMPONENTS USED IN THE MANUFACTURE OF RUBBER PRODUCTS CONT'D.

MISCELLANEOUS

AMMONIA
ASBESTOS
CALCIUM CHLORIDE
CAUSTIC SODA
COPPER CYANIDE
CHLORINE
COBALT STEARATE
DIATOMACEOUS EARTH
DIAZO AMINO BENZENE
FORMALIN
GLYCERIN
GRAPHITE
HYDROCHLORIC ACID
PUMICE
SODA ASH
SODIUM BICARBONATE
SODIUM CYANIDE
SULFURIC ACID
TRI SODIUM PHOSPHATE
ZINC CYANIDE
ZINC CHLORIDE

are chemical compounds, with chemical formulas of $CH_3.(CH_2)_4.CH_3$ and $CH_3.(CH_2)_5.CH_3$ respectively. Gasoline and kerosene are commercial blends of a number of different compounds. Boiling points range from 70°C. upwards. All are inflammable, with low explosive ranges and with flash points beginning at -45°C.

The physiological action of these solvents is that of a narcotic. They are mildly toxic as compared to the aromatic hydrocarbons. However, some particularly gasoline, may contain appreciable quantities of benzol, and if so the handling hazard will be proportionately increased. They possess irritant properties to the eyes and respiratory passages, which in most cases will serve as a controlling indicator of excessive exposure. Atmospheric concentrations in the 500 - 1000 p.p.m. range can be tolerated with safety, unless one or more of the aromatic hydrocarbons as impurities are present in appreciable quantities. In this case a working level based upon the specific aromatic hydrocarbon concentration present should be used.

Ketones:

The ketones are excellent rubber solvents, and especially find uses in the processing of the nitrile rubbers. Acetone, methyl ethyl ketone (butanone), and methyl isobutyl ketone are of the most importance. Their chemical formulas are: acetone - $CH_3.CO.CH_3$; methyl ethyl ketone - $CH_3.CO.C_2H_5$; and methyl isobutyl ketone - $CH_3.CO.C_4H_9$. Their boiling points range from 56°C. to 118°C., respectively. All are inflammable with flash points ranging from -18°C. to 23°C.

The toxicities of these compounds are mild. In high concentrations, their effects are those of a narcotic. Chronic intoxication is unknown. Atmospheric concentrations much in excess of 500 p.p.m. for acetone and 200 p.p.m. for methyl ethyl ketone and methyl isobutyl ketone produce uncomfortable eye and respiratory irritation and should be avoided.

Chlorinated Hydrocarbons:

Of this general class of solvents, carbon tetrachloride, ethylene dichloride, trichloroethylene, perchloroethylene, propylene dichloride, and monochlorobenzene find the most use in the rubber industry. This use varies. Some are used as rubber solvents, others as degreasers, and as fire extinguishing agents. Carbon tetrachloride, trichloroethylene, and perchloroethylene are non-inflammable. The three others are. Their chemical formulas and boiling points are as follows:

Carbon tetrachloride - CCl_4. 77°C.
Ethylene dichloride,(1,2 dichloroethane) - $Cl.CH_2.CH_2.Cl$ 84°C.
Trichloroethylene - $CHCl\ \ CCl_2$. 87°C.
Propylene dichloride (1,2 dichloropropane) - $CH_3.CHCl.CH_2Cl$ 97°C.
Perchlorethylene (tetrachlorethylene) - $Cl_2C\ \ C\ Cl_2$. 121°C.
Monochlorobenzene - C_6H_5Cl. 132°C.

The chlorinated hydrocarbons posses varying degrees of toxicity. Of the above named ones, carbon tetrachloride is the most severe. Serious injury and death may result from exposure. Individual susceptibility varies widely. It produces chronic effects, primarily to the kidneys and the liver. It is an insidiously dangerous solvent and requires careful handling. Trichloroethylene and perchloroethylene are considerably less toxic than the others mentioned above, but still need to be handled with discretion. Unfortunately, there are no reliable simple indices useful for clinical evaluations of over-exposure to the chlorinated hydrocarbons. Rigid inspections of the working environment are necessary to maintain atmospheric concentrations at safe levels. These vary with the individual compounds, ranging from 50 p.p.m. for carbon tetrachloride to 200 p.p.m. for perchloroethylene. The treatment of cases of poisoning has been discussed elsewhere [7].

Alcohols:

Alcohols used by the rubber industry are methyl, ethyl, isopropyl, n-butyl, and n-amyl. The chemical formulas and boiling points of these compounds are as follows:

Methyl - CH_3OH. 65°C.
Ethyl - C_2H_5OH. 78°C.
Isopropyl - $(CH_3)_2CHOH$. 83°C.
n-Butyl - $C_2H_5.CH_2.CH_2OH$. 117°C.
n-Amyl - $CH_3.(CH_2)\ .CH_2OH$. 138°C.

All are inflammable, with flash points of 12°C. and upwards. From the standpoint of industrial health hazards, those of most significance are methyl, butyl, and amyl. Methyl alcohol produces its ill-effects primarily on the optic nerve. Accidental and suicidal poisonings from the drinking of methyl alcohol (wood alcohol) frequently occur, but industrial poisonings are rare. Atmospheric concentrations should generally be maintained below 200 p.p.m., and skin contact prevented.

Both n-butyl and n-amyl alcohol are inherently more toxic than their lower homologs[8]. However, because of their lower volatilities, and their irritant properties, little hazard is encountered in their use. Sterner[9] has reported, in a ten year study of workers exposed to butyl alcohol vapors, no ill effects at levels up to 100 p.p.m. Above this level irritation existed. He suggests 100 p.p.m. as a safe working level.

Acetates:

Acetates are useful as general rubber solvents. Those of primary importance are methyl, ethyl, n-propyl, isopropyl, n-butyl, and isoamyl. Their chemical formulas and boiling points are as follows:

Methyl - $CH_3CO_2.CH_3$. 57°C.
Ethyl - $CH_3.CO_2.C_2H_5$. 77°C.
N-propyl - $CH_3.CO_2.CH_2.C_2H_5$. 102°C.
Isopropyl - $CH_3.CO_2.CH(CH_3)_2$ 88°C.
N-butyl - $CH_3.CO_2.CH_2.CH_2.C_2H_5$. 125°C.

Isoamyl - $CH_3.CO_2.CH_2.CH_2.CH.(CH_3)_2$ 142°C

All are inflammable with flash points of 9°C. and upwards.

As a group these compounds are only mildly toxic, and their industrial health hazards are few. The vapors are irritating in concentrations much above 200 p.p.m. The suggested maximum working levels are based largely on this irritating characteristic. They are considered to be among the safest of the solvents.

The preceding discussion should not convey an idea of hazardous working conditions existing in the rubber industry. However, it does indicate a few of the problems which may arise if improper handling precautions are used. We believe we have done, and are doing, a good job. However, ours is a rapidly changing industry. It is not only a huge consumer of chemicals, but a large producer as well. New materials, with their unknown hazards, are constantly being developed. Toxicological and industrial hygiene studies for them must likewise be made if they are to be used safely. This offers a challenging opportunity for industrial health.

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INDUSTRIAL HYGIENE
Friday, September 28, 1951

MORNING SESSION

"THE BROAD SERVICE OF INDUSTRIAL HYGIENE TO INDUSTRY"

William R. Bradley*
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Only a few short years ago the term Industrial Hygiene had not been coined and the diagnosis of human illness was not associated particularly with one's occupation. The working environments in certain industrial plants, factories and shops were not suspected as possibly contributing to employee ill health. In the early industrial development of this country, men were exposed to mists, fumes, vapors and dust, excessive heat and cold, poor lighting, radiant energy and excessive noise with little regard to the possible injurious nature of these substances and physical factors.

In some instances, even though it was observed that life was shortened and that persons occasionally became physically unfit for further employment in the space of only a few years, there was little attention given as to why these things were so. In fact, in some instances exposure to harmful or irritant substances was accepted as an unavoidable although disagreeable condition of employment. Industrial illnesses like phosphorous poisoning, mercury poisoning, manganese poisoning and silicosis from free silica dust that entered the lungs, for years went undetected and unassociated with employment. Mainly, environmental contaminants in the work place were regarded as nuisances - something to be endured - a part of one's job - the expected and obvious part of life in the factory. What we now regard as intolerably poor lighting or excessive noise was quite acceptable not many years ago.

Only in comparatively recent years, has there come the understanding that certain industrially used substances may be toxic or harmful if they are permitted to exist as atmospheric contaminants in work places, or if employees are subjected to physical contact with them. It was also realized that harmful substances might enter the body through the lungs and be absorbed into the blood stream or might be absorbed through the skin, as well as be taken by mouth. With this understanding, came the diagnosis and treatment of illness by industrial physicians and the recognition, evaluation and control of toxic substances in the working environments by industrial hygienists. Today these individuals, working as teams together with toxicologists and with others have undertaken the study of the toxic properties of raw materials, intermediates and finished products through investigations conducted in small animal laboratories. The way is provided, therefore, to learn in advance whether or not the many necessary and valuable industrially used substances will be potentially harmful to those who work with them.

Even though such studies have been under way for several years, toxicologists

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are the first to say, "We have only made a beginning.". One of the earliest studies, that of lead poisoning, has been continuing for more than 20 years, but a great deal more must be learned before it may be written off as finished. Toxicologists have classified dusts, for example, into those that are harmful and those that are inert, when breathed into the lungs. They have also learned that only the tinest of particles, those less than 1/25000 of an inch in diameter, too small to be seen with the unaided eye, can penetrate deeply into the air sacs of the lungs. Their studies have revealed those volatile solvents that are harmful whether inhaled or absorbed into the skin, and also just how they produce illness within the body. The studies assume greater importance today in the roll of preventing illness among industries' workmen, particularly in light of investigating the new and useful chemical substances that today are entering the industrial market.

Even now the industrial physicians are adding to their knowledge in the diagnosis and treatment of illness in those employed industrially. They are recognizing and pointing out the difference between illness caused through work in hazardous industrial environments and that from non-industrial causes. For not all sickness can be laid at industry's doorstep; in fact, the greater proportion of ill health among those industrially employed obviously is due to non--industrial causes. Likewise, Industrial Hygienists are sampling the air in work places, are learning how to analyze these samples for even trace amounts of contaminants that may be present, are studying industrial processes and designing and installing those control measures to insure healthful working conditions.

Years ago in a chemical plant producing aniline, the problem of cyanosis was ever present. The story is told that when aniline tubs or vats needed to be cleaned, the worker entered the vat with no protection against skin absortion. The supervisor customarily made his rounds of the aniline vats to see how "blue" the workers were becoming. If one worker showed sufficient signs of cyanosis, the custom was to have him go outside the plant and sit down for a while hoping the natural color of the skin would return. This method of health control did not work at all if the supervisor was late in his appointed rounds.

Also, only a few years ago, in some foundries workers would disappear at a distance of only a few feet in clouds of silica bearing dust during casting clean--out or shake-out operations. Many of these workmen did not remain more than a few years on the job and it was said they left their employment because of "shortness of breath". This situation was commonly referred to as asthma; "Poor Joe", it was said, "got asthma so bad he had to quit work." In reality "Poor Joe" had silicosis, disabling in nature to the extent that his industrial employment was essentially terminated and his income materially reduced. There were similar episodes in other industries that resulted in severe and disabling illness and we know that many of these illnesses were preventable.

Pioneers in the field of industrial health and hygiene raised their voices to say that industry and industrial processes could contribute to human illness. It is not necessary to recount the many thrilling adventures that transpired when these pioneers, interested in the health of employed persons, found the causes of illness in a few of the substances with which people work and showed that exposure to them could be avoided.

Gradually there occurred a change in thinking so that now several disciplines in science have pooled their knowledge as a team to gain a better understanding of the industrial environment. This team, spearheaded by physicians and industrial hygienists, now includes toxicologists, chemists, engineers and others. They are bringing a great body of information to the attention of industrial management - that once the causes of occupational illness are known they can be controlled. The team is aware of the fact that this changed philosophy with respect to the industrial working environment must be sold to industry in order to be useful. Part of this selling job is effected through programs such as the Regional Conference on Industrial Health held each year here in Houston, Texas. One of the most dramatic means of selling good health in industry is through actual demonstration of the benefits of environmental sanitation.

The United States Public Health Service in early recognizing illness of occupational origin sought and secured funds for establishing the nucleus of industrial hygiene groups in State Departments of Health. Persons with science backgrounds were recruited and were trained largely by visiting industry and by learning on-the-job.

Several years ago lead absorption occurred on the part of certain workers in the automobile body shops. A change in the method of production began with the advent of the "streamlined" automobile, where lead was used to fill the angles in body construction and give a rounded countour. Lead was melted and flowed into the angles where the parts of the body were welded together. This lead was then filed, mainly by hand, and then sanded to a smooth surface using portable powered sanders. Finely divided lead dust, thrown into the breathing zone of the worker by the sanding operation, was inhaled and in some instances resulted in lead absorption to the extent of physical incapacitation for work.

At that time, those physicians interested in the health maintenance of the industrial employee recognized this illness as occupational in origin. Industrial hygienists developed new methods for atmospheric sampling and for the trace analysis of these samples. Together they developed clinical tests to show early lead absorption before illness would occur. The industrial hygiene engineers studied the process and developed methods for controlling the environment to prevent employee inhalation of lead dust. The toxicologists, as a part of this team, established their studies to show what quantities of lead might be absorbed by the body without illness, beyond which point illness could be expected.

The lead absorption episode is only one example of the result of teamwork in the field of industrial hygiene. When a few in industrial management saw the benefits to production that accrued with attention to the working environment, they were quick to say "We need a program in industrial hygiene". Likewise, a few forward thinking insurance companies established departments in industrial hygiene on the premise of developing a service to their purchasers of compensation insurance and, of course, as a means to improve the status of these risks. They felt it possible to thus reach great many small companies, who might not be able to afford their own full time industrial hygiene service, as well as larger risks, who should by the nature of their work have industrial hygiene advice but who were too busy producing to realize that their most valuable production asset was the man in the plant. It has been said that a 100% physically fit man can produce 100% - if the working environment is also 100% satisfactory. But if he is only 50% physically fit or if his working environment is only 50% satisfactory, his production will fall far below that which might be expected.

A valuable service to industry has been sponsored and stimulated by the Industrial Hygiene Bureaus established in State Health or Labor Departments. They are accomplishing splendid work, only limited in their industrial coverage by the extent to which their Departments are staffed. Problems in air pollution abatement and in the control of stream pollution fall naturally on the shoulders of State Department of Health personnel, in addition to their obligation to advise industry on the problems of good health maintenance.

The service of industrial hygiene to industry can be established on a very broad basis through cooperation with many other departments within a company. This is particularly true in the larger industries whether they have their own industrial hygiene staff or call upon State Health Department or Insurance company industrial health personnel.

It seems hardly necessary to prove that a clean, well lighted, healthful working environment pays dividends through increased production, as well as providing a means for securing and holding a desirable employee group. In addition, no proof is needed that a good program of industrial hygiene serves to reduce liability due to occupational disease claims.

In working with the Legal Department, the industrial hygienist can assist by clarifying and interpreting the problems of plant environment for them. The factual data that he obtains through his studies, correlated with clinical data, can show if a claim for occupational illness is justifiable or is without foundation. Also, the interpretation of the physical factors involved in the use and handling of a product can be of assistance to those concerned with its precautionary labeling. The industrial hygienists can work closely with the Insurance Department of a company, particularly in problems of workmen's compensation. Good programs in industrial hygiene have reduced the cost of compensation insurance coverage.

Improvement in the working environment has in some cases eliminated the need for premium pay for hazardous operations. Frequently such hazards may be eliminated without hindering production, but with the result of improved production. A well trained and valuable employee who loses time from work because of a contact dermatitis, is not an aid to uninterrupted production.

Not infrequently the cost of production is reduced by the installation of industrial hygiene control measures. A good example of this situation occurred not long ago in the installation of a $50,000 project actually changing the method of producing a certain product. Material escaping from a number of vent stacks in this process constituted an odor air pollution problem. The product salvaged paid for the installation within a year and at the same time production was increased and a lower unit production cost was effected. Not all such control measures result in such tangible benefits. In fact, most benefits that might result from any preventive program appear intangible at first glance.

In the following episode it is easy to see that intangible benefits exist: George had worked in a dye plant for many years. Park of his work was removing trays of dry varicolored dyes from pan drier ovens. These trays were dumped into drums in a very dusty operation. The drums were in turn dumped into hoppers, again without ventilation. Dyes from the various hoppers were dropped into a mixing blender and from the blender into shipping containers. Although these dyes were non-toxic, they constituted a considerable nuisance problem.

The Industrial Hygiene Control provided mechanically exhausted enclosures about these sources of dust, so that the product formerly escaping into the working environment was now trapped in dust collectors. There was no additional loss of product as a result of installing the exhaust system. George remarked that for eleven years he had worked in this department. Everyday he was covered from head to foot with dye. It was nearly impossible to get the dust out of his hair or clothing, even though he took showers daily. He said he never knew it was possible to now work in such a good place. He thought that the dust was only part of his job. The laundry problem was not such a burden to George's wife. George said he felt better on the job and at home. George and his fellow workers are valuable employees. More so now than ever before. Such improvements pay dividends in improved employee relations many times over.

An example of industrial hygiene serving industry on a broad basis is an account of their procedure during developing, producing and marketing a relatively toxic product. The industrial hygienist, as part of the Medical Department, closely followed the chemists in the research laboratory and the engineers and operators in the pilot plant taking steps to protect these people against any exposure. The undertaking of such close observation of their work resulted from discussions with those persons in the company who were interested in developing this toxic product. The toxicologist, as part of the health team, was conducting preliminary animal studies on the first available samples of the new product. These studies were interpreted in terms of potential illness to employees if the product was inhaled or if contact with the skin occurred. The industrial hygienist then worked closely with the Engineering Department, who at this time were designing the large plant for final production. Steps in the process that might result in employee exposure were pointed out and the engineering control of the environment was applied, while the new plant was yet in the blueprint stage. The industrial hygienist worked closely with Safety, Product Development, Research, Production, Sales and other company groups to insure that a product in which money had been invested could be produced without employee ill health.

The service of industrial hygiene was extended beyond the company to the customer working closely with the Sales Department and their technical representatives. The advice on safe handling of the product and the engineering aid given the customer was of considerable assistance in the successful marketing and eventual use and handling of a potentially toxic product. Such service has a bearing on establishing good public relations between the company and its customers. In connection with the production of the same product, industrial hygiene was able to assist in preventing air pollution and stream pollution. The active programs in the abatement of air and stream pollution, in addition to its economic importance to a company, is likewise of importance in fostering good relations between a company and the community in which it is located.

The advent of radioactive substances available for industrial use has placed an additional opportunity for service on the part of the industrial hygienist. Quite naturally, planning for employee protection against radiation injury as a part of the total civil defense program of a company also falls on him.

The opportunity for industrial hygiene to extend a broad and meaningful service to industry has been briefly stated. It has not been possible to thoroughly cover this work, but the scope of potential usefulness for this service may be apparent. As industry realistically faces a consideration of the status of its work place environment, from the viewpoint of good employee health maintenance, it becomes increasingly evident that certain existing philosophies in this respect can be redesigned and recast in order to assure good progress. Old formulas no longer fit and must be discarded and left to the historians. The value of a program of better working environment which leads to improved health and improved employee relations can scarcely be questioned.

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INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28, 1951

MORNING SESSION

Albert H. Halff, Sanitary Engineer, Dallas,Texas,Presiding

"TREATMENT OF CYANIDE AND CHROMIUM WASTES"

By

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The chemical treatments described in this paper, for the elimination of toxic cyanides and toxic hexavalent chromium in industrial wastes, represent an outstanding case of chemical dissimilarity. Cyanides are eliminated by oxidation and conversely hexavalent chromium by reduction. Such chemical treatments are not compatible simultaneously and together. Cyanide wastes and chromium wastes must be treated separately.

Oxidation of Cyanide Wastes

Cyanides are destroyed in wastes by oxidation with a basis oxidizing agent, chlorine, and alkali or a hypochlorite (an alkaline chlorine solution) at a pH of not less than 8.5. This oxidation process, now the most widely used in the treatment of cyanide wastes, is generally referred to as the "alkaline chlorination" process. The cyanides are destroyed with chlorine to either the less toxic cyanates or completely to the non-toxic nitrogen gas and carbon dioxide which latter unites with the alkali to form bicarbonates.

The reactions showing the oxidation of cyanides with chlorine, Cl_2, are given in Table I. Those involved in the destruction of cyanides to cyanates are two, "1.a.", and "1.b." The first, "1.a.", is a reaction in which the chlorine reacts instantaneously with the cyanide at any pH to form a volatile, noxious, irritating gas known as cyanogen chloride, CNCl. The second, "1.b.", is a reaction in which the cyanogen chloride at pH of 8.5 or above, as noted by the minimum sodium hydroxide, NaOH, requirement, is completely converted within 10 to 15 minutes to the much less toxic, non-volatile and relatively stable sodium cyanate, NaCNO.

The destruction of cyanides to cyanates (see composite reaction 1.) theoretically requires 2.73 parts or pounds of chlorine for each part or pound of cyanide as CN. Actually, due to the usual presence of other oxidizable material, the chlorine requirement may be 1% to 25% higher. Theoretically, 1.125 parts or pounds of sodium hydroxide are also required along with each part or pound of chlorine applied. Actually, most cyanide wastes are sufficiently alkaline as to require only 60-90% of this amount of caustic.

The reactions showing the oxidation of cyanates with chlorine, Cl_2, are also given in this table. Those involved in the destruction of cyanates to nitrogen gas and carbon dioxide (present as bicarbonates) are two, "2.a." and "2.b.". The first, "2.a.", is a reaction in which cyanates are slowly decomposed to ammonium carbonate, $(NH_4)_2CO_3$, and sodium carbonate, Na_2CO_3, in the presence of chlorine. In this reaction chlorine does not take part chemically, but does aid in completing the reaction within 1 to 1.5 hours. The second, "2.b.", is a reaction in which the ammonium carbonate at pH of 8.5 to 9.0, as noted by the minimum sodium hydroxide, NaOH, requirement, is rapidly oxidized by the chlorine to nitrogen gas and the carbonates are converted to bicarbonates as the other main constituent. As part of this reaction, but not shown, small amounts of inert nitrous oxide, N_2O, and volatile nitrogen trichloride, NCl_3, are also formed.

The destruction of cyanates to nitrogen and bicarbonate (see composite reaction 2.) theoretically requires 4.09 parts of chlorine for each part of cyanate in terms of cyanide, as CN. Actually, due to the presence of other oxidizable matter and the formation of nitrous oxide and nitrogen trichloride, the chlorine requirements are somewhat higher. Theoretically, 1.125 parts of sodium hydroxide are also required along with each part of chlorine applied.

