occupational health

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The Role of the Emission Spectrograph in Occupational Health Investigations

By Robert G. Keenan

MANY occupational health problems arise from the industrial exposures of workers to inorganic materials. In the evaluation of the extent of specific exposures, the metallic and metal-like constituents of the inorganic substances are generally analyzed in dust or fume samples collected in the working environment. Oftentimes, the concentrations of the toxic atmospheric contaminants are relatively low and analysis of the sample becomes difficult for the analyst without a spectrograph. For the analysis of most of the inorganic constituents, comprising 70 or more metallic or metal-like elements, the emission spectrograph is uniquely suited. This instrument is used to characterize and measure the radiation emitted by specific elements.

All elements emit characteristic radiation when they are excited sufficiently by a source of energy. This source may be thermal or electrical. An example of the former is the well-known Bunsen flame used in elementary qualitative analysis for the excitation of the alkali metals to yield their characteristic flame spectra; a typical example of an electrical type of energy source is the spark, which is required for the excitation of such nonmetallic elements as selenium, sulfur or the halogens.

The most common source is the arc between graphite electrodes, the tips of which are maintained at incandescence by the electrical power of a direct current circuit. The sample is supported by the lower electrode and the materials contained in the sample are volatilized into the arc stream during the burning of the arc. During this process the metallic constituents of the sample become excited and give off radiation which is characteristic of the individual metals. This radiation can be sorted out into line spectra according to the individual wave lengths by an instrument known as a spectroscope.

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COVER PICTURE—By courtesy of the Caterpillar Tractor Co., Peoria, Ill.

This instrument which permits the observation of the line spectra in the visible region is now available in most college chemistry laboratories for students in qualitative analysis. An instrument which possesses a photographic attachment for the recording of these spectral lines is known as a spectrograph.

It possesses a specificity unparalleled by any other analytic instrument, and its sensitivity is far beyond that of most chemical procedures. It is excelled in sensitivity by very few techniques. As to precision, a deviation of 2 percent or less is no longer unusual in quantitative spectrographic procedures. For most purposes, such as analyses of atmospheric samples whose composition may vary widely from sample to sample, this is more than ample. Moreover, this precision is largely independent of the actual concentration of the metal or metalloid in the working range of the method.

From the standpoint of rapidity of application, the small amount of sample required for measurement and the low concentrations which can be detected (0.1 percent and less), the spectrograph is the instrument of choice.

The Division of Occupational Health has been employing spectrochemical methods of analysis to advantage for many years. In addition to applying those methods developed in the past, the staff continues research on newer techniques in spectroscopy. The description that follows of some of our developments and applications of spectroscopic techniques will demonstrate the support which these methods yield to our research and field investigations.

Semiquantitative Procedures

Last year spectrographic analysis played a dominant part in an extensive investigation of atmospheric pollution in the Detroit-Windsor area by characterizing the metallic components of the air over this region. The analytic problem was the determination of as many metallic constituents as possible in the atmosphere as quantitatively as was consistent with time economy. Such samples were to be collected at 31 sites, covering the entire city of Detroit, and were to be taken continuously on a 24-hour basis over a period of 6 weeks.

In addition, there was the added demand that the information be supplied within a minimum period of time in order to assist future planning of medical, engineering, and statistical work for the entire investigation. More than 1,000 samples were involved. Inasmuch as it was anticipated that many of the metals would be present in low and trace concentrations and in view of the above-mentioned requirements a spectographic procedure was the only answer to the problem.

Because time did not permit the development of quantitative procedures for each of the 24 metals to be determined, it was sufficient for the purpose at hand to develop a rapid semiquantitative procedure (*1*). This consisted of a spectrographic exposure in a 220-volt d. c. arc and, after photographic development and fixing, the spectral lines of the individual elements were compared directly with those of a standard series in a Jarrell-Ash comparator-densitometer.

For this comparison a standard series of spectrograms was prepared from known and varied concentrations of each of 24 elements over the range of 0.25 to 200 micrograms. The lines chosen for the comparison of standard and sample spectrograms were selected judiciously so as to circumvent any possible interference such as the masking of trace element lines by those of the major constituents. The spectrograms were scanned rapidly for each element in turn in the series of samples on each plate, and the quantities corresponding to the matched standard lines were established almost instantly.

By this matching procedure the author was able to complete as many as 1,500 determinations per day. This is at least 30 times the best performance of a chemical analyst. The quantities of the individual metals represented in the standard spectrograms ranged from 0.25 to 4.0 micrograms for 13 of the elements, and for the remaining groups the ranges extended from 1.0 to 200.0 micrograms. The limiting factor in this study

was found to be the time required for transferring and ashing the samples.

