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 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,

that the chief exposure arises from the accumulations of dust in cracks and on rough and irregular surfaces of floors and steps, to be disturbed by air currents and by movements of the workmen when carrying on their normal work and when sweeping. The building, in other words, is not as clean as it could be, and is of such construction as to be difficult to keep clean. If it should be found to be necessary to decrease the lead exposure of the men, it would seem to be advisable to improve the building, (floors, steps etc.) and to do all cleaning by vacuum.

Such contact as the workmen have with dirty and dusty surfaces is somewhat more important hygienically than need be, because of the poor quality of the wash-rooms, the failure to provide clothing for use during the work, and the absence of change rooms and double lockers. The need for these facilities as for the other hygienic steps referred to depends upon the magnitude of the over-all exposure to lead, which, presumably, will be determined by the study of a representative group of these men. It must be admitted, however, that the wash-room and the lunch-room facilities are rather elementary, and could not be regarded as adequate in connection with an hazardous lead trade.

Certain other activities unrelated to the procedures in the shot tower, but carried on in that building, require comment. The preparation of the metal for making bullets that shatter when they hit, and the handling of this metal, are dusty processes, which if they are to be continued, should be reorganized completely and promptly. At present the dust evolved necessitates the use of respirators during certain operations and when floors and working spaces are cleaned up. The use of a respirator may be justified in

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 mechanical means, 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 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

the dissemination of dust.

In this group of processes, also, wash-room and lunch-room facilities of an attractive and sanitary type should be available for the workmen, and it seems probable that change-room facilities and routine changing of clothing morning and evening would contribute to the effectiveness of general sanitation. The swallowing of lead with tobacco and food can be avoided by proper attention to the cleanliness of clothing and person of workmen. It seems highly inadvisable to permit or to encourage carelessness in these matters, when such carelessness may conceivably bring the total lead exposure up to a dangerous level, whereas the unavoidable occupational exposure may not of itself be dangerous. In this connection, the habit of chewing tobacco is distinctly not advantageous to the workmen and should not be encouraged. One hesitates to advise the restriction of such a personal practice.

Heat Treating with Molten Lead.

It seems probable that the use of carbon or charcoal to provide a reducing atmosphere overlying baths of molten lead used for tempering steel, diminishes the fume hazard almost to the vanishing point. If, therefore, these lead baths are handled with care against spillage of metal or dross, so that the floors and other surfaces within the vicinity of the workmen are kept clean and free of materials which could give rise to dust, there should be little hazard at the temperatures prevailing. Here again one questions the cleanliness of the surroundings and wonders as to the quantities of lead which are swallowed by the workmen as the result of the dirtiness of his surroundings, clothing, etc., and as to the quantities of dust which are unnecessarily disseminated into the air by strong convection currents sweeping across surfaces contaminated with lead dusts.

Particulate Lead in Target Ranges.

The magnitude of the lead exposure to men who go in and out of the ranges is a matter for conjecture. The maximal degree of the exposure can best be determined by air analyses, and the significance can probably be assessed with sufficient accuracy by taking into account the degree of the air contamination at the time of entrance of men and the duration of their stay within the ranges. I should recommend air sampling carried out in such a manner as to indicate the degree of contamination and the rate of subsidence of the lead particles. As a house-keeping measure I should suggest the advisability of confining the disintegrated lead to the space in which it is produced, by so designing the entrance to the ranges that a minimal amount of debris escapes over the threshold, whether in the form of particles which fall on or outside of the door sill, or as material carried out on the shoes of men who enter. The construction of the doorway will solve the former item while a simple type of scraper at the entrance would probably take care of the latter.

Recommendations for Study of Plant.

Various observations have been made on the lead content of the atmosphere in various parts of the plant. It is suggested that further observations be carried out during the coming year in order to obtain data which can be correlated with periodic analyses on the excreta of workmen.

By reason of the somewhat less than ideal condition of the plant with respect to house-keeping and sanitation, it seems certain that air analyses will not reveal the magnitude of the exposure of workmen in a comprehensive manner. Moreover, since respirators are used in some areas it is certain that air analyses

in such areas will not yield a proper basis for the estimation of inhaled lead. Accordingly, there is every reason to regard Dr. Yeager's desire to obtain analytical data on the workmen as proper and wise. Under the conditions that prevail in this plant there is no other satisfactory way of determining the actual lead exposure of these men. In order to obtain the most adequate information by such means it is necessary to consider certain matters in the light of experience.

