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several specially manufactured water-washed air units for this purpose. The grindings are picked up at the point of operation, wetted and drawn into a container of water and kept submerged in water until cleaning time. These units must be ventilated to the outside to prevent gases produced by the action of water and magnesium from escaping into the workroom area. The sludge collected from these units should be buried or burned. People working with magnesium should not wear clothing that collects these fine grindings. In other words, no pants cuffs or exposed pockets should be worn, and employees should be careful to brush all material from their clothing before leaving the job.

Much more could be said about the processing of magnesium. However, time does not permit. The companies manufacturing this metal have quantities of material and are only too willing to supply it. There have been serious magnesium fires that have caused serious injury and death.

You no doubt have the same problem in the use of respirators as we; meaning, of course, the one of getting employees to use them faithfully. I believe there will be less need for them if more work is done on special ventilation for the hazardous operations.

Something more should be said for personal protective safety equipment, since all aircraft companies on the Pacific Coast furnish this equipment free of charge to their employees. Some of the items furnished for eye protection include safety glasses, clear and dark goggles, eye shields, welders' goggles, and hoods. Other items furnished are gloves of rubber, leather and leather face canvas back; aprons of canvas, leather and rubber; respirators, for the protection of employees from harmful fumes and dusts; hard hats where needed, both aluminum and fiber; safety belts where needed; protective creams for the prevention of skin diseases; and asbestos leggings for foundrymen. Safety shoes are sold at cost on a 50-cent a week payroll deduction plan. We feel that by making this equipment readily available and easily obtainable, we receive the finest cooperation from the employees when it comes to wearing this equipment.

In the past six months we have painted all the machines in several departments according to "three dimensional seeing" plan and have had very favorable results, such as

better housekeeping, increased visibility, better lighting results, more interest on the operators' parts in keeping the machine looking neat and clean, and more attention paid to moving parts. Proper lighting, good wall color, neat and well-defined aisle lines, and the machines all newly painted give the employees a sense of responsibility to do a good, safe job.

When we first started to glue paper on plexiglas to prevent scratching while it was being handled in the shop, we built a dust-proof room to be used in placing the glue on the paper that was to be stuck on the plexiglas to prevent scratching. This room was also used as a drying room. We anticipated a certain amount of fumes and ventilated this area after a fashion. The reason for not bringing too much air in the room was to keep down as much dust as possible. We put two employees in this room doing the glueing job and after they had worked under these conditions for about three months their systems became saturated to the point that one day they both passed out. It took about four hours for one man to regain consciousness. Upon investigating the process, we found that the glue contained chloroform as a thinning and drying agent. The room was then adequately ventilated with filtered air and another room was added to apply the glue. The employees are not permitted to stay in the drying room any length of time.

This is only one of many examples that I could tell of if time permitted. I believe that we have eliminated this trial and error method now because every process bulletin pertaining to acids, solvents, or alkalis that is written up by our company has in bold type at the bottom of the bulletin plainly visible to the user "See Safety Engineering Department for Instructions for Proper Personal Precautions." We also receive a copy of every process bulletin written and if, in due time, we have not been contacted by the shop in regard to the bulletin, we place a sign at the particular location giving the precautions that must be followed by employees. The supervisor or foreman is also informed of the dangers if these precautions are not enforced. This procedure has entirely prevented anyone from introducing processes without notifying the safety department.

We found recently, when classifying our

lost-time accidents, that about ten per cent were eye cases. This percentage also held true in the first aid cases that reported to the dispensaries to have chips removed from their eyes. A year or so ago, this percentage was running almost 20 per cent, but

some reduction has been made. I find in checking our industry that we lose from one to two eyes a year and I know that you, along with the rest of us, have tried almost every means to bring this condition to an end.

Health Conservation in Airplane Manufacturing

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The problem of conservation of manpower has received a great deal of attention in industrial medical literature during the past few years, and important fundamental facts are being learned through widespread statistical studies. From the purely financial viewpoint it is very important to management when you consider that a plant has to carry a two or three per cent overload on its payroll to provide workmen to fill the jobs of those constantly absent through illness and accident. Management used not to worry so much about this overhead when good replacements were numerous. Now when it becomes practically impossible to replace a skilled individual on his job during his absence, the reduction of absenteeism becomes important.

An analysis of the causes of time lost from work through illness and accident reveals the fact that, in general, of every 100 days lost, five are due to accidents of occupational origin; ten to accidents of non-occupational origin; and 85 to illness, of which less than one per cent is occupational in origin.