To evaluate the accuracy of this semiquantitative spectrographic method, two of the elements of the group were analyzed chemically as well as spectrographically on a restricted number of samples. By this evaluation, the semiquantitative spectrographic method was shown to be fairly accurate, with an average deviation of 8 percent for lead and 19 percent for iron, the latter element being present as a major constituent.

The foregoing represents one application of the spectrographic, semiquantitative techniques which are being utilized in this laboratory.

Quantitative Procedures

Quantitative spectrographic methods have also been employed to great advantage by this laboratory. Such methods have found special use for the determination of trace quantities of certain toxic metals in animal tissues from which is derived important information on distribution and excretion of metals by various routes of administration. For this work, quantitative methods have been extended in sensitivity down to a working region of 0.0005 percent in tissue ash, or 0.000005 percent in fresh tissues as liver, kidney, and lung.

The increase in sensitivity has been achieved by the use of lithium chloride buffer salt which suppresses both cyanogen band spectra and general background (*2*). This buffer has the additional advantage of minimizing the mutual interference effects of major sample constituents by reducing their relative concentrations in the arc. A further result is the increased volatility of trace elements by the carrier-action of the buffer system.

Another important way in which to gain quantitative accuracy is by the use of an internal standard. An ideal internal standard should possess the same spectral response as that of the element being analyzed. When this condition has been realized, the spectral lines of both the internal standard and the analysis element should be produced during the same period of the spectrographic exposure; and the unavoidable variations in arcing conditions should affect equally the lines of the standard and unknown elements.

An example of such an internal standard is platinum which we use for the quantitative determination of beryllium in human and animal tissues. In this case, platinum produces its spectrum during the same period of exposure as that when the spectrum of beryllium is being formed. Another condition of quantitative spectrography is the use of constant developing conditions of the spectrographic plate. Plates are developed and fixed at 68° F.

In addition to the previous requirements, each photographic emulsion used for quantitative analysis must be calibrated to establish the photographic response. For this purpose, an iron arc is used in conjunction with an 8-step sector to establish the characteristics of the individual photographic emulsion.

The calibration of a single lot of plates is required every few months. One final condition is the maintenance of uniform electrode charges. This is done by keeping the concentrations of all elements constant in the electrode charge except the one being analyzed. Such charges consist of a combination of the metallic and nonmetallic elements in the sample or its ash, in any buffer salt used in the procedure, and in the added known quantity of the internal standard. Despite all of these seemingly involved precautions, the spectrographer can conduct with rapidity the quantitative analysis of samples.

As indicated above, one of the outstanding applications of quantitative spectrography in this laboratory is the determination of cobalt in animal tissues. The principles just discussed are employed in the development of the procedure.

The details of this method will be set forth in a subsequent publication, but it is of interest to mention here that these determinations are being conducted with an average deviation of

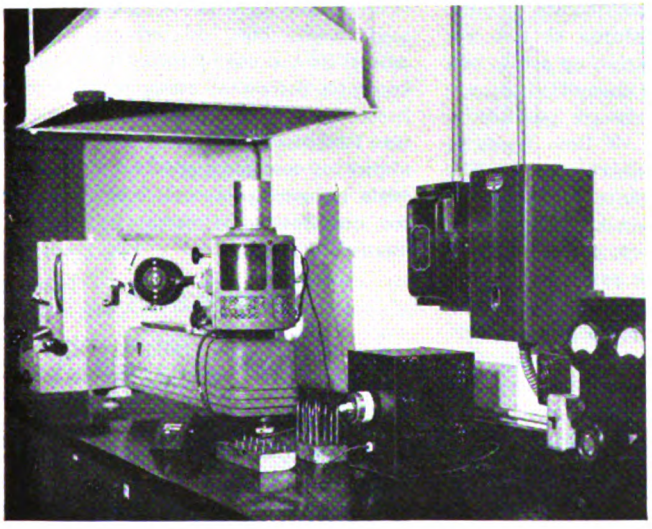

Figure 1—The Bausch & Lomb large Littrow spectrograph is shown with the d. c. arc stand and electrical control equipment. Bored graphite electrodes containing specimens for analysis and pencilled cathodes are in foreground. The canopy hood above the arc stand is for removal of toxic fumes and prevention of room contamination.

Figure 2—A comparator-densitometer, Jarrell-Ash model 200. The spectrographer is matching standard and sample spectrograms in the semiquantitative determination of metals. He was able to complete as many as 1500 determinations a day.

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about 3 percent on quantities of cobalt as low as 0.01 microgram in one-fifth of a gram of fresh tissue. The value of this procedure becomes more apparent when it is realized that the sensitivity of existing chemical colorimetric methods for cobalt is about 0.5 microgram, and that it is impossible to secure for the chemical analysis of cobalt sufficient tissue material, especially in the case of smaller animals such as mice.

