MEMORANDUM CONCERNING THE PLANT OF

THE AMERICAN CRUCIBLE PRODUCTS COMPANY

LORAIN, OHIO

This plant was visited on May 12, 1943, for the purpose of consulting with the management and inspecting the plant, to determine the present hygienic conditions, with special reference to the lead exposure of employees in the foundry and in adjoining workrooms, and to make recommendation for safeguarding the health of the employees. For this purpose information was obtained in conference with Mr. G. L. Smith, General Manager, and Mr. C. T. Williams, Assistant General Manager, concerning the nature of the work, the employment policies, the number of employees, the sickness and health records, the hours of work and recent changes thereof, the recent changes and improvements in equipment, recent changes in the products, and the medical and hygienic supervision of the plant. A cursory survey of the plant was made to observe the actual conditions of work and the facilities for production. Sanitary and hygienic facilities, likewise, were examined. Mr. J. W. Coleman, Foundry Superintendent was consulted for information of various types, in the course of the plant inspection.

In addition consultation was arranged with Mr. Dan K. Cook, attorney for the Company, in which the salient facts concerning a case of allegedly fatal lead intoxication in a young man, (Benjamin Pohonyes), formerly employed in the furnace room of the plant, were discussed. Various items of recorded information about this case were submitted to the writer, including a copy of the necropsy report of Dr. John B. Donaldson, (who also acts as medical consultant to the plant), and a copy of the report of R. F. Hanzal, Ph. D., Biochemist in the Institute of Pathology of Western Reserve University, Cleveland,

Ohio, on an analysis of a portion of the brain of the deceased Kohonyos for its lead content. Unfortunately clinical records describing the onset, course, and nature of the deceased man's illness were not available, and therefore the diagnosis could not be arrived at with even approximate certainty. The opinion was expressed that there was no adequate foundation for a diagnosis of lead poisoning in the meager hearsay information about his illness, in the necropsy findings, or on the analytical data on the brain. Concerning the latter, it was pointed out that the lead concentration of 0.1 mg. Pb per 100 grams of fresh brain, as reported by the analyst, is insufficient to justify the diagnosis of lead encephalopathy; that, in fact, if it could be established that this result had been obtained through the use of highly sensitive and accurate methods of analysis, it would tend to the contrary conclusion, since it is but little beyond the range of concentrations of lead that are found in the brain of normal persons without occupational lead exposure, and also is not within the range of values found in the brains of fatally poisoned persons.

The available facts concerning this case are referred to early in this memorandum because the possible existence of lead exposure sufficient to cause fatal plumbism is an highly important matter in relation to the environmental conditions in this plant. No stone should be left unturned to establish the true facts in this case, not so much because of medico-legal considerations, as because of the need on the part of the management to know just how serious is their responsibility for further safeguarding the health and lives of the employees of this plant. Accordingly other tissues of this man should

be obtained from Dr. Donaldson, if possible,and otherwise by exhumation of the body if that can be done, for analysis in this Laboratory. It is probable that only by such analyses can the significance of this man's occupational lead exposure be determined. Other means of measuring the lead exposure of his associates, and thereby arriving at an indirect appraisal of that of the deceased man, will be referred to elsewhere in this memorandum.

General pertinent facts obtained in conference with the management of the plant are briefly set forth as follows: -

(1) The employees number about 225 at present of which some 50 to 60 are women. The latter are new to the industry and are mostly employed in inspection and shop work - not in the foundry -, in which the lead hazards are believed to be small. (Observations referred to later indicate that there is some question on this score.) The usual number of employees is about 160, the unusual census at this time being due to the pressure for production brought on by the war. A considerable number of young men formerly in the employ of the plant are now in military service. Therefore there are quite a number of new employees including the women. There is also a considerable number of men with disabilities that disqualify them for military service. The labor turnover is considerable, but there appears to be little dissatisfaction among the employees, most of whom are of local origin. There is some apprehension at present because of the hazards of the work.

(2) About 110 persons (most of the women) are employed in the machine shop where the lead hazards are relatively slight. Another 110 are employed in the foundry and melting room and in adjacent rooms opening into the foundry, in which work similar to that in the foundry

is carried out. The lead hazards of these workers vary somewhat, but are generally similar. It is believed that the melting room is the most hazardous area.

