AT THE HARVARD MEDICAL SCHOOL SINCE 1918
and
AT THE HARVARD SCHOOL OF PUBLIC HEALTH SINCE 1921.

In the spring of 1918 Harvard University received temporary gifts, largely from New England manufacturers, in order to develop the subject of health in industry. Subscribers to this fund understood that the University would employ the money for research, for health education, and for the training of industrial physicians and others directly connected with health work in industry. The work accomplished may be divided into three classes:

1. Special Problems
2. General Problems
3. Education

SPECIAL PROBLEMS

1. Investigation in the Jute Industry.

A large manufacturer of jute products, in the neighborhood of Boston, requested a thorough examination of dust conditions in the industry, together with a report to settle the question as to whether work upon jute products caused chronic fibrotic changes in the lungs. A dust survey was carried out by Dr. C. K. Reiman and Mr. R. M. Thomson. Medical and x-ray studies were made by Doctors Wright, Tobey and Holmes. It was established that dust conditions in the mills in question do produce a slowly developing type of lung fibrosis. Methods for dust removal and physical examination of employees were recommended, which could be relied upon to alleviate the hazard. Besides immediate utility to the industry, the study was an appropriate one for the University to enter, since it dealt with a much debated question - namely, whether a simple organic dust can produce lung damage. The findings in this

case, to a certain degree, supported the idea that organic dust is not harmless, but, owing to contamination with crystalline material, dirt, et cetera, collected during packing, the results cannot be considered conclusive.

2. Manganese Poisoning.

As a result of new pressure in manufacturing, the New Jersey Zinc Company, in May 1918, was compelled to ask the assistance of the industrial hygiene enterprise in order to deal with an extremely serious industrial disease that was affecting increasing numbers of their men in a large plant, was costing heavily in pensions, and was producing threatening unrest in the working force. The men affected were examined clinically by Dr. C. K. Drinker. Thorough dust surveys were made at this time, and repeated at regular intervals subsequently, by Dr. C. K. Reiman, Mr. R. M. Thomson, and Mr. Philip Drinker. (The large knowledge of these mills now possessed by our department makes it possible to use them as a very excellent field station for testing new dust measuring devices.) Manganese was present in large amounts in the dust, and the dust hazard was amazingly severe. Prolonged laboratory investigations of manganese poisoning in animals were carried out, which eventually gave a complete picture of the action of the poison; it being shown in collaboration with the Department of Neurology that manganese affects certain of the basal ganglia specifically.

It has proved possible to make recommendations to the New Jersey Zinc Company which have completely abolished the incidance of the disease in all their properties.

As a result of this work, Dr. C. K. Drinker sees practically all cases of manganese poisoning occurring in the country, and has been instrumental in the National Carbon Company in recommending plant changes to abolish the hazard in

their plants.

The whole experience in connection with manganese poisoning illustrates the need of continued relations in dealing with any of the health problems in industry. Time is required not only to find out the nature of the hazard but to gain the complete trust and cooperation of the authorities in carrying out the changes necessary.

5. Tetrachlorethane Investigation.

A single establishment near Boston had a severe hazard in tetrachlorethane used as a solvent for cellulose acetate in making artificial silk. The instance is rather a unique one because of the speed with which Doctors Minot, Parmenter, and Smith succeeded in making the operation safe, as against the fact that Dr. Legge of the British Home Office had seen the process, and in view of their extensive and grave experience with tetrachlorethane in airplane manufacture, and in other ways, said the hazard was uncontrollable. The plant in question was too small to lead the investigators into studies of other solvents, a logical continuance of the work so well started. This is, however, an important experience in two ways:

1. The process is valuable and stopping it would have wrecked a successful industry.

2. It demonstrates the value of the diversity of University scientific personnel in studying such problems as against the necessarily more restricted types of governmental personnel.

A variety of Departments were asked advice at the start - Pharmacology, Physiology, Chemistry, Physics, et cetera, but the special clinical training of Dr. Minot at once caught the fact that certain workers, (who proved to be the susceptibles), showed, long before dangerous symptoms developed, a marked increase (sometimes even to 45%) of the large mononuclear leucocytes. Such persons were afterward regularly removed early from the hazardous work, and no poisonings occurred

subsequently.