Similarly, there has been no suitably sensitive chemical method for the determination of trace quantities of vanadium in animal tissues. Here again the spectrograph is being employed for the quantitative analysis of quantities of vanadium as low as 0.005 microgram in 200 milligrams of whole blood or fresh tissues. The accuracy obtained with the spectrographic procedure for vanadium approaches closely that cited for cobalt.

Other quantitative spectrographic methods have been developed as the needs of this laboratory demanded specific methods of greater sensitivity than that provided by current chemical methods. Perhaps the best example of these is the spectrographic method for beryllium. There is no other method of equal sensitivity or accuracy for the determination of the trace quantities of beryllium which are considered significant from an occupational health viewpoint. Other laboratories have similarly found the spectographic analysis of beryllium a highly useful and sensitive method (*3*, *4*).

The preceding paragraphs have provided concrete examples of our current applications of quantitative spectrographic methods; others, equally good, might have been selected and, when occasions arise requiring determination of trace quantities of metals, new procedures will be developed.

Qualitative Procedures

Perhaps the application in which the spectrograph is most advantageously used is in the development of complete qualitative information on the metallic composition of a sample. Forty or more metals can be determined qualitatively with a single exposure with a medium size prism instrument, or in three exposures on a large Littrow instrument.

This procedure is being utilized in securing rapid information on the metallic constituents of the following materials: (1) Animal diets—to detect the presence or absence of certain metals in the diet of control and test animals, (2) general specimens—discovery of unsuspected contaminants, (3) chemical reagents used for dermatologic investigations in which it is essential to know the presence or absence of certain skin-sensitizing metallic agents, (4) material used as dust or fume sources in inhalation toxicity studies to determine their purity, and (5) miscellaneous variety of samples from field investigations to determine the nature of the toxic materials present.

Another application is the screening of samples for specific constituents prior to their chemical analysis. When these constituents are not detectable spectrographically, this screening automatically eliminates the necessity for chemical analytic determinations on such samples. An added advantage also in the analytic screening of samples is the identification of the other constituents which may act as interferences in a chemical procedure. This foreknowledge facilitates the proper choice of subsequent chemical methods with accompanying greater accuracy and time economy as a result.

Practical Considerations

The presentation of the advantages and present accomplishments of our spectrographic procedures should not be made without mentioning a few reservations. Although once obtained, extremely rapid methods are possible, a considerable amount of time must be devoted to their development. The search for a suitable internal standard, for example, often taxes the resources of the spectrographer, but persistent search is usually well rewarded.

Another practical consideration enters into the qualitative measurements. Whereas it is true that a qualitative analysis for a few constituents can be made rapidly, complete qualitative analysis is not always a rapid procedure from which answers can be supplied forthwith. Blanket requests for complete qualitative examination of a specimen are examples of this sort. To conduct such an analysis, the spectrographer must adopt the attitude that (1) he may detect any metal in the sample, (2) he must prove to his own satisfaction that all the lines are accounted for, and (3) he must be assured that he has not mistaken a persistent line of a trace element for one of the weaker lines of a major or moderate constituent. For these reasons, a complete qualitative analysis is usually the most time-consuming type of spectrographic analysis.

Another matter of practical concern is the existence of mutual interference effects. Certain elements tend to suppress or enhance the spectra of other elements. For this reason, optimum exposure conditions demand a uniform matrix, referred to previously as the electrode charge, throughout the series of standard and unknown samples. In quantitative methods, it is desirable to employ a fixed mass of sample, the only permitted concentration variable being the analysis element.

Preparation of Samples

In our laboratory, but this is by no means true of all, the chemical preparatory work is done by the spectrographer. This is done because it is believed that a knowledge of the history of the samples, the type and the amount, provides a more satisfactory specimen for spectrographic analysis.

Summary

Some of the problems associated with the determination of trace quantities of metals in sample materials involved in occupational health studies have been mentioned. The advantages to be gained by the use of the emission spectrograph for metal analysis have been pointed out with specific reference to this Division's applications of the techniques of emission spectroscopy along with certain practical considerations for qualitative, semiquantitative, and quantitative analysis.

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Aircraft Plant President Tells of Success in Training and Employing Handicapped Workers

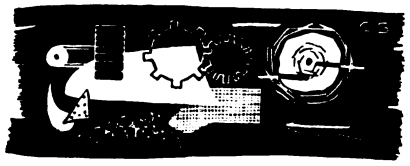
SPEAKING in Washington, D. C., at the annual meeting of The President's Committee on Employment of the Physically Handicapped, John K. Northrop, president of Northrop Aircraft, Inc.,* said:

"Our written history is dotted with records of courageous men and women who hurdled apparently insurmountable obstacles along their paths to success. An outstanding example is the man Demosthenes who, despite the handicap of a speech impediment, became articulate to the point where his name is now synonymous with great oratory. Beethoven, one of the greatest composers of all time, was deaf. Most of us have in our own circle of friends those who have overcome childhood handicaps to become particularly successful in activities requiring special proficiency in fields in which they were formerly most deficient.

