

This is, that superimposed upon self-consciousness, as is that faculty upon simple consciousness, a third and higher form of consciousness is at present making its appearance in our race. This higher form of consciousness, when it appears, occurs at the full maturity of the individual, at about the age of 35, but almost always between the ages of 30 and 40. There have been occasional cases of it for the last 2,000 years, and it is becoming more and more common. In fact, in all respects, as far as observed, it obeys the laws to which every nascent faculty is subject. Many more or less perfect examples of this new faculty exist in the world today, and it has been my privilege to know personally and to have had the opportunity of studying several men and women who have possessed it. In the course of a few more millenniums there should be born from the present human race a higher type of man possessing this higher consciousness. This new race, as it may well be called, would occupy, as toward us, a position such as that occupied by us toward the simple conscious *alalus homo*. The advent of this higher, better and happier race would amply justify the long agony of its birth through the countless ages of our past. And it is the first article of my belief, some of the grounds of which I have endeavored to lay before you, that a race is in course of evolution.

ORIGINAL ARTICLES.

HYDROPHOBIA.

Read in the Section on State Medicine, at the Forty-eighth Annual Meeting of the American Medical Association held at Philadelphia, June 1-4, 1897.

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This paper is presented more with the idea of calling attention to enforcing the fact that there is a reliable remedy for animal poison, than to offer any new developments in regard to hydrophobia. Little that is new and undisputed has been discovered since the report of the AMERICAN MEDICAL ASSOCIATION, in 1856. We are still confronted with contradictory theories and strange anomalies, which are only to be explained from the vantage ground of one who realizes that disease is not an entity, but rather a remedial effort, and that relief comes only by our ability to recognize and assist the vital forces in their inevitable conflict with all foreign material.

Although hydrophobia is one of the rarest and most fatal of acute, infectious diseases, and is produced only by inoculation of a specific animal poison, which manifests itself by symptoms due to a disturbance of the central nervous system, it is mitigated by the more important fact that the period of incubation is longer than that of any other acute specific disease. This period is variable, rarely less than a month, in some cases reaching nine or twelve months, the average being six or seven weeks, which gives opportunity for remedial measures, that as we will endeavor to show, are ample to eradicate the poison.

The etiology of hydrophobia is so well known that it needs but a few words of description; mainly coming from the saliva of dogs, rarely from cats or other animals, it is a well recognized fact that the disease never originates in the human species. Its spontaneous origin is confined to the lower animals that do not perspire. The investigations of scientists all over the

world have as yet failed to determine the true cause of this terrible malady, although the fact seems to be well settled, that the disease occurs much more frequently among the male than among the female dogs or other animals. Inoculation may arise from a bite, scratch, or from a lick upon an abrasion. Instances have been given where the disease came from the lick of a dog that was not mad.

A puzzling case occurred some years ago in England. A boy 14 years of age, while playing with a Scotch terrier, was bitten slightly on the hand. Three weeks later he became ill and died in terrible convulsions. The physicians pronounced it a genuine case of hydrophobia, but a girl who had been bitten by the same dog appeared to have suffered no harm, and, more remarkable still, the dog was examined by a competent veterinary surgeon, and pronounced perfectly healthy. Such cases are not uncommon.

When preventive measures are adopted as soon as possible, the larger number of persons escape. Children are the greatest sufferers, from being helpless and more exposed, and their cases are not open to the charge of simulated or spurious disease, and at the same time they are a complete refutation of the theory held by some authorities that there is no such disease.

The fact that during the period of incubation there are commonly no symptoms, is liable to lead to a sense of false security. But that is the time to adopt vigorous measures of prevention. Occasionally there is pain or discomfort at the seat of the wound, and sometimes mental depression, which may arise from anxiety regarding possible consequences. Even the onset of the disease is rarely attended by pain or inflammation in the wound. The first evidence of the impending disorder is usually mental depression, disturbed sleep, discomfort about the throat, with difficulty in swallowing liquids; even the attempt occasions spasms, which soon involves the muscles of respiration. The intensity of all these symptoms increase within a few hours, until the mere sight of water will cause a spasm. The reason is frequently lost, and the end from exhaustion is assured in from one to six or eight days.