3. There have been from 20 to 40 cases of lead poisoning or of illness believed to have been lead poisoning, during the past three years. These have all occurred in the spring of the year. Prior to that time the frequency of occurrence of plumbism is estimated to have been approximately half of this rate, such cases also developing in the spring time. The case of Benjamin Dohonyos, previously referred to, is the only one in which there has been the suspicion or allegation of fatal poisoning. All of the cases of poisoning have occurred among workers in the foundry and melting room. That is, there have been no cases among the employees in the machine shop. No cases have occurred among the women.

4. Improvements have been made in the plant from time to time, these consisting largely of additions to the general ventilation. Some time ago (the exact date was not noted), a special type of ventilator making use of the strong convection currents, was installed in the roof of the melting room. This has a capacity under certain specified conditions of 57,000 C.F.M., and is capable of providing 172 air changes per hour in the melting room. A suggestion of Mr. DeWitt Huffman, of the Division of Safety and Hygiene of the Ohio Industrial Commission, with respect to additional ventilation of the melting room, is being complied with, and two fans each having a capacity of 20,300 C.F.M. have been obtained for installation in the side wall of the melting room just above the melting pots. (Mr. Huffman recently inspected the plant and made certain recommendations which are a matter

of record.) An additional improvement is almost completed, in that wash-room and locker-room, and lunch-room facilities are being provided for the foundry workmen.

5. There are no preemployment examinations at present. However, a periodic check-up of foundrymen is made by Dr. Donaldson, consisting of a physical examination (details unknown) and an hematologic examination. These examinations are repeated at 90 day intervals unless Dr. Donaldson advises that the workmen be returned for reexamination after a shorter interval. Men who have complaints of illness are sent to Dr. Donaldson at once. (Inquiry was not made concerning the procedure in the case of men who may fail to return to work because of some type of illness. Whether these cases are investigated or whether they are left to the discretion of the worker, his family or his private physician, is not clear. It is believed that some mechanism should be set up for establishing the facts in such cases, for the guidance of the management.)

6. There is no instruction or supervision of the workmen at present, with respect to matters of safety and personal hygiene. The employees eat within the foundry and other rooms at will and at irregular times. They also drink milk at odd times, and keep the bottles near them at their work. No doubt the milk and other food becomes contaminated with lead-containing dusts to some degree, both by the settling of dusts upon the milk bottles and the lunch kits, and by the dirty hands and clothing of the men. Dust deposits in the nose and throat of the workmen are also dislodged and swallowed at such times. There are no regulations with respect to changes of clothing and bathing, or as to washing before eating, or as to the use of masks, and there is no program of instruction and supervision whereby the

habits of the employees can be properly guided. On this account there is a great deal of unnecessary lead exposure among the employees, and this is the more important at this time because it can be prevented almost entirely by means that are relatively inexpensive and possible of achievement in this difficult period. It is entirely possible that the establishment of effective precautions in this regard may make the difference between serious danger and reasonable safety among the greater proportion of the employees of this plant.

Further information was obtained in the tour of the plant. The hazards arising from exposure to lead compounds are the most important and will receive detailed attention. Nevertheless, there are other types of exposure to be considered, among which the exposure to silica cannot be wholly ignored by the management. Silicosis must always be thought of in foundry work, and it is suggested that this problem will eventually require some consideration in this plant. At present, however, this matter is relatively unimportant, and no further mention will be made of it.

Lead exposure in the foundry and adjacent rooms

Lead-containing materials in the atmosphere of the foundry exist in two forms, - (1) fumes given off from mixtures of molten metals at high temperatures, and (2) dusts arising from molding sands, from the cleaning and grinding of castings, from the condensation of fumes, from the oxidizing surfaces of cooling metals, and from a variety of other sources. Both fumes and dusts contaminate the air breathed by the workers, and to the extent that these fumes and dusts are borne into other parts of the plant by air currents, or on vehicles or the

clothing, shoes, and bodies of workmen, they are spread throughout the plant area. Some idea of the extent of the dustiness was obtained by noting the accumulation of dust on rafters, window ledges, shelves and other undisturbed surfaces in different parts of the plant. Some of the dust is carbon, and much more of it is disintegrated sand. Most of it contains appreciable quantities of lead, and therefore it must be accepted that lead exposure has existed wherever such dust has penetrated; also, that potential exposure continues to exist whenever a breeze or other air current passes over the deposited dust, picking up some of it as it goes and carrying it along to be breathed by persons within its pathway.