"The successful use of the physically handicapped in industry involves somewhat different problems. The potential employee may often have become handicapped well along in life, or be so mentally discouraged as to lack the necessary will to do. Although I have been greatly interested in this subject for a number of years, I must confess at the outset that I am far from the expert that many of my audience must be, and therefore must rely for my illustrative material upon my company's program, with which I am fully familiar.

"Northrop Aircraft is a business concern operating in a market every bit as competitive as that of the company making washing machines or straw hats for the retail trade. The fact that we have successfully employed a large number of handicapped people is the reason I have been asked to talk to you today. I believe I can show you that this employment has been profitable, both financially and in other less tangible but equally important ways.

"Although we had used a small number of handicapped individuals in our operations prior to World War II, as is the case with most large employers, our interest in this program was greatly



stimulated by our experiences during the war years when we were put to it to find sufficient personnel to accomplish the tasks assigned to us by the Defense Department. At that time circumstances directed our work along two lines, the first of these being the practical solution of problems inherent in the employment of the severely handicapped, which were encountered in building up necessary manpower. Our second interest centered in the improvement of prosthetic devices in an effort to qualify for useful work those previously considered unemployable.

"I think our most interesting and unique experience involved our operations at the Birmingham General Hospital at Van Nuys, Calif. In that institution, peopled as it was by those considered too ill mentally or physically for discharge to their homes, we ran a successful workshop. Even some bed patients were given small but useful tasks and were paid for their accomplishments at the same rates received by men in our factory doing similar work. The therapeutic values, both mental and physical, of this return to active and useful employment were amazing.

"Under the careful supervision of the hospital physicians, men with all sorts of disabilities were assigned 1 to 4 hours of daily work on tasks for which they were best fitted. Patients unable to leave their beds were able to make small assemblies, sort out scrambled but still valuable bolts, nuts, and rivets from salvaged sweepings, and put together simple wiring harnesses for later inclusion in more complex assemblies at the plant.

"Those in wheel chairs, or those able to get about a bit with the use of crutches, were given bench jobs. Hand finishing of parts, the completion of small assemblies, simple machine-shop activities such as drilling, burring, polishing, and bending all proved entirely suitable for the average ambulatory patient. Of course, special provisions had to be made for special cases. Men with only one hand ran drill-press operations by means of extemporized foot-pedal attachments. Special simple jigs and fixtures were provided to particularly fit the needs of the employee-patients.

"The work turned out was good on any comparative basis. Job for job, the production rate was as good as achieved in the main factory by nonhandicapped employees. There seemed to be something almost magically curative in the realization by the hospitalized individual that he was again actively contributing to the war effort and earning a proper reward in the realistic coin of the realm.

"In the treatment of the wounded, psychological factors seemed to be just as important as physical ones. Some of the most surprising results were obtained with individuals who were completely listless, or actively antagonistic to normal curative therapy. Men who were considered very ill were returned to a normal mental condition through the simple process of providing them with useful jobs and paying them for their work. The advantages of this type of rehabilitation were twofold. The patient not only seemed to recover more rapidly when contributing usefully to the economy of the Nation, but was better fitted to find employment after his discharge from the hospital. We employed many of these veterans after they were discharged from the services, with excellent results.

"I do not wish to leave the impression that our operations at Birmingham would have been practical without the close cooperation of the hospital staff. Neither am I of the opinion that the average hospitalized veteran could be taken directly into industry and given a job. My point is that with care in fitting the job to the man, and with sincere interest on the part of the employer, miracles can be achieved in the rehabilitation of the handicapped. It is obvious that the problems of effectively using the average handicapped in-

*Hawthorne, Calif.

dividual in industry are far fewer than those successfully solved in the Birmingham experiment.

"Shortly after the start of the work at Birmingham, Dr. John J. Loutzenheiser, orthopedic consultant for the Ninth Service Command, called to our attention the possibility of improvement in the mechanical prosthetic devices used in the rehabilitation of hospitalized amputees. On investigation it was found that the artificial limb industry, which as a whole was relatively small and somewhat handicapped financially at that time, had not been able to keep up with the latest advances in materials and mechanical techniques.

"At the beginning of World War II most artificial arms, for instance, were made of wood with comparatively crude metal hinges and fittings, and with leather sockets for stump attachments, and leather thongs for actuation. It was pretty obvious that the application of plastics, stainless steel, and aluminum alloys, and the best mechanical design techniques could greatly improve such products. It was likewise apparent that an improved appliance could make all the difference between helplessness and dexterity on the part of the individual concerned.