The varieties in this disease are as great as in any other, because each case is modified by the condition of the system, and the vital reactive powers of the individual.

If there is a prospect of relief from the horrors of hydrophobia, this relief may well claim our earnest attention. It is well known that from the bite of a rabid dog there is a period varying from seven days to six months, before the more acute symptoms manifest themselves. This gives ample time to eliminate the poison from the system. In "Todd's Clinical Lectures," occurs this passage, "Large evacuations by sweating may be employed more freely and with less disadvantage to patients, than by any other secretion." This is also demonstrated by the fact that many diseases are daily being cured by some form of sweating bath, and that physicians are more and more using that form of treatment. In China, and other countries, as well as our own, sweating has been successfully used in the elimination of malarial poison. Another proof is that in some Eastern countries the sweating bath is used to cure the poison of snake bite, which is much more rapid in its action than the poison from the saliva from a rabid dog. It will also readily be seen that treating this malady from the outset is a very different thing from waiting until the poison has become absorbed and permeated the whole system, and the paroxysms have

set in, when in truth there is little hope of cure under any treatment.

Hydrophobia belongs to that large class designated as ferment diseases, which depend upon the introduction and development in the system of ferment germs. Enteric fever and erysipelas are familiar examples. Simple absorption has sufficed to inoculate the patient, but in the majority of instances the skin receives more or less abrasion, and the germs are either implanted in the epithelium beneath, or introduced directly into the circulation. The abrasion may heal kindly, but in a varying time, depending upon many factors, an irritation at the seat of the abrasion, accompanied with darting pains, announces the onset. Unlike other diseases, the blood appears not to be a good soil for the development of the germs, which however circulate with it until they find the soil, or tissue, best adapted to them, and then the real havoc begins. In the dog and the man, the three pairs of salivary glands, the parotid, submaxillary, and sublingual, appear to furnish the required conditions, and to be the main seat of the lesion. The congestion of the nervous centers that so directly ensue, is probably consequent upon changes in the structure of these glands. Every physician knows well how speedily severe nervous symptoms follow such changes, how intimate the sympathy is between the glandular organs of the mouth and throat and the nervous centers at the base of the brain, and what violent hysteriform seizures often ensue in such cases. With the involution of the great respiratory tract of the nervous system come difficult respiration and its train of associated symptoms. At the same time it is more than probable that the nervous system suffers from the more direct poisoning caused by the presence of germs in the circulation, but not because they are a specific nerve poison, for when a full dissection is performed, no evidence of it is found in the nerve centers, and this excludes the nerve poison hypothesis.

In the McCormick case, as reported by Dr. Hammond, June 1874, microscopic examination revealed disease of the cortical substance of the brain, disease of the medulla oblongata, and disease of the spinal cord, also disease of the pneumogastric and hypoglossal nerves. The nerve elements were broken down and oil had taken their place, and this has been found the general direction of the disease, with slight modifications in different cases. Fatty degeneration of the nerve substance was a marked symptom.

The question quickly arises, what best can be done to arrest the action of this poison? Nature does everything possible by arousing every emunctory to action and, as in all cases of poison or morbid matter in the system, the leucocytes are called upon for their most vigorous action to relieve the patient. It is claimed that immediate suction of the wound has saved many patients. Good authorities believe that the virus remains localized, for a time, in the cicatrix, and that cutting it out even after the original wound has healed, may serve to avert the disease.