Loss Due to Occupational Accidents

Aircraft manufacturing is considered one of the "safer" of the major industries. This does not mean that we can relax in any way on our safety and medical programs. On the contrary we believe that our frequency rate of 9.5 and our severity rate of .6 has been the result of a well planned and executed safety program, and a medical program designed to meet the needs of proper initial placement and subsequent treatment of the injured worker.

Under the direction of our chief safety engineer, a well rounded safety program has been carried on which has placed emphasis on

protective eye equipment, inter-departmental competition for the safety trophy, and visual education using posters, pictures, and stories in our weekly publication. It must be emphasized here, however, that any relaxation of the continuous program of inspection and enforcement of safety rules results in an upswing of the accident rate. This was demonstrated in one of our newer plants recently during a change of safety department personnel.

Medical supervision of a worker begins before his employment at the time of the original physical examination. The physical examination given a prospective employee has always been considered a placement examination. We view it from the standpoint of adjustment of the individual to the job, not only with respect to the possibility of accident episodes, but also with respect to the physical requirements of the job and his ability to cope with them in a manner safe to himself and others. This fulfills the dual purpose of assuring the employee that he is being placed on a job commensurate with his ability and also of limiting him to jobs considered safe, if some physical defect is found to exist.

This latter phase has become of very great importance now that selection of employees must come mainly from the ranks of those physically disqualified for military service. The necessity of hiring individuals with physical handicaps has led us to make a thorough survey of all occupations where any of the various handicaps may be utilized. In cooperation with the department foremen of one of our large plants, it was determined that approximately 25% of the jobs could, if necessary, be filled with individuals having such physical limitations as blindness in one eye, totally blind, deaf, deaf-mute, limited use of

one extremity, loss of several fingers of one hand, loss of one hand, loss of one arm, loss of one leg, loss of both legs, hernia adequately supported, etc.

Intelligent placement requires, on the part of the examining physicians, a thorough knowledge of all of the plant jobs. To assist in this training we have compiled a list of all occupations in the plants with appropriate descriptions of the type of work, classification as to hazards, and physical ability necessary to perform the job.

As our labor force increases to the highest level in our history, it will be necessary to salvage not only material resources but human resources as well. In this capacity the examining physician fills an unquestioned role. After examination the employee is classified either as "unlimited", if no physical impairment exists, or as "limited", if some impairment exists which might be a hazard on some job. Those classed as "limited" may be transferred to other jobs only with the consent of the medical department.

In order to appraise correctly the health status and working ability of a prospective employee, the medical examiner must be able to do a thorough examination with the help of such diagnostic aids as x-ray, blood tests, electrocardiograms, etc. These we provide on the theory that decisions must be based on an adequate amount of factual evidence.

Our policy has always been to exclude those with communicable disease and those having such serious impairment to render them unfit to work or a hazard to themselves or others. In the interest of the all-out production drive and for the protection of workers now employed, I believe such persons still must be excluded. Part of the program for conservation of human resources must include the elimination or segregation of the few who would be a menace to the whole.

Once the employee has been put to work, we assume the responsibility of providing medical care for him for any injury or illness that he receives as a result of his work. The nature of the majority of the work, involving as it does the handling of sheet metal and small tools, results in a very high rate of minor accidents that do not produce loss of time and may necessitate only one or two

dressings. This constitutes a much greater problem from the standpoint of first-aid treatment than does the more serious lost-time accident. In this first minor group we have approximately 30,000 treatments per month (including retreatments), while there is an average of only 62 lost-time accidents per month.

The necessity of treating such large numbers of minor cases dictates the policy of placing several first-aid stations throughout the plant so that easy access may be had to them by any injured employee. In this way we can insist that everyone with an injury as minor as a scratch be treated. We feel that this policy of insisting that even the most minor injuries be treated is sound, for in this way we are able to keep the complication of infection at a virtual minimum and prevent the apparently trivial injuries from causing subsequent loss of time through infection.

When infections are discovered we believe that immediate hospitalization and treatment with hot compresses and immobilization shortens disability, thus returning the employee to work sooner.

Eye injuries form one of the commonest of the group of minor injuries. We wish to emphasize the necessity of gentle treatment and a very careful search for small embedded foreign bodies in order to prevent corneal ulcers and a loss of time from an otherwise simple injury.

Another time-saving device we have found to be the practice of hospitalizing all head injuries where the blow has been severe enough to produce even momentary loss of consciousness. Enforced bed rest for a few days is the best insurance against subsequent prolonged disability due to persistent headaches.

The keynote of all of our medical treatment of industrial injuries is to render the best possible treatment as quickly as possible so that a minimum of time will be lost from work.

