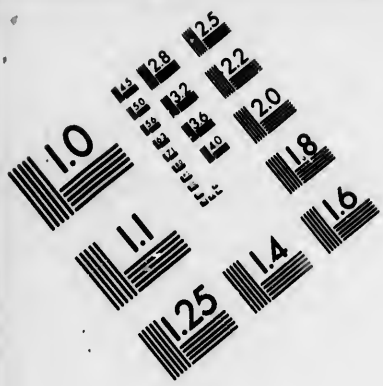

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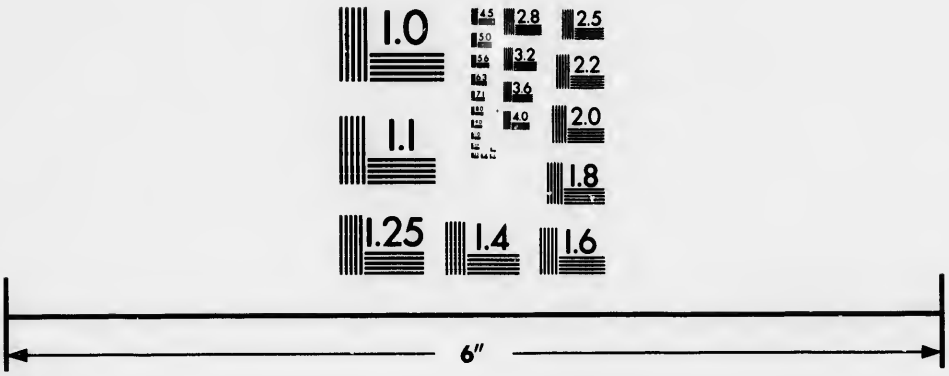

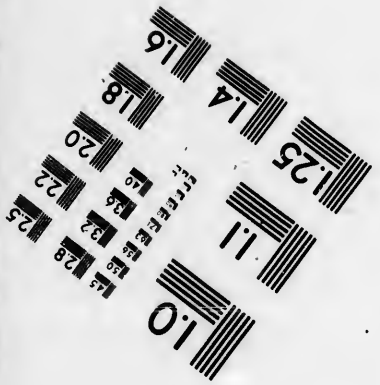

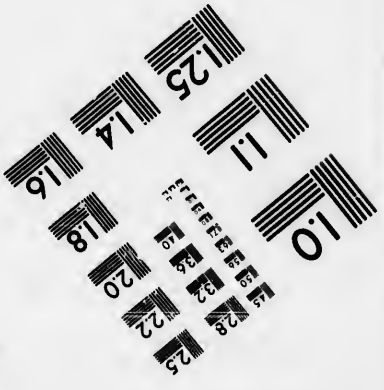

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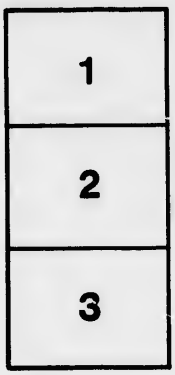

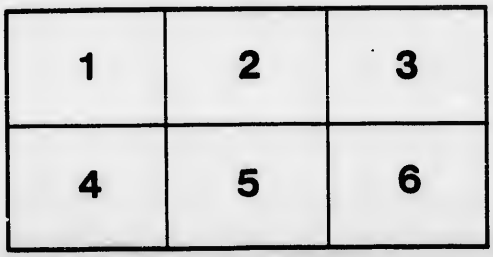

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Recent Work Bearing Upon the Pathology and Morbid Anatomy of Shock.

BY

WYATT G. JOHNSTON, M. D.,

Montreal, Canada.

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RECENT WORK BEARING UPON THE PATHOLOGY AND MORBID ANATOMY OF SHOCK. *

By Wyatt G. Johnston, M. D., of Montreal, Can.,

Assistant Professor of Public Health and Lecturer on Medico-Legal Pathology, McGill University; Bacteriologist to the Board of Health of the Province of Quebec, etc.