To diminish the production of rabies in the dog, Fleming, one of the most distinguished veterinary surgeons, recommended that dogs should be muzzled, except in times when the disease is epidemic, that they should be placed under good hygienic conditions with a heavy tax upon every animal, and that all vagrant dogs should be killed. It is claimed by some, among them Fleming, that rabies has spontaneously originated in the dog, in consequence of exposure

to extremes of heat and cold, ungratified sexual excitement, maltreatment, insufficient food, etc. Roucher, another authority, also maintained the same idea.

Opposed to this is a long array of eminent authorities who claim that rabies does not originate in the dog otherwise than by inoculation with the virus of a rabietic animal.

In the pathologic anatomy of the disease we are also involved in a mass of contradictions. Careful microscopic examinations of the brain and spinal cord, by medical experts, have been attended with entirely negative results. In some few cases there was found fatty degeneration of the nerve-cells, notably that published by Dr. Hammond in 1874, in others simple congestion of the vessels, but in the whole list there was no lesion found that was peculiar to hydrophobia.

In reporting this condition of things, the *Medical Record* stated, May 25, 1878: "We are forced to the sad conclusion that, with the present means at our command, every case of hydrophobia is necessarily fatal."

Dr. Hammond, in his report previously referred to, endorsed the plan suggested by Bourrel and also detailed by Fleming in his treatise on rabies, of having the incisor teeth blunted. So far as dogs treated that way are concerned, this was claimed to be an absolute preventive, but non-rabid dogs have been known to communicate the disease. It is a well known fact that the germs of this poison are sometimes present in the saliva of dogs that are apparently healthy, and particularly frequent in that of the spitz. It is also known that the bite of a man in anger may inoculate a man whom he bites, with poison that produces disease, if not hydrophobia. Instances are on record of a woman while in anger nursing her infant, thereby bringing on convulsions and endangering the life of the child.

The pathologic changes in the nerve substance are but the local exhibition of the general systemic poisoning. In the effort to throw off this poison a small amount of morbid matter adjacent to living structure is dissolved by the leucocytes, and is forced out of the system by way of the natural emunctories. When the system is in the throes of a vital struggle with this morbid material, there can be no excuse for thrusting upon it more of the same material, even though it be in attenuated form. The human system, when laboring under morbid influences, needs but those elements which can add vigor to the vital resistance, and the fluid which patrols the entire body, should be strengthened rather than further decomposed and disorganized by the addition of extraneous and poisonous matter.

The Pasteur treatment is the accredited method for those who have been bitten by a rabid animal, but this, like the antitoxin treatment, is simply sending one poison after another in the system, and whatever the result the victim is the chief sufferer. The Pasteur treatment has not proved uniformly successful, and in those cases where it was apparently so, it is open to question whether the patients might not have recovered without any treatment. It is well known that during the first few years of the experimental inoculations for rabies, so many deaths occurred among the patients that Pasteur himself became alarmed at his own work. Since that time, from the improvement in the treatment, the death-rate has lessened, due to the dilution of the curative lymph.

It is well enough, and most commendable, to discover the microbe which, as stated, appears "to be the veritable and sole factor in the malady," but facts go to show that the microbe is the result of the disease, except in inoculation.

Pasteur found no indication of an incubation period shorter than seven days, and he never claimed that he had discovered a *cure* for hydrophobia, but simply that a person who had been bitten by a presumably mad dog and within a few days was inoculated with attenuated virus, would not develop hydrophobia; if a certain time had elapsed after the bite this preventive treatment was of no use whatever.