The overall reaction (see composite reaction 3.) involved in the destruction of cyanides to nitrogen and carbon dioxide (as sodium bicarbonate) shows that the alkaline chlorination process theoretically requires 6.82 parts of chlorine per part of cyanide. In actual operation of this process the chlorine requirements are somewhat higher by a few per cent and the caustic requirements somewhat lower.

The alkaline chlorination process can be accomplished with the following chlorine compounds: chlorine gas with caustic, chlorine water with caustic, or hypochlorite. The same amount of available chlorine is required regardless of the choice of chlorine compound. This is to be noted from the group of reactions shown in Table II, in which one active chlorine, as Cl_2, one active hypochlorous acid, HOCl, with its inactive hydrochloric acid, HCl, (made from one chlorine, as Cl_2, and water, H_2O, in a chlorinator) or one active sodium hypochlorite, NaOCl, with its inactive sodium chloride, NaCl (made from one Cl_2, water and two sodium hydroxides) react with one or the same amount of sodium cyanide to form idential amounts of sodium cyanate and sodium chloride. Likewise, similar amounts of the three chlorine oxidizing agents react with the same amount of sodium cyanide to form identical amounts of nitrogen, sodium bicarbonate and sodium chloride.

The reason similar amounts of the three chlorine compounds are required is that the available chlorine in one chlorine, as Cl_2, is equivalent or idential to that in one hypochlorous acid, HOCl, and each are equivalent or identical to that in one sodium hypochlorite, NaOCl. One should not be fooled by the fact that one Cl2 contains 2Cl, whereas HOCl and NaOCl contain only one chlorine, Cl. The "Cl" in the compounds is no criterion of the comparative activity or availability of the chlorine. The chemical reason that one Cl_2, one HOCl and one NaOCl contain the same amount of available chlorine is that HOCl and NaOCl each contains a hypochlorite, OCl radical, which in available chlorine is equivalent to Cl_2.

That the hypochlorite or OCl fraction of HOCl and NaOCl have the same oxidising capacity as chlorine, Cl_2, is proven by the fact that each will liberate the same or identical amounts of an analagous compound, free iodine, I_2, from an acid iodide solution as follows:

$$Cl_2 + 2NaI \xrightarrow{\text{acid}} I_2 + 2NaCl$$

$$HOCl + 2NaI \xrightarrow{\text{acid}} I_2 + NaCl + NaOH$$

$$NaOCl + 2NaI + H_2O \xrightarrow{\text{acid}} I_2 + NaCl + 2NaOH$$

As mentioned previously and as shown in the group of reactions (Table II) with the three chlorine compounds, an alkali, such as sodium hydroxide, is required with either the use of chlorine as a gas or hypochlorous acid as chlorine water while none is required with sodium hypochlorite. One should not be fooled by this fact. In the manufacture of sodium hypochlorite the acid chlorine or hypochlorous acid and inert hydrochloric acid are neutralized with caustic as shown in the reactions and, in addition, the solution must contain some excess caustic.

It is to be realized that being a manufactured product, one purchasing chlorine and caustic in this form pays more for the chlorine and caustic than when each is purchased separately. Sodium hypochlorite normally is too expensive to be used for the oxidation of cyanides when required in large amounts. This means that sodium hypochlorite is too expensive to use for such treatment if more than a few pounds of cyanides are being destroyed per day.

Furthermore, when sodium hypochlorite with its excess caustic is used to destroy the cyanides in a cyanide-bearing waste that normally has a pH of 11.0 - 12.5, and therefore already contains excess caustic, the resulting treated effluent will not have a lesser pH or a lesser caustic content. Most regulatory bodies frowm on the discharge of waste, treated or untreated, having a pH greater than 10 or containing caustic alkalinity.

Furthermore, when chlorine with caustic or chlorine water with caustic are used to destroy the cyanides in cyanide-bearing wastes, the pH of the treated waste can be controlled economically between 8.5 and 9.0, a pH range where caustic alkalinity is nil and one which is satisfactory to the regulatory bodies. The saving in alkali, a usage less than the 1.125 parts of sodium hydroxide per part of chlorine quoted above, results from utilizing part of the initial alkali contained in the cyanide waste.

The alkaline chlorination process for the oxidation of cyanides with chlorine gas and caustic or chlorine water and caustic is accomplished in a "flow-thru" type chlorination plant or "batch" type chlorination plant. The "flow-thru" type of plant is normally used for the oxidation of cyanides and cyanates to nitrogen and carbon dioxide (as bicarbonates).The recirculated "flo-thru" type of plant can be used for complete oxidation of cyanides in those instances where the total waste flow to be treated is too great to hold in separate tanks for treatment. Such waste flows are also generally low in their cyanide concentration.

The physical aspects of chlorinating cyanade wastes in such treatment plants are outlined in Table III. How to consolidate wastes for chlorination is sometimes a problem. Economy in the use of chemicals and simplicity of control of chemicals applied dictate that fluctuations in cyanide concentration and volume be evened out. This is particularly a problem when the waste does not come from continuous plating operations.

The proper chlorine retention period is automatically taken care of in "batch" chlorination, but in "flo-thru" chlorination the time, as noted, is dependent upon the extent of the oxidation of the cyanide, usually 10-15 minutes, since cyanides are normally oxidized only to cyanates. This minimum retention time is overruled to a two hour retention period when metallic hydroxides, oxides or carbonates must be precipitated and removed. Last, and certainly not least, the plant must be so designed and so constructed as to eliminate any odor of cyanogen chloride and nitrogen trichloride about the plant. Through proper adherence to design any evidence of odor can be satisfactorily eliminated.

Diagrams 1 and 2 for the "flow-thru" chlorination plants, for the oxidation of cyanide to cyanate, Diagram 3 for a recirculating "flow-thru" plant for the oxidation of cyanide to cyanate or completely to nitrogen and carbon dioxide (as bicarbonates) and also applicable for the oxidation of cyanide to cyanate at a first rinse tank, and Diagram 4 for the "batch" chlorination plant for the complete oxidation of cyanide and cyanate are shown by the typical layouts.

In these Diagrams all of the physical aspects of chlorination of cyanide wastes have been adhered to in respect to consolidation of the waste, in evening out fluctuations in cyanide concentration and fluctuations in waste flow. As noted in Diagram 1 and 2, the size of the settling tank is dependent upon the presence or absence of metals. In the layout of the plants, the rule to apply chlorine or chlorine water in a closed system has been strictly adhered to except in one instance, and that not recommended except where unavoidable, as shown by the dotted lines in Diagram 1. In every other instance the chlorine is applied to the waste containing the required amount of caustic at the chlorinator injector or the chlorine as hypochlorite formed at the injector is applied to the waste at the suction of a recirculating pump. In each of these instances chlorination is always at not less than the required pH and always in a closed system and thus fulfills the conditions for eliminating odors about the plant.

Since chlorine and caustic are applied separately, the pH can be controlled automatically by controlling the caustic feed. Such automatic control, not shown in the Diagrams, is optional in any treatment plant, be it a "flow-thru" chlorination plant or a "batch" chlorination plant. Such control insures that a sufficient and economical amount of caustic is being applied at all times.

Since the method of treatment described above for the treatment of cyanide is one of oxidation, it suggests oxidation-reduction potentials. Chlorination can be controlled automatically through potential control and is optional in any treatment plant, be it a "flow-thru" chlorination plant or a "batch" chlorination plant. Such control insures that a sufficient and economical amount of chlorine is being applied at all times in the case of a flow-thru" chlorination plant and stops chlorination when the treatment is completed in a "batch" chlorination plant.

Reduction of Chromium Wastes

Hexavalent chromium is removed from wastes by reduction with a reducing agent and the subsequent precipitation of the resulting trivalent chromium with lime. The chromium is normally reduced with ferrous iron, specifically copperas or the basic reducing agent, sulfur dioxide, or one of the latter's sulfite derivatives.

A comparison of the two processes, ferrous iron and sulfite, shows a distinct advantage in the use of sulfur dioxide or its sulfite compounds. This comparison is invited by referring to the two sets of reduction reactions, Tables IV and V; one with ferrous iron, Table IV, and the other with sulfur dioxide and its compounds, Table V.

From the reduction standpoint, it requires 16 parts or pounds of copperas (a cheap ferrous iron salt) and 5.7 parts or pounds of sulfuric acid plus an "x" amount of acid, if the chromium waste is not already acid, to reduce one part or one pound of soluble hexavalent chromium to soluble trivalent chromium. By comparison, it requires only 1.9 parts of sulfur dioxide or a maximum of 3.6 parts of a sulfite salt, specifically sodium sulfite, and a maximum of 2.8 parts of sulfuric acid plus an "x" (as above) amount of acid if the chromium waste is not already acid, to reduce one part of soluble hexavalent chromium to soluble trivalent chromium. Although copperas is the cheaper chemical, so much is required by comparison with sulfur dioxide and its derivatives, that the economic advantage is with the latter compounds.

From a removal standpoint, it requires 10 parts of hydrated lime per part of chromium to precipitate the trivalent chromium and ferric iron in the ferrous iron process as compared to only one-fourth as much, or 2.5 parts of hydrated lime per part of chromium to precipitate the trivalent chromium in the sulfite process.

Furthermore, for every part of trivalent chromium in the ferrous iron process there are 23.8 parts of sludge (dry weight) produced. This compares with one--fourth as much, or 5.9 parts of sludge (dry weight) produced in the sulfite process. Considering the lesser requirements for lime and particularly the lesser sludge handling problems involved in the sulfite process, the advantages of sulfite over the ferrous iron become quite obvious.

The sulfite process can be accomplished with the following compounds: sulfur dioxide, sodium bisulfite, sodium sulfite and sodium metabisulfite. All but the last are considered in this paper. The same amount of sulfur dioxide is required regardless of the choice of sulfite compounds. One sulfur dioxide is available in one sodium bisulfite, $NaHSO_3$, and in one sodium sulfite, Na_2SO_3.

Thus, as noted in the reactions, where three sulfur dioxides are required for the reduction of two chromium, three sodium bisulfites or three sodium sulfites are also required for the reduction of two chromium.

Since the sulfite compounds are salts of sulfur dioxide and therefore contain other inert material, their required weights are greater than for sulfur dioxide, as noted under the reactions. Where only 1.9 parts of sulfur dioxide are required to reduce one part of hexavalent chromium to the trivalent state, 3.0 parts of sodium bisulfite or 3.6 parts of sodium sulfite are required to reduce one part of hexavalent chromium.

The reduction of hexavalent chromium to the trivalent state is accomplished in acid solution at a pH of 2.0 - 2.5. At this pH level the reaction is practically instantaneous. If the chromium waste is not this acid, as is most likely to be the case, an "x" amount of sulfuric acid, not shown in the reaction with sulfur dioxide, must be applied to the waste to lower it to the required pH level. If sodium bisulfite (a dibasic sulfite compound) is used in place of sulfur dioxide, 1.4 parts of sulfuric acid, in addition to the "x" amount of acid mentioned above, is required for each part of chromium being reduced. Likewise, if sodium sulfite (a basic sulfite compound) is used in place of sulfur dioxide, 2.8 parts of sulfuric acid, in addition to the "x" amount of acid mentioned above, is required for each part of chromium being reduced. Thus, in using sulfur dioxide there is an economic advantage in the lesser sulfuric acid requirements and in the lesser acid handling costs.

The removal of trivalent chromium from solution with hydrated lime occurs at a pH of about 8.5. This is accomplished with lime preferably, rather than sodium hydroxide, because trivalent chromic hydroxide redissolves in caustic. Sodium hydroxide with its very strict required control is, therefore, seldom recommended as a substitute for precipitation of the trivalent chromium.

The sulfite process for the reduction of hexavalent chromium and subsequent removal of the trivalent chromium with lime is accomplished in a "flow-thru" type of plant as shown in the typical layout, Diagram 5. This Diagram shows sulfur dioxide being fed but, for the smaller installations, chemical feed of sodium bisulfite or sodium sulfite is recommended.

In the flo-thru Diagram the chromium waste flows to a holding or equalization tank to even out fluctuations in chromium concentration. Sulfuric acid is fed to the waste as it enters the holding tank to insure that the pH of the waste is lowered to 2.0 - 2.5. In this case, the amount of acid required is the "x" amount of acid mentioned above.

A water solution of sulfur dioxide is fed to the acid waste as it enters the baffled reaction tank (5 - 10 minute retention) in an amount just sufficient to decolorize the waste, that is, to reduce the colored hexavalent chromium to the colorless trivalent chromium.

Lime, as a slurry, is then added to the sulfonated waste in the small rapid mixing tank in an amount sufficient to raise the pH to 8.5. This causes the trivalent chromium to be precipitated from solution as chromic hydroxide and this, along with some calcium sulfate, settles out in the two hour settling basin. These precipitates are occasionally vacuumed from the settling basin, or, if in sufficient amount, drawn off as sludge, as indicated in the Diagram.

Since the acid, sulfur dioxide and the lime are applied separately, the pH at two points in the plant can be controlled automatically by controlling the pH of the initial raw waste with acid (pH 2.0 - 2.5) and the sulfonated waste with lime (pH 8.5). Such automatic controls, not shown in the Diagram, are optional in any such treatment plant. Such control insures that the initial pH of the waste is at the proper level for rapid reduction of the chromium with sulfur dioxide and that a sufficient amount of lime is being applied at all times.

Since the method of treatment described above is one of reduction, it also suggests oxidation-reduction potentials. The sulfur dioxide feed can be controlled automatically through potential control and is optional in any treatment plant. Such control insures that a sufficient amount of sulfur dioxide is being applied at all times. What is equally important, such control insures that it is being applied economically. An excess of sulfur dioxide is to be avoided. It is generally known that excess sulfite depletes oxygen from water in this respect a treated effluent from such a plant, while being free of chromium, could possibly have a B.O.D. greater than that of the initial waste.

* * *
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NOTE: The eight Tables and Charts referred to in this paper, follow between this page and page 80 of this Report.

REACTIONS SHOWING OXIDATION OF CYANIDES WITH CHLORINE

Destruction of Cyanides to Cyanates

1.a. $2Cl_2 + 2NaCN \longrightarrow 2CNCl + 2NaCl$

1.b. $2CNCl + 4NaOH \longrightarrow 2NaCNO + 2NaCl + 2H_2O$

1. $2Cl_2 + 4NaOH + 2NaCN \longrightarrow 2NaCNO + 4NaCl + 2H_2O$

	CHLORINE	SODIUM HYDROXIDE	SODIUM CYANIDE	SODIUM CYANATE	SODIUM CHLORIDE	WATER
PARTS	2.73	3.07	1 (As CN)			
	1	1.125				

Destruction of Cyanates to Carbon Dioxide (as Bicarbonates) and Nitrogen

2.a. $3Cl_2 + 4H_2O + 2NaCNO \longrightarrow 3Cl_2 + (NH_4)_2CO_3 + Na_2CO_3$

2.b. $3Cl_2 + 6NaOH + (NH_4)_2CO_3 + Na_2CO_3 \longrightarrow 2NaHCO_3 + N_2$
$6NaCl + 6H_2O$

2. $3Cl_2 + 6NaOH + 2NaCNO \longrightarrow 2NaHCO_3 + N_2 + 6NaCl + 2H_2O$

	CHLORINE	SODIUM HYDROXIDE	SODIUM CYANATE	SODIUM BICARBONATE	NITROGEN	SODIUM CHLORIDE	WATER
PARTS	4.09	4.62	1 (As CN)				
	1	1.125					

Destruction of Cyanides to Carbon Dioxide (as Bicarbonates) and Nitrogen

3. $5Cl_2 + 10NaOH + 2NaCN \longrightarrow 2NaHCO_3 + N_2 + 10NaCl + 4H_2O$

	CHLORINE	SODIUM HYDROXIDE	SODIUM CYANIDE	SODIUM BICARBONATE	NITROGEN	SODIUM CHLORIDE	WATER
PARTS	6.82	7.69	1 (As CN)				
	1	1.125					

TABLE II

REACTION OF CYANIDES WITH VARIOUS CHLORINE COMPOUNDS

A. FOR DESTRUCTION OF CYANIDES TO CYANATES:

SOURCE OF CHLORINE COMPOUND	CHLORINE COMPOUND WITH CAUSTIC		SODIUM CYANIDE		SODIUM CYANATE		SODIUM CHLORIDE		WATER
Chlorine Gas: Cl_2	$Cl_2 + 2NaOH$	+	$NaCN$	$\rightarrow$	$NaCNO$	+	$2NaCl$	+	H_2O
2. Chlorine Water: $Cl_2 + H_2O \rightleftharpoons HOCl + HCl$	$HOCl + HCl + 2NaOH$	+	$NaCN$	$\rightarrow$	$NaCNO$	+	$2NaCl$	+	$2H_2O$
3. Sodium Hypochlorite: $Cl_2 + H_2O \rightleftharpoons HOCl + HCl$; $HOCl + HCl + 2NaOH \rightarrow NaOCl + NaCl + 2H_2O$	$NaOCl + NaCl$	+	$NaCN$	$\rightarrow$	$NaCNO$	+	$2NaCl$		

B. FOR DESTRUCTION OF CYANIDES TO CARBON DIOXIDE (AS BICARBONATES) & NITROGE

SOURCE OF CHLORINE COMPOUND	CHLORINE COMPOUND WITH CAUSTIC		SODIUM CYANIDE		SODIUM BICARBONATE		NITROGEN		SODIUM CHLORIDE		WATE
1. Chlorine Gas: Cl_2	$5Cl_2 + 10NaOH$	+	$2NaCN$	$\rightarrow$	$2NaHCO_3$	+	N_2	+	$10NaCl$	+	$4H_2$C
2. Chlorine Water: $Cl_2 + H_2O \rightleftharpoons HOCl + HCl$	$5HOCl + 5HCl + 10NaOH$	+	$2NaCN$	$\rightarrow$	$2NaHCO_3$	+	N_2	+	$10NaCl$	+	$9H_2$(
3. Sodium Hypochlorite: $Cl_2 + H_2O \rightleftharpoons HOCl + HCl$	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		

TABLE III

PHYSICAL ASPECTS OF CHLORINATING CYANIDE WASTES

A. In "Flow-thru" Chlorination Plant (Where at least part of treated waste passes continuously thru the plant)	B. In "Batch" Chlorination Plant (Where all waste is recirculated until treatment is finished)
1. How to Consolidate Waste for Chlorination	
1. Use Holding Tank, one	1. Use Holding Tanks, two or more
2. How to Even Out Fluctuations in Cyanide Concentration	
1. Use Equalizing Tank (Same as Holding Tank above) with Recirculating Pump if necessary.	1. Not required
3. How to Even Out Fluctuations in Waste Flow	
1. Pump waste to point of chlorination.	1. Not required
4. How to Allow for Proper Chlorine Retention Period	
1. Use 10-15 min. Retention Basin if cyanides oxidized to cyanates only and metallic precipitates can go to sewage plant. 2. Use 2-hour Settling Basin if all cyanides oxidized to CO_2 and N_2 or if metallic cyanides treated. 3. Use existing Holding, Equalizing or First Rinse Tank. Latter for oxidation to cyanates only.	1. Use Holding Tanks above. Settling Basin or Lagoon should follow Holding Tank if metallic cyanides being treated, unless metallic precipitate can go to sewage plant.
5. How to Eliminate Odors about Plant	
1. Apply caustic and chlorine to form hypochlorite or its equal with their application to the waste in a closed system with good mixing.	1. Apply caustic and chlorine to form hypochlorite or its equal with their application to the waste in a closed system with good mixing.

TABLE III

PHYSICAL ASPECTS OF CHLORINATING CYANIDE WASTES

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5. How to Eliminate Odors about Plant	
1. Apply caustic and chlorine to form hypo-chlorite or its equal with their application to the waste in a closed system with good mixing.	1. Apply caustic and chlorine to form hypo chlorite or its equal with their application to the waste in a closed system with good mixing.

