

June 9, 1941

Mr. William P. Yant
Mine Safety Appliances Company
Pittsburgh
Pa.

Dear Yant:

In accordance with our conversation in Pittsburgh, I am sending you herewith certain notations which we have assembled together on various projects, which in our mind are sufficiently important either in a general sense or in their relationship to the National Defense to justify consideration. I have thought it wise to send you several suggestions rather than one. Also, where it is feasible to do so, I have estimated the cost of doing the work. Where this has not been done with a certain definiteness, we have had in mind work which would go over a period of a year, the cost of which would be variable, dependent upon the intensity with which the problem is attacked. It would seem to me that no one of these problems should be tackled unless some such a sum as \$10,000.00 were available for carrying it to the point at which one could see a definite accomplishment.

I think you can get a clear idea of our general attitude toward these projects, and I should appreciate any comments or suggestions which you may wish to make concerning them. If for your own information or for other reasons, you would like them set up in somewhat different form, do not hesitate to say so. In any case I wish to assure you that I am very sympathetic with your point of view and I shall also be deeply appreciative of any efforts which you may wish to make in our behalf.

With kindest personal regards,

I am

Sincerely yours,

RAK:is

Robert A. Kehoe, M.D.

KE 0007676

Project No. 1

The necessity for excessive overtime and the elimination of vacations of workers employed in defense industries focuses attention upon the problem of fatigue. In 1917, in Great Britain an Industrial Fatigue Research Board was set up to study "the sum of the results of activity which show themselves in a diminished capacity for doing work." Much attention has been then and subsequently devoted to many factors limiting the output of workers, as poor posture, insufficient light, noise, inadequate ventilation, rhythm, humidity, temperature and motion of air, rest periods, boredom, etc. During this period, much progress has also been made by physiologists in the study of the economy and mechanism of muscular work. Recently, there has been an independent growth of interest in the influence of exposures of workers to injurious chemical agents upon the health of workers. Data have been rapidly accumulating upon the concentrations of various noxious gases which may be safely breathed for various periods.

As yet, however, the possible influence of such safe (or even of dangerous) concentrations of noxious agents upon the ability to perform work does not appear to have been a subject of investigation. Any limitation of performance produced by toxic substances is better designated by the term toxic asthenia rather than by fatigue or exhaustion. The term fatigue should be restricted to the state produced as a result of the repeated functioning of some bodily mechanism, as muscular contraction, passage of a neuromuscular impulse, glandular secretion, etc.

The term asthenia covers any inability to perform normally whether due to excessive past performance or to environmental causes. Its use does not preclude the possibility that a state of poor performance induced by a toxic agent may be brought about by a mechanism similar to that operating in fatigue.

The investigation of toxic asthenia should have as its purpose first a search for the existence of the state, and, if found, the measurement of the magnitude of the limitations of performance induced by various toxic agents. More important, however, would be the study of the mechanisms by which such limitation occurs. An investigation of this nature would throw light upon the extremely common complaint of chronic "exhaustion" or "tired-felling." One of every five persons who consults a physician is said to do so because of this (Dowden and Johnson). Its occurrence in workers must be the occasion of a very considerable limitation of production.

The approach to the problem might involve the following steps:

1. The selection of a suitable experimental animal. In the early stages it would be well to avoid the use of human subjects to avoid the psychic influences which may occasion weakness.
2. The adoption of some suitable quantitative test for ability to perform work.
3. The choice of toxic agents.
4. The measurements of performance ability during and after exposure to toxic agents.

5. An approach to the mechanisms involved. Here it would be necessary to consider the mechanisms suggested for severe asthenic states, and to seek a common feature among the many recognized causes.

6. Where possible the recommendation of means to avoid the limitations of performance due to toxic substances, either by (a) setting up limits of concentrations not interfering with performance or (b) seeking means of neutralizing the effects based upon a knowledge of the mechanisms involved.