I recollect one of my teachers in Pathology quoting in full Johannes Müller's lecture upon the functions of the spleen, the full text of which is alleged to be as follows: "Gentlemen: We will consider to-day the functions of the spleen. As nothing at all is known about the functions of the spleen we will therefore pass on to the next subject." The pathology and anatomy of shock appear to be treated in much the same summary manner by those who write on the subject. Pearce Bailey, "Accident and Injury in Relation to Diseases of the Nervous System" (p. 202), writes as follows:

"The belief which was at first systematically formulated by Page has now become general, that in by far the larger number of litigated

* Read in the Symposium on Shock, Toronto, 1898.

cases of nervous disorders which follow railway and allied accidents there is no gross injury to the nervous tissue. Psychical concussion may be a cause of subjective nervous symptoms, and if severe may indirectly cause organic injury. But the conception as a cause for general nervous symptoms and as a pathological condition is without foundation and has been almost entirely abandoned. By far the larger number of cases of the traumatic neuroses may be explained by the theory that the symptoms are those of hysteria or neuræsthenia, functional disorders of which the pathology is unknown. There are, however, a few cases in which the symptoms are somewhat different from those of hysteria or neuræsthenia, and which may depend upon the structural lesions of the brain and cord though our knowledge of their pathology is largely speculative."

Again the same author (Ibid p. 233) says: "Little is known of the pathology of neuræsthenia. It rarely kills, and there are no recorded autopsies in which the lesions found were sufficiently adequate to account for the neuræsthenic symptoms. In the autopsies which have been made of persons who died during the course of the disorder the nervous system has not been examined with sufficient care to discover any morbid appearances in the ganglion cells. Hodge, and, more recently, Lugaro

have shown, however, that visible alterations in form and structure occur in the ganglion cells of animals as a result of fatigue. And since fatigue is the most prominent feature in the clinical picture of neuræsthenia it is to be inferred that the pathology of the disorder is to be sought for in the nutritional disturbances of the ganglion cells. It would be useless to speculate here as to how these changes are brought about or what their essential characteristics are. It is enough to say that it seems probable that to explain the disturbances of function there are structural changes which may eventually be seen and to a certain extent understood. But until our knowledge regarding the pathology of neuræsthenia is more exact and full, it must continue to be classed with the functional diseases."

I have selected this author as being the most recent American writer on the subject and because his statements represent correctly the general consensus of opinion on this subject at present. While the remarks above quoted refer more particularly to the traumatic neuroses which are chronic in character and whose relations to shock are remote they also apply to the acute and immediate effects of shock, such as appear after severe injuries from crushing or other causes. The essential feature which all forms have in common is that the discoverable nerve lesions are far

from characteristic and are not extensive enough to explain the profound and often very complicated disturbances of the nervous function found clinically. The fact that in one case a profound condition of shock may accompany a relatively slight injury while in a severer injury little or no shock may exist, also that in some cases the shock may be late in appearing points on the whole to the central rather than the peripheral nervous system being chiefly affected. It is in the ganglion cells of the brain cortex and the spinal cord, but especially the former, that changes have been sought for.

Virchow found nearly thirty years ago, in examining bodies where severe cerebral concussion had occurred years before, that the same ganglion cells, or as they are now called, neurons, were frequently found to be calcified, and hence it appeared probable that anatomical changes had existed in them at the time of the accident. This point was not established experimentally, however, and for many years no further anatomical observations of importance were made on the subject. In 1890, Schmaus of Munich made a number of observations and experiments as to the connection between myelitis and compression or other injuries of the cord. By striking upon a board placed along the back of a rabbit he was able to produce a series of paralytic and paretic

symptoms with almost an absence of gross lesions, capillary hemorrhages being almost the only anatomical change. Schmaus' studies were made more with reference to the fibers than the nerve cells and did not establish the occurrence of changes in these, but the more recent investigations in the same direction by Kirschgässer showed alterations in the cells also.

