there were the characteristic changes of locomotor ataxia. His pain sense was greatly diminished in both legs; he confused heat and cold; and deep pressure was not always recognized. Moreover, he complained of a pronounced pressure sensation over his bladder, and of intense lightning-like pains in his limbs. There was incontinence of urine and he was very constipated. The Argyll-Robertson pupil was present and the discs were gray. The heart and lungs were not conspicuously diseased, and the examination of the urine was negative.

The symptom which makes the case interesting and unusual was the presence of a fine rhythmical tremor of both hands and arms. The pill-rolling position of the fingers was well illustrated. Voluntary effort temporarily quieted this movement, after which it became more intense. It was absent during sleep and was helped by rest. After muscular effort in one hand the tremor was first quieted and then increased. There were no other symptoms of paralysis agitans. The mask-like face was absent, as well as the stiffness and contractures. The patient died from apoplexy.

Autopsy.—The autopsy revealed the presence of a large hemorrhage into the right lateral ventricle. The spinal cord, brain, peripheral nerves, muscles and ganglia were removed and hardened in formalin for study. The cortex, stained by the Weigert method and by hematoxylin and acid fuchsin, showed no pathologic change. In the pons, the fibers of the pyramidal tract were less distinct than in the lemniscus, which, however, may not be of much importance. The posterior columns were intensely degenerated throughout the length of the cord. In the thoracic and lumbar regions the degeneration was almost complete. At the sixth cervical segment the degeneration was still intense, but the number of healthy fibers was greater than in the thoracic regions. The posterior roots were intensely degenerated at all levels, while the anterior roots were intact. In the lumbar region the cells in the anterior horns showed distinct change, and this was also true—though to a less degree—in the cervical region. The nucleus of the nerve cell was much swollen, and the cells had lost their dendrites. The columns of Clark were well preserved. In one spinal ganglion there was some round-celled infiltration, but apparently no change in the cell. The other tracts of the spinal cord appeared to be intact.

I was unable to find any of the changes described by Dana in his case of paralysis agitans reported in 1899, except in the cells of the anterior horns in which the dendrites had disappeared, and the nuclei were swollen and displaced. In Dana's case there was fatty degeneration of the muscle, but I was unable to find this in my case.

The pathologic findings in this case are what one would expect to find in a fairly well-advanced case of tabes, and I do not feel justified in claiming that any part of the lesion present accounted for the presence of the tremor. I can not even say that the arterial change was sufficiently advanced to warrant any comparison with those cases of paralysis agitans in which it has been claimed that lesions resembling those of old age were found. But the pathology of paralysis agitans is still a matter of much doubt.

I was unable to find in my case lesions resembling those described by Schifferdecker, who found degeneration of the muscle spindles. The case that I have just described is possibly one of tabes associated with paralysis agitans.

1732 Pine Street.

Ten Thousand Photographs a Second.—Photographs taken in one-tenthousandth part of a second are an achievement of the Institute for Technico-scientific Investigations in Neubabelsberg, near Berlin. The destruction of bone by a modern small-bore bullet is shown by a series of photographs taken during the progress of the bullet.

HAVE DRUG ADDICTIONS A PATHOLOGIC BASIS?*

ALBERT E. STERNE, A.M., M.D.

INDIANAPOLIS.

In studying the pathology of drug addiction, it seems to me we have a threefold problem to solve. First, there is the hereditary abnormal aspect—the psycho-cellular pathology; second, the acquired abnormal conditions of the individual, which lead to the use of drug stimulants—the pseudo-pathology; and, third, the effect on the system of the particular drug used—the true pathology of the addiction.

PSYCHO-CELLULAR PATHOLOGY.

I am perfectly well aware that good authorities deny the influence of heredity among drug habitués, but I do not believe that this ground can well be maintained. First of all, it is a matter of record in the study of the histories of a large percentage of habitués of all kinds, that we find taints of varying degree among the ancestors of these individuals. It is a matter of very common occurrence to learn that either one or both parents, or some immediate ancestor, had been the victim of chronic nervous or mental affections, or had been addicted to the habitual use of alcohol, morphin or some other narcotic. When we consider the especial meaning of heredity, it should become apparent that the influence on the individuality and innate characteristics of the nerve cells of the offspring should be distinct.

