(a) Education: The order in which the education proceeds matters little, so long as we see to it that the mine operator or farm owner learns of the danger from hookworm both to his employee and to himself, and of the economic gain sure to follow its eradication; that foremen are taught adequate methods of oversight and are compelled to assume definite responsibility for sanitary conditions within assigned areas, and that the laborer himself, whether farm hand or miner, is plainly, directly and repeatedly shown how to avoid infection.

But we may go further than Reed and Chow and insist that until practical sanitary instruction is introduced into all schools, little improvement can be expected. Ordinary hygiene is being taught more commonly than heretofore, but this must be supplemented, especially in the agricultural and mining districts, by simple illustrated lectures and the distribution of literature about hookworm and other parasites and about the use of the latrine and proper disposal of its contents. Medical colleges, too, must teach not merely physiology and therapeutics; they must reinforce their departments of preventive medicine, so that every student and graduate shall be an apostle of practical sanitation. All possible encouragement must be given to the widespread organization of local bureaus of health, to be under the supervision of the department of police, as in Japan. Nothing can educate either the public or the health officer as conclusively as complete vital statistics. At present, no one in China knows what people die of or what the death rate is. The bureaus of health must be educated to proceed without delay to supply these deficiencies. There is scarcely a doubt that they will welcome every friendly suggestion from institutions or organizations whose aim is known to be of service. In Changsha, for several years past, the staff physicians of the Yale Hospital have held appointment as counselors to the chief of the city bureau of health.

The scientific worker should be so educated as to be able with the least possible loss of time to devise such a substitute or such a modification of the manure the farm hand now has access to as will remove from him the great source of his infection.

(b) Isolation: If no coolie were permitted to enter a mine until examined and pronounced free of hookworm, uncinariasis in mines would soon be a dead issue. The same would be true of camps or any estate where communication could be controlled and infected persons isolated for treatment. But for those vast areas of farmland to which nightsoil is brought without control, the problem will remain unsolved so long as the worker has to use for fertilizer feces that contain living ova.

Substitution.—Hookworm will disappear from China only when the method of substitution succeeds—substitution not of something else for human excrement as fertilizer, but of a nightsoil freed in some way of its danger, to take the place of one full of hookworm ova carried directly from the privy to the growing crop long before any process of fermentation has destroyed the ova therein. The solution of this tremendous problem will be greatly accelerated as here and there throughout the land organized investigation can be made to determine, amid varying conditions of soil, temperature and meteorology, how to treat human excrement in order to eliminate the danger of infection for the worker who comes into dermal contact with it, at the same time preserving its value as fertilizer. The

mere statement of such a problem for a vast country like China, abounding in superstitions and devoted to the keeping up of traditional custom, is almost alarming. And yet, at a time like this, when the traders of the West are extending their commercial interests throughout China for the sake of profit to the citizens of their respective lands, is there not a call for unselfish service as well? It is a call for funds and for workers to grapple with one of the world's big problems of sanitation. And the local authorities will help. Throughout the summer of 1916, while the survey was in progress in Sinhwa and another at Changteh, hookworm was a prominent topic of conversation at not a few official dinners, and government officials, from the highest down, when they learned of the danger of hookworm and of the economic gain likely to follow its suppression, gave assurance of their financial and moral support to any reasonable, practical measure. The governor of Hunan, himself deeply interested in the whole campaign, offered to set aside a suitable tract of land for experimental purposes; and his example was followed by several wealthy landowners. The government bureau of mines, and all others who have been approached, say frankly that they wish guidance in organizing and studying methods of hookworm control. They wish their mines and properties cleared of hookworm, and will cooperate in bringing this about. Such signs are full of hope. They mean that, given such cooperation as the International Health Board has been able to extend to other countries, the local Chinese authorities will not be behind those of other nations in working both for the eradication of the hookworm menace and for a gradual reform of the entire system of sewage disposal, that is even more fundamental than the problem of mere hookworm infection.

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THE RELATION OF LOW BLOOD PRESSURE TO A FATAL TERMINATION IN TRAUMATIC SHOCK*

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It is desirable, in view of the cooperation on the part of several of the physiologic laboratories of the United States in the work on the nature and treatment of traumatic shock arising from war conditions, that the results of such work be made public as early as possible in brief communications. Such is our reason for the form of the present note.

The experimental facts, in part unpublished and in part drawn from previous work, are as follows:

1. When the cells of the brain and medulla oblongata are deprived of blood for a period of from ten to twenty minutes, a change in the staining reactions of the cells is demonstrable if the brain and upper portion of the spinal cord are removed some minutes after the circulation to the head has been restored.¹

2. There is a greater susceptibility of these previously damaged cells to strychnin. Paralysis and fail-

* From the Department of Physiology, Columbia University.
1. Gomez and Pike: Jour. Exper. Med., 1909, 11, 257-265.

ure of function from administration of strychnin during the resuscitation period occur more readily in the anterior (cephalic) portion of the central nervous system, which has been deprived of blood for a time, than in the posterior portion through which the circulation has been maintained continuously.²

3. Such damaged nerve cells will recover when a proper supply of oxygenated blood is provided. Respiration, blood pressure and pulse rate soon become normal.²

4. Transection of the spinal cord in the upper thoracic region may be done without fatal results some hours after the circulation to the brain has been restored. Transection of the spinal cord at this level in animals with brain intact is not ordinarily fatal.