The London *Lancet*, of Oct. 31, 1885, says: "We can not but think that Pasteur's inferences are sanguine and premature." In the year 1895 the *Lancet* published a statement from Dr. Magner, in which he pointed out that Pasteurian statistics were very misleading, and quoted from a report of the Registrar-General of England, to show that in the five years preceding the establishment of the Pasteur Institute, the number of deaths from hydrophobia were 155, whereas in the five years thereafter they reached 159. He thought that was a strong argument that the Pasteur Institute had no effect in diminishing the deaths from hydrophobia. An article in the *Paris Journal of Medicine*, by Prof. Peter, stated that the inoculations pretended to be antirabic by M. Pasteur were in principle nonsense, and in practice deceptive. Statistics have shown that the mortality from hydrophobia, in and around Paris, the seat of the Institute, has not been in any way lowered, but on the contrary, has increased ever since Pasteur began his inoculations. In 1895, 272 persons died of hydrophobia after undergoing the Pasteurian treatment, which ought to have saved them from any attack of the malady. . . . In 1866, a girl named Pauline Kiehl, was taken to the Institute, but as hydrophobia had already set in Pasteur declined having anything to do with the case. The girl was then taken to Dr. Leon Petit of Paris, who cured her by the vapor-bath treatment. . . . Dr. Lutaud, editor of the *Journal of Medicine* of Paris, with straightforwardness asserts that Pasteur does not cure hydrophobia, but he gives it. . . . In 1894, Dr. C. W. Dulles of Philadelphia, made a report to the Pennsylvania Medical Society, of his special study of hydrophobia, covering a period of over ten years. His figures give an average, from a total of seventy-eight cases, of one per annum to every 4,500,000 of population, with an excess of cases in the vicinity of Pasteur Institutes. In fact, he charges directly that not only has Pasteur's methods "increased the number of deaths from hydrophobia," but that "there has been added to these a large number of deaths due to inoculation of what ought to be called Pasteur's disease." . . . Dr. Dolan, editor of the *Provincial Medical Journal*, taking a general survey of Pasteur's methods and his numerous failures, says that "Not only does Pasteur not protect from the disease under the very conditions demanded by himself, but he has added a new terror to it by the introduction of paralytic rabies."

In Long Island City, on April 25, 1897, a strange dog severely bit a 6 year old boy named Charles Silk. Two days thereafter the child was taken to the Pasteur Institute in New York and a course of treatment commenced at once, which lasted fifteen days. After completing the course at the Institute the mother of the child was told that her son was insured against dog

bites for ten years to come, but three weeks from the day of being bitten, the boy died, a pronounced case of hydrophobia.

Better than Pasteur institutes, and better than all other remedies, or rather preventives, would be what is proposed by an eminent English writer, Mrs. Maynell, in the London *Chronicle* and that is the utter extinction of the canine race, holding that the life of one child is of more value to the world than that of all dogs, and that one of the inevitable results of our advancing civilization will be their extinction. While the dog forms a prominent feature of the domestic life of our day, the services he renders are by no means an adequate offset to the danger with which his presence continually menaces the community.

The Pasteurian treatment is a grievous mistake, although it is as yet the only method that has medical sanction. There is a simpler, safer and more scientific treatment for the dreaded disease, based not upon the old fashioned practice of putting foreign matter into the system, but on the more modern and exact principle of eliminating the poisonous taint. That is the hot air or vapor bath treatment as practiced in many lands, but particularly by Dr. Buisson, formerly of Paris. By this means patients have been cured, even after hydrophobia had set in.

In the year 1826, Dr. Buisson was called in to attend a woman attacked by hydrophobia. According to custom he bled her, and happened to wipe his hands on her handkerchief, covered with saliva. "Perceiving a mark on the first finger of my left hand," he writes in a book published in Paris in 1855, "I became aware too late, how imprudent I had been. As soon as I reached home, I cauterized the wound with nitrate of silver. On the seventh day I experienced a sharp pain in the region of the scar. Imagining, however, that it was in consequence of the cauterization, I paid no great heed to it, but the pain became so intense that I was obliged to put my arm in a sling. The pain grew more and more acute, commencing at the first finger and following the radial nerve till it mounted to the forearm. The paroxysms lasted two or three minutes, with intermissions of five or six minutes. At each paroxysm the pain spread to the length of several centimeters, when it passed the elbow it became intolerable. My eyes were extremely irritable, and felt as though likely to start out of their sockets. I was painfully affected by light, and consequently by all luminous bodies, such as glass and metals. My hair seemed to stand erect. My body seemed lighter than air; I believed that by springing from the ground I could have lifted myself up to a prodigious height. I had tightening of the throat, constant nausea, salivated much, and expectorated incessantly. I felt that my sublingual glands were swollen, but when I wished to assure myself of the fact by looking at them in a glass I was unable to carry out my design on account of my eyes. I had a constant longing to run and to bite, and my only alleviation was to walk quickly up and down my room, biting my handkerchief the while. I had a horror of water."