Rehabilitation following injury and early return to work, if this can be accomplished with braces, casts, or other aids, is encouraged. Attempts are made to provide suitable types of work in keeping with the handicap. We have estimated that it is more economical to return a man to work, even though he can

do only a portion of a full job, than it is to keep him off work until completely cured. Therefore, our aim is to conserve manpower by returning an individual to work as soon as possible. We believe this pays in morale, earlier recovery, lower compensation cost, and increased production.

Loss Due to Non-Occupational Accidents

Of the total loss of man days due to accidents among our workers, only about one-fourth are attributable to industrial accidents, whose prevention and treatment we have been discussing. Off-the-job accidents, although not the responsibility of the employer, are none the less still his concern. A disabled worker represents the same industrial loss from the standpoint of replacement and production regardless of the cause of his disability. Therefore, if these off-the-job accidents account for the greater loss of time, I believe that industries should expand their plant safety campaigns to extend beyond the factory gates and into the employees' off hours. This waste of our human resources should not go unchallenged.

The secret of reduction of accidents in this group lies in education. The National Safety Council has pointed the way and pioneered in this field. We are attempting to carry this on by articles and cartoons in our weekly and monthly publications which stress off-the-job safety. Seasonal conditions such as sunburn or holiday and week-end trips receive special attention through these channels.

It will be interesting to note whether or not the reduction in private car driving during the coming year will not tend to reduce these accidents. I believe we can anticipate a lower rate this next year.

Loss Due to Occupational Disease

We find by an analysis of illness statistics that less than one per cent can be traced to causes associated with hazards of the job. The vast majority are due to the common every-day factors of disease, such as respiratory diseases, digestive diseases, etc.

However, a great deal of time and effort is spent in keeping the health hazards of the various jobs under control. This requires constant vigilance on the part of our toxicologist and industrial hygienist. He has to be

familiar with every manufacturing process and is kept informed of changes as they are contemplated or made. This job is now particularly difficult due to the rapidly changing methods and processes in this industry. Many chemicals and compounds are being used with which there has been little or no previous toxicologic experience; consequently the toxicologist must be ingenious enough to devise entirely new methods of sampling, new standards, and new methods of analysis.

The jobs or processes where chemicals, dusts, fumes, vapors, or other toxic agents are known to exist include:

Operation	Hazard
Spray painting—	Solvent vapors, zinc chromate
Degreasing—	Trichlorethylene vapors
Sand blasting—	Silica dust
Die casting and grinding—	Lead fumes
Electrical assembly—	Lead fumes, trichlorethylene vapors
Welding—	Fluorides, oxides of nitrogen, and metal fumes
Anodizing—	Chromic acid
Pickling, etc.—	Oxides of nitrogen, hydrofluoric acid
Plating—	Hydrocyanic acid
Linotex installation—	Solvent vapors

Two methods of analysis may be used to determine the presence of health hazards; one, the examination of the personnel in suspected areas for clinical evidence of illness or intoxication; and second, examination of the environment for evidence of harmful or toxic agents. The latter is more scientific and accurate, but should be corroborated by periodic physical examinations or spot checks on individuals in areas of suspected or potential hazard. It is necessary to check these potential sources of hazard at regular intervals and under the varying working conditions of day and night so that the period of greatest concentration may be determined. The maintenance of a continuous record of these determinations is very important as an index to guide us in instituting specialized examination procedures to determine early signs of intoxications.

It is also advisable occasionally to check areas where hazards are thought less likely to exist. For example, we found that in the foundry around the lead pots the vapor concentration was always very low. An obvious hazard existed and was being well taken care of. However, an analysis in the detail assembly department where considerable bench soldering was being done revealed a considerably higher concentration. The hazard was much less obvious here but more real; and in this case it was much better to have diagnosed the hazard by laboratory means than by the possible subsequent illness of several workers.

I wish to emphasize the importance of keeping the toxicologist informed of any change of processing. Vendors are very apt to make unfounded statements of the safety of chemical solutions or be themselves unaware of the hazardous or toxic properties of the vapors developed from them. A new process of gluing rubber to gas tanks was instituted once in our assembly department. Fortunately several workmen became sick from exposure to the fumes during the first two or three days. I say "fortunately" because the solvent being used was found to contain a high percentage of benzol. Had the symptoms been less acute, a longer time might have elapsed and much permanent damage been done before this hazard would have been discovered. I cannot too strongly stress the fact that the toxicologist should be kept informed of all contemplated changes in, or institution of, new processes.