4. Lead Investigation.

In 1921 the American Institute of Lead Manufacturers spontaneously made a grant of $51,000, which was used for a period of three years by Doctors Aub, Anne S. Minot, Fairhall and their associates, in an extensive analysis of lead poisoning. The lead manufacturers subsequently gave more money. A large volume of published work resulted, and the facts brought out have had much to do with changing the point of view in treating lead poisoning and in fully understanding the pathogenesis of the condition. Two years ago, while in Europe, I was much gratified to find that this lead work really dominated all that was being thought in connection with lead poisoning or the use of lead as a therapeutic agent.

The investigation resulted in an intimate relation with the lead industry, most profitable both to the manufacturers and to medical science.

The lead researches were practically wholly of a laboratory and hospital type. They did not deal with the problem of lead poisoning prevention and field work in general. Much might be done upon these two latter lines.

5. Zinc Investigation.

In 1923 an opportunity similar to that provided by the lead industry was presented by the zinc industry under the auspices of the New Jersey Zinc Company, with large resources to investigate the hygienic and medical significance of zinc and define the conditions of industrial poisoning if they existed. This work occupied the full time of Dr. Lawrence T. Fairhall, Dr. Katherine R. Drinker, and several associates, during two years, and required the fairly constant cooperation of Mr. Philip Drinker and his engineering associates, in connection with problems of dust measurement of a particularly

difficult type. Owing to the fact that zinc is a relatively innocuous material, the immediate medical importance of the findings was not so great as in the lead investigation, but the experimental work was of high grade, and has resulted in a far better realisation of the importance of zinc in biological processes than we have had in the past. Indeed the results of the work were of more importance for general biology than for industry unless, as is the case, the demonstration that there is no actual industrial zinc hazard can be considered as of great practical importance.

The investigation proved that zinc could cause a brief unpleasant experience, consisting of a chill and fever, if inhaled as freshly formed oxide. This reaction was demonstrated, however, to be non-specific, (although generally known as "brass founders' ague"), since similar symptons could be obtained from freshly formed magnesium oxide, and were shown to have occurred from copper and manganese compounds. Upon the general biological side zinc was shown to be a constituent of practically all plants and animals, and in the human being the amount was practically as great as iron. Its possible function in the organism is not yet clear, but there are interesting indications regarding it.

6. Carbon Monoxide Investigation.

In 1921 Dr. C. K. Drinker was asked to form a Commission to investigate the best methods for treating carbon monoxide poisoning. The most important work of the Commission was done by Professors Henderson and Haggard of Yale, in the development of the carbon dioxide inhalation treatment of gas poisoning. Dr. C. K. Drinker, Mr. L. A. Shaw, Dr. Alfred Redfield, Dr. K. R. Drinker, and Dr. W. B. Cannon, collaborated in careful examination of existing resuscitation devices and in formulation of regulations regarding their use. The final report of the Commission, from Dr. C. K. Drinker, has absolutely determined the policy of the American Gas Association in regard to treatment of gas poisoning and, since this

Association dominates the whole field, the importance of the work has been great.

As a result of the interest this work aroused, Dr. C. K. Drinker has continued as advisor to the Gas Association, and recently to the National Electric Light Association, in regard to resuscitation from asphyxiation and publication of educational material in regard to it. This material, prepared under his direction, has been distributed to over eight million persons in this country and Canada.

Investigation for bettering the treatment of asphyxiation has continued steadily in the laboratory, and has resulted in better knowledge in regard to carbon monoxide treatment, and the recent recommendation of a higher concentration of carbon dioxide than that advocated in the original report.

7. Nickel Investigation.

In 1924 the International Nickel Company, contemplating the utilization of sheet nickel for cooking utensils, asked for information as to its possible effect when in contact with foods, and finally, on recommendations from our group, requested a careful examination of the situation. A monograph analyzing the clinical and biological literature upon nickel, and a considerable volume of experimental work here in the laboratory, resulted from attention to this problem. The International Nickel Company has in its turn kept in constant communication with the laboratory since this contact, and during the present summer has again entered investigation with the laboratory in regard to the effect of nickel chromium and molybdenum upon food stuffs; this investigation being carried out for their information as to the possibility of using stainless steel alloys for cooking utensils. This second investigation is under the guidance of Dr. L. T. Fairhall, and is now in progress.