TABLE IV

REACTION SHOWING REDUCTION OF HEXAVALENT CHROMIUM WITH FERROUS IRON SALTS

Reduction in Acid Solution

$$6FeSO_4 \cdot 7H_2O + 6H_2SO_4 + 2H_2CrO_4 \longrightarrow Cr_2(SO_4)_3 + 3Fe_2(SO_4)_3 + 5OH_2O$$

$6FeSO_4 \cdot 7H_2O$	$6H_2SO_4$	$2H_2CrO_4$	$Cr_2(SO_4)_3$	$3Fe_2(SO_4)_3$	$5OH_2O$
Copperas	Sulfuric Acid	Chromic Acid	Chromic Sulfate	Ferric Sulfate	Water
16	5.7	1.0(AsCr)			

REACTION SHOWING REMOVAL OF TRIVALENT CHROMIUM WITH LIME

Removal in Slightly Alkaline Solution

$$12Ca(OH)_2 + Cr_2(SO_4)_3 + 3Fe_2(SO_4)_3 \longrightarrow \underline{2Cr(OH)_3}\downarrow + \underline{6Fe(OH)_3}\downarrow + \underline{12CaSO_4}\downarrow$$

$12Ca(OH)_2$	$Cr_2(SO_4)_3$	$3Fe_2(SO_4)_3$	$2Cr(OH)_3$	$6Fe(OH)_3$	$12CaSO_4$
Hyd. Lime	Chromic Sulfate	Ferric Sulfate	Chromic Hydroxide	Ferric Hydroxide	Calcium Sulfate
10.0	1.0(AsCr)		2.0	6.2	15.6

TABLE V

REACTIONS SHOWING REDUCTION OF HEXAVALENT CHROMIUM WITH SULFUR DIOXIDE AND ITS COMPOUNDS

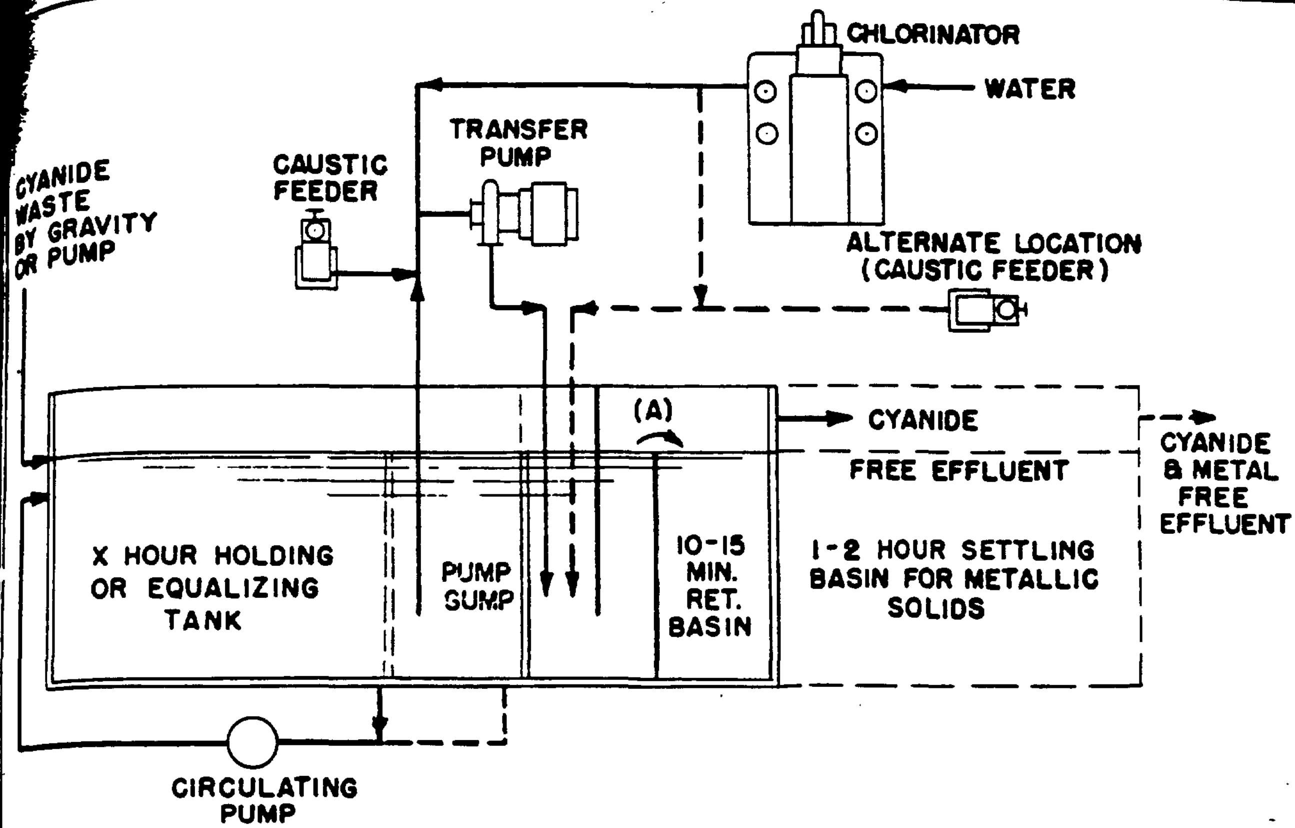
Reduction in Acid Solution

	Sulfur Dioxide Compounds		Sulfur Acid		Hexavalent Chromic Acid		Trivalent Chromic Sulfate		Sodium Sulfate		Water
1. Reduction with Sulfur Dioxide - SO_2	$3SO_2$ 1.9			+	$2H_2CrO_4$ 1(AsCr)	$\longrightarrow$	$Cr_2(SO_4)_3$			+	$2H_2O$
2. Reduction with Sodium Bisulfite-$NaHSO_3$	$3NaHSO_3$ 3.0	+	$1.5H_2SO_4$ 1.4	+	$2H_2CrO_4$ 1(AsCr)	$\longrightarrow$	$Cr_2(SO_4)_3$	+	$1.5Na_2SO_4$	+	$5H_2O$
3. Reduction with Sodium Sulfite-Na_2SO_3	$3Na_2SO_3$ 3.6	+	$3H_2SO_4$ 2.8	+	$2H_2CrO_4$ 1(AsCr)	$\longrightarrow$	$Cr_2(SO_4)_3$	+	$3Na_2SO_4$	+	$5H_2O$

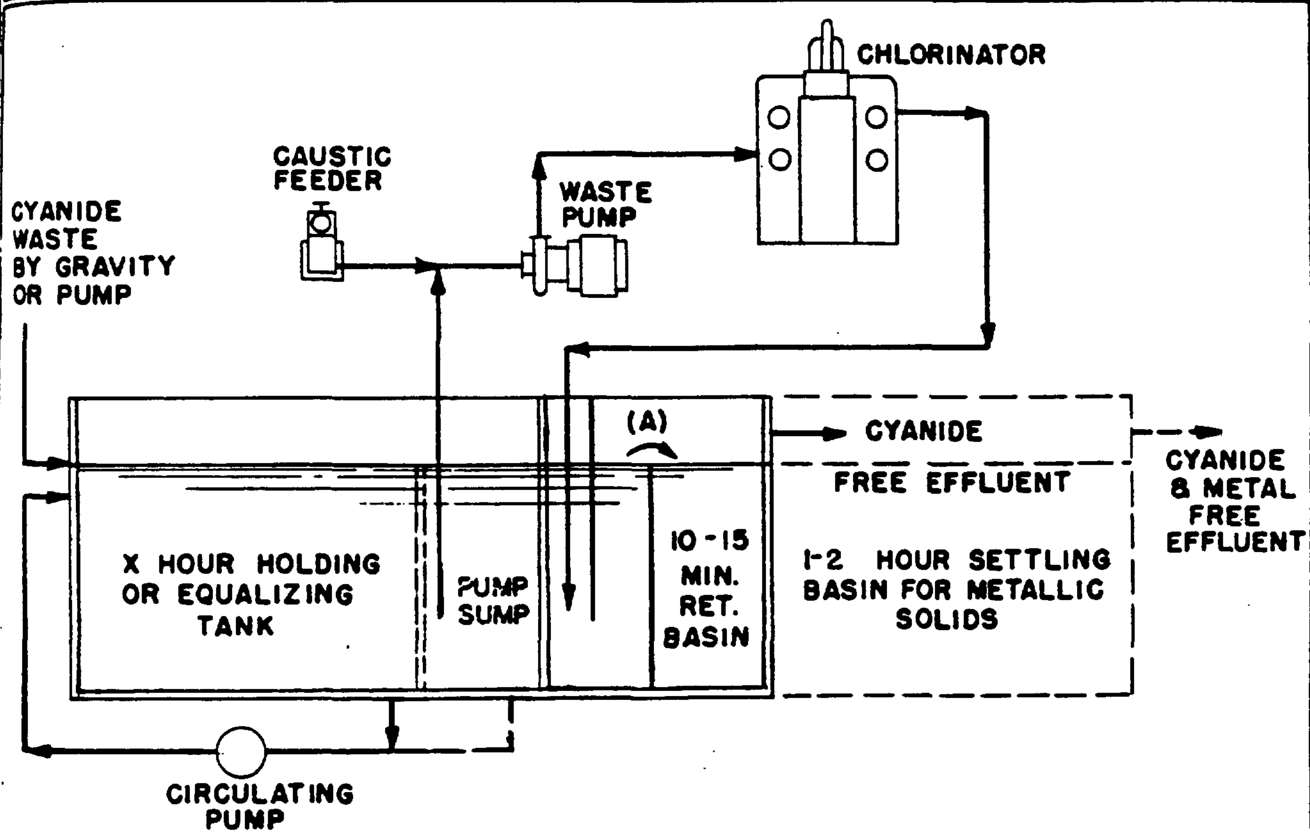
REACTION SHOWING REMOVAL OF TRIVALENT CHROMIUM WITH LIME

Removal in Slightly Alkaline Solution

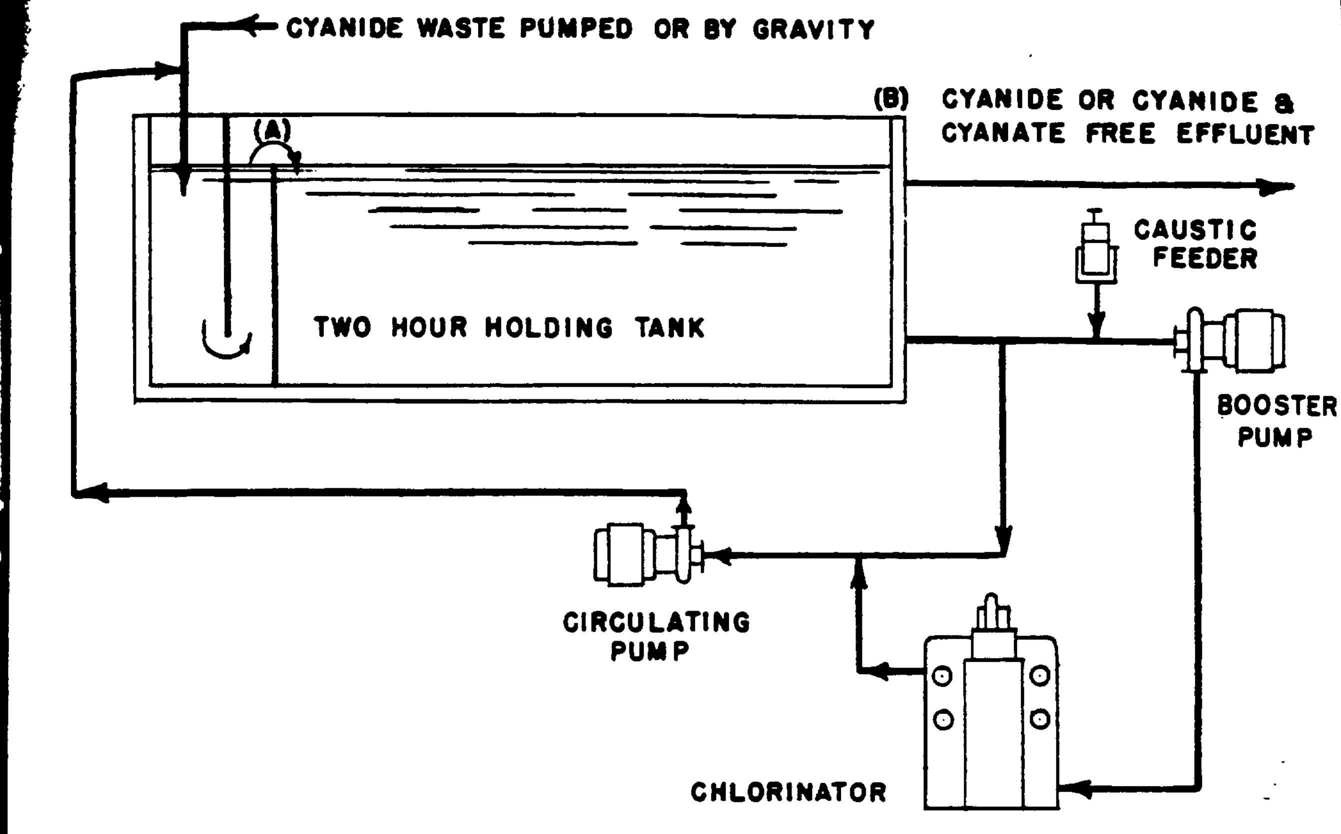
$3Ca(OH)_2$	+	$Cr_2(SO_4)_3$	$\longrightarrow$	$2Cr(OH)_3 \downarrow$	+	$3CaSO_4 \downarrow$
Hyd. Lime		Chromic Sulfate		Chromic Hydroxide		Calcium Sulfate
2.5		1(AsCr)		2.0		3.9



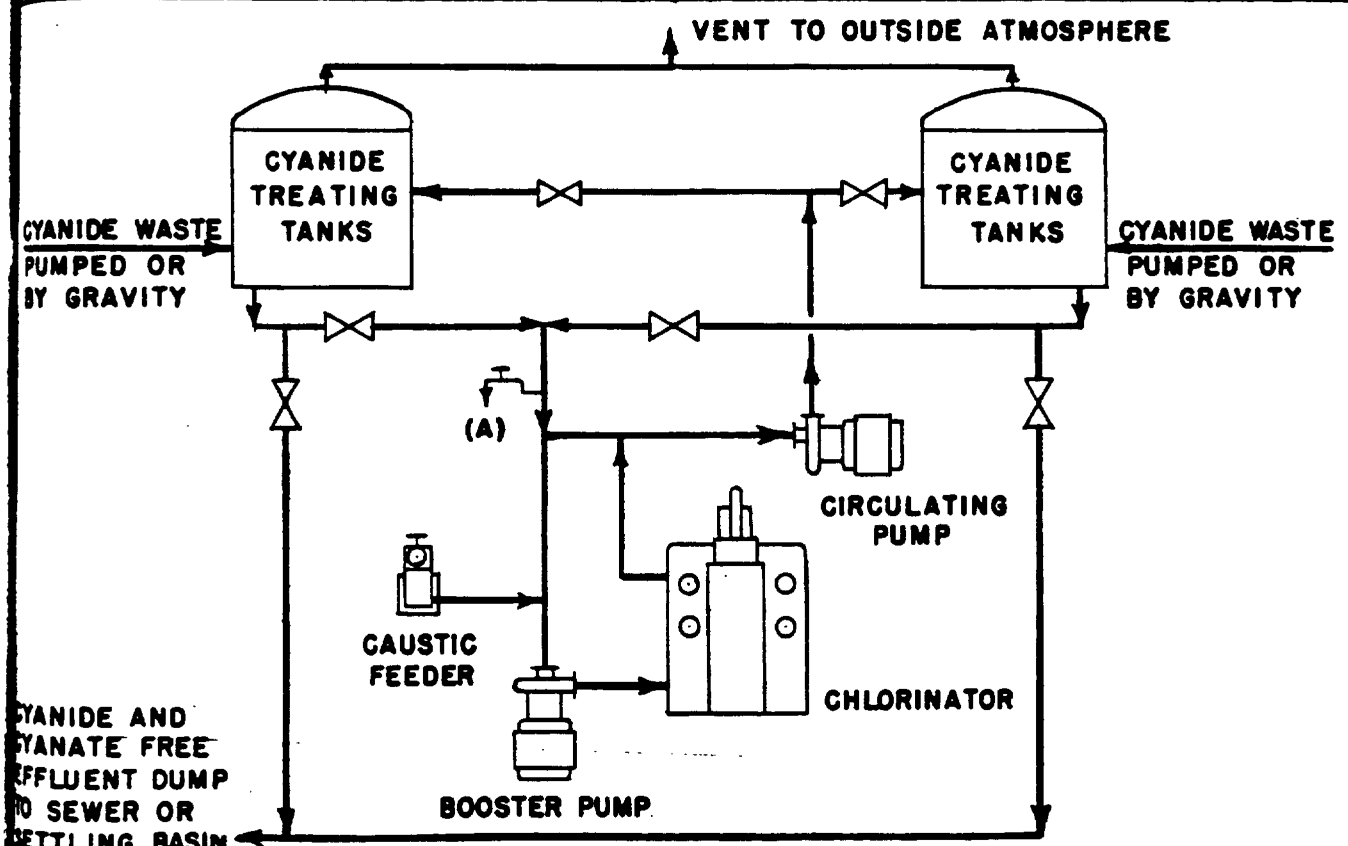
1 - TYPICAL DIAGRAM OF "FLOW THRU" CHLORINATION



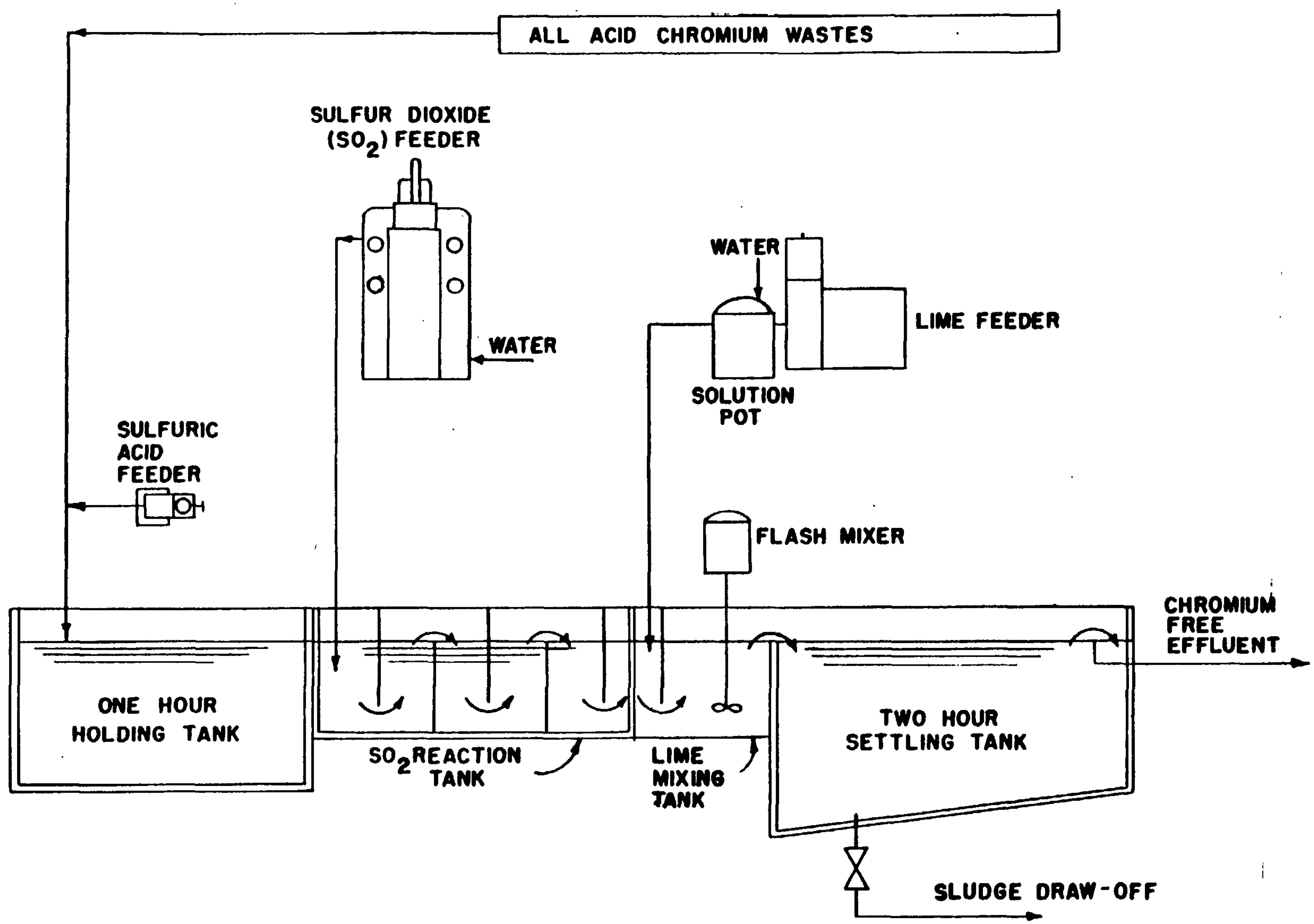
2 - TYPICAL DIAGRAM OF "FLOW THRU" CHLORINATION



3- TYPICAL DIAGRAM OF "FLOW-THRU" CHLORINATION



4-TYPICAL DIAGRAM OF "BATCH" CHLORINATION



5 — TYPICAL DIAGRAM OF
SULFITE TREATMENT—CHROMIUM WASTES

INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

MORNING SESSION

"BIO-TESTS AND WASTE TREATMENT DESIGN"

Charles E. Renn
Professor of Sanitary Engineering
The Johns Hopkins University
Baltimore, Maryland

In the past two years we have added a program of waste tolerance investigations to the conventional sanitary and industrial waste analyses carried on in our laboratories. I think that I can explain why we think that this has been useful by reading some of the questions that we have tried to answer. These have come to us from various industries, and while I am stating them in an abstracted form, I think that you will recognize features common to your own industry's waste problems. You may be interested in the kind of thinking that went into finding the answers.

1. We can't get sulfuric acid to neutralize our alkaline wastes as the water control board requires. Neutralization with commercial carbon dioxide or with stack gases looks like a possibility. There are high concentrations of vanadium and zinc in the waste. The stream above our property is stocked with brook trout, and they say that there is bass fishing in the broad sections below us. If we bring the waste to pH 8.2, where we get maximum sludge, with CO_2 can we discharge it into the creek? What will happen if the pH drops as low as pH 6.5?

2. We plan to treat our waste with chlorine to reduce the B.O.D. Our chemist finds that most of the chlorine taken up produces chlorine addition products. Are these likely to cause trouble in the area of our proposed plant site where is a small but long established pound net fishery?

3. The wastes from our plastics section throws down a large volume of very light sludge when we neutralize it with excess lime. The sludge settles slowly and we will require more settling basin area than we have on the property. If we bring the waste to pH 6.5 with soda we get very little sludge. Is there any disadvantage as far as aquatic life is concerned in treating to the lower pH?

4. We think that we can spray the wastes from our lye peeling operations on some sandy dune land at one side of the lake. Our well people say that the seepage will be into the lake. Are we likely to build up any residues in the soil or ground water that will kill fish or produce algal blooms in the lake?

5. What should we do with the sludge from our cooling towers? At our plant we try to keep down algae and slimes by alternating treatments with a chlorophenol compound and copper salts. Despite this we do get sludges and we have to unload the reservoir three or four times a year to keep the screens from clogging. Can we carry the sludge and waste cooling water directly to the river, or will we have to make an extra lagoon to draw down at a lower rate?

6. Last year we had a big fish kill below the plant. We were blamed for it, but we think that the trouble came from orchard spraying just before the rains in May. Now we're coming into another spring and we want to check the cause of the kill if it comes again.

7. The principal waste from this process contains an organic nitrogen fraction that breaks down to yield cyanide. We can treat it by the alkaline chlorine method, though the chlorine requirement is very high. It may be possible for us to hold it in lagoons to reduce the cyanide content. How much dilution will we need if we chlorinate the waste? What will we need if we lagoon the waste?

8. The waste is going to be a strong brine, with low pH and high ammonia content. We can drain it into the big bog lake on our land. When we have heavy rains the lake flows out into a creek that is taken for water supply. They have an old slow sand filter down there that they follow with chlorination. What effects would flooding out of our lake have on the creek? Will there be dead fish? What's the story on algae and filter clogging at the water plant? Will there be nitrates and nitrates to worry about?

9. The main waste treats very nicely on our pilot trickling filter. We also have a salt rich waste that we incinerate because it is toxic. It looks as though we can get the B. O. D. out of this on a trickling filter, too. If we could get the toxic fraction broken down on the filters, we could shut down the incinerator. What will the treated effluent do to fish? Are there any conditions that we ought to be on the guard against if we run the salt waste on the filters, conditions that might carry the toxic fraction through the bed?

10. At the new mill we plan to lubricate the fibre with a synthetic detergent. In the pilot treatment plant this caused us some trouble with sludge settling. Can we separate this rinse water with the detergent and discharge it to the river without treatment?

You can see at once that the answers to these questions will not come from Sanitary engineering tests and general references. You can also see that stream and effluent standards are not going to give you specific directions. You are going to have to find out for yourself.

One view, which is superficially attractive, is that we should develop some sort of standardized test with fish or other aquatic organisms that would let us build up a catalog of toxicity and tolerance values for most of the common industrial waste components. We could then design treatment against the handbook, and waste treatment engineering would be at least as simple as building a bridge.

Those of you who have worked close to problems of stream reclamation will know that the economical solution depends upon the rapid screening of many factors that affect water quality and aquatic life. You can't make fundamental studies of each, there is never time and money for such detailed and thorough examinations. Very early it is necessary to divide the problem into a few simple questions that can be answered by critical tests. It is necessary to choose tests that represent the limiting conditions of temperature and hardness, silt content, dissolved oxygen range, time of flow and contact period, dilution, and other factors that modify the action of wastes. We have to say that some conditions are more important than others, and that the range of a measurable factor will not extend above or fall below certain limits. The economy of the operation depends upon the early design of your experimental tests.