Ordinarily there is but one result to such a condition as this. "For some time past," continues Dr. Buisson, "I had been persuaded that a vapor bath was able to prevent, but not to cure hydrophobia. My thoughts being occupied solely with death, I sought that which was the most prompt and least painful, to put an end to my life. I resolved to die in a vapor-bath. I took a thermometer in my hands, fearing

that the heat I desired might be refused me. I had been but a few minutes in the bath before I felt a change for the better. This gave me hope. At 127 degrees F. I was cured. At first I believed it was merely a long intermission from pain, which would be terminated by contact with the air outside the bath. After the bath I dined and drank with ease, and went to bed and slept well. From that day to this, nearly twenty years, I have felt no sort of pain or uneasiness."

Dr. Buisson again says: "Experience has proved to me that hydrophobia may last three days. The cure is sure by following my system the first day, uncertain the second, impossible the third. Who would wait for the last day, knowing my means? One would not even wait for the malady, one would always prevent it. Hydrophobia never shows itself before the seventh day after the bite, and one can then go a long journey to procure these baths, called Russian."

The *Lancet* says: "Hydrophobia was cured by the late Dr. Buisson in his own and eighty cases by vapor baths, raised rapidly to 135 degrees F., and more slowly to 145 degrees F." "A vapor bath," writes Dr. Buisson, "prevents the development of hydrophobia and cures the malady when developed. In order to convince all sensible persons that I am really in earnest I offer to inoculate myself with the disease. This fact should be a sufficient guarantee of the certainty of my method of cure."

It is interesting to state that in London there is now established a Buisson institute, under the care of a qualified physician, for the gratuitous treatment of hydrophobic cases. A number of cases of undoubted hydrophobia have been successfully treated by means of these baths in India, and the Viceroy of India has notified Mr. F. E. Pirkis, R. N., of the London Buisson Baths, that the government will afford facilities for the placing of Buisson baths for the treatment of hydrophobia, in government hospitals and dispensaries in India. Twenty baths for that purpose are being immediately dispatched. In looking over a late paper from Calcutta, it was noticed to contain an advertisement of thirty-four Buisson Baths, located in different parts of India, where that treatment could be obtained free by needy sufferers.

There is no possible doubt as to the value of the Turkish bath in all disorders of the ferment class, and whether it is competent to the complete eradication of the poison, or to arrest destructive tissue changes when once they have thoroughly begun, will appear doubtful only to those who are not familiar with the wonderful restorative action of heat when used in its higher potency. The simple treatment of a hot air bath has actually cured the disease in the last stages and restored the patient when in the extreme horrors of rapidly approaching death. A prompt use of the hot-air bath in every case of a bite from a dog can not but do good, even if there is no question of the animal being rabid, and when the animal is mad it is a safe and effective remedy. Whoever is willing to investigate the merits of the hot-air bath will soon learn that it has a valid claim to the title of certain cure for hydrophobia.

