

are those actually associated with operating procedures plus certain incidental and unnecessary lead exposures which arise from relatively crude methods of housekeeping and general sanitation. The exposure to vapors of molten lead at the top of the tower may be appreciable. This could be reduced if necessary by giving further detailed attention to the ventilation, especially over or at the side of the perforated pan into which the molten metal is run. One suspects, however, that the cleaning up of the area around the melting pots and the equipment in this space results in more dust than is necessary. By careful attention to the smoothness of the floor and by cleaning with a vacuum cleaner, the dust here could largely be eliminated.

On other floors, the handling of the shot, in sorting, grading etc., the exposure to dusts may be slight. It seems probable that some dust is created by all the operations, but it would appear

Memorandum in Connection with Visit to Remington Arms Co., Inc.

Survey of Plant

Various plant operations were examined with the idea of noting the general character of the lead hazards and the degree to which they might be deserving of study. The following notations are not designed to describe the operations or their hazards in detail, but are intended as a rough working basis for further study and also as tentative suggestions for making improvements.

The Shot Tower

The hazards in the present method of making shot

ing, in other words, is not as clean as construction as to be difficult to keep found to be necessary to decrease the lead it would seem to be advisable to improve steps etc.) and to do all cleaning by vacuuming.

Such contact as the workmen have with dusty surfaces is somewhat more important than it should be, because of the poor quality of the clothing provided. It is necessary to provide clothing for use during the work in the rooms and double lockers. The need for the other hygienic steps referred to depends on the degree of the over-all exposure to lead, which has been determined by the study of a representative group of workers. It must be admitted, however, that the sanitary facilities are rather elementary, and are not as adequate in connection with an hazardous work as they should be.

Certain other activities are carried on in the shot tower, but carried on in the open air. The preparation of the metal for making shot, the handling of the metal when they hit, and the handling of this metal when they are to be continued, should be carried on in a more prompt manner. At present the dust evolved during the operations and the spaces are cleaned up. The use of a respirator during certain operations and the cleaning of the spaces are cleaned up. The use of a respirator during certain operations and the cleaning of the spaces are cleaned up.

where lead dusts occur, one may describe satisfactory cleaning methods, in general, as being either (1) by vacuum, or (2) by wet methods, - hosing, mopping, or sprinkling.

Bullet Molding.

Some degree of lead exposure is certain to exist in connection with bullet molding by any of the processes now in use, as the result of fumes from molten metal, and dusts and metal particles which collect on floors and on equipment around the operations. The magnitude of the actual danger from these combined sources is unknown but probably small, but again such improvement as may be necessary for hygienic reasons can probably be obtained by more rigid and more efficient housekeeping.

An additional and avoidable hazard arises from the tumbling of bullets punched out by the newer cold process. The tumblers produce considerable and, I should judge, dangerous quantities of dust of metallic lead. These should be carefully hooded to prevent

certain intermittent and comparatively infrequent jobs. Otherwise it is an admission of the unsatisfactory status of plant operations and should not be condoned except during periods when plant processes are in a developmental stage in which the nature of the eventual hazards is unpredictable.

The handling of dross in this building is not satisfactory. Such dusty materials should be segregated as quickly as possible into a separate and well isolated area, and should be handled, so far as possible, by means of, with specially designed, dust-proof equipment. The floors in such an area should be smooth so as to be easily cleaned and other equipment should be arranged in an orderly and convenient manner with an eye to minimizing handling. Cleaning should be done by vacuum if possible. Indeed

evening would contribute to the effective
The swallowing of lead with tobacco and
proper attention to the cleanliness of o
men. It seems highly inadvisable to per
looseness in these matters, when such can
bring the total lead exposure up to a da
unavoidable occupational exposure may m
In this connection, the habit of chewing
advantageous to the workmen and should n
hesitates to advise the restriction of a
Heat Treating with Molten Lead.

It seems probable that the
to provide a reducing atmosphere overly
for tempering steel, diminishes the fume
vanishing point. If, therefore, these
care against spillage of metal or dross,
other surfaces within the vicinity of th
free of materials which could give rise
little hazard at the temperatures prevail
questions the cleanliness of the surround
quantities of lead which are swallowed
of the dirtiness of his surroundings, of
quantities of dust which are unnecessary
by strong convection currents sweeping a

and the significance can probably be ascertained by taking into account the degree of the time of entrance of men and the duration of the ranges. I should recommend air sampling in a manner as to indicate the degree of contamination and subsidence of the lead particles. As a result, it should suggest the advisability of confinement to the space in which it is produced, by means of the ranges that a minimal amount of dust is a threshold, whether in the form of particles of the door sill, or as material carried into the enter. The construction of the doorway should be while a simple type of scraper at the entrance and care of the latter.