Knowing what concentrations of waste may be tolerated by fish, aquatic insects, snails, worms, or micro-crustaceans is only part of the story, but it may be the critical test that you need. There is an implication in the view that it is desirable to maintain the normal animal and plant life of waters that we sometimes overlook. This value extends beyond the interests of sportsmen, commercial fishermen, and the recreation business. The simple fact is that water in which a variety of living things are found is good for many purposes; it will have good industrial quality and it is likely to require little treatment for many uses.

At the Johns Hopkins University Sanitary Engineering and Water Resources Laboratories we have developed several very simple techniques for using bio-tests with fish and other aquatic organisms to measure the probable values of waste treatment processes. I should like to show you one of these in some detail.

We have studied the behavior of several wastes that contained toxic components that were highly volatile and biologically unstable. This made it necessary for us to control the concentrations of active materials in a running water system of test aquaria. The aquaria batteries consist of Lucite chambers that recieve filtered, chlorine free water from the city supply. This is cooled or heated as necessary before entering the manifold that feeds the aquaria. We find that we can obtain very good flow regulation of our dilution waters by drawing them from a constant head source through a manifold that is pierced with drilled holes of selected standard sizes. We have picked diameters that will give us a geometric sequence of discharge rates, in this case, we can select flows ranging from 2 liters to 16 liters per hour for each aquarium section, or we can combine them for closer ranges of ultimate dilution.

We deliver the waste that is to be diluted through a series of small gear pumps of the type used in the rayon industry. These have turned out to be the most satisfactory and least expensive metering pumps for the range of delivery rates that we must use. Each of these pumps delivers 0.3 ml. of test solution per revolution; they operate best in the range 25 to 45 rpm. A very convenient feature grows from this; at the lower rpm. a 20 liter carboy of test waste will feed an aquarium for about 48 hours -- enough to give the operator an occasional necessary week end fishing trip.

We can control the speed of pumping very satisfactorily with a hydraulic transmission and suitable belt reduction systems that drive a common shaft to which the pumps are coupled by micarta and steel gears. We mount the pumps in standard clamp type saddles that make it very easy to change pumps or to throw them off the line without disturbing others in the series.

It is very important to filter out all particulate material from test solutions that are pumped through these systems. We have found that small sacs of nylon filled with nylon staple, bound at the end of the intake lines work very well indeed. When such precautions are taken it is possible to run continuous tests of a month's duration with no more than casual attention to mechanical features of the system.

This piece of equipment is the result of a great deal of grief and frustration with other varieties of metered, continuous flow aquaria. It is free of bugs, and it works most satisfactorily.

One feature that makes the system useful for the study of chemical wastes is the possibility of pumping several separate solutions into a single aquaria — you simply couple the necessary pumps. You may, for example, feed an ammoniacal waste from an acidified storage carboy with no loss of ammonia. At the point of entering the aquarium section it may be mixed with dilute alkali delivered by a second pump to give an alkaline water similar to that anticipated in the receiving waters of a projected plant site. We can store biologically unstable wastes in a cold room at a distance. We can modify water hardness and pH by pumping in supplementary solutions. In general, we find better control and freedom from precipitates and filter clogging when solutions are mixed at the aquarium cell entrance.

We save time and make the most of our small investment in equipment by running preliminary, roughing tests, in small tank type aquaria. When we have discovered the vague zone between definite toxic activity and possible tolerance, we carry the tests to our continuous flow, metering system for confirmation and more critical exploration of the ranges.

We like this equipment because it gives us a graphical demonstration of the action of diluted wastes -- we can secure dilutions as low as 1/10 and as high as we wish -- upon anything that will live in an aquarium. We've worked with a number of fish, with snails, mayfly nymphs, crayfish, and mussels. In salt waters we have studied mussels, barnacles, oysters, and bryozoa.

Since most wastes must be shipped to us, the dimensions have been carefully considered. We have been able to run satisfactory tests of the tolerance of warm water fish, for example, with as little as 20 gallons of waste. This element is important because it is often necessary to bring waste from considerable distance and to store them in limited refrigerator space. Finally, we have to pay for our city water, and the pennies that we save help out in other places.

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CORRECTION

The paper presented on pages 84 and 85 was written by Dr. [illegible] Fish, Western Gulf and Colorado Basin Office, Federal Secur[illegible] Agency, Public Health Service, Albuquerque, New Mexico, an[illegible] presented by Albert H. Halff in the absence of Dr. Fish.

INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

MORNING SESSION

REMARKS

Albert H. Haff, Sanitary Engineer, Dallas, Texas

I find it very difficult, in this case, to proceed along the accepted pathway of the commentator in that Dr. Renn's paper leaves so little left to be said. He has answered the question why there should be such a thing as a bio-test in a very practical and understandable manner. He had described so clearly the equipment developed for bio-tests, as they are conducted at the Hopkins Sanitary Engineering and Water Resources Laboratories, that those who may follow this approach can easily avoid the many headaches associated with new techniques. Further comments on my part in regard to either the "why" or the "how" of bio--testing would indeed be superfluous.

Traditionally, the commentator is expected to bring forth some criticism--presumably as evidence of his qualifications to be a commentator. If I must do so--my criticism would be that Dr. Renn's paper was entirely too short. Unquestionably, in the interest of maintaining good relations with the program committee, Dr. Renn was obliged to confine his subject to those phases of bio-tests that could be covered adequately within the time allotted.

However, the field of bio-tests is extremely broad--and it is controversial as well. As Dr. Renn has stated, bio-testing must reveal, through a relatively few standardized procedures, all of the significant facets whereby pollutants can affect water quality and aquatic life. Water quality seems not so difficult. Aquatic life, however, considering its involved dependent and inter--dependent complexities, poses problems that appear virtually insoluble through the media of rapid screening tests.

You, as industrial engineers, wish to know what type and degree of treatment is required whereby your plant wastes will be rendered innocuous to aquatic life. The problem goes far beyond the simple question of whether or not some test fish are killed by your proposed effluent within a predetermined length of time. The ramifications of biological consequences set in action when pollutants alter an aquatic environment figuratively stagger the imagination. We cannot hope to explore all with the time and facilities ordinarily available. Patently, it demands sound reasoning and interpretation of data to decide which of the many possible tests will most fully reveal the full impact of a pollutant upon water and its many types of inhabitants--all of which play more or less essential roles in maintaining what we so loosely term "good water." Unfortunately,those decisions must be made, for the bio-test--in spite of admitted limitations in its present stage of development--constitutes the only practical approach to the problem.

I, for one, would have welcomed a further development of Dr. Renn's statements that "it is necessary to divide the problem into a few simple questions that can be answered by critical tests. . ." and "we have to say that some conditions are more important than others. . " I am certain that anyone facing the decisions involved preparatory to bio-testing would find the benefit of Dr. Renn's knowledge and experience invaluable. Just to name a few of the questions that inevitably will arise: What species and sizes of test organisms will best serve my needs? What Criteria shall I use to evaluate my results? Can I depend upon my laboratory results to indicate what will happen in the field? Anyone who has considered bio-testing can add to the list of questions, but these will suffice as an example. Perhaps Dr. Renn will enlarge upon his statements that I have quoted during the forum to follow.

I believe it is the prerogative of the commentator to contribute one original thought bearing upon the subject at hand. My topic for the day will be a plea for a better understanding between the biologist and the engineer--particularly during their joint ventures into the field of bio-testing. Engineering is a precise science. The engineer is taught whenever possible to reduce all things to formulae and laws that will hold as true in Maine as in California. The engineer by training tends to think in terms of things that vary only in a definite and predictable manner. The biologist, on the other hand, is taught early in his career that one common characteristic possessed by all living organisms is their ability to change in a totally unpredictable manner and thereby adapt themselves to an altered environment. The biologist tends to think that, within certain limits at least, much is unpredictable and nothing is impossible--it is merely statistically improbable.

When these two diverse trainings join--as they should in the field of bio-testing--some degree of mutual misunderstanding seems inevitable. The engineer tends to accept af face-value the determinations wherein the test organisms did not die and to get on with the design of his waste treatment plant. The biologist, thinking of the inherent variability of living organisms--the greatly increased resistance to DDT acquired by flies to name one striking example--is apt to stall for more data before committing himself. Obviously, the two must find a common practical meeting ground somewhere between their diverse viewpoints and, in so doing, will learn much to their mutual advantage.

In closing, I wish to thank the Gulf Coast Conference on Industrial Health for the opportunity of participating in your meeting--and for the privilege of appearing with Dr. Renn.

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INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

MORNING SESSION

"BIO-ESSAY METHOD FOR CHEMICAL INDUSTRY WASTES"
A Discussion

E. R. Strong
Southwest Research Institute
San Antonio, Texas

The passing of Public Law No. 845 and the increased vigilance of some states in the enforcing of existing stream pollution statutes has caused many industries to ask questions similar to those quoted by Dr. Renn. Dr. Renn very ably stated the facts when he suggested that the answers to these questions are not usually forthcoming without some research - - especially answers to those questions concerning the toxicity of wastes to aquatic life.

In a good many instances, industry with a toxicity problem is not located near a research group or university, which is both capable and willing to perform the necessary toxicity studies and related research. Then, the industry must do the work itself.

While bio-assay procedures are relatively simple and do not require elaborate equipment, they do present a new concept to a majority of chemists and engineers performing them for the first time. The observing, recording, and interpretation of biological data is not completely comparable to the same processes for chemical, physical, and general engineering data. Also, a good portion of the literature is a hindrance rather than an aid. As a result of the lack of proper knowledge, many toxicity tests are carried out very haphazardly and erroneous conclusions are drawn. Engineers and chemists are not the only ones at fault, a good many biologists are off on the wrong foot. Some common failings in the use of fish as test animals are:

1. Improper selection of test species - - one far too hardy, such as gold fish, is used.

2. Fish are not acclimated before test.

3. No controls maintained during test.

4. Many tests are conducted for too short a time - - few minutes to few hours.

5. Too few fish are used in the tests.

Even though the use of fish to evaluate toxicity of a waste water is a very old method, there is today still a lot of disagreement among experienced investigators concerning the precautions necessary in using fish as test animals.

The federation of Sewage and Industrial Wastes Associations realizing that there was such disagreement and that a problem existed, formed a sub-committee to very critically study the situation and to recommend, if possible, procedures for conducting waste toxicity bio-assays. Dr. Renn was asked to join in this study, but was unable to do so - - it is obvious that he already had his hands full aiding industry to solve its problems.

The Federation's sub-committee met several times and after many long hours of deliberation plans to publish the first part of its efforts - - a listing of recommended procedures for evaluations of acute toxicity of wastes to fish. Present schedule is in the November issue of "Sewage and Industrial Wastes." While this publication is not intended as a cure-all, it should be an excellent aid or guide to the chemist or engineer untrained in biological sciences but faced with the problem of performing this type of work.

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INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

MORNING SESSION

Air Pollution Panel

"REMOVAL OF SOLIDS FROM HIGH TEMPERATURE STACK GASES"

Principal Speaker

Fred J. Fischer,Jr.
American Air Filter Company, Inc.
Louisville,Kentucky

As a major topic in the discussion of Industrial Waste Disposal, experiences in each community have taught us to place great emphasis on the emission of solid materials from the high temperature stacks in industry. The nation wide emphasis on air pollution and public nuisance control has focused attention especially on those operations where hot and often moist gases are involved. These gases invariably contain considerable quantities of solid material which are ultimately discharged to the atmosphere. In the strict sense of the word, most of these materials can not be considered as industrial waste. Their control and reclamation have brought about, in some cases, very attractive returns to the industry which at one time considered them waste and nuisance.

A classification of industrial stacks can be made in the following categories and covers in a greater part the wide range of industries now located in the Southwest.

In the first group we have the high temperature kilns, dryers, and coolers. Here, as in all categories, the particle size of solids in the stack gases from kilns and dryers, where the chemical reaction or calcining takes place is very small with high percentages of the material, by weight, in the low micron or sub-micron range. The rotating kilns or dryers generate very high dust loading as the air is drawn through the tumbling material inside the kiln. These include cement kilns, lime kilns, clay calcining kilns, and others with exhaust gases in the very high temperature range of 900° to 1300° F. It is very difficult to apply exhaust equipment that will do an adequate dust collecting job, and stand up under the heat and moisture.

Figure 1 shows a typical kiln exhaust on a direct fired burner of coal, gas or oil, being exhausted through a wet type dust collector, exhauster, and to the exhaust stack. This is an arrangement that can be found in lime kilns in both the chemical plants and paper mills.

Typical examples of the exhaust stacks in the lower temperature range between 450° and 900° F. are found in the aggregate dryers of the asphalt paving plants. It is not uncommon in these plants to experience dust loadings of between 8 to 40 grains per cubic foot in the exhaust of the aggregate dryer. Such dust loadings in the stack must certainly be controlled by adequate dust collection equipment.

the dust loading from 13000# per hour to 1200# per hour. This in itself at one time seemed adequate, however, the appearance of the discharge from the dry collector was soon considered a nuisance. The exhaust gases were then introduced to two large towers in parallel each 32' in diameter. The velocity in these towers was estimated at 10' per minute. Here the discharge was reduced from 1200# per hour to 300# per hour. Yet the 300# per hour still did not meet with approval of the particular municipality and tower discharge caused a whitening of the ground and trees in the immediate vicinity. Finally an orifice type cleaner exhausting the towers was installed as the final cleaner. Further reductions in the dust load of exhaust gases from 300# per hour to 6# per hour were effected to the satisfaction of the plant owner. The collected material can be disposed of in various ways, continuously or otherwise.

The second group of boiler stack pollutants has most generally been controlled by the dry centrifugal collectors or in some cases the high voltage Electro-Statics. Yet the wet collection has been shown to be of definite help in controlling this problem on a number of installations. The range of collection efficiencies is definitely within the limitations of the wet collector. Corrosion becomes a problem from the sulphur products usually found in fuel being burned. It has been found that a lining of lumnite cement inside a wet collector will allow it to function with a high degree of efficiency and yet be protected from deterioration.

In the third group of industrial stacks discussed, the foundry cupola takes a prominent place as one of the greatest offenders. Extensive West Coast tests have indicated that the orifice type collector shows promise in dust control for this group. A new comer in the field of cupola exhaust is the bag type collector using as a filter media a woven glass cloth. This type has shown promise on cupola exhaust after the high temperature has been reduced by a wet chamber.

The small particles of metal fume which are exhausted from the electric steel furnace are a distinct nuisance to both the inside areas of the foundry building and the immediate surrounding location. By applying a local exhaust hood immediately over the top of the furnace to control this fume by as small amount of air as possible and yet not interfere with the working operation of the furnace, it is possible to reduce this exhaust and nuisance problem satisfactorily.

Applications of high efficiency wet type dust control equipment have in general yet to be tried with the two remaining operations of this group; namely, the blast furnaces, and open hearth stacks of the steel mills. Here the exhaust volumes are great and particle sizes of fumes to be collected are so small that there has been general reluctance to tackle this most difficult problem. Yet it seems that in the very near future the present day emphasis on air pollution and public nuisance control will be focused greatly so that the attention of regulating agencies, owners and collection equipment manufacturers will be forced to improve this condition.

While most of these contaminants by virtue of their nuisance characteristics are now referred to as waste, the metal manufacturing industry and the carbon black operations in chemical and petroleum industries have realized unknown dollar returns from reclaiming material that once was carried to the surrounding countryside. In some cases this may be the most valuable end point of the product.

It can then be seen that in collecting waste and reclaiming part of the by-products, industry stands to gain first, control of air pollution; second, general good housekeeping; and third, valuable realizations from reclaimed material.

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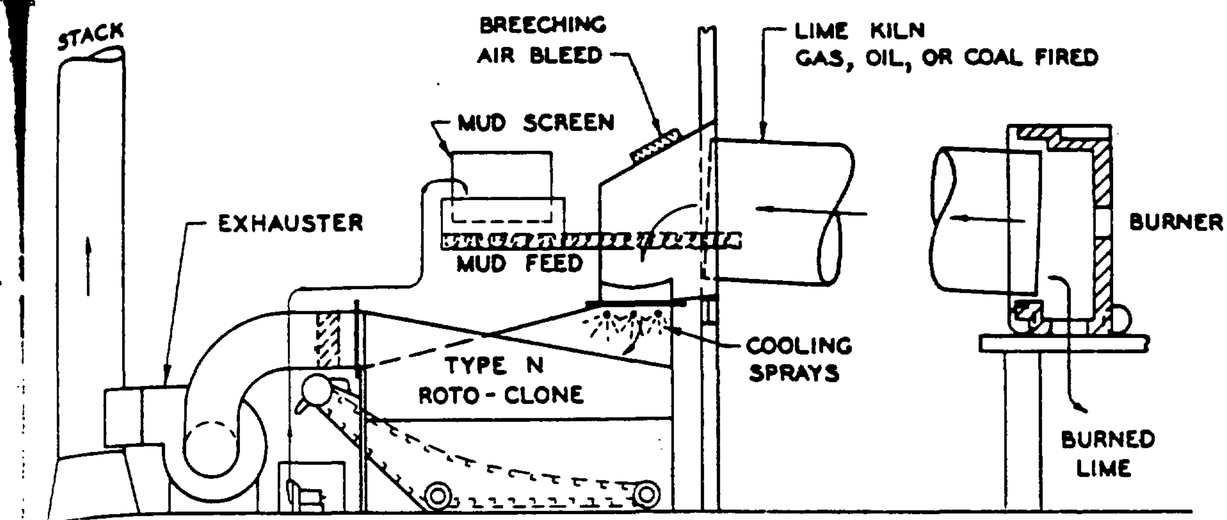
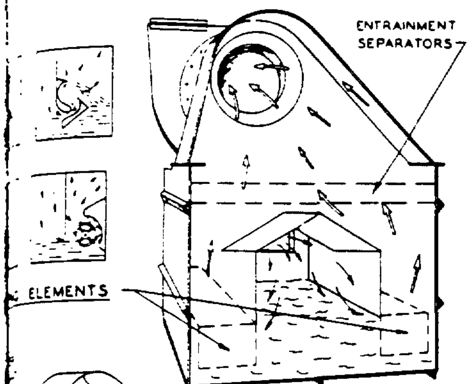
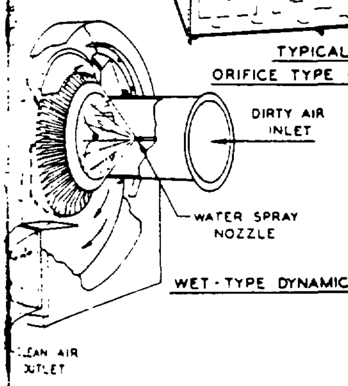
NOTE: The four illustrations referred to as Figure 1, 2, 3 and 4 in Mr. Fischer's paper, are shown on the following unnumbered page.



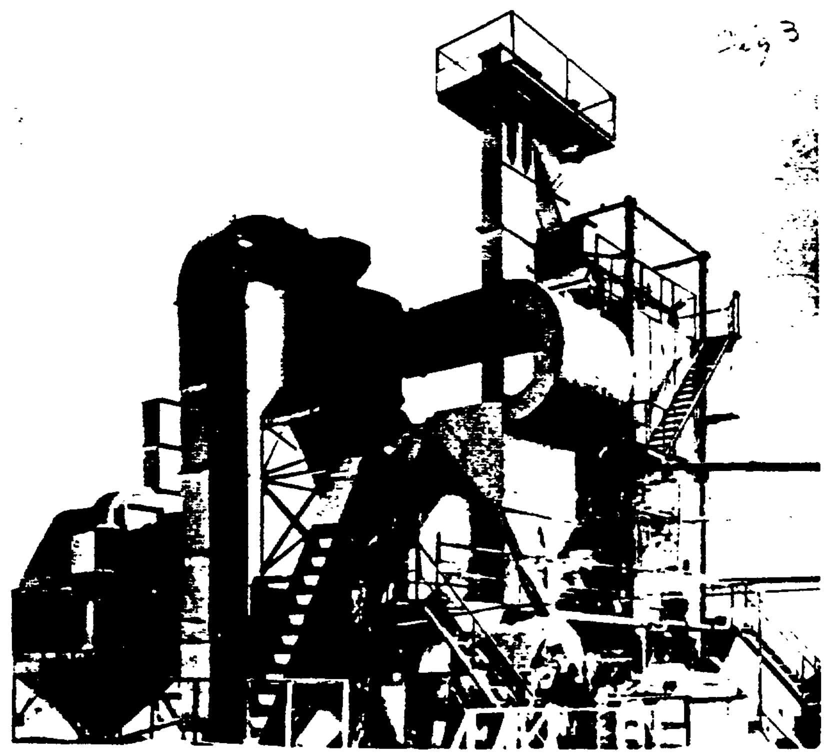
DUST CONTROL FOR LIME KILN

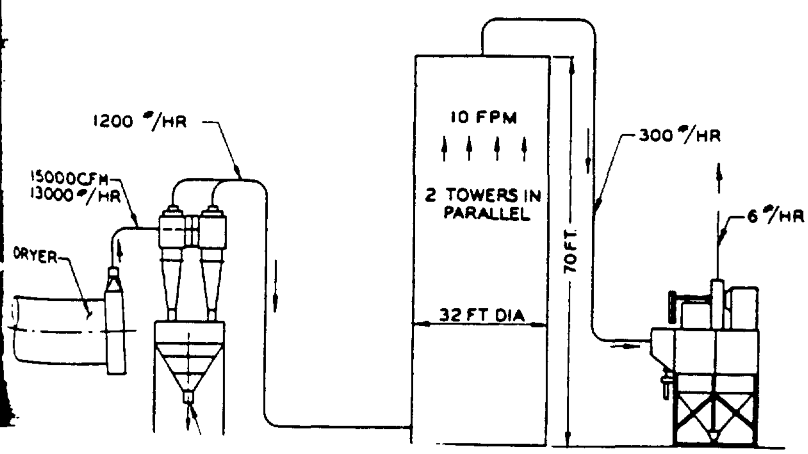


TYPICAL WET
ORIFICE TYPE COLLECTOR



WET - TYPE DYNAMIC PRECIPITATOR





THE COLLECTION REQUIRED TO SATISFY PUBLIC NUISANCE COMPLAINTS FROM NEIGHBORS IN A PLANT AREA IS ILLUSTRATED BY THIS LIMESTONE DRYER PROBLEM. IT EMPHASIZES THE IMPORTANCE OF VERY HIGH DEGREE OF SOLIDS REMOVAL WHEN HEAVY CONCENTRATIONS ARE INVOLVED. PRIMARY COLLECTION, EVEN WITH 90 PER CENT REMOVAL WILL NOT ALTER DISCHARGE APPEARANCE OR NEIGHBORHOOD COMPLAINTS. THE ADDITION OF THE WET COLLECTOR TO REMOVE PRACTICALLY ALL OF THE SOLIDS PROVED THE NEEDED ANSWER.

INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

MORNING SESSION
Air Pollution Panel

"THE DISPERSION OF SMOKES AND ODORS FROM POINT, LINE AND AREAL SOURCES"

Principal Speaker

J. M. DallaValle
School of Chemical Engineering
Georgia Institute of Technology
Atlanta, Georgia

We have available a rather extensive amount of information relative to the concentrations of atmospheric pollutants in many industrial cities. Records of the degree of pollution are quite valuable in connection with evaluation of alleged nuisances, property damage, etc. But atmospheric pollutants, as is well known, do not always distribute themselves uniformly from day to day, even though the overall amount produced remains constant. So much depends on wind direction and intensity and topographical conditions that short-time samples do not yield reliable indices. It is not easy to arrive at an "average" estimate of atmospheric pollution in a given city, except in few cases, as for example when the city is small in area or where meteorological conditions permit what we may call confined dispersion of pollutants.

This paper presents a brief resumé of conditions arising from three special sources of atmospheric pollution. In each case, we shall assume that the terrain in the direction of wind motion is relatively level. As to the wind velocity profile, which has a marked effect on the nature of distribution downwind, we shall touch briefly on its significance later. The distribution equations for the three cases - point, line and areal sources - presented below are not seriously affected by the limitations imposed if we consider that the sources themselves are subject to change from hour to hour as are also meteorological conditions. What is important is that the equations show how the dispersion of pollutants downwind achieve their maximum effects at different places.

Point Source

A single stack or chimney may be regarded as a point source. If the quantity of pollutant issuing from it is known, it is possible to obtain its distribution at ground level downwind for any wind velocity. The theory of the latteral dispersion of a cloud from a point source has been worked out by Bosanquet and Pearson (1936) and later by Sutton (1947). We shall not deal with the general theory and derivation of formulas here since it suffices to indicate the conclusions brought forth by the equations. If we denote the height of the stack by H and the quantity of pollutant issuing from as C (weight per unit time), then it can be shown that the concentration at ground level, C_o, expressed as weight per unit volume is

$$C_o = \frac{C \cdot 10^3}{4\sqrt{2\pi}\, u\, x^2} . \exp\,(-\,20H/x) \qquad (1)$$

where u is the wind velocity and x the distance downwind. The units, of course, must be consistent. Thus, if u is in mph, then x must be in miles, etc. If equation (1) is differentiated and rendered a maximum, we deduce that the maxium concentration of the pollutant (assuming it is composed of gases or vapors or extremely fine particles) occurs at ground level when

$$x = 20\,H\ ,$$

that is, we can expect the maximum to occur for odors or corrosive gases and vapors at a point 20 stack heights downwind, regardless of wind intensity. At very great distances, the exponential term approaches unity and we see that the concentration varies inversely proportional to the square of the distance from the source.

Baron, Gerhard and Johnstone (1949) have modified the Bosanquet-Pearson equation (1) to account for the settling of particles whose motion is assumed Stokesian. Their equation for the fraction of particle bearing cloud at ground level per unit distance is

$$\phi = \frac{20\,u_s(35.6\,H)^{20u_s/u}}{u\,x^{(1\,+\,20u_s/u)}}\exp\,(\,-\,20H/x)\ . \qquad (2)$$

Here, u_s is the terminal velocity in Stokes' settling for a particle of given size. For this type of dispersion, the maximum amount of the cloud settles at a point downwind

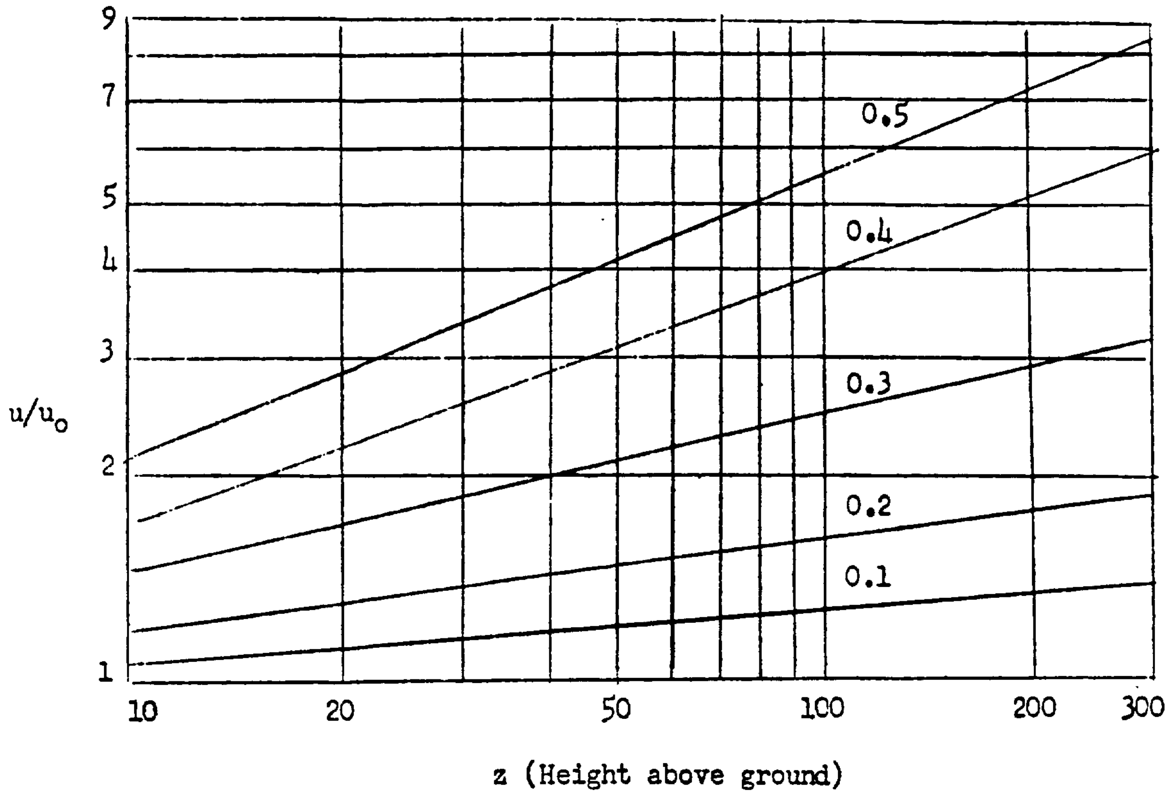
$$x = 20\,H/(1 + 20\,u_s/u)\ .$$

Thus, the coarser the particles, the closer does the maximum come to the stack for a given velocity of wind. In no case, however high the wind velocity, will the maximum occur at a point greater than 20 stack heights downwind.

The Bosanquet-Pearson equations discussed above arise from simple considerations of the usual diffusion equations applying to a point source with appropriate boundary conditions. Sutton (1947) has presented a different equation based on modern turbulence theory. In this connection, it is necessary to utilize the wind velocity profile since the height of the stack above the ground and the intensity of the wind at the top of the stack influence markedly the kind of distribution obtained downwind. Sutton has shown on the basis of numerous investigations that the wind velocity profile may be represented by an empirical equation of the form

$$u/u_o = z^{n/(2-n)} \qquad (3)$$

Where u_o represents any reference velocity (say an average velocity at some fixed position above the ground) and z is the height to which the velocity u corresponds. The value of n depends on many factors and lies between 0.25 and 0.5 (usually). It can only be obtained experimentally. Typical wind velocity profiles are shown plotted logarithmically in Figure 1 next page.



Note: Diagonal line represent values of n .

Figure 1

Sutton's equation giving the concentration of a smoke or gas at ground level in weight per unit volume is

$$C_o = \frac{2C}{\pi k_y k_z u\, x^{2-n}} \exp\left[- H^2/ k_z{}^2 x^{2-n} - y^2 / k_y{}^2 x^{2-n}\right] \tag{4}$$

where k_y and k_z are vertical and horizontal "spreading" coefficients having an order of magnitude of 0.1 and not usually exceeding 0.2. The coordinate y refers to either side of the x direction - the mean direction of the wind. The value of n is, of course, that value which characterizes the wind velocity profile given in equation (3). If we put $y = 0$, the maximum concentration is seen to occur when

$$x = (H/k_y)^{2/(2-n)} \quad . \tag{5}$$

Due to the value assumed by n, the maximum in this case can occur for values greatly exceeding the 20 stack heights deduced from our equation (1).

The modification of Sutton's equation to allow for settling of particles has been accomplished by Baron and his co-workers cited above. While undoubtedly this modification results in more accurate results, little is really gained considering the fact that the size-distribution of particulate matter issuing from a stack is usually not known and the value of n determining the velocity profile of the wind is difficult to average. In general, except for high values of n, the Bosanquet-Pearson equation (2), while giving a distribution lower than the modification of Sutton's equation, is perhaps, all things considered, equally good and much simplier. A comparison of results obtained by means of equation (2) and Baron's modification of Sutton's equation is shown in Figure 2.

The figure illustrates an important fact, namely, that the real effect produced by pollution from a stack is not felt except at considerable distances from it. Maximum effects do not usually occur at less than 20 stack heights downwind. Thus, for a stack 300 ft in height, we should not expect the maximum effect to be shown at distances less than 6000 ft distant from it. The equations we have given above have been tested in several instances abroad and have been found to represent actual conditions. The industry contributing to the pollution of a city must therefore consider that its chief complainers will not come from the vicinity of the source of pollution, but at a considerable distance from it. This simple fact is frequently overlooked. The equations also exhibit the importance of stack height, for as may easily be seen, the higher the stack, the further removed downwind is the maximum effect felt and the less is its intensity.

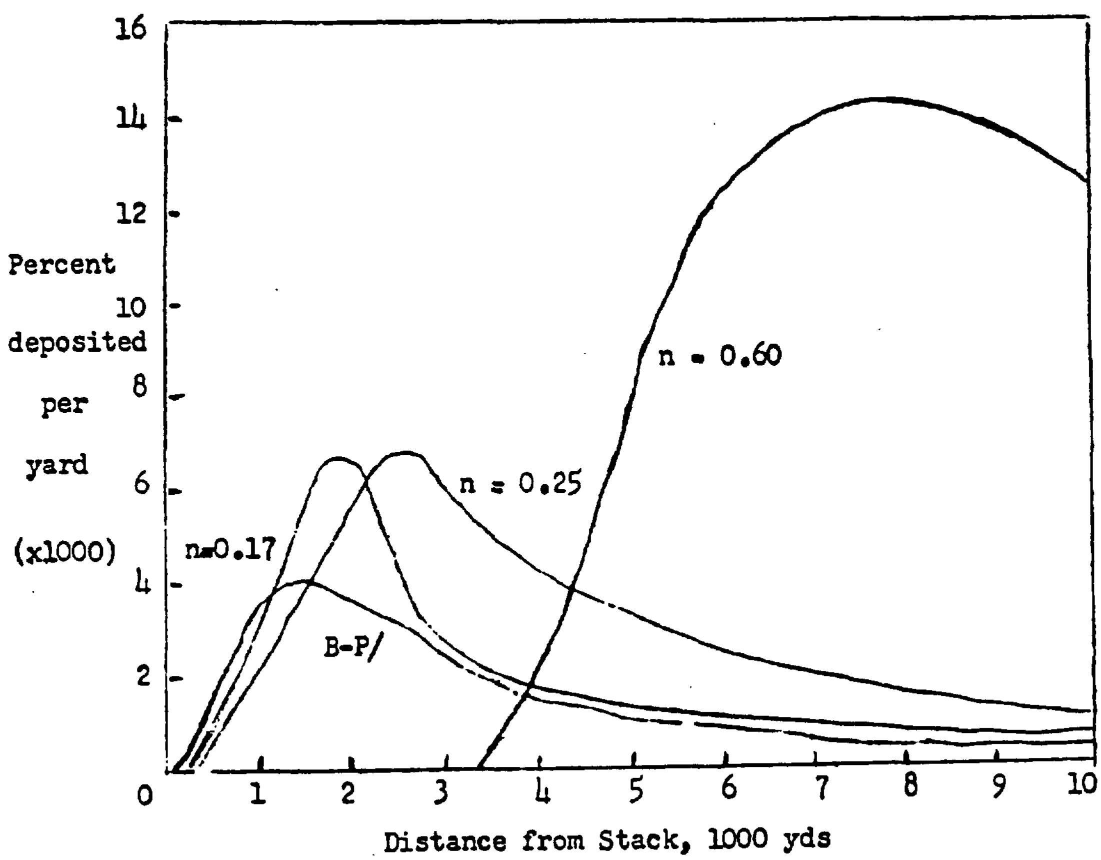


Figure 2. Effect of wind velocity profile on deposition

The equations we have given illustrate well the importance of height of stack and wind velocity in determining the region of area wherein we can expect difficulties from stack effluents. It is clear that while both pollutants and wind velocity are fluctuating quantities, it is nevertheless possible to make reasonably good estimates of them and thus predict what may be expected downwind. For a line source, it is not easy to make an estimate of average height, although with some careful observations it is not too difficult a task. For point sources in which the pollutant issues with a rather high vertical velocity, it is of course necessary to make some corrections to the stack height used. In such cases, the stack height used in the equations we have given should be increased. It is further clear that the equations are of immense help in predetermining the height of stack which should be used to avoid complaints within populated areas. We have not used the information concerning dispersion of smokes and gases in this country to the extent we should. We have relied more on legal approaches to control of pollution than on engineering knowledge.

Areal Sources

Area sources refer to pollutants issuing from extended surfaces. A "dust bowl" is an areal source, as is also a large industrial area.

There is no simple means of predicting the net effect downwind beyond the areal source unless we can approximate the cloud of pollutant to a line source at some fictitious height. However, we can estimate within the area source how much pollutant is gathered up within it. In such a case we must know the average wind velocities at two different heights and the corresponding concentrations of pollutant. Let the elevations for these observations be z_1 and z_2 and the corresponding wind velocities and pollutant concentrations u_1, u_2, C_1 and C_2 respectively. Then the pickup in weight per unit area within the areal source is given by the equation

$$C = \frac{\rho_o k^2 \ (u_2 - u_1)(C_1 - C_2)}{\ln^2 z_2/z_1} \tag{7}$$

where ρ is the density of the air and k is a constant having a value of approximately 0.5. In this equation, if ρ_o is expressed in lbs/cf, u in fph and C_1 and C_2 in cf/cf, then C will be expressed in lbs/cf/h. The above equation was derived by the author (1948) and gives results of reasonable magnitude for selected conditions. However, it requires further experimental confirmation.

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INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

MORNING SESSION

D i s c u s s i o n

Martin C. Wukasch, Senior Engineer
Industrial Hygiene Section
Texas State Department of Health
Austin, Texas

While the printed program lists a single topic for the two speakers of this hour, I believe all present will agree that essentially the time has been utilized to illustrate two important considerations of air pollution, namely control and evaluation.

Mr. Fischer's paper on the former aspect clearly reveals that even for a single type of contaminant - solids - a great variety of control devices and procedures are available. He has shown us that the selection of the most desirable or feasible methods must result from a careful engineering study of the problem. One cannot help but add that although many control methods may exist, to obtain the cooperation of some few obstinate offenders, the ultimate in salesmanship is often required to minimize a nuisance when no public health hazard can be proved.

Mr. Fischer also reminded us that the possibility or reclaiming valuable by-products should certainly not be overlooked. Economic gain often serves to stimulate provision of more positive controls when humanitarian considerations fail. The State Health Department has a vast amount of evidence to establish this fact. As one example, we could cite a Texas metal processing plant where relief from civil damage suits necessitated a long needed bag house collector. The unit recovered sufficient lead fumes to entirely defray its costs in one year. In the industrial hygiene session held this morning in another room, many of you heard Dr. William Bradley cite the story of a $55,000 control unit which salvaged half its cost in reclaimed products within four months. These spectacular examples indicate that further research on the utilization of by-products or trade wastes can also serve in the solution of atmospheric pollution problems.

Dr. DallaValle's paper on technical evaluation was concerned with the sources of pollution and the mechanism of dispersion. He also discussed the chief sources of pollution and their relative degree of importance. The nature of atmospheric contaminants and their behavior were dealt with only from the physical standpoint. Dispersion and diffusion of contaminants from point, line, and areal sources were outlined to illustrate the importance of the dilution factor with reference to the relative position of the contaminating source and the points where complaints may be expected. The complexity of an accurate technical evaluation of the many variables which one must consider in air pollution work were again emphasized in this paper. It becomes quite apparent that a single grab sample obtained at a randomly selected location will not provide tenable quantitative results. It is also a well established fact that a series of coincident adverse conditions which serve as the basis for complaints seldom ever are repeated or can be duplicated for the benefit of the investigating engineer. This is particularly true of unusual meteorological conditions. I believe that all of these considerations fully confirm the necessity for having a comprehensive, adequately equipped, full time and continuous air pollution program if one is to make progress in this field.

Most of you are aware that except for certain defined nuisances[1] there is no Texas legislation specifically applicable to air pollution control. Last year at this meeting I recall that several inquiries were made concerning the wishes of the State Department of Health in regard to legislation. In anticipation of such inquiries again this year, these matters were recently discussed with Dr. Geo. W. Cox, your State Health Officer, who stated the following:

"The need for proper legislation more effectively to meet conditions resulting from air pollution is growing more obvious each day. Property owners should have the reasonable and comfortable use of their property. Any condition which annoys, gives trouble, or causes vexation should be corrected. No condition that endangers life or health should be permitted.

"The State Department of Health urges the passage of proper legislation, but feels that it should be more of a permission or optional type as air pollution does not exist over the entire State but only in local areas. Where this condition exists local authorities should be given the proper laws to meet this condition."

Dr. Cox believes that most pollution is strictly a community problem, that it can only be abated by community action and that as such conditions arise it is the problem which all must work in close cooperation to correct. With the proper legislation defining certain rights as well as defining certain types of pollution, and with trained personnel working in conjunction with those causing such violation, most of our pollution troubles can be solved.

The State Health Department appreciates greatly the interest shown by many in the various phases of air pollution control and is grateful to the Houston Chamber of Commerce not only for providing this particular panel today but also for their continuous interest manifest in the activities of the Public Health Subcommittee on Air Pollution. Dr. Cox felt so keenly about this interest, and also that which has been voiced by many citizens and industries in this area, that he recently requested an engineer to make a thorough study of the well publicized Los Angeles County program. Mr. Otto Paganini of the State Health Department's district office located here in Houston recently returned from California. With your permission I'd like to call on him and have him tell us briefly some of the highlights of the Los Angeles County activities. MR. PAGANINI:

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1. Article 695, Texas Penal Code and Article 4477, Sect. 1(g) and Sect. 2(i), Revised Civil Statutes.

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INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

MORNING SESSION

REMARKS

Otto Paganini, Industrial Hygiene Engineer
Bureau of Sanitary Engineering
Texas State Department of Health, Houston District Office
Houston,Texas

The Los Angeles County Air Pollution Control District was brought about by the necessity arising from an acute atmospheric problem which had resulted from rapid municipal and industrial growth. The problem is one in economics as well as in discomfort to the well being of the citizens of that county. At first a cooperative program was started through smoke abatement bureaus that could be established in the incorporated cities and the county. Due to lack of cooperation on the part of the industrial cities and after considerable research on laws and accomplishments elsewhere, the California legislature enacted a statute** which declared each county also to be an Air Pollution Control District. However no powers or appropriations initially are authorized or provided. To activate the Los Angeles County program a public hearing was held by the County Board of Supervisors that the air was being polluted or could be polluted and would affect the health and well being of the citizens of the county.

The district is completely financed by the county. Its present budget is $500,000 of which $75,000 is for research on improving sampling and analytical methods, study of control equipment and further physiological evaluation of minute amounts of chemicals with special emphasis on irritation of the eyes and throat and damage to crops. The staff consists of research, engineering inspection and enforcement divisions. A total of 125 technical and administrative personnel are provided.

All plans must be reviewed by the district's engineering department before a permit for construction of air pollution control equipment can be granted. This has resulted frequently in great savings through suggested modifications which increased efficiency of operations or prevented costly installation of improperly designed equipment. A considerable quantity of free sulfur is now being reclaimed by processing hydrogen sulfide gas from refinery operations. Such installations are quite profitable ones.

Control of steel mill dust from open hearth operations has also brought economic blessings through recovery of waste heat. In some cases sufficient high pressure steam is generated to meet all the plant's requirements. Other benefits could be cited, but time does not permit.

The Los Angeles County Air Pollution Control District work will no doubt make a big contribution not only to their own area and state, but also to the nation as a whole. Contributions occur from the accomplishments in controlling atmospheric pollution at the source, and from the research to develop more economical control and analytical methods.

** Assembly Bill #1, 1947.

Fifty-four large private and municipal dumps have discontinued burning their combustible wastes by substituting the sanitary land fill. Backyard incinerators are being eliminated as incorporated cities provide collection of combustibles. This, too, assists in reducing the overall pollution problem.

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History of Martin C. Wukasch

Mr. Wukasch is a native Texan who was born in Austin 36 years ago. He obtained his B. S. in Chemical Engineering from the University of Texas in 1941. While in school he was elected to Phi Etta Sigma, Scholastic Fraternity, and for two years held a student assistantship in the Physics Department. Upon graduation he became associated with the laboratories of the Shell Oil Company in Pasadena. Early in 1942 he was called by the War Department to Aberdeen Proving Ground, Maryland, where for two years he engaged in development work on pilot models of artillery materiel at the Ordnance Research Center.

For the past eight years he has been with the Bureau of Sanitary Engineering of the Texas State Department of Health. Since 1946 he has been directing the Industrial Hygiene program to which has been added certain non-industrial technical health evaluation activities, air pollution, radiological public health and the Chemical and Radiological Warfare Defense phases of the State Health Officer's Civil Defense program. As an example of the latter, during the past summer months he conducted three comprehensive courses on Radiological Warfare Defense for Civil Defense Instructors.

Mr. Wukasch obtained his M. S. in Public Health Engineering from Georgia Institute of Technology in 1950. He is a registered professional engineer and holds membership in the Travis County Chapter, Texas, and National Society of Professional Engineers. Other memberships include:

American Public Health Association
Texas Public Health Association
Texas Chapter and National - American Industrial Hygiene Association
American Conference of Governmental Hygienists
American Association for the Advancement of Science

He is Texas Editor of the Industrial Health Monthly.

Mr. Wukasch is married, has two sons, and is an active member of the Lutheran Church.