5. Transection of the spinal cord is fatal if done soon after the reestablishment of the cerebral circulation, or if done soon after the return of the respiration and the blood pressure to their normal conditions. Death follows in from five minutes to an hour.³

6. Section of the spinal cord in the upper thoracic level lowers blood pressure. Increasing blood pressure by clamping or ligating the descending aorta just above the diaphragm will restore the failing encephalic (including bulbar) functions, if the increase is brought about soon enough.

7. In cases of severe damage to the cells of the central nervous system, no return of function, or only an extremely slow and imperfect return, is possible so long as the blood pressure remains low. The conditions may be improved by increasing the blood pressure artificially. The conditions become worse when a fall of blood pressure is brought about by some means which does not involve transection of the spinal cord.

It is true that the conditions produced in our animals do not, at first sight at least, coincide in all respects with the conditions as they are supposed to exist in traumatic shock in which the trauma does not involve the central nervous system directly, and the objection may at once be raised that conclusions drawn from such a series of experiments cannot be transferred without modification to apply to conditions in a traumatic shock. But whatever the other conditions in traumatic shock may be, we find strong evidence for the view that some physical damage within the central nervous system must be included as one of them. Such damage may or may not be demonstrable histologically, but a considerable personal experience with conditions in which low blood pressure and diminished blood supply to certain regions of the body, added to the experimental facts contained in an extensive literature on these subjects, have led us to the conclusion that neither low blood pressure of the magnitudes recorded in cases of surgical or traumatic shock, nor the diminished supply of blood to the brain is sufficient in itself to produce such speedy death as is often reported in surgical or traumatic shock. What the nature of this injury to the central nervous system is we shall not now attempt to say. Porter's⁴ views on fat embolism as the cause of surgical or traumatic shock are suggestive in this connection. The profound shock sometimes seen in caisson disease, in which air embolism is a common occurrence, is in line with Porter's observations.

There is no question in our minds that the general systemic blood pressure of mammals is higher than is strictly necessary for the maintenance of the life of

uninjured cells. But injured cells require a better blood supply for their restoration than uninjured cells do for mere maintenance. There is, then, a possibility of a factor of safety in the blood pressure in the organism in health. There is a sufficient margin of safety to restore injured cells to a condition approaching normal if the injury has not been too great.

The general conclusion which we have reached as the result of a consideration of all the conditions known to us is that the general conditions of resuscitation⁵ apply also in surgical or traumatic shock. Some means of raising the systemic blood pressure is necessary in the treatment of surgical shock. The laboratory worker has several such means at his disposal, but none of them are susceptible of easy and successful clinical application. Experiments looking toward the development of some method of raising blood pressure which will be susceptible of clinical application are now in progress.

A TYPHOID CARRIER PROBLEM

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In the first week of April, 1917, I was delegated to investigate an intermittent outbreak of typhoid fever in Bakersfield, Kern County, Calif. The records of the health department of that city showed that for a twelvemonth, beginning June, 1916, cases of typhoid fever had appeared scattered over the city, both sexes had been attacked, and the age range had been from 3 to 46 years. That the outbreak was intermittent was evidenced by the total absence of typhoid in the city during September, October, November and December, 1916. In all, there had occurred twenty-two cases, with a mortality of 9 per cent.

The municipal water supply had been examined from time to time by the state bureau of sanitary engineering, and the typhoid incidence could not be connected with it. The matter of shellfish and of ice cream was also investigated with negative findings. Suspicion was therefore naturally directed toward the milk supply of the city.

There were twenty-five dairies supplying the people of Bakersfield, not including numerous producers who owned one or at most two cows and supplied their own family and the families of neighbors in their immediate vicinity. Furthermore, during the twelvemonth, the families in which one or more cases of typhoid had developed had, like other families in the city, repeatedly changed from one dairy to another or even to a neighbor's supply, when purchasing milk for domestic consumption. To ascertain definitely the name of the dairyman who had been supplying a family during the incubative period of the typhoid illness in that family was, therefore, an exceedingly difficult task.

Much direct and cross examination of members of the families in which typhoid had occurred brought forth a mass of confusing and conflicting evidence. This evidence was carefully weighed, and all irrelevant and extremely doubtful data ruled out by the investigator. The result left nine dairies under suspicion. These nine dairies were then investigated, and the result left three dairies still under suspicion. The evidence thus far gained, when taken in conjunction with the case report, showed that from June to September,

2. Stewart, et al.: *Jour. Exper. Med.*, 1906, **8**, 309-310.

3. Pike: *Am. Jour. Physiol.*, 1912, **30**, 436-450.

4. Porter: *Boston Med. and Surg. Jour.*, 1917, **170**, 248.

5. Pike, Guthrie and Stewart: *Jour. Exper. Med.*, 1908, **10**, 417-418.