Loss Due to Non-Occupational Illness

The loss of time through non-occupational illness accounts for about 80-85 per cent of the total loss through accident and illness. It would seem logical and important then to study the causes of the illnesses in this major group to the end that measures may be instituted to lower the rate. It becomes doubly important now to study this group because we have every reason to expect these rates to increase due to the following reasons:

As employment reaches into the groups previously unemployed, utilization will be made of those with poorer physical qualifications and consequently poorer endurance and resistance to disease. The increase of working hours, increase in the employment of women, the increased nervous tension, the necessity of working odd shifts, and the pos-

sibility of working and living under more crowded conditions will all probably have their effect.

Special studies of sickness-absenteeism can be of greatest value when made as an individual plant study; for undoubtedly so many factors influence these rates that preventive measures can be instituted only on the basis of accurate knowledge of the specific problems involved. This of course requires a good record system for making available the statistics usually developed in the insurance and medical departments of every company.

Once the principal causes of sickness-absenteeism have been determined, it will become obvious that reduction of time lost through this cause can be effected through better methods of treatment or through prevention. The employer has no part or responsibility in the treatment of these non-occupational illnesses. Therefore, his only contribution can be on the side of prevention of illness. Expressed conversely, this means maintenance of health.

This problem of maintenance of health, of course, begins with our first contact with the employee at his entrance examination. Through this means conditions which will not immediately disable, but the correction of which would be to his health advantage, can be brought to the employees' attention. Periodic health examinations can also be made to recheck individuals with physical impairments. It is important to examine individuals of the older age groups because of the known increased frequency of disabilities. It is also important to examine supervisory personnel regularly because of their greater responsibility and value to the organization.

It is necessary to keep an accurate check on everyone returning to work so that examination or inspection may be made of those who have been disabled through illness. It is necessary also to check the causes of absence so that those with communicable disease will not return during the contagious stages. The job of a returning worker may need to be changed temporarily, if he has been absent due to surgery.

Fatigue in relation to hours worked is a problem that deserves more attention as more overtime is worked. Beyond a certain point,

there is a definite diminishing of work returns. Absentee studies should help to determine this optimum work week through analysis of sickness frequency in relation to overtime worked.

The importance of health education is well recognized, and articles of general interest are used in our monthly magazine. At present a series on "Vitamins and Health" is being run. It is important that such items be interesting and stimulate a desire on the part of the employee to seek further information through his physician.

The subject of nutrition is important and is receiving much national publicity. In an attempt to get some practical answer to this complex problem, we are conducting a nutrition survey in cooperation with the California Institute of Technology. It is still in progress. As we had expected, dietetic histories and physical examinations conducted on over 1,200 employees revealed evidence of inadequate diets and greater or lesser deficiencies in the majority of those examined. Education regarding normal food requirements and eating habits is needed. We believe that where a balanced diet adequate in minerals and vitamins can be obtained, the worker's health interest is best served by his obtaining these elements in their natural form rather than through synthetic supplements.

A great deal of education is needed regarding the proper eating and sleeping habits for those on the second and third shifts. These working hours are not injurious to the health of the individual if he establishes regular habits regarding eating and sleeping.

Educational programs should also point out to employees the high cost in production loss due to absenteeism and try to emphasize the

necessity of every production worker giving a full six-day week for fifty-one weeks of the year. It is a patriotic duty to keep well. Vacations are necessary and can be dispensed with only at the cost of health and efficiency.

The medical department of a plant has, in addition to its responsibility of treating injuries, the duty of rendering such minor medical aid to the employee on the job that may insure his staying on the job and working more efficiently. This includes rendering of such minor treatments as may be necessary for the relief of symptoms caused by throats, headaches, minor digestive disturbances, etc. Approximately 10,000 such minor treatments are rendered each week at Lockheed.

Scrutiny of every worker leaving the plant because of illness is important so that he may be advised regarding the necessity of proper medical care. It is the privilege of the employee to consult the doctor for advice concerning his medical problems. When early signs or symptoms of disease are present, the employee is referred to his own physician for advice and treatment. Treatment is never undertaken at the plant.

It is not the province of industry to usurp the position of the private physician by rendering treatment for non-occupational conditions. We feel that it is important to foster this patient-physician relationship and believe that this can be done by cooperating with the employee's physician, who in turn should be made to feel a responsibility in cooperating with the plant by returning the employee to work as soon as practical. The actual responsibility for the employee's health is thus placed primarily on practicing physicians. Cooperation is necessary between the industrial physician and the worker's private physician to the end that the ideal of effective preventive medicine be carried out.