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PILOT STUDY OF SYNTHETIC ORGANIC WASTE DISPOSAL on TRICKLING FILTERS

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The Chemcel Plant of the Celanese Corporation of America, located at Bishop, Texas, produces a number of synthetic organic chemicals by partial oxidation of butane and propane. Among the principal products of this process are acetic acid, acetaldehyde, formaldehyde, methanol, butyl and propyl alcohol, and various special solvents. As a by-product the plant produces, at a relatively constant rate, waste water containing small quantities of the major plant products plus various aldehyde polymers and condensation products. The combined plant waste streams at present have approximately the following characteristics:

pH - 4.8 to 5.2

BOD - 12,000 to 14,000 ppm

The effluent streams which are produced in different sections of the plant are pumped to a pit and combined. From there the combined effluent stream is pumped to a solar evaporation pond system covering some 375 acres for disposal.

It is felt that some treatment process not involving the impounding of large quantities of water would represent a more ideal and possibly more economical solution to the problem, and the company has been working for some time toward the development of such a process. In the past, several outside organizations have also worked on this problem, and a number of solutions have been proposed including chemical treatment and catalytic oxidation. However, each of these proposals was deemed unsatisfactory from the standpoint of high capital cost, high operating cost or failure to produce a satisfactory effluent. In the fall of 1948 a British publication (1) which told of the successful destruction of formaldehyde on high rate trickling filters came to the attention of the company. About the same time Mr. B. W. Dickerson, of the Hercules Powder Company, presented a paper (2) before the Manufacturing Chemists Association concerning the successful pilot scale treatment of phenolformaldehyde wastes on high rate trickling filters. Following a study of information from these two sources, the decision was made to install a small pilot plant to determine whether or not the Chemcel waste could be satisfactorily treated by biological oxidation at a reasonable cost.

This paper is in the nature of progress report covering this investigation to date as conducted at the Chemcel Plant by Celanece personnel in cooperation with Southwest Research Institute at San Antonio, which had been previously retained by the company to work on stream pollution and waste disposal problems. Southwest Research Institute, in addition to aiding in the formulation of the experimental program, performed most of the BOD determinations and other special work such as bacteriological investigations which could not be performed at Chemcel.

Because of time limitations no attempt is made to present at this time the complete operating data obtained on the pilot filters during the past two years. Instead, it is felt that in the brief time allotted, a discussion of our general experimental program and our conclusions concerning the treatment of toxic wastes on filters will be of greater value.

At the beginning of the program, in 1949, a 50,000 gallon tank was filled with the plant waste being produced at that time to serve as a feed supply of constant composition throughout the tests in order to decrease the number of variables and simplify the experimental program. In September, 1950, this feed was exhausted, as the result of an expanded program, and a new feed supply representative of the effluent produced during the fall of 1950 was obtained. These two effluents were found to be different in strength, largely because of process changes resulting in a reduction in the amount of water present in the waste.

The initial pilot installation consisted of only a single filter made from 30" O. D. carbon steel pipe, mounted vertically, containing a filter bed of 1" - 2" limestone 6' deep (1.02 cu. yds.) obtained from the City of Corpus Christi Sewage Disposal Plant. Recirculation pumps were installed in parallel on separate electric circuits to insure continuity of flow over the filter at all times. These were originally vane-type pumps with neoprene impellers but were shortly changed to cast iron rotary gear pumps. These pumps were satisfactory but had a very short service life and were later replaced with direct driven turbine pumps which have proved very satisfactory. Small centrifugal pumps were not considered for this service because of the ease with which they plug in the suction line.

Control of recycle flow was effected by means of a constant head tank, a fixed weir, and a variable bypass weir mounted on top of the filter. While this did not permit precise control of the recycle because of slime collecting on the weir, it was felt that any type orifice or variable area meter would be even more undependable considering the small flows to be metered.

The original feed control consisted of an electric clock-work which lowered a large rubber hose equipped with a siphon break, at a controlled rate, thus lowering the level in the feed tank. At a later date, when 24 hour supervision of the unit was available, hand control of the feed rate was instituted.

As the program progressed additional equipment was installed. The present pilot plant consists of a three stage filter, each stage identical with the filter described above. Each filter is followed by a 30" deep lagoon having a retention time of some 16 days (a capacity of approximately 750 gal.). Immediately following each filter but before the flow enters the lagoon, a settling basin with provision for daily sludge draw-off has been installed.

A splash plate distribution system is used on all filters since the plugging characteristics of the effluent, as well as the low head available from the weir box make any other system mechanically unreliable.

The filter was placed in operation on a feed of plant sewage to build up a slime growth on the filter bed. After this growth was established a portion of the sewage was replaced by plant effluent. The amount of effluent added was gradually increased over a four week period until at the end of that time no sewage was being added. A 45 gpd plant effluent feed rate was chosen for the initial run because it was felt that any lower loading would require an uneconomically large plant scale filter to secure satisfactory thruput, and that the maximum thruput on the unit could be determined after a satisfactory effluent had been produced.

At the beginning of the program it was decided that the progress of the treatment would be followed by BOD, formaldehyde, pH, and COD determinations. Of these, all but BOD's were run at Chemcel. BOD's were run tri-weekly by the City of Corpus Christi Sewer Department laboratory during 1949 and 1950 but have been run weekly since the beginning of 1951 by Southwest Research Institute.

Formaldehyde was determined by the modified Schiff test using a calibration curve and a Fisher electrophotometer. pH measurements were made with a Beckman Model H pH meter. Chemical oxygen demand was determined using sodium dichromate as the oxidizing agent according to the method of Moore, Kroner, and Ruchhoft (4) All BOD's were determined using standard techniques and phosphate buffered dilution water.

Since the plant waste contains no nitrogen or phosphorous, diammonium phosphate was added to give a C/N ratio of 20:1. This ratio was held throughout the entire program. However, beginning in February, 1950, an equal amount of additional phosphate was added as sodium hexametaphosphate.

The single stage filter operated from September through November, 1949, at feed rates of 40, 45, and 60 gallons per day. This period of operation served largely as a mechanical shakedown for the equipment, but several general conclusions were reached. First, single stage filtration would not produce satisfactory effluent. Second, increasing recycle ratios from 30:1 to 60:1 had very little, if any, effect on filter performance. Third, recycle rates below 30:1 lead to channeling and ponding of the filter as a result of the low liquid flow and extensive biological growth. Fourth, BOD removal in the order of 1.5 per cu. yd. per day could be expected.

The effluent used as feed during this period had a BOD of 7500 ppm and a COD of 17,000 ppm. While the feed to the unit was supposedly of constant composition, the feed analyses indicated periodic variations in composition larger than would have been expected from the normal variation inherent in the analyses. It is believed that this variation was a result of either stratification in the feed tank or the effect of temperature changes on an equilibrium mixture of aldehydes and aldehyde polymers.

Following the initial runs in the single stage filter, the decision was made to install a second stage filter in series. Since Dickerson (3) had reported that lagooning of formaldehyde-containing filter effluent resulted in further formaldehyde removals, it was decided to install a lagoon in series with each filter. These lagoons were constructed from galvanized iron, carried a 30" liquid depth, had a retention time of some 16 days and a capacity of approximately 750 gal. Four over and under baffles were installed in each lagoon to reduce channeling. It was planned to seed these lagoons with algae, in the hope that the oxygen liberated by the algae would promote the growth of aerobic microorganisms and assist in the purification process.

This two stage system was placed in operation in January, 1950, and operated at a feed rate of 45 gpd and a 30:1 recycle ratio. After some two month's operation the recycle was increased to 60:1 without an appreciable change in filter efficiency although smoother operation was obtained. In April, 1950, it became apparent that a satisfactory effluent probably would not be produced by the system as operated at that time. The piping on each filter was then changed so the recycle passed completely through the lagoon between each pass through the filter. This resulted in stabilization of filter performance and increased BOD removals on both of the filters. Filter operating conditions were unchanged from April through August, during which time the effluent BOD dropped to some 100 - 200 ppm for several weeks, then increased to 800 - 1000 ppm. This swing in BOD has not been satisfactorily explained.

Average filter efficiencies for the two stage runs during this period are shown below:

	Average Filter Efficiencies - %	
	Lagoon in Recycle	Lagoon Not in Recycle
	BOD	BOD
1st filter	53	35
2nd filter	48	22.5
Overall (including lagoons)	86	75

	Lagoon in Recycle Average Concentrations & Loadings	
	BOD ppm	BOD #/day/yd.^{3}
1st stage feed	7500	2.38
1st stage effluent	3500	1.12
2nd stage feed	2750	1.0
2nd stage effluent	1450*	0.53*

*The second stage BOD dropped from 2500 ppm to 100 - 200 ppm, then increased to 600 - 800 ppm.

During this period, because of channeling, the quantitative effect of the lagoons on the purification process is open to question although the data indicate removals of some 300# BOD/acre/day in the first lagoon. The second stage lagoon contained a dense growth of algae during periods when the formaldehyde concentration was below 35 to 40 ppm. After approximately one month's operation, gas bubbles were observed rising to the surface of the lagoons from the layer of sludge which collected on the bottom. Infrared analysis of this gas indicated it to be largely methane and carbon dioxide with a trace of formaldehyde. These observations indicate that some purification did occur in the lagoons, although, because of channeling, any quantitative idea of their performance is questionable.

Facilities for sludge removal were omitted from the two stage system since one objective of the project was to develop a process requiring a minimum capital investment. It was thought that the lagoons required for a plant scale disposal system would be from 15 to 20 acres in extent and could serve as sludge collectors without requiring cleaning more often than at 5 year intervals.

In September, 1950, the initial feed supply was exhausted and a new supply obtained. This new feed, which was found to have the characteristics outlined previously (about twice the strength of the initial feed) was charged to the filter abruptly, with no acclimatization period. The filter operated for some five weeks with no drop in overall efficiency although the first stage efficiency dropped to some 60 - 70% of its previous value. After this, the second stage and overall efficiency began a gradual decline which lasted until January, then the overall efficiency reached some 40%.

During this period, several measures were taken to improve the filter efficiency, none of which were particularly successful. First, the recycle ratio was increased to 100:1. Second, the filters were seeded daily with small quantities of sanitary sewage and brewers yeast. Third, the filters were seeded weekly with two bacterial cultures developed by Southwest Research Institute which had proved successful on a laboratory scale in removing residual BOD from filter effluent.

Since a very dense growth on the first stage filter, consisting mainly of a fungus, Fusarium, was causing serious ponding, the first and second stage filters were reversed late in November. This resulted in no change in the performance trend of either filter (that is, the old first stage filter began to follow the same trend of dropping efficiency as had the second stage, while the old second stage filter performance leveled off). It is thought that this effect was the result of a buildup of some toxic compound in the second lagoon.

During freezing weather in February, 1951, a power failure caused a loss of circulation over the filters and the entire system froze solid, sterilizing the filters. The filter was placed back in operation, the growth re-established on plant sewage, and re-acclimatized to plant effluent. The feed rate to the filter was reduced to 25 gal/day effluent, diluted with 20 gal/day tap water to give BOD loadings and concentrations comparable to that of the previous summer, fairly good BOD removals were obtained. The BOD of the second lagoon effluent immediately dropped to a minimum of approximately 100 ppm, then began increasing as during the previous summer.

When it became apparent that the two stage system would again probably not produce a satisfactory effluent, several changes, listed below, were made. It was thought that if these changes were successful, the effect of each could be determined at a later date. These changes were:

1. A third filter, already built, was placed in series with the other two filters.

2. Settling basins were installed immediately after each filter to allow daily sludge removal.

3. Rock filter beds were replaced by prefabricated hollow tile media.

4. The dilution water was replaced by high pH lime softener effluent.

Filter performance improved immediately following these changes and at present, effluent BOD's of 20-30 ppm are being produced.

Throughout the entire program a series of pH changes through the system have been noted, with the following pH ranges being obtained at present.

1st stage feed	- 5.8 - 6.2
1st stage effluent	- 8.0 - 8.2
1st lagoon effluent	- 7.9 - 8.1
2nd stage effluent	- 8.7 - 8.9
3rd stage effluent	- 8.9 - 9.1
3rd lagoon effluent	- 8.9 - 9.1

An attempt was made to correlate COD and BOD on the filter effluent, but no satisfactory correlation was obtained.

Although the filters were steam traced, no effort was made to hold precise temperature control on the filters, since it was felt that a plant scale unit would have to operate without temperature control. While the data are insufficient to evaluate the effect of temperature on efficiency, it has been observed that sudden changes in temperature have a greater effect on efficiency than continued low temperatures.

No attempt has been made in the foregoing to discuss the economics of a full scale disposal system. It is thought that the limited thruput now being obtained on the filters is below that required to be competitive with solar evaporation. However, preliminary estimates have indicated that if thruputs approaching twice the present can be obtained, the combined operating and capital cost should compare favorably with the cost of solar evaporation.

While much work remains to be done before a plant scale disposal system can be designed, it is believed that several points have been definitely established, namely:

1. Chemcel effluent can be purified on trickling filters without chemical treatment other than the addition of nitrogen and phosphorous.

2. Recycle ratios in excess of that required to give good distribution do not give an appreciable increase in efficiency.

3. Serious ponding can be expected on the first stage filter at recycle ratios at least as high as 100:1. This ponding can be largely eliminated by the use of hollow tile filter media, although even then, periodic flushing with high pressure water is required.

4. A carbon/nitrogen ratio of 20:1 is satisfactory but could possibly be increased.

5. BOD removals of 1.4 - 1.6 #/day/cu.yd. can be expected on the first stage filter, at total BOD loadings of 2.75 #/yd.^{3}/day.

Several points remain to be clarified. The most important of these are:

1. What is the maximum truput obtainable while maintaining present effluent quality?

2. Can a satisfactory effluent be produced during low temperature operation?

3. Can the second and third stage filters be operated at loadings approaching the first stage loading?

4. What is the cause of the presently unexplained variations in BOD removal in the second stage filter under constant operating conditions?

It is felt that when the above questions have been answered, sufficient data will be available to permit the design and economic evaluation of a plant scale unit to be undertaken.

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INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

AFTERNOON SESSION

"THE ORGANIZATION OF AN INDUSTRIAL WASTE PROGRAM"

R. R. Balmer
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The organization of an industrial waste program is influenced to some extent by the basic pattern of operation as established by individual companies. There are however, certain general aspects which are common to this specialized effort regardless of the company organization. This discussion will concern the elements of an industrial waste program as it applies at the plant level.

The object of the program should be to control wastes so that nuisances will not be created, governmental regulations violated, or neighbors unreasonably affected. How is this to be done?

First, make a waste survey to find out what is being discharged.

Second, determine the condition of the receiving waters and estimate their capacity to assimilate the wastes. This should be done during the period the first step is being carried out and for as much longer as may be necessary.

Third, investigate means of reducing or eliminating wastes at their source.

Fourth, investigate controlled discharge.

Fifth, after all other means of reducing wastes have been exhausted, determine the treatment required.

To follow this plan takes considerable time but results in a maximum conservation of materials and the most efficient solution of the disposal problem.

The waste control group established to carry out the program usually is made a part of either the production or technical department. Sometimes, however, it may be found in the medical, service or engineering department. Whatever the choice may be, the production and technical groups will have to work in close cooperation with the chosen waste control leader.

The group personnel requirements will consist of a leader, technical assistants, operating assistants and laboratory workers. The leader should have the following qualifications:

1. Initiative

2. Ability to get along with all groups of people, win their confidence and learn what goes on during the night shift as well as the day shift.

3. Possess a knowledge of all plant processes and layout, or have the ability to learn and understand them.

4. Possess an understanding of the pollution problem and its technical details.

The first two qualifications are of prime importance and the larger the job, the greater their importance. The last two qualifications may be developed by study and experience. If the magnitude of the survey is large enough, the leader should not be assigned other duties. His membership in the State sewage and industrial waste association should be encouraged as he will benefit and be stimulated by their publications and meetings.

The technical assistants will be needed to help establish the program, supervise the field work, gather, evaluate and correlate process data, interpret analyses, design and operate pilot treatment units, and assist with reports. The operating assistants will collect samples, read flow measuring devices, operate treatment works, perform simple field tests and other tasks incident to the work. The laboratory personnel will perform analyses and assist in the operation of pilot treatment units.

The assistance of the plant engineering department will be needed to install samplers, flow measuring devices and pilot treatment units. It should be their responsibility to design and construct treatment works based on the technical recommendations of the waste group.

Before any work is actually started, the leader should be given an opportunity to describe to the supervisory staff the long range plans of his work with indications of what cooperative assistance may be needed. At a later date, an article in the plant publication should acquaint every employee with the efforts being made to improve conditions.

The Waste Survey

All sources of wastes should be located. Their volume and pollutional characteristics should be determined and related to production volume, process cycles, equipment variation and other factors causing fluctuations. The general procedure should be as follows:

1. Obtain or make an up-to-date map of the sewerage system and learn the plant lay out.

2. Study the production flow sheets, visit the actual installations and talk to the technical and operating personnel to learn what and where wastes may be expected, the existence of any fire or health hazards in sampling, the possibility of toxic substances being present which would interfere with the BOD test and the

presence of other substances which would interfere with the methods of chemical analysis to be used. The need for any special determinations such as chromium or zinc should also be determined.

3. Study any material balances which have been made between raw materials, finished product and losses to the sewer, air and dump.

4. Review water consumption figures as these records may provide the only practical means of estimating the total plant waste flow.

5. Locate any waste reducing or treating equipment and determine its efficiency.

The actual sampling program usually starts at the outfall and progresses up sewer finally reaching the individual sources. Whether the collections should be made individually or composited, of constant volume or in proportion to flow, and for what period of time, will depend on the circumstances at each location. Sampling devices may cause considerable trouble and delay. With some ingenuity and trial and error, a suitable arrangement can be installed for almost any set of circumstances. Flow measurements and production data should be obtained simultaneously with the sampling.

Receiving Waters Survey

A record of the condition of the receiving waters above, at, and below the outfall should be maintained. Arrangements should be made to receive the monthly record of the stream gauge readings for a station above the plant if one exists. These readings for all important streams are made by the U. S. Geological Survey. Depending on the circumstances, special studies may be required on the receiving waters. For example, an unusually large number of samples may be taken during the period of extra low stream flow to obtain a detailed coverage of pollution conditions when they are at their worst. If fish kills occur, detailed chemical analyses may be made to determine the cause. It may even be desirable to investigate the muds just below the outfall to see whether there has been any appreciable build up of toxic materials settling out of the water. If there is a real problem of toxicity to fish, it may be desirable for the waste group to set up several aquariums in the laboratory and run approximate fish toxicity tests. If more precise data is desired, the services of a qualified organization might be contracted for to run complete tests. It may even prove profitable to have a qualified organization make a biological survey of the receiving waters to determine the effect of the plant waste on biological life.

The Reduction or Elimination of Wastes at Their Source

From the information developed as a result of the waste and receiving waters surveys, it will be possible to determine whether the plant discharge is satisfactory and, if not, to what extent it should be reduced. It may be advisable at this time to consult with the State pollution control authorities to obtain their opinion on what conditions would be satisfactory. From the waste survey, it will also be possible to select those sources which will be most amenable to reduction. Some of the methods used to reduce waste loads are:

1. Good housekeeping.

2. Careful review of procedures to take advantage of techniques such as counter current washing.

3. Change of process to a more efficient one.

4. Change of raw materials so that less waste will be produced.

5. Equipment improvement.

If there is doubt about the wisdom of spending the time and money to investigate means of reducing waste, it is suggested that a probable means of waste treatment be assumed and a cost estimate made for such a treatment plant. Usually these cost figures add impetus to the waste reduction effort.

Controlled Discharge

If the pollution problem is seasonal or occurs only when there are occasional peaks, the most economical solution may be to store wastes and discharge them at a constant rate over a longer period of time. This method may be applied to a batch discharge which occurs in a matter of a few minutes by catching the flow in a hold up tank and allowing it to dribble out over a twenty-four hour period. In the canning industry a system is used where several months total flow is retained in large open basins and discharged at a constant rate during the remaining months of the year. The small dribble tanks are common where batch discharges of potent material are made. Where this method is applicable it is usually less expensive than any alternate method.

Treatment

If it has been shown that sufficient waste reduction can not be obtained by any other method, then treatment will have to be provided. Where BOD reduction is the objective, trickling filters are frequently used. This process is able to withstand shock loads and over a period of time may adapt itself to materials which were originally toxic. An example is the successful treatment of formaldehyde which is generally considered toxic to biologic life. Industrial wastes are sometimes deficient in necessary nutrients. This can be overcome by the addition of domestic sewage.

The activated sludge process is not usually suitable for industrial waste treatment as it is sensitive to changes in load and toxic materials. Before any treatment plant is built, a pilot plant installation should have been run successfully to prove its feasibility and establish rate of operation. Any treatment method is costly as the capital and operating expenses produce no income.

While this discussion has concerned itself entirely with liquid wastes, the existence and need for control of atmospheric discharges should not be overlooked and may logically become one of the duties of the waste group. A cloud of black smoke issuing from a stack is no longer a pleasing symbol of humming industry. The public's nose in recent years has become much more acutely sensitive to odors and unnatural discharges to the atmosphere. Many of the principals of our discussion apply to the atmospheric pollution problem.

The public demand for clean streams and pure air is an indication of the increasingly higher standard of living enjoyed in our country. Pollution abatement costs money but the public is willing to pay for it, particularly if that cost is indirect.

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INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

AFTERNOON SESSION

DISCUSSION

T. W. Edwards, Utilities Engineer
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Gentlemen:, those of you who are engaged in, or about to begin, a plant waste survey are indeed fortunate to have heard Mr. BALMER today. He has given you a very concise statement of the steps necessary to the success of such a program. I am going to emphasize a few of his recommendations that I consider most essential.

Point Number One, MAKE A LONG RANGE PLAN. Among other things this plan should OUTLINE THE OBJECTIVES, PERSONNEL NEEDS OR AVAILABILITY, OUTSIDE SERVICES REQUIRED,ESTIMATE OF TIME REQUIRED TO COMPLETE INITIAL SURVEY.

Point Number Two, SELL THIS PLAN TO PLANT MANAGEMENT, for without their enthusiastic support results will be slow in coming. Mr. BALMER mentioned one tool that can be very valuable in this selling job. A COST ESTIMATE FOR FACILITIES TO TREAT THE EXISTING WASTE will probably indicate an expenditure of sufficient magnitude to justify a careful and complete study of the problem.

Point Number Three, SELL THE PROGRAM TO PLANT OPERATING PERSONNEL. In some cases this will have been done as a part of Point Two. If not plant management can be helpful by showing its enthusiasm and by pointing out that THE OBJECTIVES ARE TO REDUCE POLLUTION AND IMPROVE OPERATIONS AND NOT TO SERVE AS A TATTLE-TALE ON SLOPPY OPERATIONS. In many cases process wastes contain losses that must be replaced by purchased raw materials. Oftentimes separation methods applied at the point of discharge from the process will recover these materials for re-use. Re-use of waste water should be considered. By indicating to the operating group the favorable effect on their operating costs of these possibilities their cooperation can usually be secured.