Reference has already been made to the contamination of the food and milk of workmen by reason of the deposit of dusts upon and in them, as well as through their contact with unclean hands and clothing. Such lead, of course, is swallowed. Some portion of this is absorbed and is, therefore, a source of danger. A greater danger arises from the inhalation of dust and wherever lead-bearing dust is distributed into the air breathed by workmen, there is the possibility of dangerous lead absorption. A still greater danger exists when the finely divided fumes of lead are given off by molten metal, for the reason that the fumes when breathed are more easily and quickly absorbed than the larger particles that go to make up dust.

The absorption of inorganic lead compounds through the skin does not occur to an appreciable or hygienically significant degree. The intact skin absorbs practically none, while the abraded skin is a wholly unimportant source of occupational lead exposure. On this account cleanliness is important only in preventing the swallowing and the inhalation of finely divided lead compounds.

A. The fumes in this plant are not adequately controlled. Those arising from the furnaces are removed to a considerable extent by the ventilator in the top of the melting room. However, at times they are drawn into the foundry proper, and even at best they are not forcibly picked up at their point of origin and carried outside the building. The skimming of the crucibles causes the release of a great deal of fume which is not effectively removed. Ultimately some provision should be made to take care of this, by skimming under some type of ventilated hood, or by skimming the crucibles or pots within an area that is adequately ventilated by the furnace ventilators - i.e. under some hood like structure that separates the furnace area from the remainder of the melting room. The tilting furnace, likewise, should be ventilated when metal is being poured into pots. Those fumes will hardly be removed adequately by general ventilation.

The fumes given off by pots in transit to the molds trail out behin the moving pot and are breathed in fairly high concentration by the following attendant. These fumes are also given off upward and all about. They are not picked up by the roof-ventilators - 6 in number, each with a capacity of 8559 C.F.M. in the center elevated bay - with adequate speed or efficiency, but are merely swept slowly into the general stream of air removed by the ventilators. Direct and forcible ventilation of the pots so as to propel the fumes to the roof ventilators is needed. The fumes are also given off profusely when the metal is poured into the molds, and also when the remainder of the batch is poured out into an open ingot mold. When the castings are being poured the fumes go upward fairly well, but they are entrapped to some degree by the structure of the comparatively low ceiling of the bay

in which the casting is done. Certainly the ventilation at this point should be improved eventually.

2. The dissemination of dust in the plant is not controlled sufficiently. First, it is not removed at its point of origin as well as might be done. For example, one man was observed smoothing large castings with a grinding apparatus without any ventilation. He was seated on a low box or stool and the casting was on the floor. The debris collected on the floor near by. A better way of handling this would be to have the casting on a bench, the top of which was made in the form of an exhausted grill. An alternative arrangement would be a bench fitted with a hood at the back with exhaust ventilation. Another example of this may be seen in the room in which metal is cleaned in a cabinet. This cabinet is not dust tight. Certain unnecessary openings permit dust to be thrown into the air of the room, with the result that there is serious exposure at the back and to the right of this cabinet, where none should occur.

Second, the dust produced in certain operations is not confined to the area of the operation. The areas adjacent to the foundry are not separated from the foundry to a sufficient degree. Consequently the people within these rooms or spaces are exposed to dusts from the foundry in addition to those that may be created by their own work. It is an important principle of preventive practice to isolate groups of workers so far as possible from unnecessary exposure. Tight partitions, doors and windows, and the elimination of unnecessary traffic from dusty areas into areas that can be kept clean, go far to carry out this principle.

Third, dusts are created at points at which they would seem to be unnecessary. For example the sand-reworking apparatus creates a

tremendous amount of dust in starting up, by blowing the dust on the floor in clouds from beneath it. This could be prevented by a change in the design of this portable equipment, by moistening the area of the floor in which it operates, or by carrying the sand to some other site, for reconditioning.

Fourth, dust is permitted to remain where it can be dislodged mechanically or by air currents. Rafters, ledges, shelves and other flat areas are heavily covered. All unnecessary places for the deposit of dust should be removed, andall that remains should be cleaned by vacuum at regular and frequent intervals so as to prevent unnecessary contamination of the air of the plant. Detailed care in house-keeping should be given, and all plant procedures should be examined and revised with the idea of eliminating all operations that create and disseminate dust unnecessarily.