8. Zinc Contamination of Foods.

During the present year the zinc industry, owing to the growing use of zinc foil wrappers for foods, has asked for information as to food contamination from such wrappers; a matter that required direct laboratory investigation. The work in question has been finished and reported in the Journal of Food Industries. This research and the one covering nickel chromium and molybdenum have been done in cooperation with the Bureau of Chemistry of the United States Department of Agriculture. This is a particularly fortunate alliance, since findings having the combined approval of the Federal Department and of the enterprise here at Harvard carry an authority which apparently is regarded as practically final. Members of the Bureau of Chemistry now consult us here frequently, and Dr. Fairhall and Dr. C. K. Drinker are in constant communication with them in Washington, and there is a definitely established mechanism as to methods of cooperation.

9. Investigations of Dr. Alice Hamilton.

In 1921 Dr. Hamilton, with Dr. Wade Wright, Mr. Philip Drinker, and others, carried out an examination of poisoning due to mercury in the felt hat industry. Dr. Hamilton has written many papers on industrial poisoning due to lead, aniline compounds, and other subjects of immediate importance in labor administration. Her value as a general influence in the field of industrial health cannot be overestimated. Her opinion is sought constantly by many large organizations, and her decisions result in decisive action.

10. Poisoning due to Radium.

In 1924 Dr. C. K. Drinker, Dr. K. R. Drinker, and Dr. W. B. Castle, were requested by the Company, and were the first individuals given a thorough opportunity, to investigate the interesting cases of necrosis of the jaw due to

radium which occurred in Orange, New Jersey. The work done was brief, but the report made to the Company, and eventually published, has been proved to have been correct. The experience was the single instance we have had of failure on the part of the University organization to impress a company with the necessity of following a course of action recommended. The failure probably would have occurred with any organization undertaking the work on account of the smallness of the plant and the severe financial strain it was under at the time the work was done.

11. Investigation of Health of Store Employees.

In 1919 Dr. Arthur B. Emmons was placed in charge of a general investigation of the health of store employees. This investigation was financed by a group of large department stores in Boston and in other cities. Retrospectively the largest usefulness of the study seems to have been the fact that the very existence of the work caused store executives to pay more attention to the importance of health conditions amongst their employees, and they have continued to maintain health departments of improved character.

It is worth while to note that the type of problem illustrated by this department store enterprise is far more difficult than the defined variety of problem presented by the action of a definite poison. During the infancy of the industrial health enterprise which has been conducted in the Medical School and the School of Public Health, we never considered it wise to enter situations which did not have two characteristics:

1. They must present problems worthy of University attention; that is, there must be an element of abstract, scientific interest in every instance, which could not be met without the utilization of the distinctive type of individual found in the best university laboratories.

2. The problem must give reasonable promise of being susceptible of solution.

It was our feeling that the survival of the Harvard enterprise depended upon demonstrable success at the start. It is possible this period has been passed, and that we should now be less cautious in our selection of field tasks.

12. Investigations on the Effect of Temperature and Humidity.

These fall into two categories:

(a) Mr. C. P. Yaglou has continued the valuable work begun by him at the Bureau of Mines station in Pittsburgh, and has recently completed a most thorough analysis of working efficiency at high and low temperatures with varied humidity. There is no doubt that the experiments carried on with the rather perfect laboratory equipment which the School possesses could be transferred almost bodily to certain industries.

(b) Messrs. Yaglou and Drinker were given opportunity to construct a constant temperature and humidity room for the treatment of premature infants at the Infants Hospital. The work in question required a high degree of engineering skill, since it was found that present methods of holding temperature constant in large rooms were wholly inadequate. The results have been very gratifying clinically, and rooms of the same sort are being constructed under the direction of Mr. Yaglou at four other hospitals. There is little doubt that such rooms will become an essential part of the equipment of infants' hospitals. Important experimental results have been obtained by Dr. Blackfan and his associates, especially showing the remarkable effect of optimum humidity upon the nutrition of infants, and the striking effects of optimum humidity and temperature upon convalescence from acute gastro-intestinal infections in young children.

13. Dust and Fume Estimations.

Mr. Philip Drinker, since joining the industrial enterprise, has busied himself steadily with the problem of devising new methods for measuring the amount of particulate materials in the air. Starting with a modification of the water collecting type of apparatus, he passed on to the development of an electrostatic device which is now used in this country, South America, Australia, and South Africa.