Recommendations for Study

Various observations have been made of the content of the atmosphere in various parts of the plant. It is suggested that further observations be made during the coming year in order to obtain data which will permit periodic analyses on the excretion of workers.

By reason of the somewhat limited knowledge of the plant with respect to house-keeping, it is certain that air analyses will not reveal the exposure of workmen in a comprehensive manner. If respirators are used in some areas it is

there is no other satisfactory way of determining the exposure of these men. In order to obtain information by such means it is necessary to rely on the light of experience.

The Significance of the Lead Content of

Dust-laden air when breathed leads to the partial deposition of dust on the mucous passages. Variable proportions of such dust, under different conditions, enter the nasopharynx and are swallowed, whence it is largely evacuated with the feces; therefore, the quantity of lead which appears in the feces on one day, minus the quantity ingested with food and tobacco (or otherwise) on the day before, represents the dust deposited in the nasopharynx as the result of dust inhalation. On the basis of this principle, the study of the feces of exposed workmen who have worked on the day before, gives a clear idea of the extent of their exposure to dust. Dust inhalation, careless ingestion, or a combination of the two is very useful, therefore, to study the feces of workmen who are actually working, but if two or more days elapse between working day and the collection of the feces, the results are valueless. Such samples should not be collected on a day during any kind of holiday or lay-off. The rate of evacuation of feces is substantially equal for all men. It is not necessary, nor is it feasible

as to what is desired, written instructions
hands, where these can serve any useful purpose
are either given to them when they are ready
or, better, the containers are delivered to them
sample can be collected after or before washing
and changing clothes. The necessary instructions are
following paragraphs.

The chemically clean jar supplied
of feces must be kept and opened in a place free
of dust, and in which it will not be over-
be kept sealed in its paper bag until it is to be

A single average or normal specimen
collected directly into the jar. No intestinal
used, nor should any preservative or other
sample. (If preservative is required a small amount
added in this laboratory.) Great care must be
introduction of dust or any other foreign
Laxatives or cathartics must not be employed
medicine be taken for at least forty-eight hours
tion of the sample, except on the advice of a physician

The rubber ring should be carefully
clamped carefully and securely, the jar should be
name and date, and sealed in its paper bag

Lead in the urine, as distinct from feces, is the result of actual lead absorption, and concentrations of lead vary with a number of factors, which, in order of decreasing importance, are: (1) the lead actually available in the tissues of the body; (2) the rate of the stream of lead entering the blood through the portals of absorption, and, (3) the water intake over a period of time. If the individual under study has absorbed significant quantities of lead from the environment, the urinary lead level is indicative of the extent of lead absorption, i.e. the lead content of the urine makes the determination of the urinary lead level of great practical importance as a measure of the magnitude of lead exposure over a considerable period of time. To be of maximal value for this purpose, the urine should be samples of sufficient volume to smooth out fluctuations or changes in rate of water intake and output. Urinary samples are less valuable than samples of blood over a period of time. Spot samples, on the other hand, require adequate care against minute contamination of the examiner, rule out the misleading results due to accidental contamination of samples which can occur without continual supervision. In some cases, multiple urinary samples are necessary to ascertain the lead level.

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The chemically clean bottle of urine must be kept and opened in a place free of dust, and neither excessively hot or cold. The bottle must be kept sealed in its paper bag until it is to be stoppered tightly and returned to the laboratory. No attempt should be made to obtain samples without the physician's orders, unless the premises are unusual. It is generally advisable to collect the sample at home, to the home where the sample can be collected at any time of the day or night, after bathing and changing clothes.

Urine should be collected at convenient times over a period of hours. If more than three quarts have been obtained, the excess should not be used, nor should any preservative or other substance be added to the sample. (If preservative is required, it should be added to the container in this laboratory.) The laboratory should exercise against the introduction of dust or other material into the container during the collection. The quantities of water or other liquids should be limited. To speed up the collection of the sample, no other measures should be taken except on the advice of the physician in charge.