"Let me give you a simple example. Most arm amputees operate their prosthetic equipment by movements of unimpaired portions of the body. For instance, the actuation of a mechanical right hand or hook is normally achieved by a forward deflection of the left shoulder. If the mechanical connection between the shoulder and the hook involves excessive friction or sponginess, no amount of dexterity in the use of the shoulder can possibly transmit the required deftness to the mechanical hand.

"Early in World War II the average connecting device was a rawhide thong which was guided to the hand through metal or leather leads. These guiding devices were often so located that a movement of the arm would change the length of the actuating thong or cable. Friction was often so great that to apply a 2-pound load at the hand required a 10-pound effort at the shoulder. The result of these simple mechanical deficiencies was that many necessary functions were impossible to the patient equipped with the prosthetic devices then available.

"The application of the advanced material and mechanical techniques readily available to the aircraft industry changed this situation to a marked degree. First, under the complete sponsorship of our company, and later, under nonprofit contracts with the Government, we were able to greatly improve the dexterity of the amputee, simply by fitting him with a good mechanical device. The application of 2 pounds at the artificial hand or hook now required only 2½ pounds at the shoulder, instead of the previous 10 pounds, and it was possible to transmit this energy by a mechanism which worked equally well, regardless of arm or hand position.

"Several volunteer amputees were deeply interested in the development and laughingly referred to themselves as our 'test pilots.' All sorts of new gadgets were flight-tested by them, and their reports, enthusiastic or otherwise, directed our efforts. It may seem a small thing, but the joy of one of these men was unbounded when, for the first time in 20 years, he was able to pinch the lobe of his ear, scratch the back of his neck, and achieve other similar, simple, everyday actions.

'The more necessary and more complicated motions involved in dressing and undressing, eating and drinking, driving a car, and returning in all respects to personal physical independence followed in normal sequence. Later on we gilded the lily a bit by providing special equipment for amputees who wished to bowl, play golf, or engage in other sports activities.

"One of our early cases was a bilateral, above-elbow amputee who had been seriously wounded in the Battle of the Bulge. When he arrived he was virtually helpless and deeply depressed, as well he might be. His spirits rose almost at once, however, when he saw the progress that had been made up to that time, and realized that there was definite hope of his being physically self-sufficient again. He worked for several years in the testing of our prosthetic devices and rapidly became able to dress and undress himself, tie his own necktie, drive a car, and eat and drink with good and unobtrusive table manners. He was adept at the delicate jobs of removing a chocolate from a box without crushing it and lighting a cigarette. Since leaving the company he has been married and is now a successful rancher in Texas.

"In recent years plastics have been largely substituted for leather and wood, stainless steel cables for rawhide thongs, light aluminum alloys for the previous iron structural members, and ball bearings for crude riveted or bolted joints. All of these improvements have been made available to the prosthetics industry, which has gladly availed itself of them so that today the amputee has far better equipment and can be far more quickly and successfully rehabilitated than was possible at the start of World War II.

"The activities mentioned to this point are related to our main subject today, but do not apply directly to our principal interest, namely: First, how does a large manufacturing concern successfully integrate the handicapped into its operations; and second, how profitable is this operation from a purely business standpoint? I must again refer to our experience at Northrop Aircraft as being the one with which I am best acquainted.

"According to a recent survey, about 2,000 of our personnel are handicapped. Included in this group are the blind, the deaf, paraplegics, amputees, those suffering from cardiac ailments, and almost every other nontransferable physical disability.

"The first essential to the large-scale employment of such people is a genuine interest on the part of top management in the success of the program. It makes no difference whether this interest stems from humanitarian motives or from an urgent need for added manpower. It is only essential that management impress upon its medical department, as well as its general supervision, the idea that, as a company policy, handicapped persons are to be used wherever possible. It then becomes necessary for the medical department to spend enough time with each handicapped applicant to fully analyze his abilities and disabilities, and to give time and thought, in cooperation with the personnel department, to the proper placement of the individual concerned.

"Much harm can be done by overestimation of a handicapped worker's ability to perform a given task. In this evaluation a plant medical director plays an important role. Working with the personnel department a close esti-

mate must be made of the physical ability of the new employee. It is important to be as sure as possible that the new man or woman will be happy and reasonably successful on the first assigned job.

"It is better to underestimate than to overestimate capabilities in the early training and adjustment period. Common sense indicates that a blind man should not be put to work operating a high-precision machine at first, that an amputee should not be employed in a job requiring frequent and active movement from place to place, and that the deaf cannot perform effectively where proper performance depends upon oral direction.

"Supervision must have a friendly attitude during the necessary period of indoctrination, without resort to expressed sympathy or overindulgence, and continual surveys are necessary to ascertain if the placement is successful.