At the present time, in collaboration with Mr. Hatch of the Engineering School, experiments are being done to ascertain the best type of hood construction to control silicious dusts. The problems encountered have been physical and mathematical to a large degree, but it is doubtful whether the physicists and mathematicians could have been induced to pay the slightest attention to them had the work not been done in a department devoted to human interests through medicine and hygiene. It seems probable it will be possible to construct a type of hood that will eliminate silicious dust as a problem in many industries.

14. Artificial Respiration.

As a result of experiments of a general character being carried out by Mr. Louis A. Shaw, the idea occurred to Mr. Shaw and Mr. Drinker that a new type of respirator might be constructed, in which the body of the subject was inclosed in a steel box with the head protruding through an ingenious rubber collar at the end, and by making positive and negative pressure in the box artificial respiration could be given. Funds were provided by the Liability Insurance Fund of the Consolidated Gas Company of New York. The apparatus was constructed and proved to be highly satisfactory. It effects in the natural manner, and as long as desired, respiration of any depth. A second machine was then constructed and placed in the emergency ward of Bellevue

Hospital, New York. Within the past two months four cases, three of them apparently quite hopeless, have been resuscitated through use of the apparatus. One of these required twelve hours practically continuous operation of the machine before natural breathing was safely established. In one hospital here it has been used for as long as five days continuously with success so far as respiration was concerned, but in that case the disease was fatal.

It is an interesting fact that since the publication of details of the device a month ago, twelve of the machines have been ordered, and it is certain they will be in general operation throughout the country within the next year. The appliance is elaborate and expensive, but is so certainly efficient as to make its way.

The occasional grave respiratory disturbances of the new-born, which are likely to disappear if the infant can be tided over a few days, has led to experimental work, now in progress, to produce an apparatus of this sort feasible of use with infants.

Experiments also growing out of this are now under way with the purpose of producing an apparatus designed to administer high oxygen content, by inexpensive but effective means, in the various types of disease in which it may be clinically serviceable.

GENERAL PROBLEMS

An enterprise of the sort which has developed here in the School of Public Health cannot exist on the basis of practical interests alone. In my experience, the reason why a University can do the sort of work which has been done here in the past ten years, is because a University laboratory can give

opportunities for mental growth attractive to the sort of young men who if called upon can solve practical problems rapidly and effectively. In order to give men of such caliber the setting they desire, it is preeminently essential that the laboratory should conduct a large amount of abstract scientific work. In order to illustrate what is meant, certain instances may be given:

1. Silicosis.

Dr. Wallace Fenn, now Professor of Physiology at the Rochester Medical School, spent three years in these laboratories working on the problem of phagocytosis of different types of inert particles. His work, which was of the most general physiological nature, and which was published in the Journal of General Physiology, demonstrated certain of the reasons why silicious dusts cause damage. Dr. Fenn could hardly be thought to be especially interested in the latter problem. His work, however, is of great practical importance in understanding one of the major hazards in industry throughout the world, and has been so recognized in the literature on the subject. It has had a definite effect upon the field work in lung fibrosis carried on in the Department.

2. Investigation of Circulation and Respiration.

Out of interests arising in 1920 through experiments designed to explain certain of the distressing symptoms occurring in advanced heart disease, Dr. C. K. Drinker, with Dr. E. D. Churchill, Dr. Hermann Blumgart, Dr. A. H. Turner, and others, passed through a long series of experimental examinations upon the heart and circulation, which have required the devising of new methods and have been important not so much for the results obtained as for the interest they have stimulated to examine the circulation in certain novel ways.

Dr. Turner is now making an extensive series of studies upon the circulatory efficiency of women, and is slowly attempting to develop standards upon which

college women may be graded in this particular. The interest in these studies is most important for the general problem of physical education. One student, working for a Doctorate in Physical Education, is now engaged in a second series of studies upon the effect of posture upon circulatory conditions; posture in this instance being reduced to very simple terms by causing the subject to rest on a tilted table and rotating him slowly from the horizontal to the vertical. Different individuals apparently show pulse and blood pressure alterations at different and characteristic angles. (This and other work coordinates intimately with the work of Henderson, Bock, and Dill, in the Fatigue Laboratory.)

Two other workers, with the same general interest, have just completed a careful examination of the effect of breathing the same concentrations of carbon dioxide. It has been demonstrated that subjects react to carbon dioxide very differently, and that the same subject does not behave the same on successive days. This experiment has proved not only important for the possible determination of physical efficiency in the individual, but has thrown light upon the use of carbon dioxide in certain cases requiring resuscitation.