In Brooklyn, N. Y., June, 1874, a case came under my supervision. A suspected dog was confined but broke away and in his career of biting other dogs also bit a Prospect Park laborer, one George Wagner. As the dog was to all appearances suffering from rabies he was immediately killed. The man's wounds were

cauterized with nitrate of silver and on the third day thereafter he was brought to the Turkish bath. He was bitten through the palm of one hand and partly through two fingers. He complained of what seemed like neuralgic pains in the hand and arm, which were swollen, and also pains in the head, back and throat. He underwent the processes of the bath twice daily during one week and once daily for two weeks longer. The baths were administered with exceptional vigor in his case. Soon every unpleasant symptom vanished and for many years afterward he was well and hard at work.

Dr. M. Hermance, also of Brooklyn, N. Y., in 1877 saved a boy from the agonizing death of hydrophobia, by the use of the vapor bath, which was applied while the patient was tied down in bed. In about three-quarters of an hour after beginning operations a profuse perspiration was induced. When he began to sweat freely signs of returning consciousness appeared, which increased as the perspiration was continued, until in the space of about two and a half hours he was fully restored to consciousness, with a perfect relief from all his hydrophobic symptoms, the pain in the bitten hand and arm included, of which he had complained very much in the intervals of consciousness between his convulsions.

There is also most positive evidence regarding this form of treatment from Wilmington, Del. In the year 1869 three children of that place were bitten by a rabid dog. This dog also bit a heifer, a cow and two other dogs. The four animals soon afterward died of hydrophobia. The children were placed under the care of Dr. John Cameron of that city and by him were taken to Philadelphia and there subjected to the Turkish bath daily for two weeks. Although the wounds were very severe and the discharge from one of them was of the color of verdigris for several days, they healed without difficulty and no symptom of the malady has been manifested since.

In 1866 Rev. J. J. Curran of the Industrial School, Arlington, N. J., published a case which occurred under his care. One of the pupils named Klee was bitten on the hand by a dog on January 2. As the wound healed rapidly nothing more was thought of it, but on January 22 unmistakable symptoms of hydrophobia manifested themselves and increased for two days, when there appeared no possible hope for him. Then a small kerosene oil stove was lighted and placed on the floor; on top of this was placed a pan of boiling water and over all a chair, on which the boy was seated. Around the chair and boy and vapor-making machine were wrapped several folds of blankets, pinned about his neck and fitted so that the steam was retained about his body. He was also given a dose of sweating medicine and in five minutes the perspiration was streaming from every pore of his body and in ten minutes after he said: "The pains are all gone!" He was kept in this condition for about half an hour. The result was that the boy was cured and two months after he was as well as he ever had been and so continued.

The natives of Australia, and also of India, have a successful habit of at once taking violent exercise on beginning to feel ill. This is the principle of the Turkish bath treatment, that is, to relieve the system of its impurities by sweating.

Sir John Drummond Hay, who was many years English minister in Morocco, long before Pasteur's time, stated that the Arabs there cured hydrophobia

by sweating. The patient was swathed in woolen covering till all but smothered, placed in a small tent (these tents are always of black camel's hair, much more impervious than canvas) and then the tent was closed so as to exclude air as much as possible and the patient left until profuse perspiration carried off the poison. This treatment was found invariably successful.

A St. Petersburg newspaper states: "We are informed by good physicians that if the patient, immediately after being bitten, will go into a bath and stay there seven days he will have excellent chances of recovery. The poison in the blood will be eliminated by a steady and vigorous perspiration. Some physicians have attained good results by washing the wound with warm vinegar and then applying hydrochloric or muriatic acid."

There is undoubtedly an hysteric or "mental hydrophobia," as it is sometimes called, induced by emotion, or through fear of the disease after having been bitten, which may lack many of the characteristic symptoms of the true affection and differs from it notably in its rare fatality. Such cases, serious enough to the patient for the time being, would be most easily and agreeably treated by the Turkish bath. Herein would come one of the great advantages to the community, which every city would enjoy by having, what would be most desirable to all, a public Turkish bath, that would be open to such cases as well as to any other. A few days' or, at most, a few weeks' treatment at such an establishment would put the patient out of reach of any danger from hydrophobia.