C. As indicated previously, the instruction and regulation of the workmen are not such as to prevent the unnecessary lead exposure associated with careless and inept personal conduct. The habits of the men with respect to personal cleanliness, place and time of eating, use of respirators, and the like are not conducive to safety and they must be corrected.

D. The medical supervision is not open to serious criticism in any general professional sense, so far as the writer is aware. However, the necessity of determining the actual severity of the lead exposure of the workmen, as well as certain medico-legal considerations, suggest that it is lacking in certain respects, especially with reference

to preemployment examinations and quantitative determination of the extent of punctate basophilia in the blood of workmen. There is also a requirement recently imposed by the Ohio Industrial Commission that quantitative lead analyses be carried out on the urine of persons reported to the Commission for compensation for lead poisoning. There are certain other reasons for the belief that lead analysis may be helpful in appraising the hazards of employment in this plant, and of these more will be said later. Suffice it here to say, that assistance in this respect can be given by this Laboratory if it is believed by the management to be desirable.

With respect to preemployment examinations, it should be pointed out that certain types of chronic illnesses and disabilities should disqualify workmen for employment under conditions of significant exposure to lead compounds. More importantly, the diagnosis of plumbism in its incipiency may often depend upon information obtained about the general health of the employer before exposure. Here the previous medical history as well as the blood picture before exposure to lead, are of great importance for a number of reasons.

Apparently there are more cases of complaints of illness among the workers than have been noted previously. This, in our opinion, is an important medical problem. A number of factors have probably combined to bring it about. The lead exposure is greater during the winter months because of the poorer general ventilation that is almost inevitable in cold weather. This is generally true in brass foundries in our experience. Although this factor has existed for years, and therefore is not a new problem, it is more significant during the present period because the general level of lead exposure in the plant has been increased by the operation of several factors. There is little doubt

that the increased production associated with the war, has increased the quantity of lead that passes through the plant. There is some likelihood that the lead concentration in brass castings has been subject to progressive increase during recent years. (Plant data on this point have been requested.) The hours of work have also been increased, and the total number of days of employment per week, per month, and per year have gone up. The result is that the total annual lead exposure of many of the employees has increased, with a consequent increase in the rate and gross quantity of their lead absorption. Under these circumstances, granting that the exposure is within hygienically significant levels, a higher frequency of occurrence of lead poisoning is inevitable. Certain other factors could be mentioned but the point need not be labored. It is quite apparent that under present circumstances the incidence of lead poisoning in the lead trades in American industry generally is on the increase. This is one of many plants so influenced by the war. The occurrence of cases of poisoning is accompanied by apprehension, especially among the newer employees, among whom also the incidence of actual poisoning is likely to be disproportionately high. The remedy for this situation lies in the combined efforts of the plant management and the attendant physician. The former must do everything in their power to reduce the lead exposure, and to bring it within limits of safety. The latter must put forth a greater effort than is normally called for, to protect the more susceptible persons by locating them in the least hazardous jobs, to recognize the earliest toxic effects of lead absorption, to differentiate them from other chronic or intercurrent illnesses, and to transfer those persons who develop prodromal or incipient symptoms of plumbism into work that will give them

less exposure. In addition it is highly important that mistakes in diagnosis shall not be made, especially on the side of failure to recognize lead poisoning, since these will lead to bad feeling and distrust on the part of the employees. Once they are convinced that the physician can neither be deceived nor influenced either by themselves or the management, his position in relation to themselves and their private physicians, - who may not always take the trouble to inform themselves or to deal fairly with either their patients or their colleagues -, will be established.

Eventually it will be advantageous to eliminate hazardous lead exposure from this plant. This may be costly, but in our opinion the cost of permitting hazardous conditions to exist will become prohibitively expensive in American industry. The control of lead exposure in this and in other industries is essentially an engineering problem, which, when equipment and expert advice are readily available, is not unsurmountable. We believe that the operating design of brass foundries is destined to be altered by localizing melting and pouring operations in one part of the plant when adequate ventilating equipment can be concentrated, by installing conveyor systems for molds, and by isolating the other less hazardous occupations in areas in which lead exposure will be reduced to the vanishing point. Such steps are probably not feasible at present, and therefore present recommendations must concern themselves with less fundamental and somewhat less effective improvements. It is hoped that the principles on which these recommendations are based will be recognized, and that present emergency procedures will be followed eventually by adequate preventive steps.