Point Number Four, SELECT A FULL TIME PROJECT LEADER. This is essential in practically all cases if results are to be obtained in due time with a minimum of confusion. Now don't think for a minute that you are going to lose his time in this program. Because you will be repaid by a man that is intimately familiar with the technical phases of your process as well as the physical aspects of your plant layout.

TO SUMMARIZE:

ONE, MAKE A LONG RANGE PLAN,
TWO, SELL THIS PLAN TO PLANT MANAGEMENT,
THREE, SELL THE PROGRAM TO PLANT OPERATING PERSONNEL,
FOUR, SELECT A FULL TIME PROJECT LEADER.

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INDUSTRIAL WASTES SYMPOSIUM
Friday, September 28,1951

AFTERNOON SESSION

TO HAVE OR NOT TO HAVE!

A Discussion of

PUBLIC RELATIONS IN INDUSTRIAL WASTE DISPOSAL

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Mr. Chairman, Mr. Ehlers, Mr. Danse and members of the Industrial Waste Disposal session:

I consider it an honor to be asked to discuss the paper on *"Public Relations in Industrial Waste Disposal", presented by Mr. Vic Ehlers of the Texas State Department of Health. I also feel an extra privilege in being a discussant of this paper along with Mr. L. A. Danse or "L.A." as he prefers to be called, from General Motors Corporation of Detroit, Michigan! It has been my pleasure to work with or hear both of these men on numerous occasions in the past, and after their fine presentations today, I feel inclined to say "Amen", to their sage remarks and then sit down. The many years of experience in public health, in teaching, and in industry makes "Vic" and "L.A." much more in the category of experts in public relations than I.

I had a professor in college, (University of Michigan, of course), who once said that there were two very important spots on any program, the beginning and the end. He also explained that it was the responsibility of the speaker at the beginning to stimulate the audience to thinking, while it was the duty of the last speaker to summarize the truths and the gems of the previous speakers. Since some of these gems might not have been recognized, and to bring them to the front of your mind, I would like to be somewhat academic, short, and to the point in summarizing the paper of Mr. Ehlers and the remarks of Mr. Danse.

Public relations is not new! It is not a child of the twentieth century. Public relations is described in the Bible! In the Book of Deuteronomy 23, verses 12 and 13 certain sanitation laws were followed, and this was 1491 B. C. Hippocrates respected public relations in the fifth and fourth centuries B.C., when he wrote about public office. This is only to illustrate that public relations is not new!

A second feeling is that public relations can be had or cannot be had, depending upon whether or not your agency, industry or company wants or does not want it. Let me set you straight right now. Your agency, or company, or industry has public relations whether it wants it or not and also whether or not it plans for it. The question of having public relations is not one for them to decide. What is

* This paper was not made available.

within their power, however, is the decision as to whether they are going to have good or bad public relations. This decision they can make and must make. Public relations is not something that comes just because you have a good publicity agent or publicity program.

This brings up the third common misconception, and that is that public relations and publicity or propaganda are one and the same. It is true that good public relations require well-planned publicity, but it is not analogous that publicity in itself is good public relations.

Now if the three concepts are correct and, I believe they are, since Mr. Ehlers and Mr. Danse have both brought them out in their showing of good public relations by practical examples, then just what is "public relations" and what can we as representatives of official agencies, industry and the democratic way of living do about it? It is up to us, and don't you forget it. It is in your laps as individuals and as a representative of the agency or industry that employs you.

Personally I like to consider the definition of public relations as simply the "distilled essence of what people think of you" (1). Whether they think good or bad of your organization depends upon how what you do affects them. In other words it is what we do and how we do it that forms people's attitudes and behavior towards us and not always what we advertise or say that establishes our public relations.

If public relations is a relationship with people, then the public relations program or our agency, industry or company must concern every member of our respective organization. It is not a responsibility held solely by the "public relations committee", the "public relations specialist". the "public relations section". It is the responsibility of not only the organization as a whole, but is also the composite and individual responsibility of every worker, every employee that is connected with the organization. A poor impression by a single employee can often turn an individual's attitude toward your whole organization.

I was very much impressed by the examples of Mr. Danse regarding the "before and after" concept of this type of effort in public relations. General Motors Corporation's respect for the comfort, pleasure and health of the people of the community in which they were planning on putting a plant, showed that they were interested in the future good will of the community. It cost money, but it helped establish good will, favorable attitudes and good public relations. Please do not feel that all public relations, however, must be expensive. The important thing, as brought out by Mr. Danse, is that it must be done before rather than after, if it is to be most effective. Don't wait until your industry's waste material has spoiled a good recreational area, killed sea food or fresh water fish, decreased value of real estate or disturbed the people by irritating odors, smoke or materials that ruins house paint and spoils clothes. The damage done to your public relations at this point is then really expensive to repair. A little foresight into your probable waste disposal problems will enable you to dispose of your waste in such a manner as to be technically practical as well as good public relations building.

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(1) "Building Sound Public Relations", by Edith Wensley, National Organization for Public Health Nursing - New York, 1949.

Finally, let your public know what you are doing. Be frank in your industry as well as your community regarding the waste disposal problems and what your company is doing about them. Don't hide your light under a barrel or wait until a suit or public complaint is issued before you inform your community that your organization is conscious of the problem and is attempting to remedy it. If it is a weighing of values that must be decided, they will be with you, when they feel you have been sincere in respecting their health,safety and comfort. Don't think that just because the product of your company is essential to life, that it is also true that the public will give up its health and comfort and have a favorable attitude towards you no matter what you do. Don't kid yourself--be realistic!

In closing, I wish to say that we certainly have been fortunate in having for this conference all of the fine speakers who have in so many ways shown all of us how important it is to work together. Team work is essential if we are to accomplish our job in a democratic way. All persons concerned must be represented. I am especially pleased that your Planning Committee saw fit to include on the program this year, a member of the family that is relatively new, a neophyte, so to speak, in the field of Industrial Health. On many occasions yesterday and today, mention has been made relative to the need of health education and the use of techniques common to health education. We, as a professional group, are indeed grateful to you and may I close with the offer that in the planning of your program relative to public relations, health education and community participation, feel free to call upon the technical services of the national, state and local public health education personnel in your respective public health departments. They will feel honored for the privilege of working with you and I am sure that you will find their services to your benefit.

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CIVIL DEFENSE
Friday, September 28,1951

AFTERNOON SESSION

George D. Broyles, Jr., M. D.
Harris County Medical Society, Houston, Texas
Presiding

French M. Robertson
Southwestern Federal Civil Defense Regional Director
Dallas, Texas

It gives me a great deal of pleasure to speak to representatives of the Gulf Coast Industries. Some of you are old friends, and it is always good to be with old friends.

My pleasure in being with you this afternoon is greatly increased by the fact that you and I stand shoulder to shoulder in striving to preserve our Christian and Democratic Way of Life.

At a time like this it is essential that our country use all its productive resources. Our National strength is the chief reliance of the world in its efforts to overcome the forces of tyranny and aggression.

You have proven your devotion over the years. You have proven it in good times and in times of strife. You have been the backbone of democracy in the United States.

The production of Texas Industry played a larged part in making it possible for us to throw back and defeat the aggressive hordes of Hitler.

The production of Texas Industry is now making it possible for us to hold and strengthen the free world against communism.

We all know that in fighting for peace we must consider the material side. On this front, Texas Industry has made its greatest contribution to protect the land we love. Industry has fought incessantly for peace but when the chips were down and our National integrity and security has been threatened, you in industry have stood shoulder to shoulder with our soldiers in the field. Again today industry is being called upon to help protect our Freedom. And again today you have accepted the challenge. You are accomplishing the undreamed of task of producing for a dual economy; one for the needs of a civilian population, to keep their standard of living high and raise it still further, and the other to keep our defense strong and to further strengthen them. This is a tough job but a job industry can do.

Since we have drawn the line in Korea against communism aggression, our defense activity has grown by leaps and bounds. It is still going to grow further. We are serving notice now to all would-be world conquerors that America is ready, her people are ready, and her industry is ready. We are willing to sacrifice if we must, to fight if need be, and to give our material wealth and our lives to keep Freedom alive. The Hitlers of the past have disbelieved us and they have perished along with their ideologies. Let the Hitlers of the present take notice that we are a united people and the world's most powerful Nation. Let them take note that we seek peace at all times but let them fully understand that we will never give up one iota of freedom to maintain this peace.

Now our dual economy is going to produce many problems, but problems that we can and must solve.

One of these problems is of vital concern to everyone of you assembled here today. That is the problem of plant protection.

The United States has been in the fortunate position in World War I and II of being free from attack on the mainland and having a period of time in which to prepare for wars fought abroad. It is unlikely that we will be so fortunate again. The pattern of swift attack by Germany on neighborning countries and that of the Japanese on Pearl Harbor, without warning, provide better guides to the future. The difference will be that the methods of infiltration and sabotage have been improved and more effective weapons are available.

Our isolation will continue to offer a measure of protection but may lead to a false sense of security. The difficulties of attack would be great in spite of development of long range aircraft and missiles. This suggests the desirability of full scale efforts on the part of any prospective enemy to infiltrate our industry and to destroy our will and ability to fight. Mass sabotage prior to or at the same time as military attack may be an important means of destruction of vital industry.

Espionage is the foundation upon which all other enemy actions are based. Accurate information may mean success, while lack of information may lead to false estimates of the situation and failure. Thus, denial of information to the enemy becomes an essential means of defense.

It is necessary that management be fully aware of the possibilities of enemy undercover activities. There is a tendency to dismiss the thought of espionage as something that is practiced abroad but not here. The truth is that espionage efforts are pressed in those countries, that an enemy plans to attack. Until the world situation improves, we cannot escape the conviction that the United States has been so singled out.

Sabotage may take a number of forms, such as a slow down, minor interruptions or planned efforts to deny use of the plant for various periods of time. Possibly the best way of finding out what could be done would be to assign to a plant official the job of figuring out the best means of sabotage for the purpose of slowing down production or producing a major shutdown. Slowdown would probably be desirable before the advent of hostilities. Complete destruction might be desired at the time of attack, unless the enemy had a hope of invading and making use of the plant at a later date, in which case a lesser degree of damage might be desired.

In considering the possibility of enemy attack, there is reason to believe that a simultaneous effort might be made to destroy as many of our vital installations as possible. Probably such attacks would be without warning and carried on simultaneously or at least at such close intervals of time that there would be no opportunity to recover from the first blow.

All of you know that businessmen cannot risk new enterprises unless there is a good chance of commensurate return in profit. A similar appraisal of warfare may be useful in arriving at conclusions by management of American Industry. Global war will require tremendous effort. The enemy cannot afford to risk trained men and valuable equipment unless the results of a proposed attack offer adequate return in reducing our ability to fight. This sort of thinking should make it possible to arrive at a reasonable answer as to what plants or groups of plants are profitable targets from the viewpoint of the critical need of the items produced. These factors must be considered by the enemy in reaching a decision as to the desirability of attack and chances of success and may be used from the opposite viewpoint in planning defense.

The objectives of defense are to minimize the effects of enemy efforts to reduce our war potential. Briefly, the requirements are maintenance of security of information affecting National Defense, combating subversive efforts, anti-sabotage measures, protective construction, and the establishment of a means of control and relief in time of disaster, whatever the cause.

Probably the greatest need will be for disaster relief and damage control. The objectives will be to avoid panic, carry out rescue and first aid activities, fight fires and control other forms of damage and get the plant back into operation as soon as possible.

The responsibility for plant protection rests basically with management, certainly to the extent of planning the preventive measures that should be taken and putting into effect those that do not materially increase cost. No outside agency is in a position to determine what the danger spots are and the most effective means of reducing hazards. However, plant managers should maintain liaison with local military commanders.

As indicated earlier in this talk, the hazards to industry may be much greater in any future war than in World War II. Furthermore, the delineation between peace and war may be much less sharply defined. It would be realistic to assume that efforts are being made at present to collect all available information on our industrial plants vital to war and that plans are being made for attack and internal disruption of our effort. In fact, it is known that communists are active in infiltrating both heavy and key industries.

I would like at this time to discuss the hazards of (1) espionage, (2) sabotage and (3) enemy attack.

In speaking of espionage I can tell you that enemy agents want information on industry which will lead to an evaluation of our war potential and information which may be used to advantage in sabotage and attack. Specifically, the following information is frequently sought:

1. Capacity, rate of production, industrial mobilization and details of orders on hand.

2. Plans and specifications of munitions produced.

3. Test records of newly developed items of equipment.

4. Sources of raw materials and components.

5. Destination of completed units and transportation routes.

6. Data on production methods.

7. Critical points and possible methods of effective sabotage.

8. Measures in force for security and to prevent sabotage, such as, frequency of inspections by guards and their dependability.

9. Dissatisfied labor elements that might be employed in subversive plans.

Espionage agents may be expected to use great ingenuity in obtaining information. For example:

1. They might infiltrate into plants as employees, visitors, inspectors, or by other means.

2. Obtaining information from employees by stealing, purchasing or encouraging them to "talk shop"

3. Stealing information from records or other sources and reporting personal observations and studies of production operations, test runs, or classified materials.

4. Using various means of reproducing documents, products, processes, equipment or working models.

5. Using "fronts", such as commercial concerns, travel agencies, import-Export associations, scientific organizations, and other organizations to obtain confidential information or pertinent statistical information which can be translated into strategic information.

6. Using threats of danger to friends or relatives of an employee to obtain information.

7. Picking up information in social gatherings.

Likewise, a great deal of ingenuity may be expected in sabotage. There may be numerous small acts or much more serious sabotage requiring shutdown of the plant because of heavy damage, power interruption or interference with some other essential service.

A major sabotage effort that would have the effect of shutting down the plant for a long period of time would require a well-planned operation. To be effective an outside group assisted by the connivance of confederates employed by the plant usually would be necessary. To be successful the effort would require accurate information concerning those methods necessary to produce the anticipated damage and probably would require execution by expert saboteurs. Specific examples might be as follows:

1. Damaging buildings and equipment by explosives, fire, breakage, abrasives, chemicals or addition of foreign bodies.

2. Damaging power systems, communications, water supplies, and other utilities, taking advantage of bad conditions to avoid suspision.

3. Tampering with gauges, precision tools, and testing devices.

I indicated earliesr that attack by the most effective weapons available would be the probability in the initial stages of any future war. It is not my intent here to give a detailed statement of the effects of the various weapons which might be used but rather to present a brief statement which will indicate the types of hazards.

With the use of the atomic bomb consideration must be given to the effects of blast, fire, ionizing radiation and radioactive contamination. High explosive bombs, individually, are incapable of producing the widespread damage produced by the "A" bomb. Incendiary bombs containing the combinations contained within the high explosive bombs are highly effective in starting fires so extensive in character that control may be extremely difficult. The future of guided missiles has not been well established. At present the launching of missiles from submarines must be accepted as well within enemy capabilities. The use of chemical, bacterial and radiological toxic agents must be considered hazards.

The need for maintenance of internal security against the three hazards I have outlined to you is a continuing one. In time of peace the way is prepared for enemy attack and internal disruption. The measures employed to reduce such hazards are largely preventive in character, and it seems appropriate that they be discussed and studied separately.

Internal security comprises security of information, prevention of sabotage and combatting subversive efforts. There are also normal peacetime measures for prevention of lost time and damage which, if actively prosecuted, will increase production and may reduce the effectiveness of enemy efforts. Fire protection, safety training, installation of protective devices and maintenance of sanitary conditions come in this category.

Since information is essential for planning and executing all offensive action by the enemy, its security is vital to defense. In general, espionage may be rendered ineffective by the following measures:

1. A careful loyalty check of personnel, particularly before employment.

2. Prevention of unauthorized entry to the premises.

3. Special guarding and handling of classified material.

4. Restriction of movement within the plant and alerting of employees and others who have information on plant activities.

The prevention of sabotage involves control of the would-be-saboteur operating from within and denial of access to key points within the plants to outside operators. The measures employed to prevent sabotage by employees or their giving assistance to enemy agents are quite similar to those required to prevent espionage. The prevention of a major sabotage effort by outside agents may require an increased guard force or other more effective means.

A second requirement is the reduction of damage from sabotage by preventing the spread of fires and localizing other effects by prompt and decisive action. Frequent exposure to the elements increases the damage and temporary protection against the weather may be required.

While active means of preventing and limiting damage by sabotage are far more important, economy of the guard force requires that all available physical measures of protection be provided.

Time does not allow a further discussion of other aspects of plant protection. Most of the measures I have discussed this afternoon are familiar to you as a result of experience in World War II, but the problems of minimizing damage from an atomic attack and other new forms of bombs are not so well established. The main requirements are these:

1. An effective organization to be set up now to study the various aspects of the problem.

2. Planning be prosecuted actively

3. Protecting measures be put into effect as rapidly as possible.

4. Full cooperation be maintained in such efforts with local, state, and federal agencies.

All of this adds up to the fact that in the event of enemy attack, dependence could not be placed on outside aid because civil defense and community protective services would probably have more calls than they could handle. Therefore, plants must organize for self-protection.

Self-protection is nothing more than the concept of organizing and training small groups within your organization to perform specialized services, such as policing or fire fighting, to safeguard the plants and its occupants in time of disaster. The civil defense self-protection program is not expected to replace normal protection. It is designed to help you expand your services. You should select personnel whose natural talents and past experiences fit them for specific tasks and whose normal duties can be safely interrupted.

At the outset you should get in touch with your local civil defense authorities.

You will find that they have pooled information and experience from many sources and can give you invaluable guidance. Moreover, if you tie in your program with theirs, standardize your equipment in accordance with their recommendations, and make joint plans, you stand a much better chance of coming out ahead in an emergency than if you operate alone.

In closing I want to extend the cooperation of the Federal Civil Defense Administration in your civil defense planning. We must work together in the matter of such importance.

The whole world looks to America and her people to keep the torch of democratic freedom alive in a world given over to imperialism, fascism violence and aggression and opportunism of the worst type.

The alternatives and their consequences are as plainly visible as the handwriting on the wall. Either America will lead the world into a new era of Freedom, Peace and Prosperity or Russia will plunge it into a new dark age of tyranny and slavery. Today the choice is ours. Tomorrow, if we allow the hour of our opportunity to pass, the decision will go to Russia.

Which shall it be? You and I will have to answer the question and stand responsible for our answer to future generations. As we pause to make our decision it will be well for us to listen again to the prophetic voice of Lincoln. He spoke to our fathers in 1862, and they gave heed to his warning. He speaks again, this time to us in the hour of even a greater crisis. He declared in words that spell either the ultimate doom of American Democracy or its ultimate triumph that "We shall nobly save or meanly lose the last best hope on earth".

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Biographical Sketch of French M. Robertson

French M. Robertson, Texas lawyer and oil industry executive, has been named Director of the Southwest Civil Defense Regional Office, the Federal Civil Defense Administration announced. His office was established April 15, 1951, in Dallas, Texas, and will supervise FCDA activities in Texas, Louisiana, Arkansas and Oklahoma.

As a member of the Texas Prison Board, Mr. Robertson is widely known for the many reforms he inaugurated in the Texas prison system. He is a former county attorney of Haskell County, Texas, and has been active in industrial associations and in the Texas Chambers of Commerce.

Mr. Robertson entered the Air Force in 1942, and after 45 months of service was discharged as a lieutenant colonel. He was awarded the Legion of Merit for his work at Warner-Robbins, Georgia, where he organized and supervised the training of Air Service Groups of Chinese who later were sent to China.

At Venice Air Base, Florida, he planned and supervised basic military and technical training for air service groups. He returned to Warner-Robbins to be assistant director and later director of basic and military training for the Air Service Technical Command for North and South Carolina, Georgia and Florida. Later he was transferred to the general staff where he was responsible for the training of approximately 40,000 military and civilian personnel. After his discharge he returned to the oil industry in Texas, in which he had been active since 1931.

The Dallas regional FCDA office has been fully staffed, national headquarters announced.

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CIVIL DEFENSE
Friday, September 28, 1951

AFTERNOON SESSION

A. T. Deere
The Dow Chemical Company
Freeport, Texas

Mr. Chairman, ladies, and gentlemen.

When I was asked by Mr. Wood to take this assignment, I was given the latitude of discussing provisions and preparations an individual plant should make for either civil or war disaster.

Civilian defense means the protection of the home front by civilians to minimize casualties and damage and preserve maximum war effort. The term home front, for the purpose of this discussion, would mean the individual plant. I would like to have you think of defense for the individual plant as defense against disaster resulting from any cause - anything that would interfere with its maximum war effort.

Plants situated on the Gulf Coast should develop their defense against disaster in three major classifications. These are natural disasters, like explosions, floods, and hurricanes; enemy military action, such as air raid and invasion; and sabotage. Protection against all of these for the individual plant may well be the responsibility of one organization.

Mr. G. M. Kintz, of the Accident Prevention and Health Division, Bureau of Mines, is said to have stated that a successful disaster organization plan, whether for a single plant, community, or entire state, should have three characteristics: (1) it should be simple and easy to understand, (2) it should be all inclusive, yet flexible for functioning at any disaster regardless of size or nature, (3) and it should provide for the recognition of those constituted authorities of state or local governments having jurisdiction over, or affected by, the disaster. The second of these, "It should be all inclusive, yet flexible for functioning at any disaster regardless of size or nature," best brings out my point.

In speaking of enemy action, usually we think of air attack, saboteurs landed upon our beaches, shells hurled into our plants from off shore, or possibly invasion, the latter being something we contemporaries have never known in this country.

In the present situation, we are, as never before, confronted with a different type of danger at the hands of the enemy. We heard for the first time during the Spanish conflict in 1936 about the so-called Fifth Column. The axis powers used it with a high degree of success. In World War II we were fortunate in that we had beforehand fairly well prevented the establishment of an axis powers Fifth Column in the United States. We are not so fortunate in the present situation. For many years now the Communists have been developing a Fifth Column in this country in every city and community, and in our industrial plants.

J. Edgar Hoover recently said that there are some 37,500 card-carrying Communists in the United States. "It must be remembered," he said, "that there are actually six levels to the Communist Party. In the first instance, you have the professional Communist, who was referred to in other years as the card-carring member of the party. Secondly, there is the concealed Communist. Then there is the sympathizer, the fellow traveler, the innocent who has been duped by the Communist and, finally, there is the opportunist." "The Communist themselves," said Mr. Hoover, "have made the boast that for every party member there are 10 others ready, willing, and able to do the party work." He stated that a fundamental premise of Marxism-Leninism is that whatever advances the Communist cause is moral and that it is the purpose of the Communist to conduct sabotage, espionage, and subversive activities by whatever means and methods they find neccesary. By simple arithmetic we find that although there are only 37,500 so-called card-carrying Communists in the country, there are 375,000 who will take orders and do their work. That constitutes quite an army in itself.

Again quoting Mr. Hoover, "There is a hard core of known Communists in the United States trained and ready to sabotage vital industries when given the word to do so." These Communists, according to Mr. Hoover, including their agents and sympathizers, are emphasizing infiltration into heavy industries, especially those engaged in vital defense efforts.