Within the past five years, the study of the neuron or ganglion cell has attracted much attention from neuro-pathologists. The various modifications of the Golgi method have enabled the changes in the fibers to be studied with precision, while still more recently a number of methods, notably those of Nissl, Van Gieson, and Barker, have enabled the minute changes in the ganglion cells to be studied out. The result of these studies has been to show that a number of important changes can be made out in the arrangement of the chromatin and the cell substance. This is shown in some cases by the abnormal distribution of the chromatin particles, in others by their almost complete disappearance. As the authors by no means agree yet among themselves as to the exact character of the lesions or their significance they need not be discussed at length here.

In addition we must bear in mind the occurrence of artefact effects due to the methods employed and of post-mortem changes previous

to the autopsy. Further the particular method employed and especially the personal equation where different observers employ the same method seem to cause differences in the result. This will explain in large measure the numerous minor discrepancies and diversities of opinion in the literature of the subject.

Within the last few years however, the advances made in neuro-pathology and in microscopical technique, valuable for the study of conditions, is such as, I think, to necessitate revision of this too agnostic standpoint. In the many articles published on the subject, the tendency is to show that changes of some sort in the ganglion cells are a fairly constant accompaniment of injury to the nerve centers which apparently leave no gross changes. The procedures employed by Van Gehuchten, Goldscheider and Flatau, Hodge, Levi, Mann, Lugaro and others agree in the main as to the fact of such changes being demonstratable, although there is a want of uniformity as to their exact nature. Ewing and Van Gieson have rendered important service in pointing out clearly the distinctions between artefact changes, due to decomposition, and those really representing marked alteration in the nerve tissues. We have the latter again occurring under two sets of conditions: one where the nervous tissue alone is especially involved, and

the other where it forms part of a general disturbance as in the case of toxæmia, etc.

The studies of Kempner and Pollock, that a number of definite changes in the nerve cells occur after infection or intoxication with the products of the sausage poison bacillus (B. botulinus) further afford the important evidence that when injected with protective serum these changes remain absent. It is noticeable that some of the most striking changes which attract the eye of the observer, such as the vacuolation of the nerve cells, etc., are now known to be merely post-mortem in origin.

With regard to the psychical element upon which so much stress has been laid, this perhaps has been unduly exaggerated. Morton Prince's observations on this point are very striking; he investigated a large number of football players of American colleges without finding a single instance of the conditions analogous to "Railway Spine," as a result of the game. Now short of actual warfare and railway collisions, there is probably no condition which would seem at first sight more conducive to spinal and nervous concussions than football as played in American colleges. He explains the absence of the neuræsthenic symptoms by the mental state of preparedness and the concussions being far from unexpected. Similarly, the fact that railway employes are more or less in a state of expectantness, and this ex-

plains their greater immunity than passengers, and of course the various emotions, fright, etc., are less liable to affect them than the latter.

The studies of the nerve cells hitherto have given much information as to changes in structure but little as to changes in function, although Hodge found that in stimulating the nervous cells in guinea pigs he produced a state of exhaustion with a lessened amount of chromatin; this change has not been quite satisfactorily corroborated by others. In any case, attention has been fixed, perhaps too much, on the chromatin elements, which have possibly only a minor part in exhibiting the functional activity of the nerve cells. It is obvious that some procedure in demonstrating the chemical and metabolic changes which take place would be capable of throwing great light upon this matter. This want to some extent has been supplied, at least as regards phosphorus, by the method of Lilienfeld and Monti (Ztsch. f. Physiolog. Chemie., 1893), who used the phospho-reaction brought out by means of molybdate of ammonia reduced by pyrogallol as an evidence of the relative abundance or lessened quantity of phosphorus compounds in the cells, which, as regards function, is perhaps a better index than the chromatin. The reaction has been used by a number of others, including Sherrington and Helde. It was

found somewhat uncertain in regard to tissues though useful in test tube experiments.

A decided improvement in technique has been found by A. B. Macallum of Toronto, who uses an aqueous solution of 1—4 per cent phenyl hydrosine hydrochloride, which must not be more than 2 or 3 days old. It distinguishes sharply between the molybdate compounds and the phospho-molybdate compounds, the former appearing brown, the latter dark green, at first almost black; the reaction is certain in the absence of an alcohol or a caustic alkali. On adding an acid solution of molybdate ammonium and nitric acid, a deep blue violet color appears.