The Significance of the Lead Content of the Feces.

Dust-laden air when breathed into the thorax results in the partial deposition of dust on the tissue of the lungs and air passages. Variable proportions of such dust, dependent upon a number of factors, enter the nasopharynx and eventually the alimentary tract, whence it is largely evacuated with the feces. Roughly, therefore, the quantity of lead which appears in the feces on any one day, minus the quantity ingested with the food, drink and chewing tobacco (or otherwise) on the day before, is equivalent to that deposited in the nasopharynx as the result of breathing dust-laden air. On the basis of this principle, the study of the feces of a group of exposed workmen who have worked on the day before, will give a fairly clear idea of the extent of their exposure to lead, whether through inhalation, careless ingestion, or a combination of the two. It is very useful, therefore, to study the fecal lead excretion of men who are actually working, but if two or more days intervene between a working day and the collection of the sample of feces, the result is valueless. Such samples should not be collected over the week end or during any kind of holiday or lay-off. For most men, a single normal evacuation of feces is substantially equivalent to a 24-hour sample. It is not necessary, nor is it feasible to collect a 24-hour fecal

sample, since the single average sample has been found adequate.

In order to avoid gross contamination of fecal samples with dust from the plant, it is necessary to have the men collect such samples at home. Accordingly the men are instructed as to what is desired, written instructions are placed in their hands, where these can serve any useful purpose, and the containers are either given to them when they are ready to depart to their homes or, better, the containers are delivered to their homes where the sample can be collected after or before working hours, after bathing and changing clothes. The necessary instructions are given in the following paragraphs.

The chemically clean jar supplied for the collection of feces must be kept and opened in a place which is clean and free of dust, and in which it will not be overheated or frozen. It must be kept sealed in its paper bag until it is to be used.

A single average or normal evacuation should be collected directly into the jar. No intermediate container may be used, nor should any preservative or other material be added to the sample. (If preservative is required a sufficient quantity will be added in this laboratory.) Great care must be exercised against the introduction of dust or any other foreign material into the sample. Laxatives or cathartics must not be employed nor should any other medicine be taken for at least forty-eight hours before the collection of the sample, except on the advice of the physician in charge.

The rubber ring should be carefully adjusted, the top clamped carefully and securely, the jar should be labeled with the name and date, and sealed in its paper bag.

Samples should be packed carefully to avoid breakage and shipped by express to Dr. Robert A. Kehoe, Kettering Laboratory of Applied Physiology, College of Medicine, Eden Avenue, Cincinnati, Ohio.

The Significance of Urinary Lead.

Lead in the urine, as distinguished from that in the feces, is the result of actual lead absorption. The urinary output and concentration of lead vary with a number of factors, chief among which, in order of decreasing importance, are (1) the quantity of lead actually available in the tissues of the body, (2) the magnitude of the stream of lead entering the blood and tissues from various portals of absorption, and, (3) the water intake and output per unit of time. If the individual under study is not actually absorbing significant quantities of lead from the lungs or alimentary tract, the urinary lead level is indicative of the magnitude of the previous lead absorption, i.e. the lead content of the body as a whole. This makes the determination of the urinary lead excretion of great practical importance as a measure of the magnitude of occupational lead exposure over a considerable period of time prior to the observations. To be of maximal value for this purpose, it is advisable to collect samples of sufficient volume to smooth out the variation due to the changes in rate of water intake and output. Therefore small (spot) samples are less valuable than samples collected over a considerable period of time. Spot samples, on the other hand, if collected with adequate care against minute contamination, under the observation of the examiner, rule out the misleading influence of intentional or accidental contamination of samples which are collected by workmen without continual supervision. In some instances both types of urinary samples are necessary to ascertain the facts as to the actual

urinary lead excretion. In either case the greatest care possible is required to obtain uncontaminated samples. The instructions listed below should be strictly observed.

Instructions for the Collection of Large Samples of Urine for Lead Analyses.