"Our blind people have done especially fine jobs. Some perform highly skilled work, and their supervisors have commended them again and again. Based on merit alone, they have received repeated increases in pay and repeated increases in responsibility. I sometimes feel that they are more grateful for the increased responsibility, strange as it may seem, than they are for the monetary recognition. One of the men, Joe Oberta, recently submitted several ideas to our suggestion award committee and received monetary compensation for them. The suggestions provided a faster and more accurate assembly and offered improvements in production that can be used by blind mechanics as well as those who can see. These men never see the results of their intricate handiwork but get great satisfaction from hearing the turbojets roar as each airplane leaves the factory for delivery to the Air Force.

"The technical abilities of the blind are often very surprising to those inexperienced in their employment. It is a well-known fact that their other senses develop far beyond the proficiency normally achieved by the average person. They are able to make highly complicated electrical, hydraulic, and mechanical assemblies with a lower rate of rejection and a higher rate of production than the average employee. They have often completed thousands of production hours without the loss of a single minute due to an industrial mishap. These people do not ask for, or need, any sympathy. They want only an opportunity to prove their ability and willingness to do a good job, and thoughtful consideration on the part of the employer and his supervisor in the proper selection of suitable jobs and in the somewhat prolonged training period.

"In some cases it may be necessary to give considerable thought to the proper fitting of a job to a man. Recently we received an application from a young man who is a paraplegic bound to a wheel chair. In spite of his handicap he appeared to have considerable ability and a high degree of intelligence and judgment, as well as a great deal of manual dexterity.

"The most suitable job available was on the second floor of our factory, but the building is of typical low California construction, with only stairways to get the employees to and from their work areas. This seemed momentarily to present an insurmountable obstacle to a man in a wheel chair, but since we felt he could be of considerable value to us in this particular job, we arranged to have him obtain a freight elevator operator's license. Consequently, he comes to work daily, transports himself to and from the job by way of the freight elevator, and goes about his business. The time spent in making the necessary arrangements has been well worth while.

"Although we have felt for many years that our handicapped personnel are at least on a par with our unimpaired employees, we only recently made a factual study. This study in effect matched impaired and unimpaired people under conditions as nearly identical as possible. Comparative performance was recorded of individuals in the same age and experience group, doing the same kind of work under similar conditions. The record revealed that impaired individuals consistently performed in a manner equal to, and in some respects better than did unimpaired personnel. Handicapped people were found to be more regular in their work attendance than the unimpaired. They were found to have a better record with respect to nondisability-on-the-job injuries, and their production rates were as good or better than average.

"Our initial interest in this whole subject was largely humanitarian, for at that time few managements had seriously considered it from a business standpoint. However, we have found that the employment of the physically handicapped, when properly matched to the job and properly trained for the job, is just plain good business. I know of several other large organizations which have reached exactly the same conclusion, and I know of no organization, where the problem has been approached in the right spirit, which has had unfavorable results.

"We are presently engaged in the largest peacetime industrial effort of our history. With 61,000,000 people employed, there is still a need for additional workers in many parts of the country. Yet industry as a whole has not taken advantage of the potential manpower which exists in the pool of American citizens who, though handicapped to a greater or less extent, are still fully capable of performing countless occupations faithfully and well. It is our job by word and deed, to demonstrate to industry the complete practicability of the use of large percentages of the handicapped in almost every conceivable industrial endeavor.

"Although the work of our handicapped people speaks for itself and they are writing their own tickets to success, we must give great credit to the interest being created among industrialists and others in this Nation through the annual 'National Employ the Physically Handicapped Week.' Through the work of the President's Committee and the diligent effort of its executive officials on Federal, State and local levels, the public has become more conscious of the great potential value of the thousands of capable handicapped persons in this country.

"If this program is carried to its maximum effectiveness by individual industries through the coordination of organizations such as this Committee and the State and local committees, everyone will benefit. The handicapped will be able to carry their heads high, industry will have a valuable source of manpower to draw on, and each community will have absorbed into its economic life outstandingly loyal citizens who have already demonstrated our American brand of courage by bearing their personal crosses without surrender and without complaint."

CALIFORNIA

Lettuce Packing Industry.—In response to a request from the Monterey County health officer, an investigation is being made of exposure to acetaldol in the lettuce packing industry. The acetaldol is used to prevent the stem ends of lettuce from turning brown during shipment. Exposure to this material, which causes complaints of irritation to the nose and throat, is also the subject of a union complaint. Preliminary investigation indicates that the problem is one which involves much irritation, but that serious or lasting damage to the health as a result of such exposures does not appear likely. Nevertheless, a more complete and thorough investigation of the magnitude of exposures and the potential health hazard is being conducted. In the meantime, several measures for prevention of the irritating and unnecessary exposures have been devised and are being recommended.