Recommendations

A. Medical recommendations

1. All persons applying for employment in the foundry, or in any other area in which lead exposure may occur should have an examination to determine the status of their health. The examination record should contain a comprehensive medical history, previous history of employment, data of a complete physical examination, and certain laboratory results including those obtained by a routine examination of the urine to determine its reaction, the presence or absence of albumin and sugar, and the nature of the sediment (microscopic), as well as those obtained by examination of the blood. The numbers of erythrocytes and leucocytes, the types of leucocytes, the concentration of hemoglobin, and the numbers of stippled erythrocytes should be determined. For hygienic control as well as for medico-legal purposes the extent of stippling in the blood must be ascertained by some satisfactory quantitative means.

2. Periodic examinations should be carried out at such intervals as may be indicated. These should consist of a complete checking of all previously recorded quantitative results such as weight, temperature, pulse, blood pressure, urinalysis and hematologic data, and in addition the subjective complaints of the employees should be investigated carefully, avoiding leading questions and suggestion so far as possible. Persons with symptoms or signs suggestive of incipient lead intoxication should be studied carefully and if circumstances warrant the procedure, samples of blood and/or urine should be obtained for analysis for lead. (Methods for collecting and forwarding such samples will be given in a later part of this memorandum.)

3. All illnesses among employees exposed to lead should be studied with care by the plant physician, unless the illness is obviously unrelated to the occupation. Every effort should be made promptly to arrive at a diagnosis that will stand up under critical legal inquiry. Such additional consultation or laboratory investigation as may be necessary to substantiate the diagnosis should be made early, while the means of excluding lead exposure as a factor are still in existence. If much time elapses between the onset of illness and the collection of precise information required for diagnosis, it may later be impossible to establish the facts. Only when it has been established that the occupation is or is not responsible for an illness, has the professional duty of the plant physician been completed, so far as the industrial aspects of the case are concerned. Treatment of the case may or may not be assumed by him according to the circumstances. However, so far as possible he should see that proper treatment is given in cases of occupational illness, whether by himself or by a colleague.

4. There should be some mechanism for the prompt investigation of illnesses that prevent employees from reporting for work, lest cases of lead poisoning be neglected at the onset. Such investigation should be sufficient to establish the nature of the illness. This can usually be done in the first instance by a non-medical representative of the plant, but early medical information, obtained either by the plant doctor or through a private physician, should be had.

5. The plant physician should visit the plant at regular intervals, so as to maintain familiarity with the conditions in the plant, and with the work in which employees engage. He should know the specific hazards of the various occupations at first hand, and should keep abreast

of all changes in the conditions and operations in the plant. With this information in addition to knowledge of the condition of the men, the physician should be in position to recommend transfers of men to work involving less exposure from time to time, as circumstances may indicate. More will be said on this point later.

. It is believed that some observations should be made at an early date for the purpose of determining the extent of the lead exposure in the plant. Such observations will establish the degree of the present hazard and thus provide better basis for judgment as to the frequency and character of the examinations of workmen. It will also give a base line for appraising the success of measures taken subsequently for reducing the lead exposure. There are several means by which this can be done. Air analyses can be made by this Laboratory or at some later date by an industrial hygienist representing the Ohio Industrial Commission. In our opinion it would be much more useful to make observations upon the men. The analysis of samples of blood, urine and feces obtained from carefully chosen men will give conclusive evidence of the extent of the exposure, and will establish the degree of the present danger more effectively than can be done by any other means. The samples can be obtained by Dr. Donaldson in conjunction with regular or special examinations, or they can be obtained by other means. Without going into detail as to the procedures that might be used, it would seem desirable for Dr. Donaldson to consult with us so that we may jointly decide what is the best means of accomplishing the purpose under present conditions. Both the methods and the cost associated therewith can be arranged to suit the circumstances. To this end it is suggested that if it is feasible, Dr. Donaldson might come to Cincinnati for a

day, (or more if he wishes), in which we shall be glad to place any information and facilities at his disposal.

D. Recommendations for the reduction of lead exposure. (Fundamental improvements in operating procedures and equipment have been suggested previously.)

1. The cleanliness of the plant can be greatly increased by the systematic improvement of the housekeeping. All unnecessary dust and debris should be cleaned up and kept cleaned up. The use of brushes and brooms for this purpose is contraindicated. The rafters, window-ledges shelves, etc. should be cleaned off regularly by means of a vacuum sweeper. Operations that cause unnecessary dissemination of dust should be done away with and satisfactory procedures should be substituted for them. Materials, equipment, castings in process and all other objects should be handled and located in an orderly manner so as to facilitate cleaning.