When the sample has been collected, the bottle should be stoppered tightly, labeled with the name of the patient, and sealed in its paper bag.

clothing before entering the room in which taken and must bathe.

Approximately 100 cc of ur directly into the sample bottle in the p or attendant. The stopper (and the prot paper) should be removed and held by its attendant so that it may not be containi desk, table or other object. It should as soon as the sample has been obtained, covered with the filter paper shield. N material may be added to the sample.

The bottle should be label patient and the date and hour at which t packed with care against the possibility

It must be emphasized that industrial plants should be obtained und workman has removed his clothing, and ha then has entered a clean room, free of a voided. In every instance the stopper o removed and held by the examiner so it w table or shelf or other surface. After it should be returned directly to the bo with the filter paper cover, and secured or string. It should also be stressed t

that such samples be obtained whenever a man potentially exposed to lead hazards presents himself to the plant physician with complaints which are compatible with or suggestive of a diagnosis of plumbism. Containers and needles can be sent on short notice for this purpose.

Instructions for the Collection of Blood for Lead Analysis.

Blood samples must be taken in a space which is free of dust. Despite this precaution it is necessary to use the most meticulous care against the contamination of samples with surface or atmospheric dusts.

The subject or patient must remove any dust laden clothing before entering the room in which the sample is to be taken, and must bathe.

The cork should be removed from the tube in which the blood is to be drawn only during the withdrawal of the blood, and should not be permitted to come in contact with the table top

to obtain a spot sample of urine, and a corroborative sample of some hands is confined chiefly to diagnostic purposes when one wishes otherwise as urinary samples. For this reason their use in our of the person from whom they are taken. They are not as valuable in that they can be obtained without any dependence upon the efforts manner that no possibility for contamination exists they are valuable or checking the validity of urine samples. When obtained in such in the instructions listed below, are of use chiefly in verifying blood samples, collected in the manner indicated

The Significance of Blood Samples.

is expected of them.
Instructions in such manner that they will understand fully what the collection of large samples should be given careful verbal

tube by means of a rubber band.

The sterile needle provided be used to withdraw approximately 10 cc of blood tube. Under no circumstances may any substance be added or any intermediate of the needle be sterilized by boiling in water. If the needle be rendered non-sterile accidentally, it must be discarded before use. After use it may be rinsed with sterile water and returned to the tube. Cotton should be wrapped around the hub to prevent breakage in transit.

The blood samples should be labeled with the name of the patient and the date and hour at which the sample was taken and packed with care to see that the contents do not leak or may not occur in transit.

The sample should be mailed to the Kettering Laboratory of Applied Physiology, Cincinnati, Ohio.

Suggested Procedure for Work

In order to determine the exposure associated with the operations discovered, to discover the variations that occur from time to time, a group of representatives on the basis of their reliability in doing so and on the further basis of the constancy

ployment in relation to some particular type of occupational exposure. (This selection was made tentatively at a conference between Drs. Yeager and Kahoe). These men should be followed quarterly, so as to see any seasonal influence due to temperature, ventilation etc. by means of fecal samples and, so far as possible, by large samples of urine. If large samples of urine cannot be obtained, spot samples may be used, but for reasons indicated, these will be less useful than large sample. Blood samples could be used to supplement the spot urine sample if desired, but the expense of the work will be increased there 7.

Containers for the collection of these samples will be shipped by express from the laboratory. In numbers sufficient

among workmen during the year, it is suggested that blood samples and spot urine samples be obtained on them promptly for analysis and prompt report by telegram, these to be checked, later, if need be, by large samples of urine.

It is further suggested that blood smears be provided on all men on whom samples are obtained, and that these be sent to us at the time the samples are forwarded. These should be unfixed, unstained smears taken on carefully cleaned slides, spread as uniformly as possible, and of a thickness suitable for differential counts. They should be allowed to dry in the air, labeled and sent to us in slide boxes, the latter to be returned by us.

Complete occupational histories and medical records should be supplied on each case taken under study so that our data will be as complete as possible. Needless to say all information

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Cost of Processed

The actual cost of lead and is approximately \$5.00 per sample. We work at cost, and suggest that Remington quarterly, for the cost of the analytical plus such express, postage and telegraph the quarter. If any trips to the plant with this work, the cost of traveling will for prompt reimbursement. Such trips, obviously at the request of Remington Arms. Any by a member of the staff of the laboratory such trip will be subject to mutual understanding such trips are anticipated at present.

Director
of Arms