I would pause here a moment to say that we are fortunate indeed to have such a splendid organization as the Federal Bureau of Investigation under the superb leadership of Mr. Hoover. That, ladies and gentlemen, is one organization in which we can have complete confidence, both as to integrity and ability.

There are today between 200,000 and 250,000 industrial plants in the United States. According to Maj. Gen. Francis H. Griswold, during World War II 120,000 plants directly or indirectly were working on defense projects. Again by simple arithmetic, we find that the enemy has in this country now, enough agents, Communists and fellow-travelers, to average two to every plant in the United States and almost four to every plant that during the war was engaged in production for defense. One well trained saboteur in a defense plant may be all that is needed to take it out of the running and completely stop its production. He can certainly pinpoint his missile better than a bomber pilot can his.

Therefore, ladies and gentlemen, it would be foolish for us to prepare our civilian defense for enemy military action and overlook this danger that is real and much more imminent. Air attack, to say the least, is speculative, but there is nothing speculative about the dangers from this source.

Plant security is a broad subject within itself. There are two types, internal and external, and there are several agencies of the Government sharing these responsibilities. Industry may expect to receive advice, counsel, and assistance on plant internal security from the Munitions Board and the Armed Services (that is, Army, Navy, Air Force) and from the Federal Bureau of Investigation. The Armed Services concern themselves with the establishment of preventive measures, while the F.B.I. concerns itself with the investigation of acts of sabotage, espionage, and subversive activities. Also, the Army has a plan for protecting vital defense plants against outside forces - enemy attack. This latter plan is new since the last war.

On the day of Pearl Harbor in 1941 we began immediately our efforts to get armed external protection for our Freeport plants. Vulnerable as we were there within two miles of the Gulf, we had visions of immediate enemy attack. Several days passed, and no one in the Army seemed able to do anything for us. Finally, two companies of National Guardsmen arrived one night.

Not very long after that, within a few weeks, two six-inch guns were mounted at the mouth of the Freeport Harbor. Next, in a few more weeks, two anti-aircraft units moved in around us.

We are informed that under the new plan, details already being worked out, in event of such an emergency, without awaiting orders, certain armed detachments will move in around strategic defense installations for immediate protection from external forces.

In the Gulf Coast area following World War II, some of the industries discontinued their own protection departments. The larger industries, for the most part, did not, but in all cases the departments were on a reduced scale. These are in an excellent position to expand and enlarge, making use of their experienced employees to guide and teach new recruits with a higher degree of departmental efficiency.

Those departments of the Gulf Coast industries that remained active have not failed to associate themselves together for their common good. The Industrial Plant Protection Association of Texas, organized during the war, has continued to function. Occasional organized training sessions have been held, including one at A. & M. College. The Dow Chemical Company for two years now has held two-day-session security conferences. The last of these was held at Lake Jackson in March of this year and was attended by representatives of the security departments of all the Dow plants in the United States and Canada, as well as those of other major industries along the Gulf Coast.

A good security department would include facilities for investigating applicants for employment, including those of contractor. In fact, in time of war every person who enters the plant should be investigated. This investigation should include photographing and fingerprinting, with the fingerprints being submitted to either the Department of Public Safety, the Munitions Board, or the Federal Bureau of Investigation for searching against their files. Not only is fingerprinting valuable as a protection against undesirable persons gaining admission to the plants, it is very useful to identify victims in event of disaster. Extensive use of our applicant fingerprints was made to identify victims of the Texas City disaster.

A pre-employment security questionnaire should be required of every applicant. The information given on this questionnaire should be gone over thoroughly in a pre-employment interview by a security officer, not by members of the employment office. Frequently, such interviews will disclose intentional discrepancies and omissions. Further, such interviews will tend to insure accuracy of addresses, names of references, former employers, etc. Particular attention should be given to the whereabouts of the applicant since he reached maturity. If he is foreign born, attention should be given to the matter of whether he has been naturalized. His education, affiliations, and former employment should receive special attention. Criminal records will reveal the identy of convicted arsonists.

It is the practice of some industries to, following this pre-employment interview, grant the applicant temporary employment approval pending an extensive investigation. This applicant investigation may be conducted by mail, telephone, or both. Since the beginning of World War II, we at The Dow Chemical Company, Texas Division, have fingerprinted and conducted investigations of some 80,000 individuals. Quite a system of mailing forms and questionnaires was worked out, and during the war we received some 95% response to these inquiries.

In the investigation of an applicant, in addition to inquiries directed to his references and former employers, inquiries should likewise be directed to ministers, postmasters, Justices of the Peace, Chiefs of Police, and other reputable people in each community in which the applicant formerly resided or worked. If he should have arranged in advance to thwart the investigation, such additional inquiries would tend to disclose his true reputation.

Following World War II we curtailed the investigation of applicants somewhat but we did not discontinue fingerprinting and photographing. We take only a small bit of personal data in connection with the fingerprinting at present. The return to the World War II footing in our plants as relates to applicant investigation is being held in abeyance for the time being pending a more serious turn of the current international situation, but it can be reactivated in 24 hours.

I do not intend to leave the impression that we have relaxed our vigilance against the infiltration of Communists into our plants. Detecting them is made somewhat more difficult however by reason of the fact that we no longer require the extensive questionnaire information, but I feel that we have been entirely successful both in detecting and removing them.

When we think about natural disaster in the Gulf Coast area, tropical hurricanes stand out because they are capable of causing losses of almost atomic bomb proportions. It has been said that the energy generated in a hurricane is equal to that of one atomic bomb every three seconds. Because of our vulnerability to hurricanes, war or no war, annually, we on the Gulf Coast must be prepared for the hurricane season. I do not believe that threatened enemy attack of our shores could be much more demoralizing than one severe hurricane in the Gulf of Mexico. The two are different in some respects, however. We can expect hurricanes each year. The timing is not quite so certain with the enemy. Through years of study and the development of scientific equipment, scientists can, fairly accurately, predict the formation and course of travel of a hurricane. Our intelligence might not work so well with the enemy.

Tropical hurricanes are dangerous, especially if proper advance preparation is lacking. Only recently Hurricane Charlie struck Kingston, Jamaica, and left 150 people dead and losses exceeding $50,000,000, to say nothing of the thousands who were left homeless. Grady Norton, Chief of the Weather Bureau's storm warning service at Miami, Florida, said recently, "Hurricanes are still the killers they always were. No part of our Atlantic or Gulf Coast is immune to them. It is far better to prepare in advance than to hold mass burial afterward."

The Galveston hurricane in 1900 cost some 6,000 people their lives. In the great Miami hurricane in 1926, more than 100 people were killed, and damage exceeded $100,000,000. In 1928, 1,836 were killed and 1,870 injured, again in Florida. On Labor Day in 1935 in the Florida Keys the winds surpassed 200 m.p.h., this being the most violent storm ever to occur in the Western Hemisphere and it left 376 dead or missing. The New England hurricane in 1938 killed 600 people and caused the greatest loss of property in the history of the world from such disasters, $300,000,000.

The effect of hurricanes, so far as loss of life and property damage is concerned, can be reduced to a practical minimum by advance preparation, proper construction, timely information, and prompt relief.

I have with me a copy of the master plan of the Disaster Preparedness and Relief Committee, Brazoria County Chapter, American Red Cross, which spells out a plan not only for combating the hurricane menace but for use in disasters from any natural cause. The same plan, with a slight extension of authority and jurisdiction, could well become Brazoria County's civilian defense plan. I shall not attempt to go into extensive and intimate details of our plan. It is broad in its scope and flexible in its application. It is integrated with our industrial activities, heavy industry as well as agricultural and marine industry. It utilizes the facilities of all the industries, and its committee is comprised of some 350 volunteer workers trained and organized for immediate action. This plan has had national recognition and was the topic in a panel discussion in the 1947 Cleveland, Ohio, Red Cross national convention. Since that time it has been a source of pride to us to observe that other communities have employed ideas and lifted sections from it in formulating their own plans. I have here the recently completed master plan of the Galveston County Red Cross Chapter, which I find is identical to ours in many respects.

Our plan calls for liaison with the Government agencies responsible for hurricane warning, for dissemination of hurricane information, evacuation of the civilian population, sheltering, the administration of relief in the wake of the hurricane, and for rehabilitation. Inasmuch as a number of the Brazoria County disaster committee members are employees and officials of major industries in the area, it would be difficult for an outsider to recognize the line between industry and Red Cross.

In addition to the Red Cross plan, our company has its own plan, very complete and elaborate in detail. At the beginning of each hurricane season, the company's general hurricane preparation committee reviews the established plans to determine that everything is ready in case a hurricane occurs. These plans call for rigid inspection of all buildings, areas, and facilities, tying down of loose and lightweight materials and buildings. Emergency equipment and supplies are checked.

If a hurricane in the Gulf threatens, the management holds conferences with the general hurricane committee, and when deemed proper, preliminary notice of shutdown is issued. This calls for the first steps to be taken toward a possible plant shutdown.

When the conditions appear to be more dangerous, management issues its second notice and, later as the situation develops, its final shutdown order. Eight to twelve hours are required for orderly and safe shutdown.

Skeleton stand-by crews are retained, and all others are sent home. Most people follow the advice of the Weather Bureau and evacuate; however, nothing is mandatory about this.

Here the Red Cross plan of evacuation begins to function. During evacuation all employees are kept closely advised of conditions during and after the hurricane and are told when it is safe to return. Use of standard commercial radio stations in Houston, Dallas, San Antonio, and smaller places in south and east Texas are utilized in conveying this information.

Because of the efficient, timely, and accurate nature of our warning service, because of the reliability of electronic and other hurricane detection equipment, coupled with the splendid cooperation of the U. S. Weather Bureau, we have been able to gain and hold absolute confidence of our people. This has almost completely eliminated hysteria and excitement. Evacuation, consequently, is very orderly and with a minimum of confusion. Should enemy action ever necessitate evacuation, this factor would prove to be a real asset.

Industry has some very elaborate hurricane detection equipment, including radar, a chain of recording barometers installed at a number of points from Brownsville to New Orleans, anemometers, rain gauges, and short-wave radio for communication. Information is funneled into the U. S. Weather Bureau, and they in turn issue the reports and advisories to the public. Industry's role is to assist and cooperate with the U. S. Weather Bureau and not to forecast weather or issue advisories.

Efforts are now being exerted by a group of industries around the Gulf Coast to organize a short-wave radio network. This network, when completed, will be operated in conjunction with the U. S. Weather Bureau. It will serve to gather hurricane and weather information, to disseminate weather reports and hurricane advisories and to aid in rescue and relief after a disaster has struck. It will be privately financed and on a non-profit basis. It will have no direct connection with either the American Red Cross or United States civilian defense. It will be known as the Gulf Industries Weather Network and will consist of five or more master stations and probably as many as eight or ten satellite stations. Industrial membership is invited.

From the tragic 1947 Texas City disaster we in the Southwest have taken many pointers. A very important one of these is that of mutual aid among industries. In the September 10 issue of "Chemical and Engineering News" Associate Editor Will Shearon, to whom I am indebted, presented a very excellent article titled

Organizing for Disaster Control. I recommend this as good reading.

In this article Mr. Shearon upholds the theory that an industrial plant defense organization be designed to face any type of disaster. He described mutual aid as "a plan of cooperative action in which assistance of other companies or organizations will be made available at his request to any member having an emergency which may be beyond the ability of the affected member to control." Membership in such mutual aid plans is not limited to industrial plants, but may include municipal, state, federal, and civic organizations.

In this article he has treated plans now in practice in several of the more concentrated industrial areas. The two outstanding local plans of this type are the recently organized Mutual Aid System of Texas City and the Mutual Aid System of Baton Rouge, Louisiana. Of course, such a plan would not work so well in the case of an isolated industrial plant.

Though not as a part of any such organized plan, our plants at Freeport and Velasco have rendered aid in the past to plants in distress at Sweeny, Texas City, Orange, and Houston. To my knowledge, we have never been the recipients of any such aid, not having had occasion for it, for which we are thankful.

The problem which American industries have confronting them in the present war, due to the atomic bomb, is a new one. In other wars we have had principally to concern ourselves with sabotage, possible invation, shoreline shelling, and remotely with air raid attacks with the conventional type bomb. Defense measures against these hazards were based upon knowledge and information we gained from other countries not so fortunate as ours, countries which, in other wars, experienced actual battle conditions.

But, with regard to the danger of our being subject to A-bomb attack here on the Gulf of Mexico, that which I am about to say may not be in strict keeping with the theory of most civilian defense leaders. It may even seem to be in contradiction to the warnings of certain national figures whose purposes and duties it is to alert the public to the dangers and possibilities of enemy air attack. Certainly, it is not my desire to discount or minimize these.

Every one knows about Chief of Staff of the Air Force General Hoyt Vandenberg's statement, before a committee, that our defenses could be expected at most to stop only 30% of the planes of the enemy in event of air attack.

Notwithstanding this admonition of General Vandenberg, if we should describe a circle around the nearest Russian airport, according to military experts, the aircraft of the type known to be in possession of the enemy might well reach the industrial areas in the northern and eastern parts of the United States and a few might get through to the central parts, but there is some reason and comfort in believing that few,if any,would ever be able to fly as far as the Gulf Coast with a payload, surviving reasonable anti-aircraft defense measures across the country.

During World War II we heard much from military people about calculated risk. In planning our A-bomb defenses, the big question is whether there should be any "calculated" risk. In the February session of the armed forces economic mobilization class here in Houston, members of the faculty indicated that it was reasonable to expect that the enemy would select highly concentrated areas on which to drop its A-boms; that because of the immense cost, it was improbable that the enemy would single out a lone and isolated industrial plant on which to spend an atomic bomb. The <u>most value</u> derived from their use is the mass human destruction and demoralizing effect. Those of us responsible for the security of isolated industrial plants, consequently, may have some A-bomb defense value in their isolation.

For an isolated industry, regardless of its importance to the war effort, especially where it is spread out over 5 to 10 square miles and employing 10,000 people, it would be practically and financially infeasible to construct atomic bombproof shelters, underground or otherwise. If an atomic bomb were to be dropped on such an isolated plant, it would likely take everyone by surprise anyway, and few, if any, would have an opportunity to reach the shelters. Therefore, a sensible approach to the problem of defense against A-bombs in the case of an isolated plant would, in my judgment, call for about the same sort of defense as was organized for air raid during World War II, plus protection against radiation. A survey of most of the industries on the Gulf Coast discloses that about the only A-bomb defensive measures taken so far by any of them has been to establish radiological monitoring services. In so far as I am able to determine, none of them has taken steps to construct shelters. I do not know of any that built air raid shelters in World War II.

Plant defenses should also include biological and chemical monitoring services. Biological monitoring is necessary especially where a plant does not have the protection of food and water inspection by city or state inspectors. In fact, the same might be said for chemical monitoring service.

One possible, though maybe a little unorthodox, method of defense of isolated plants, such as those in Brazoria County, was pointed up in a story which I ran across the other day about a small community some 40 miles from Cleveland, Ohio. This community had practically no funds for its defense against air raid. The story goes that the defense committee went out on a hillside and erected two high poles bearing strong spotlights. These spotlights were focused upon a large arrow pointing in the direction of Cleveland bearing the words "this way to Cleveland."

Industrial management is ready and waiting for our Federal Government to give the go-ahead. I do not believe that any lack of preparation by industry is due to apathy, for management is sufficiently alert and willing. Why should <u>industry</u>, though, become any more concerned than <u>Congress</u>? Only last month committee members of Congress voted to reduce the <u>civilian</u> defense appropriation, thereby indicating, whether intentional or not, that air raid danger may not be as great as it might have once appeared. After all, <u>Congress should know</u>.

One of the Houston newspapers, in defense of this stand by Congress wisely observed that "it would take 250 million dollars to build enough bomb shelters for the whole country. It would take more money than even the Federal government can spend. It would take millions of tons of scarce materials, badly needed for military purposes. The job <u>could not be done in years of feverish construction</u>."

Congress also knows that enemy attack can be stopped not by building bomb shelters, but by building impregnable military might

I should like to compliment the Houston Chamber of Commerce for its splendid leadership in arranging this conference and Dr. Kerr and Mr. Wood for their efforts in the organization of this panel. I have enjoyed it very much, thank you.

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A. T. DEERE

Born in Louisiana

Educated in public schools of Dallas and Southern Methodist University

Received law degree from Jefferson University, Dallas, Texas

Joined F.B.I. in 1934, leaving that organization in 1941 to go with The Dow Chemical Company as departmental superintendent, in charge of several departments

Was active during war in war drives, head of civilian defense in the Freeport-Velasco area

Since the war, quite active in local civic matters, President of Brazoria County Chamber of Commerce in 1947 and 1948

Chairman, Disaster Preparedness and Relief Committee, Brazoria County Chapter, American Red Cross

Member of Texas Economy Commission

Vice President of East Texas Chamber of Commerce

Married, father of two children

Reside in Lake Jackson, Texas

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INDUSTRIAL NURSING
Saturday, September 29, 1951

MORNING SESSION

Miss Jeannette Bartholomew, R.N., The Texas Company, Houston, Texas, Presiding

"MEDICAL SUPERVISION IN INDUSTRY"

J. F. McCahan, M. D.
Council on Industrial Health
American Medical Association
Chicago, Illinois

During the past forty years there has been a tremendous increase in the practice by industrial firms of employing nurses to render nursing care to the ill or injured employee and to assist in the inauguration and maintenance of adequate health programs in industry. The status of the nurse in industry working without direct medical supervision presents an important inter-professional problem. Because of ethical and legal considerations governing medical and nursing services, certain fundamental principles are necessary for the successful administration of an industrial health program.

We need to clarify these legal and ethical principles, both for the members of the interested professional organizations, and for industrial employers.

It is not a simple matter to develop a set of guiding principles, acceptable to all, which will delineate the essentials of medical-nursing service relationships in industry. The task is made somewhat easier, however, when we relate principle to purpose. So it would seem appropriate at this point to ask, what are the purposes of an industrial health service? A health service in industry should provide: a safe and healthful work place; health counselling and health education; personal medical services as required for (1) observances of laws, codes and health regulations, (2) emergency medical care, (3) health conservation and (4) job placement. These basic purposes are as essential and applicable to the most simple as to the most elaborate health service.

It has been authoritatively proved that a successful service will substantially reduce accidents, absenteeism and labor turnover and will increase production and morale. The maximum benefits are received by management and employee alike when they both have accepted the medical department as part of their daily industrial life. It is, therefore, of prime importance that the physician and nurse have the desire and interest to become an integrated part of the industrial team and that their abilities and personalities are so constituted that executives and employees look to them for help and advice. The industrial physician, assisted by the industrial nurse and working closely with management, is responsible for the development of a program of health maintenance.

The ultimate value of physicians and nurses in industry is dependent upon several factors, including: Training, experience and aptitude; a position of authority in the industrial organization; good rapport with workers; good relations with their professional colleagues; thorough knowledge of work environment and processes; and effective use of community health resources.

The physician in industry must be guided by certain limiting factors based on ethical and legal codes which govern his relationships with the individual patient and with his fellow practitioners. He must be a competent physician who is qualified and willing to take a genuine interest in applying the principles of preventive medicine, surgery and hygiene to employed groups and who will devote regular hours to such service in the working environment. His responsibility for the supervision of the industrial nurses working with him may be direct or through written instructions developed by him. In cooperation with properly qualified assistance, consultants and agencies, he will develop industrial hygiene services directed at improvement of the working environment and control of all unhealthful exposures. Finally, he will institute a health program which will include: (1) prompt and dependable first-aid, emergency and subsequent medical and surgical care for all industrially induced disability in accordance with the statutes governing workmen's compensation; (2) health conservation of employees through medical supervision and health education; (3) close correlation with the family physicians, dentists and other community health agencies for proper management of non-occupational sickness and injury; (4)good records of all causes of absence from work as a guide to the establishment of preventive measures.

The industrial nurse, working under direct medical supervision, will assist the physician in carrying out this program. Personal medical services involving the establishment of a diagnosis and the definition of treatment or the performance of specific preventive measures are functions of the physician. However, it is desirable for the nurse to participate in such services if she acts under medical supervision or if she acts in an emergency.

When the industrial nurse is working without direct medical supervision (i.e., a physician who does not make regularly scheduled visits to the plant), the scope of the services that she renders will depend upon her background of training and experience, her general aptitude and ability, and the instructions as written and signed by her attending physician.

The Bureau of Legal Medicine and Legislation of the American Medical Association, after studying the nursing practice acts and the medical practice acts of all the states, has advised that "standing orders" have legal status when defined as follows: "Standing Orders means a written or printed compend of directions outlining routine medical or nursing services and procedures, of an emergency nature, approved and signed by a licensed physician and acknowledged by him to be services and procedures which may, in his absence, and until his arrival, be performed by a particular registered nurse (or a particular practical nurse.)" Regardless of the foregoing, the nurse working without proper medical supervision is markedly limited in her scope of activities as they relate to medical and surgical care.

In the absence of direct medical supervision, and at the time of employment, the industrial nurse should acquaint her employer with the legal and ethical scope of her services. If she is asked to perform services exceeding her training and licensure, she should seek advice from the nearest official medical or nursing agency.

In respect to industrial health services other than those involving specific diagnosis and treatment of a personal nature, the nurse can exercise considerable initiative. If she is well trained and properly motivated, she can do much good work in the fields of health counselling, health education, industrial hygiene, safety and sanitation. Practical limits must be based on her training, experience, and availability of qualified consultants.

Industry that employs health personnel should recognize the ethical and legal potential of its health service staff and cooperate with them in operating within these limitations. This involves becoming familiar with and keeping within the bounds of the State Medical Practice Act, the State Nursing Practice Act, the State Workmen's Compensation Act, the State Non-Occupational Disability Insurance Law and the Federal Harrison Narcotics Act.

Health services in industry approach their maximum effectiveness when management and labor understand and accept the scope, purposes and principles that guide the industrial health team in its program of health maintenance. It would seem obvious that the industrial health service offers more to industry when under direct medical supervision. However, we must be realistic and recognize the fact that now and probably for an indeterminate time into the future, there will be nurses administering health services in industry without direct medical supervision. Under these circumstances it is the industrial nurse's responsibility, at the time of her employment, to acquaint her employer with the legal and ethical scope of her services. It is through the slow process of education by demonstration that the medical and nursing professions, working as a team on the individual community level, can convince industry of the real values that accrue from medical supervision of industrial health services.

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1951 FOURTH ANNUAL GULF COAST REGIONAL CONFERENCE
O N
INDUSTRIAL HEALTH

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Glenn Purcell	Shell Chemical Corporation	Houston, Texas
Rodney Quinby	Quinby Employment Service	Houston, Texas
James L. Ragan	Celanese Corporation of America	Bishop, Texas
R. A. Randall	Carbide & Carbon Chemicals Corp.	Texas City, Texas

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