In all probability, in the light of modern scientific research, we must admit that there is no such thing as hereditary disease, but it is equally certain that the conditions, characteristics and environments of the parent cell may be conveyed to the fetal cell to a disproportionate degree. True heredity must reach back to the very initial fertilization of the male and female cell. It must exist in the primary conception of fertilization. The particular development of this individual fertilizing cell undoubtedly modifies either in the one or the other direction, the manifestations which may be, at the beginning, inherent in this cell. After fetal life, conditions of environment and education, and the development of associations, further serve to modify for good or for evil the inherent characteristics of the primal cell. On this basis of reasoning, it seems to me that it would be impossible to conceive of malignant disease as existent in the primal fertilization, else would the ovum never develop into maturity. This would not necessarily obtain where we were dealing merely with tendencies of the parent cell, which might later develop through circumstance or environment into a nervous diathesis, resulting finally in a state of atavism. It is a well-known fact that the progeny of chronic invalids, of epileptics or of alcoholists, and mental and moral wrecks, develop the tendencies of ancestry to an augmented degree. The annals of criminology, as well as of the great charitable institutions of the world, reveal this to a remarkable degree. It is my belief that the same thing can be demonstrated in the peculiarities of the offspring of those addicted to the inordinate use of the various drugs.

We will all of us grant without question. I believe, the effects on the mental and moral sphere of the progeny of drug habitués; yet the mental and moral deter-

* Read in the Section on Nervous and Mental Diseases of the American Medical Association, at the Fifty-fifth Annual Session, June, 1904.

mination of these cells must be dependent on the healthy organic conditions of these cells, on their ability to exhibit the normal characteristics of brain cells, especially as regards their motility—that is, their power to alternately become active and to fall into repose.

In the histories of those drug habitués who take up the, so to speak, inherent tendency to the use of the drug, it is remarkable to find the constantly recurring fact that either one or both parents or immediate relatives were also drug users.

PSEUDOPATHOLOGY.

The occasional causes for the acquirement of drug habits are too numerous to classify, but, taken as a whole, they may be subdivided into, first, the use of drugs purely as a stimulant; and, second, their use to efface some physical or mental distress, whether this be in the nature of pain, worry, grief or shock. Ultimately, the main factor in the causation of all drug habits, whether they be based on hereditary influences, on physical or mental weakness, or on physical or mental pain, is always the same, namely, the weakness of the nerve cell and the lack of vital force, which make the individual powerless to combat the strenuousness of existence. In the one or the other direction, the victim seeks to fortify his failing mental or physical power through the aid of a stimulant.

Unless the individual be burdened by extremely strong hereditary taints, or be the subject of innate, vicious moral principles and of the lowest and lower grades of intellectuality, there is usually some element of physical weakness in play, which he endeavors to overcome by artificial means. A study of the individual histories of such persons will almost invariably show that there has been some definite cause which has brought about a physical incapacity to deal with the problems confronting him. It is not at all unusual to find that a previous illness has resulted in bodily prostration, not infrequently associated with a greater or less degree of insomnia, to overcome which the patient has had recourse to alcohol in some form to sustain the physical vigor, and to opium in some form to bring on sleep. It is almost as frequently true that mental or psychic pain has been the source of the drug addiction.

In this connection, it is but just to say that members of our own profession have often been derelict in their attitude toward their patients, in that they themselves have thoughtlessly prescribed stimulants of the alcoholic variety and used narcotics of the morphin variety in a careless manner, and in individuals whose resisting power was so low that they readily became the victims of a habit which had been found to bring such material relief. I take this occasion to condemn the practice, wherever it may exist, of using opium to induce sleep. Opium and its derivatives should be used only for the definite purpose of relieving intense pain, and then only as a last resort and under circumstances which warrant the physician in the belief that his patient will not become addicted to its use.

To the ever-increasing army of alcoholics and drug users, men and women of the higher social strata are bringing a vast contingent, certainly as large, if not even greater, than the total number of recruits from the lower classes. The reason for this is not hard to find, when we consider for a moment the vast amount of intellectual and vital force necessary to keep up with the advance and demands of civilization. While it is equally true of lawyers, clergymen, and social idlers, perhaps the best example and the one which appeals most to us,

is that of the physician who himself becomes a drug habitué. Unfortunately, a greater and greater number among our profession are seeking assistance and solace in that direction. We are especially unfortunate in that our knowledge of medicine and of the various drugs, and the readiness with which we find them constantly at hand, make the physician the easiest victim of all.

The physician, with a large amount of work and worry, with the ceaseless mental strain, often associated with physical hardships and loss of sleep through the demands of his professional duty, who misses this week one night of sleep and the next week two or three, feels that he needs something to stimulate and keep him in professional harness. He says to himself that he knows all about the drug he is using, that he knows its influence, that he knows its effects and its side effects, that he can stop when the latter show themselves; but it is for all the world like getting on a toboggan slide and determining to step off when you are half way or three-fourths down the course. It is a very easy thing to determine to do, but an extremely hard one to accomplish. It has always seemed strange to me that physicians who need such stimulants do not seek the safe refuge of strychnia, instead of the dangerous solace of opium and alcohol.