Some twelve years ago, four children, living at Newark, N. J., were bitten by a dog supposed to be rabid, and more than \$1,000 was subscribed to send them to Paris that they might undergo Pasteur's treatment. If the people were only awake to their best good and would subscribe liberally for public Turkish baths they would have a better and surer remedy right at their own doors.

On March 28, 1897, Dr. Frank D. Gray, in Jersey City, was bitten by a St. Bernard dog that had shown some slight symptoms of rabies. Evidently not knowing any better way, Dr. Gray sailed for Paris to take the Pasteur treatment. Had he been aware of the eliminating power and healing virtues of the Turkish bath he could have remained at home and saved himself the mental torture as well as the expense incident thereto. It is very pleasant and desirable to go to Paris, but to "wash and be clean," is much more desirable.

The conclusion that is forced upon us by these facts is that in all cases of infectious disease our chief efforts should be directed to promoting the eliminating power of the patient. This is working in harmony with and assisting the vital resistance to disease. Whatever tends to invigorate the individual enables him the more quickly and surely to surmount the difficulty. Herein lies the most important element. When it is understood that in the proper application of heat, and in that we recognize all forms, whether it be the use of hot water, the Russian bath or the above all most desirable Turkish bath, and the fact remains that in heat we have an agent capable of counteracting the poison of rabies, then it may well be asked, What poisonous influence can resist its potency? Knowing this we should do all in our power to arouse the the public mind to the value of the public Turkish bath, which

should be established by the people in every city in the land and so conducted that its blessings would ramify through every stratum of society. Thus would we hasten on the time when hydrophobia will cease to be a terror in the land and disease will not be the inheritance of every child, but rather that good health will be the pride and possession of every citizen.

A STUDY OF THE BLOOD IN TUBERCULOSIS.

OR THE RELATION OF LEUCOCYTES TO THE BODY AND THEIR AID IN INTERPRETING VITAL PHENOMENA.

Presented to the Section on State Medicine, at the Forty-eighth Annual Meeting of the American Medical Association, held at Philadelphia, Pa., June 1-4, 1897.

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No branch of science appeals to us so deeply as the study of life; and it is the object of the following research to investigate some of the causes which tend to shorten life, and if possible to devise means of detecting these causes before they have produced permanent injury to the individual.

In presenting the subject I feel very keenly my inability to do it the justice which it deserves. But realizing that success is achieved in any line of research only after repeated efforts, and often after many failures, I am encouraged in the undertaking, believing that the closer we adhere to nature, the nearer we shall arrive at the truth. Also I regret that the limited time which is necessarily allowed for the presentation of the subject, prevents my giving proper credit to many authorities whose researches have rendered me valuable assistance in forming the following deductions.

A Preliminary study.—The animal organism has been the subject of study and discussion as long as any now before the scientific world. Previous to the time when the microscope came into use, vital phenomena were very imperfectly understood. But since that date much progress has been made.

A study of the living organism may be made with reference to its structure or morphology, or with reference to its functions. In former papers,¹ dealing with the blood in tuberculosis, I have considered almost exclusively the morphology of cells and their physiologic chemistry. In these departments I have pointed out numerous analogies existing between leucocytes and the larger organism. But the present paper will be more in the line of

A study in functions.—I shall attempt to point out, interpret and classify the phenomena of cell life, and to ascertain if analogies cease with the morphology, or if they are also extended to the functions.

1. In studying the functions of a living organism, I shall begin with the simplest form of animal life, the leucocyte. I shall first note cell phenomena, and then interpret and classify them, with reference to ascertaining how far they reveal the conduct or behavior of the cell, or the plan or purpose of its actions. With this in view, a small quantity of fresh blood or lymph is prepared in the form of a hanging drop.

Among the first phenomena noted are those pertaining to cell metabolism. Cells are observed to partake

¹ Medical Record, Sept. 5, 1896; March 13, 1897.