Topic 5 deserves fuller consideration. Whether or not the effects of toxic substances prove important, a wider knowledge of the extent of the occurrence of asthenic states among industrial workers, and an understanding of their causes are highly important. Its significance extends far beyond the immediate problem of defense production.

KE 0007679

*for information
sent to J. out*

An understanding of the mechanism of the asthenic state, like the understanding of the origin of cancer, seems to be made difficult by the wide variety of causes which have been suggested. This may be illustrated by citing the classification given by Alpers.

I. Transitory Asthenia

A. Acute systemic disorders

1. Acute infections of all sorts, and acute nutritional, degenerative, and metabolic disorders
2. Chronic infections or degenerative states: Diabetes, tuberculosis, nephritis, arterio-sclerosis
3. Involutional processes (senilitis)

II. Constant

A. Muscular

1. Myasthenia gravis
2. Muscular myopathies of other sorts, as progressive muscular dystrophy

B. Endocrine Disorders

1. Adrenal syndromes
2. Pituitary syndromes
3. Thyroid syndromes

C. Psychogenic Disorders

1. Neurosthenia
2. Psychasthenia
3. Anxiety states

D. Miscellaneous

1. Narcolepsy

A consideration of these causes reveals a number of unanswered questions. What toxic agent is responsible for the extreme weakness which follows influenza? What is its nature and how does it operate? What are the toxins involved in chronic infections? Do any of these induce morphological changes in nerve cells analogous to those alleged by Crile and others to be produced in severe exhaustion produced by lack of sleep or excessive work? To what extent are neurocirculatory influences involved? Do any toxic agents affect the adrenal glands or other glands of internal secretion? What is the mechanism of psychogenic weakness, purely nervous, neurocirculatory through the mediation of glands of internal secretion, or by formation of toxic substances? Are there interferences with cellular respiration? How do the remedies suggested for fatigue (gelatin, phosphates, ephedrin, corticosterone, etc.), function and are they effective?

Project No. 2

A considerable number of requests is received by this Laboratory for information and advice in connection with plant activities involving a variety of hazards, especially, however, because of our published work, that of lead exposure. Recently several requests have come from physicians and plant managers, who have stated that the lengthened hours and speed of production in their plants, incident to the present emergency, have been responsible for greatly increasing the lead exposure of their employees. Whereas conditions have been apparently safe as to lead exposure, they are now dangerous. There is no doubt of the importance of the time factor in occupational lead exposure. Nor is there any doubt that the degree of exposure is greatly influenced by the urgency of production schedules. Accordingly, it is highly desirable at this time to study conditions in hazardous occupations and to determine what can reasonably be done to prevent greatly increased exposures and an increased occurrence of illness. Unfortunately such difficulties are especially likely to develop in small industries that are unable to afford the cost of an adequate study of their problem. We make a practice of giving as much help as possible but our funds are allocated to specific purposes and we cannot use them otherwise except to a limited degree. It would be highly advantageous if a fund were available (to be accounted for in detail) for carrying out such medical and hygienic investigations as could clearly be justified on the basis of the need for such

assistance, and the inability on the part of the industry to pay for it. We are convinced by our experience that the improvement of plant conditions through the use of present methods of study and the application of well known methods of control, in small or backward plants, would do more toward the maintenance of industrial health during this emergency than would any other type of hygienic work. Industry, and especially small industry, needs hygienic assistance in applying what is known, quite as much as it needs new information in this field. A moderate sum of money available in the hands of a group like this, with purely professional (i.e.unofficial) access to industrial plants, would be of the greatest benefit. Such a fund would enable us to do many things for industry that should be done, and which otherwise will not be done. Opportunities for work of this type have to be taken advantage of when they arise and when there is a difficulty to be overcome. If they are passed up they may not recur for a long time.

The mechanism for providing a fund for the purpose outlined above may not be readily available, but if the validity of the thesis is accepted, the formal difficulties should not be unsurmountable, especially when the fund would be administered by the Board of Directors of the University.