TRUE PATHOLOGY.

In considering the third problem before us, namely, the effects on the tissues of the system as a whole, and on various organs, notably the central nervous system in particular, we have a peculiar difficulty to overcome.

It must be remembered that most users of drugs have been addicted to the habit for longer or shorter periods of time, during which processes other than those induced by the drug used may have concurrently been in play. To arrive at the true pathology of any addiction, therefore, it would be necessary to exclude all factors other than that of the drug employed. Unfortunately for the solution of this particular problem, few persons, relatively speaking, die from the effects of drugs used in habitual wise. Intercurrent diseases usually bring on death. In acute poisoning, as in cases of suicide, the effect is so rapid on the vital centers that cellular changes have had no opportunity to occur, and in those cases rescued by immediate efforts, presumably few, if any, develop; at least, we are unable to study them.

We must, therefore, confine our inquiry into such pathologic conditions as may be found in individuals who have been habitués for periods of time, and here again we are confronted with a universal difficulty, for the ultimate effects on chronic users of the common drugs, like alcohol and opium, is that the entire system becomes highly acid. This really in itself constitutes a true pathology, and, in my opinion, it is the true pathologic basis. Just in this feature, however, we encounter another problem. We know that acidity of the organism, if that state exist through a space of time, in itself induces cellular changes within the various organs. So far as the minute and even the gross alterations of tissues are concerned, these are very similar in all conditions of an acid character, no matter what particular factor may have produced the hyperacidity. This is as true of the use of opium as of alcohol, the effects of which have been well studied and are clearly understood.

It has been claimed that the pathology of chronic morphinism differs materially from that of chronic alcoholism. On this ground it has been claimed that the effect on the offspring of morphin habitués is in no

wise similar to that of the effect on the offspring of chronic alcoholics. To this doctrine I am absolutely opposed. If it be granted, as it undoubtedly will be, that addiction to any drug through a long period of time brings with it a deterioration of cellular activity in the higher nerve centers of the user, then we must also admit that the character of the fetal cell would be determined in analogous wise to that exhibited by the cellular deterioration in other affections. This is especially manifest when we consider the development of the ovum in utero of a mother whose system is impregnated by the physiologic effect of opium. Examples of this malignant and characteristic effect have repeatedly been found in newborn infants of mothers who, during the period of gestation, had been using morphin, either alone or in combination with other drugs, constantly. Such infants, immediately after birth, differ from ordinarily healthy children in that they are very apt to be inordinately drowsy, refuse to nurse, and have been known to sleep steadily for twenty-four hours. After the period of somnolence, the stupor disappears and these infants show excessive irritability, have colic pains, and are liable to become very cyanotic. These are the so-called "blue" children (Happel). The cyanosis is probably due to a lack of closure of the ductus arteriosus and foramen ovale in the heart. The administration of opium in those instances where the development of the child has not been irreparably arrested, promptly relieves not only the irritability and the colic-like pains, but also the cyanosis, and, moreover, the opium must be administered constantly and the child must be weaned away from it, in the same way as in adult narcotism.

It must be understood that the foramen ovale is never closed until after the birth of the child, that it is the very last remnant of fetal existence which remains to be completed. If so malignant an organic defect can result from habitual use of morphin, then I cannot conceive of any valid ground on which to dispute the effect on nerve cells in the brain, notably in the presence of the evidence which is manifest in the relief of the symptoms through the administration of opium in any of its forms.

In many instances, we are dealing with the finest, most minute details of the anatomic and physiologic structures of the body. The effects of alcoholism in this respect are well understood. We know that alcohol, used in constant and varying quantities, exercises an extremely deleterious influence on the vascular system throughout its entirety. Secondly, we know that it extends its pathological effect to the various cellular tissues of the body, notably that of the nervous system. I am referring here especially to the individual who is denominated a "steady drinker," the man who always drinks and who prides himself on the fact that he never becomes intoxicated. It is just this man in whom the effects of the stimulant are most manifest. The occasional or periodic drinker—unless these occasions become so frequent as practically to form a continuity—comes to little or no grief, but the steady drinker is the one in whom the delicate regulatory mechanism of the vascular system becomes early impaired. From this point onward, the pathologic process is constant and destructive, and ends in the hardening of the blood vessels, which predisposes to tissue inanition and faulty metabolism. In consequence, we note the general disturbance of the emunctories, with disease of the kidneys, liver and the other organs of the body. In the nervous system, the effect is especially bad. Here we note not only vascular changes with degeneration of the

blood vessel walls, but we have characteristic cellular changes in the brain; disarrangement of the chromophyl-granules, with distortion and dislocation of the nuclei and nucleoli, and vacuolization of the cells.