The interest in pure physiology which the laboratory has steadily maintained, has resulted in a constant inflow of students working for the Doctor of Philosophy in Physiology, and it is from this type of individual that the most useful members of such a group as has been developed here must be recruited. Were the laboratory devoted wholly to investigations of practical field problems, it is quite certain that mental starvation would slowly snuff out the whole enterprise.

3. Skin Metabolism.

During the past two years Mr. L. A. Shaw has developed unique methods for measuring the passage of gas through the skin, and the metabolism of the skin

itself. The results make it possible to study skin diseases in a new manner, and one which may be productive of the greatest usefulness. Arrangements are now being made to place the apparatus devised in the skin clinic at the Massachusetts General Hospital.

EDUCATION

1. Journal of Industrial Hygiene.

The Journal of Industrial Hygiene was started in 1919 as a joint enterprise with certain of our English colleagues who were interested in the subject. It has slowly attained, and holds, a subscription list of about 1,000. It has been a strong asset in the Harvard industrial health work, affording a convenient medium for centralising our publications and providing the single journal devoted to industrial hygiene. On several occasions I have felt it would be well to divert the money we devote to the Journal to other activities in the School, but the further I go into the subject, and the more I see of the practical field, the more I feel that the Journal should not be curtailed but should, if anything, be somewhat enlarged and made more useful through extension of the abstract department and the occasional publication of monographs.

It should also be remembered, if the activities of the School were to enlarge, that in Miss Marion Shorley we have an extraordinarily efficient editorial worker. Should it be necessary to contemplate anything like a general editorial office, it would be very difficult to find a woman with the training, accuracy, ability to read foreign languages, and general reliability she possesses.

2. Teaching.

The supposition that a number of industrial physicians would wish to come

yearly to learn details of industrial medical practice has proved wrong. Industrial physicians come for brief periods of time to learn how to meet some special hazard, but there is as yet no fully developed art of industrial medical practice as distinguished from general medical practice, and though men undoubtedly need what could be gained here in a short time, they are unable to visualize just what their needs are. It is probable that for the next ten years we shall continue to train individuals in the special technique of dust measurement, gas analysis, effect of carbon monoxide and electric shock, effects of high and low pressures, and many specialized topics, but it seems improbable that we shall very soon have much demand for the general training of industrial physicians.

CONCLUDING STATEMENT

It is hard to evaluate adequately the cooperation which has been necessary in carrying out the projects which have been listed. We now have close affiliations with the Engineering School; with three students working for the Doctor of Science in Industrial Sanitation and registered in the Engineering School but working here with us. We call upon members of the Engineering and Physics Departments quite constantly, and it is a matter for gratification that they are beginning to call upon us. For example, some years ago it became necessary for me to investigate the possible action of the magnetic field in relation to a purely nervous disease. The Physics Department was able at once to help me with the installation of apparatus and the standardization of the experiment. It would have required many months to have learned the things they were able to tell me in a few minutes. In the other direction, The School of Engineering now recognizes the experience and skill of Mr. Philip Drinker in the measurement of dusts and fumes and air, and the probability that advances

in this field will be more apt to come from him than to come from the Engineering laboratory. Problems of smoke removal are brought him by the Engineering Faculty.

It was thought at the outset that the industrial work would probably result in relations with the School of Education. Until recently, in connection with physical education, this has not been true. It has begun in that, however, and may soon develop further.

Owing to the fact that the whole activity has been housed in and near the Medical School, it has been possible to call upon a very large number of medical departments in connection with the problems. The most notable group has perhaps been that of the medical clinic at the Massachusetts General Hospital, but the Departments of Neurology, Biochemistry, Bacteriology, and Vital Statistics, are called upon incessantly. Perhaps the most interesting feature of the problems which arise in connection with industrial health, is their very varied and unexpected type. A university is peculiarly adapted to attack such problems because of the diversity of information available, due to the many different departments making up the whole organization.

The work at the Graduate School of Business Administration, under Dr. Mayo and Dr. Henderson, has, of course, close interest in relation with this work, and leads to valuable discussions and mutual suggestions; especially, in the nature of it, the work of Drs. Henderson, Bock, and Dill. Future opportunities will obviously come for increasingly intimate cooperation with Business School activities and problems.