Project No. 3

The manufacture and use of lead-bearing steels brings about a type of industrial lead exposure which may be of serious proportions under suitable conditions. The actual dangers in the manufacture of such steel can probably be controlled adequately by the application of satisfactory ventilation, but the exposure that may rise from the subsequent use of leaded steel under conditions in which it is cut and welded and fabricated into various articles at high temperatures is somewhat difficult to control. The comparatively small production of leaded steel up to the present time has limited the hazards of manufacture and use, in that all the operations involving this product have been intermittent and of brief duration. It is believed that this is the sole reason that certain serious difficulties have not materialized, since the lead exposure of certain operations is quite severe for the duration of the operation and for a short period thereafter.

It is quite conceivable that the necessity for speed in steel-cutting operations will lead to a great increase in the demand for leaded steel. It has been reported that the British are using considerable quantities. If the demand becomes great in this country, it will be met, and thereby a somewhat unpredictable hazard will be created. It would seem wise to know much more about this problem before it develops in acute form for it can be a source of very great difficulty, confusion and delay. Arrangements could be made to study this problem under present and apparently safe conditions and to follow developments

very closely. It is questionable whether any one or several of the steel-producing groups will be in position to sponsor the type of comprehensive study that would be required to evaluate this hazard properly, and it is believed that it would be valuable in relation to the national defense to have as much information as possible at the earliest possible time. This involves a large amount of costly analytical work. The cost of a modest program of investigation would approximate \$10,000.00 per year. This estimate is based upon the cost of periodic observations on 150 to 200 workmen whose work gives rise to the various types of lead exposure in question, plus certain traveling expenses incident to a careful survey of operating procedures, in steel plants engaged in making leaded steel and in certain shops in which such steel is used most extensively.

KE 0007685

Project No. 4

An important question in relation to the health of the public in general has to do with the hygienic significance of spray residues. Recent studies of the U. S. Public Health Service, just now published in Public Health Bulletin No. 267 would seem to give a fairly adequate practical answer to this problem for present purposes. On the other hand the extent of the exposure of the persons studied by Public Health Service investigators could not be determined to quite the desired degree, since the quantities of lead and arsenic ingested, the period of time involved, and the quantities absorbed and retained were not ascertained.

A further step in the solution of this problem in physiological terms would seem to be indicated and our experience with the study of lead intake and output in human subjects would make it particularly advantageous for us to carry out observations on the absorbability of lead as lead arsenate, and its fate in known dosage over considerable periods of time. Recently developed procedures for highly accurate studies on the arsenic metabolism (used in connection with a study of the toxicity and mode of action of mapharsene) are available and by some expansion of present facilities the arsenic phase of the above problem could be carried adequately.

We are not in position to pursue this study at the expense of present sponsors of industrial toxicologic investigations, but a sum approximating \$10,000.00 allotted out of public funds, could be employed to obvious public advantage. This is not a

defense project, except to the extent that any such potential danger to the public health may have increased importance during times of stress and periods of great economic and perhaps dietary change. The importance of the problem certainly justifies consideration regardless of other immediate problems.

Project No. 5

This Laboratory is undertaking a prolonged and extensive study of the sources and the effects of pollution of the air of cities with particulate matter of certain types, notably certain metals. The work will have to move slowly, but it could be expedited considerably by additional facilities, especially in personnel. Preliminary work is in progress in Cincinnati, but observations elsewhere are contemplated when certain facts have been obtained with respect to Cincinnati and vicinity. It is obvious that detailed consideration should be given to present plans and certain possible extensions of them before funds could be requested or granted for general use or for some specific phase of the problem. The appended pages will give some idea of the scope of the work. (These are confidential for Mr. Yant's information only and should be returned when they have served that purpose.) Clinical work is to be carried on in relation to the dust studies, with particular stress on the search for evidence of effects upon the respiratory tract. This general hygienic study is believed to be of sufficient general importance to justify the expenditure of public funds at this or any other time.

KE 0007688