If the process does not go too far, we find in such cases manifestations of the disturbance of the function of the nerve cell, with a loss of power for activity and repose, which is indicated by a general neurasthenia and cerebrasthenia. If, however, the process passes beyond this point, which I should designate that of "recoverability," then we have exhibited the paralysis of power of the cells in whatever field of function they may represent.

What has been said of the pathologic effect of alcohol is, I believe, equally true, though probably in far less degree, of other drugs used to excess. While many good authorities contend that this is not the case and that morphinism and its sister vices are purely diseases of the moral and mental sphere, it seems to me that they forget the essential power of motility in the brain cells. It seems to me that it makes no difference whether we are dealing with a brain cell of motor function, or moral function, or intellectual function, the same principles must hold good in any or all of these cases. I am an adherent of the doctrine of the motility of the nerve cell, which in its normal condition has the power to change somewhat its form by withdrawing its dendritic processes from contact with other processes, but in nowise has the power of changing its concrete location. If, therefore, for any cause this loss of motility in the nerve cell, which is a structural thing, becomes impaired beyond the power of recovery, then we have a pathologic basis of a structural nature in the cell itself. I believe, therefore, that not only chronic alcoholism, but also chronic drug addictions of every kind have a physical basis. We must not lose sight of the fact that structural changes of the cell, heretofore beyond our limits of vision, are now known to be possible of study by means of intense lateral illumination, which has increased the power of our microscopes many hundred-fold.

In the near future we may justly hope to acquire definite knowledge of pathologic cellular and other changes, of which at the present time we have no adequate conception.

Just as the fundamental factor for the necessity of all stimulation by drugs lies in the innate loss of force within the nerve cells, so the universal ultimate pathologic effect of almost all drugs used to excess is to render the entire organism highly acid. Certainly this is true of alcohol and of opium, the most common addictions. Whether or not many of the pathologic tissue changes do not depend directly on the hyperacidity of the system remains as yet a matter of doubt and study.

While this is undoubtedly true, it seems to me that we may even now assume that drug addictions have a pathologic basis, expressed as follows:

1. By the hyperacidity of the system.
2. By minute structural changes within the cerebral cells in particular, and probably also alterations in the vascular tissue.

In addition, we must admit that hereditary influences and the presence of faulty conditions—physical, mental and moral—play a most important rôle in the development of narcotic habits, but that, while they may have a pathology all their own, this must in nowise be considered an intrinsic feature of the true pathology of drug addiction itself.

DISCUSSION.

DR. A. J. PRESSEY, Cleveland, stated that probably what is really inherited from parents addicted to alcohol or morphin is a feeble constitution, a neurasthenic condition, and a lowered vitality. But it is perhaps doubtful if such a person is much more liable to acquire a habit than a child born of parents who have given to their offspring the same condition from some other cause. Persons only get alcoholism from alcoholics and morphinism from morphin. During the past ten years Dr. Sterne has treated from 50 to 75 morphin patients each year. A very large per cent. of these patients have been persons who were born of parents of average health and who were free from either alcohol or morphin addiction. A large per cent. of these patients acquired the habit from taking morphin for the relief of severe and long-continued pain. One-half of his patients year after year are physicians; this is not a reflection on the profession. He is sure, judging by observation and by patients' statements, that more than three-fourths of these physicians acquired the habit from severe pain long continued; they were not born degenerates. A man is not necessarily a degenerate because he takes morphin. Dr. Sterne claimed five years ago that an acid condition of the patient is the cause which produces the extreme nervousness during the withdrawal of the morphin. Dr. Pressey has since that time given various forms of the alkalies, but with the one exception of phosphate of soda, has received no benefit, and asked Dr. Sterne if he still believes there is a hyperacidity and from what form of alkali he receives the most benefit.

DR. RICHARD DEWEY, Wauwatosa, Wis., referred to the chemical union of the alcohol or the morphin and other narcotic products with the nerve cells. He stated that about two years ago he read an article by a Russian, who published the results of some researches in which he claimed to demonstrate the chemical union of the morphin with the nerve cells, and it has always seemed to him that researches in that direction would be of value.