Gold Dust.—A joint program with the U. S. Bureau of Mines is under way for the purpose of establishing a dust counting evaluation program for a large gold mine in the Mother Lode country. Equipment and materials are being purchased for a dust counting laboratory, and company safety engineers are being trained in accepted technique and procedure for dust counting. The company plans to discuss the subject of dust exposures at its employee safety meetings for the purpose of imparting knowledge to the miners concerning the health hazards in connection with mining operations and also for the purpose of obtaining employee cooperation in the elimination of excessive and unnecessary dust concentrations.

The company believes that dust suppression measures can be carried out in the most effective manner only through such cooperation with the workers. In our opinion, programs of this kind are a real service, and we anticipate that many other large companies with industrial health problems will learn of the benefits to be obtained in this kind of activity and will inaugurate similar programs.

ILLINOIS

Cholinesterase Tests.—Illinois physicians have been offered a new service by the State Department of Public Health in connection with organic phosphate exposures To determine the exposure, tests for cholinesterase activity in the blood are made by the state chemists. The tests are made on 5 cc. samples of heparinized blood, rather than on micro samples, which the physicians mail to the laboratories. Preliminary studies had indicated that the cholinesterase values were not reduced after holding 7 days at room temperature, although the distribution between plasma and red blood cells was altered.

LOS ANGELES CITY

New Publication.—To further good industrial health, a new monthly periodical, called *Occupational Health News*, is being written for industrial physicians, engineers and nurses. Many plant managers also are on the mailing list The October issue included articles on radiological health, dermatitis in industry, sanitary maintenance, and other pertinent subjects.

TENNESSEE

Personnel.—Dr. Edward C. Mulliniks became director in 1952 of the Tennessee Industrial Hygiene Service, filling the position held by the late Dr. H. H. Hudson. To give better service to industry in upper East Tennessee, Mr. Robert H. Wolle, industrial hygiene engineer, was assigned to the Regional Office of the Tennessee Department of Public Health in Knoxville.

Having served as health officer in Springfield, Mo., from 1938 to 1941 and in Johnson City, Tenn., from 1945 to 1951, Dr. Mulliniks is well-known and experienced in the field of public health.

WISCONSIN

Noise.—Over 400 persons attended the three industrial noise control clinics held in Eau Claire, Neenah, and Watertown, Wis., on September 25, October 30, and November 6, respectively. Planned by the Wisconsin Council of Safety for members of the medical, legal, and allied professions as well as for those persons in industry who are responsible for health and safety, the clinics offered four formal presentations and a 1-hour question and answer period.

Dr. H. G. Kobrak of the University of Chicago spoke on the physiology of hearing and the damage to the ear by excessive noise. Dr. Meyer F. Fox of Milwaukee's Mount Sinai Hospital covered the medical problems involved in clinical evaluation of hearing loss.

Dr. William L. Lea, director of the Industrial Hygiene Division, Wisconsin Board of Health, explained the physics of sound generation and transmission, and the importance of frequency and intensity. The uses of the sound level meter and the octave band frequency analyzer were discussed in relation to the evaluation of industrial noise exposure. The principles of operation and the use of the audiometer in evaluating employee hearing were also explained.

Mr. Harry A. Nelson, director of the Workmen's Compensation Division of the Wisconsin Industrial Commission, discussed the legal aspects of industrial noise and explained the reasoning employed by the Commission in deciding compensation cases.

Cosponsors of the clinics were the Industrial Hygiene Division of the State Board of Health, the Industrial Commission, and the Wisconsin Manufacturers' Association.

Physicians Offered Fellowships in Industrial Medicine

The Institute of Industrial Health of the University of Cincinnati will accept applications for a limited number of fellowships which will be offered to qualified candidates who wish to pursue a graduate course of instruction in preparation for the practice of industrial medicine. Any registered physician who is a graduate of a class A medical school and who has completed satisfactorily at least 2 years of training in a hospital accredited by the American Medical Association may apply for a fellowship in the Institute of Industrial Health. (Service in the armed forces or private practice may be substituted for 1 year of training.)

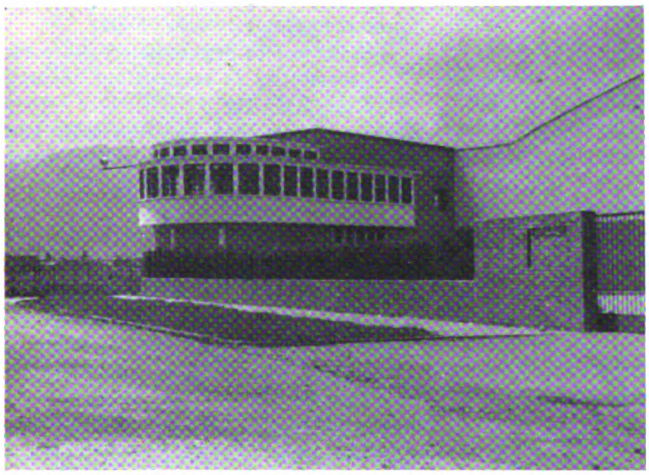
The course of instruction consists of a 2-year period of intensive training in industrial medicine, followed by 1 year of practical experience under adequate supervision in industry.