Details of methods are very fully given in Dr. Macallum's paper (Proc. Royal Soc., Vol. 63, p. 467, 1898). Mr. P. H. Scott, working under his directions, found that the Nissl's granules in the nerve cells gave a distinct phosphorus reaction which was also present in the nerve elements of the retina in an eye which had been exhausted by prolonged exposure to light, and the corresponding eye blindfolded, in experiments on rabbits. Dr. Macallum has kindly written to me concerning the necessity of great care in the preparation of the reagents, especially in the keeping of the acid ammonium molybdate solution tightly stoppered so as to prevent evaporation. The nitrate molybdate reagent is improved by dissolving one part of

pure molybdic acid in four parts of strong ammonia and adding thereto, slowly, 15 parts of acid, nitrate, sp. g. 1. 2, proportions indicate weight. Solution is faintly yellow with decantation, remaining free from precipitate.

It seems desirable that an examination should be made of the condition of the nerve elements with regard to the presence or absence of such changes in cases of shock. There is a good deal of clinical evidence to show that in the absence of gross alteration in the functions some condition is present where the vital powers are greatly lessened, and a slight additional disturbance of this vital force will produce unexpectedly fatal results. For instance, it is common to find cases transported long distances and apparently suffering from a mild degree of shock for a trifling operation, perhaps the removal of a nearly detached limb seems expedient, and a whiff of chloroform or ether is given and the patient never rallies from this short and trivial anæsthesia; this occurs most commonly in alcoholic subjects.

In reference to this point I wish to call attention to the recent studies of H. K. Wright, formerly of Montreal, who has shown that organic changes of the nature of granular degeneration in the nerve cells process occurs as the result of overdoses of bromide of potassium, either in man or animals. He has also shown that a similar condition is produced by

chloroform and ether anæsthesia, and this may explain in part why the accidents occurring as above described so frequently follow the administration of an anæsthetic. At the same time we must not too hastily conclude that the neuron which has become so prominent lately is to be made the base for everything in neuro-pathology, as apart from the previous explanation of late death after anæsthetics in epilepsy probably, and in Graves' disease certainly, the disturbances of the internal secretions, owing to the irregular and abnormal condition of the thyroid gland, appear to be a true explanation of the difficulty. As regards epilepsy, Ohlmacher has recently published observations showing that in a number of cases at all events enlargement of the lymph glands exists (the so-called status lymphaticus) and often there is persistence of the thymus gland. That these conditions exist in otherwise inexplicable sudden death has long been known and the relation seems, if not proven, at least possible. What seems to be needed at present is the careful working over of pathological material and particularly a careful study along the lines laid down by Nissl, Macallum, and others, of the chemico-pathological changes which are associated with the conditions of nervous disturbance.

In my own laboratory, although a number of observations have been made in this direc-

tion, we do not so far feel prepared to communicate the results, as we do not feel that we have yet gotten at the bottom of the personal equation. It seems in this line of work in particular very difficult to compare the results of one observer with those of another. We have been able to confirm in a general way the views of Ewing and Goldscheider as to which changes are due to artefact conditions and which ones indicate general systemic disturbance. Our opinion as to the conditions of the nerve cells in shock must be reserved for further consideration.

On the whole it may be stated with considerable confidence that minute anatomical intracellular changes of some sort underlie the conditions of shock encountered in railway surgery. It is probable, too, that limited lesions of minute dimensions due to hæmorrhage, etc., are more common than has hitherto been supposed and the marked increase in the number of cases of syringomyelia which have come to light since attention has been directed to their occurrence makes the assumption of purely functional explanations less and less tenable for the majority of cases.

I may add a word or two as to the pathological conditions which justify us in assuming shock as the cause of death. We should insist upon all the causes including hæmorrhage being rigorously excluded, and establish a com-

plete and thorough autopsy, noting the absence of gross anatomical lesions of vital organs as well as the absence of conditions such as fat embolism or fatty degeneration recognizable only by misroscopic examination.