2. Cleaners should be carefully instructed in their work and supervised in respect to both their work and their care to avoid unnecessary exposure. Workmen also should be instructed against sweeping, brushing, and the use of air pressure lines so as to avoid creating unnecessary dust.

3. All the operations of the plant should be looked at critically with the idea of eliminating sources of dust and fume.

4. Where is is believed that respirators should be worn, these should be worn. The respirators should be cleaned and maintained in perfect condition by a responsible person. The men should also be supervised to see that they use respirators when they are required.

5. The cleanliness of the men must also be increased by proper facilities within the plant and by a program of education and supervision.

6. A locker-room sufficient to house two lockers for each foundry man should be provided together with bathing facilities. (The facilities being provided are excellent in some respects, but they can be rearranged to advantage without excessive cost or inconvenience.) One end or side of this should be for clean clothing. This side should be so arranged that men do not enter it except when they are clean. That is, they should enter it when coming to work, removing their own clothing, (down to the skin), and hanging them in the locker; then moving to the opposite side, they remove their work clothing from the other lockers, and after dressing in them, they enter the foundry. At the end of the shift, the work-clothing is removed, returned to the lockers on the "dirty" side of the locker-room; the men bathe , return to the clean side, put on their clothing and leave the plant. No workman who contaminates his clothing with lead compounds should work in the clothing he wears home, and no such workman should wear his contaminated clothing except in work hours. To do either of these is to run the risk of wholly unnecessary contamination of his home, his food and the air he breathes when off the job.

7. Work clothing must be provided on some mutually agreeable basis, and arrangement must be made for having such clothing laundered from time to time.

8. Facilities must be provided to enable the men to wash up and to free their clothing of excessive quantities of dust before eating lunch. (The separate lunch-room newly provided is a good idea. It must be seen that it, rather than the foundry and adjacent rooms, is used for that purpose, and also that it is kept clean and free of dust.) Dirty shoes and clothing, and above all dirty hands will continue to

cause contamination of the food eaten there, unless some proper technique is developed to prevent this result. Food and milk must not be kept and eaten in the foundry. This must be forbidden and prevented by supervision. It is better not to drink milk then to drink it under the present conditions.

7. In all of the preceding matters, it is apparent that instruction and supervision will be required to accomplish anything useful. Accordingly, responsibility must be vested in someone who will have the knowledge, tact and above all, the time, to look after these matters. Supervision of men and critical examination of machinery and operations with a view to safety, care and inspection of safety equipment, and similar work devoted purely to hygiene and safety engineering, is a time-consuming and responsible job. Such work is needed in this plant. With respect to instruction, regulations advising workmen as to desirable and required practices, together with the reasons therefor, should be posted. Safety meetings can also be held from time to time as the opportunity and need for them arises. These should not be empty "pep talks," but rather useful discussions of necessary and important matters, in which the men are encouraged to make suggestions and to raise questions.

8. Certain additional recommendations

1. There is one means of reducing the exposure of certain individuals, the hazards of whose work are recognized as being unusually severe. This consists in the rotation of workmen from jobs involving severe exposure, to work in which the exposure is smaller or perhaps even negligible. In this plant the workers in the machine shop need have no significant lead exposure, and in the main they do not. This provides a sizeable reservoir for the absorption of men who may be able to continue without illness, if they could be rotated into the shop from

themselves, cause lead exposure, and if certain of the preceding recommendations could be carried out effectively, the lead exposure in much of the foundry would be so low as to provide opportunity for surcease from severe lead exposure. The furnace men, the skimmers and pourers are probably exposed more severely than the others. These men, perhaps, could be rotated periodically. Some consideration of the possibilities here ought to be given by the management, and some further discussion of the principles and the time factors involved in such a procedure could be had with Dr. Donaldson in such a way as to provide an intelligent basis for a program of this type.

5. Reference has been made to instructions to workmen. A tentative set of instructions is attached hereto as an appendix. It will be necessary to adapt these to the local situation. It may be necessary to delete or modify certain rules to fit present facilities, and to make further changes and improvements as time goes on.

Signed: Robert A. Kehoe

Robert A. Kehoe, M. D., Director,
The Kettering Laboratory of Applied Physiology, College of Medicine, University of Cincinnati, Cincinnati, Ohio

Date: May 19, 1943