During the first 2 years, the stipends for the fellowship vary, in accordance with the marital status of the individual, from $2,100 to $3,000. In the third year, the candidate will be compensated for his service by the industry in which he is completing his training.

A 1-year course, without stipend, is also offered to qualified applicants.

Requests for additional information should be addressed to the Institute of Industrial Health, College of Medicine, Eden and Bethesda, Cincinnati 19, Ohio.

WORKERS' BABIES CARED FOR IN MODERN NURSERY PROVIDED BY INDUSTRY



Women employees of a large bottling plant in Bogota, Colombia, take their babies to work with them each day and leave them in an attractive, well-equipped nursery provided by the factory management. The plant, which produces a variety of soft drinks and bottled carbonated water, is one of the largest in that area, employing over 600 workers of whom about a fourth are women.

A labor code in Colombia requires that employers, when they hire more than 50 women, must establish and sustain a sala-cuna, or nursery, for the women's children under 2 years of age. Older children also are often cared for. The law requires that medical services and a full-time nurse be provided for the children. Information and photographs contributed by Marion F. Trice, Industrial Hygiene Engineer, Division of Health and Sanitation, Institute of Inter-American Affairs, Bogota, Colombia, S. A.

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NOTICE—PUBLICATION CHANGES PRICE

Foreign Commerce Weekly, formerly priced at $9 a year for domestic subscriptions, $12 for foreign, is now $3.50 a year, domestic, and $4.50 a year, foreign. The magazine may be ordered from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

AVAILABLE PUBLICATION

The annual report of the number of professional registered nurses employed full time in United States industries during 1951 has been compiled and prepared for distribution to those persons who need the information. The figures were compiled by the Division of Occupational Health, Public Health Service, in cooperation with State and territorial health departments.

Address requests for copies of the publication to the Division of Occupational Health, Public Health Service, Federal Security Agency, Washington 25, D. C.

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Atomic Energy Commission, Declassified Document Number UR18 (1948).

(*4*) Cholak, J., and Hubbard, D. M.: Spectrographic determination of beryllium in biological material and in air. *Anal. Chem., 20*: 73 (1948).

LETTERS from the READERS

Subject: Formaldehyde vapors

SIR: We are particularly interested in an article in the October issue of OCCUPATIONAL HEALTH, page 170, entitled "Eye and Throat Irritation Due to Formaldehyde," because of our experience with this substance in 1951. Quoting from our annual report, the story is summarized as follows:

"The unusual exposure to formaldehyde vapors encountered in nuisance proportions in the clothing industry was the result of storage of crease-resistant cloth during the summer season. It is understood that the cloth is treated in the mills with a paraformaldehyde preparation and under certain storage conditions vapors emanate in sufficient quantity to irritate the eyes of the workers. Sixteen mills located in New York and New Jersey supplied the nine local shops using the material. Workers in six shops gave a history of noticing the vapor and in three of these the concentrations caused several complaints. A study of the air in one Baltimore establishment showed a concentration of one part of formaldehyde in a million parts of air. As cooler weather approached the difficulty disappeared."

Apparently the problem created by using formaldehyde in cloth is not an unusual one. We have been concerned with whether or not such cloth coming in contact with the skin, particularly in hot weather, would produce skin irritation. No such cases have come to our attention, yet neither have we given this phase of the work any publicity.—**Charles E. Couchman, Director, Bureau of Industrial Hygiene, Baltimore City Health Department, Baltimore, Md.**

Workshop on Public Health and Industrial Dentistry Planned

A one-day workshop on "Trends in Public Health and Industrial Dentistry" has been planned for Friday, January 30, to be held at the Hotel Statler in New York City. The discussions, to which all members of the health professions are invited, have been planned by the First District Dental Society of the State of New York.

Occupational oral medicine and public health will be discussed in the morning session by a panel of speakers which includes Drs. A. J. Lanza, J. A. Salzman, W. A. Harrigan, and D. H. Goldstein. Subjects for the afternoon panels are "Dental Care in Occupational Health Programs" and "The Private Dentist's Role in Program Planning: Practical Problems and Issues."

Admission to all the sessions is free. For registration forms, write to Public Health Workshop, First District Dental Society, Hotel Statler, New York, N. Y.

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