DR. S. M. CROWELL, Charlotte, N. C., declared that he has come to the conclusion that we, as American physicians, know but very little about the pathology of either alcohol or drug addictions because so few physicians have studied these conditions scientifically or made clinical researches. They have been too prone to look on them as malicious habits which could be abandoned at will, and most physicians try to get rid of such cases as quickly as possible, as they are so difficult to treat in general practice. As a consequence of this attitude of the profession little positively is known of the pathology of this condition. Dr. Crowell does not believe that the pathology is the same in alcoholism, opiumism and cocaineism. He thinks that the pathology in these cases is due, not so much to a hyperacidity of the system as to a toxemia of some kind. He does not believe in the alkaline treatment of opiumism as advocated by an English author, though occasionally some alkaline preparation may be given as indicated. He considers that the rational method is to eliminate whatever this effete material may be from the system by the various emunctories and not to rely on the alkaline treatment.

DR. SMITH ELY JELLIFFE, New York, said that one of the greatest troubles in the way of pathology is the lack of facts concerning the actual conditions. Physicians suspect a great deal, and talk very glibly of acid conditions, alkaline states, suboxidations, lack of elimination, insufficient water in the system, etc., but there are practically no recorded data available beyond a few really good studies by Faust and his colleagues. He made a motion that the section have a committee appointed to investigate one of these subjects and apportion among the members work in some particular line. He suggested that some one investigate the nerve cell changes in acute morphin poisoning, as has been partly investigated by Ewing; another, the state of the leucocytes or distribution of the blood elements. Another fruitful line of inquiry opened up by Faust concerns the development of antitoxins for morphin. These are some of the problems, none of which has ever been thoroughly worked out. By this means something definite

may be obtained in the line of rational pathology of drug habits.

DR. ALBERT E. STERNE, Indianapolis, stated that the paper was an inquiry into the pathology of drug addictions and that naturally some etiologic factors were included. He believes that when more is known of the true pathology of drug addictions the condition suggested by Dr. Dewey of the chemical union of drugs with nerve cells may be found. In cases in which the fetus is affected by the use of drugs by the mother it must be by means of some kind of chemical action, but whether it is a chemical union with the nerve cells or a chemical union with the fluid tissues of the blood is not known. The only agency that carries chemical power in the body is in the blood corpuscles themselves. Dr. Sterne can not see wherein the system can escape acidity, though a great degree of hyperacidity must not be expected in these conditions. The system never becomes so intensely acid that the secretions of the body will have a decidedly acid reaction unless it be secretions from the stomach. The secretions which are normally alkaline have lost their alkalinity and, therefore, there must be a hyperacidity. In Dr. Sterne's opinion it is revelations of this character which account for the so-called characteristic abstinence symptoms of these cases. If the stomach is washed out repeatedly these abstinence symptoms are frequently absent. It is his practice to use a large amount of some saline solution or bicarbonate of soda. This promotes elimination and it brings fluid into the body and into the tissue which are practically water hungry and promotes metabolism. Dr. Sterne admits that he believes these symptoms have a physical basis, but he is uncertain just what that basis is. Everything external to the effect which the drug itself exercises on the system must be eliminated.

The chairman announced later in the day that he had appointed the following committee: Dr. Smith Ely Jelliffe, New York; Dr. Brooks F. Beebe, Cincinnati, and Dr. Albert E. Sterne, Indianapolis.

FAT EMBOLISM OF THE LUNG, FOLLOWING FRACTURES.

WITH REPORT OF TWO CASES.*

F. GREGORY CONNELL, M.D.

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SALIDA, COLO.

The study of fat embolism has been comparatively neglected by Americans. It has never been the subject of a paper read before the American Medical Association, and in the perhaps 250 cases that have been reported in the literature not over a dozen have been contributed by writers of this country.

These facts, with an experience of two cases in as many years, led to a study of the subject and to the belief that it is deserving of more consideration than is usually given it, and to a presentation of the subject, at this time, in the hope of stimulating an interest that might result in more definite knowledge.

HISTORY.

Magendie,¹ in 1827, was the first to demonstrate, experimentally, that the injection of oil into a vein might produce dyspnea and even death. In 1839 R. W. Smith² noted two cases of fatty heart with free oil in the blood. MacGibbon,³ in 1856, reported an instance in which delirium tremens was complicated by sudden dyspnea,

* Read in the Section on Surgery and Anatomy of the American Medical Association, at the Fifty-fifth Annual Session, June, 1904.

1. Magendie: Vgl. dessen *Leçons sur les Phénomènes Physiques de la vie*, vol. I, p. 139, 1827.

2. Smith: *Dublin Jour. Med. Sci.*, n. s., vol. ix, 1854.

3. MacGibbon: *Amer. Jour. Med. Sci.*, January, 1856.