The chemically clean bottle supplied for the collection of urine must be kept and opened in a place which is clean, free of dust, and neither excessively hot or of freezing temperature. It must be kept sealed in its paper bag until it is to be used and should be stoppered tightly and returned to the bag after each use. Attempts should not be made to obtain samples within a plant or during work periods, unless the premises are unusually clean and free of lead compounds. It is generally advisable to have the containers delivered to the home where the sample can be collected before and after work hours, after bathing and changing clothes.

Urine should be collected directly into the container at convenient times over a period of hours or days until not less than three quarts have been obtained. No intermediate container may be used, nor should any preservative or other material be added to the sample. (If preservative is required a sufficient quantity will be added to the container in this laboratory.) Great care should be exercised against the introduction of dust or any other foreign material into the container during the period of collection. Unusual quantities of water or other liquids should not be taken in order to speed up the collection of the sample, nor should medicine be taken, except on the advice of the physician in charge, during this period.

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

Instructions for the Collection of Spot Samples of Urine for Lead Analysis.

Urine samples must be taken in a space which is free of dust.

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.

Approximately 100 cc of urine should be voided directly into the sample bottle in the presence of the physician or attendant. The stopper (and the protective cover of filter paper) should be removed and held by its top in the hand of the attendant so that it may not be contaminated through contact with desk, table or other object. It should be restored to the bottle as soon as the sample has been obtained, after which it should be covered with the filter paper shield. No preservative or other material may be added to the sample.

The bottle should be labeled with the name of the patient and the date and hour at which the sample was taken, and packed with care against the possibility of breakage in transit.

It must be emphasized that spot samples collected in industrial plants should be obtained under observation, after the workman has removed his clothing, and has bathed thoroughly, and then has entered a clean room, free of dust, where the sample is voided. In every instance the stopper of the bottle should be removed and held by the examiner so it will not be put down on any table or shelf or other surface. After the voiding of the sample, it should be returned directly to the bottle which then is capped with the filter paper cover, and secured in place by a rubber band or string. It should also be stressed that workmen entrusted with

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

The Significance of Blood Samples.

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

or any other potentially unclean surface but should be held by its topmost part or laid down within its filter paper wrapping, and replaced as soon as the blood has been obtained. The filter paper cover should be replaced and secured around the neck of the tube by means of a rubber band.

The sterile needle provided in a second tube should be used to withdraw approximately 10 cc of blood directly into the blood tube. Under no circumstances may any anticoagulant or other substance be added or any intermediate container be used, nor may the needle be sterilized by boiling in water. If the latter should be rendered non-sterile accidentally, it should be flamed gently before use. After use it may be rinsed out with cold water and returned to the tube. Cotton should be placed at either end and 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 cork is secure, and that breakage may not occur in transit.

The sample should be mailed to Dr. Robert A. Kehoe, Kettering Laboratory of Applied Physiology, College of Medicine, Cincinnati, Ohio.

Suggested Procedure for Work During 1940.

In order to determine the magnitude of the lead exposure associated with the operations discussed above, and to discover the variations that occur from operation to operation, and from time to time, a group of representative men should be selected, on the basis of their reliability in doing what is required of them and on the further basis of the constancy and duration of their em-

ployment in relation to some particular type of occupational exposure. (This selection was made tentatively at a conference between Drs. Yeager and Kehoe). 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 samples. Blood samples could be used to supplement the spot urine samples if desired, but the expense of the work will be increased thereby.

Containers for the collection of these samples will be shipped by express from the laboratory, in numbers sufficient to care for the samples agreed upon.

If there are cases suggestive of lead intoxication 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 clenned slides, spread as uniformly as possible, and of a thinness 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

so obtained will be held in confidence and such publications as result therefrom will not reveal the source of the data. Moreover, any confidential medical information unrelated to lead exposure on individual workmen need not be transmitted.

Cost of Proposed Work

The actual cost of lead analyses in this laboratory is approximately $5.00 per sample. We propose to carry out this work at cost, and suggest that Remington Arms Company Inc. be billed, quarterly, for the cost of the analytical work at the rate above plus such express, postage and telegraph charges as may accrue during the quarter. If any trips to the plant are required in connection with this work, the cost of traveling will be submitted promptly for prompt reimbursal. Such trips, obviously, will be made only at the request of Remington Arms. Any bill for services rendered by a member of the staff of the laboratory in connection with any such trip will be subject to mutual understanding in advance. No such trips are anticipated at present.

Director, Kettering Laboratory
of Applied Physiology