While no fixed courses will be offered, embryology and zoölogy will be taught, but only animals found native to the region will be utilized. An opportunity will be given to teachers and others over the State to study zoölogy in the field at a time when animal life is most abundant and the places of the interrelation of organisms apparent.

THE FUNCTIONS OF THE SPINAL CORD FROM A CLINICAL STUDY. BY GEO. A. TALBERT.

In this day of great scientific research I know of no subject that presents such intense interest as some of the problems that confront the neurologist. This interest is not stimulated so much by the actual knowledge possessed as it is, perhaps, by the mist that envelops the subject. We might say that just enough is known to create enthusiasm for greater research.

The difficulties that observers have encountered are manifold, and for this very fact they have been led to be cautious many times in coming to a conclusion. The very methods that seem necessary to obtain the facts may defeat the end desired. The operator is never quite certain how near he has approached the normal condition. The artificial means that are often used must necessarily be rough imitations of the natural state. Let us take an illustration:

If the cerebral lobes of a frog are removed the animal seems to perform no movements except as a result of an external stimulus. The animal remains in a quiescent stage for hours and even days at a time. But if the proper stimulations are brought about the animal seems to possess the power of performing as complicated movements as a perfectly intact frog. There is a want of spontaneity. This would show that the seat of the will must be in the removed parts. If, however, the animal is kept alive for some time after the operation, we find that there are movements which point quite strongly to the guidance of an intelligent will. Some observers have found that if the frog is kept alive long enough it will catch flies and other food that comes in its way, and it is even known to bury itself in the earth at the approach of winter.

So from this we might have some doubt about our first conclusion. We probably would be led to think the shock that necessarily follows such an operation may to a certain extent give us abnormal phenomena, and really be a defeat of the normal condition. I have several times in my own observations looked upon the results with some apprehension. This furnishes us with an example of the many difficulties which are to be encountered in laboratory investigations. We

are presented with similar barriers when we try to draw conclusions from clinical cases. We are never quite certain of the mischief that may result from the disease or injury.

Realizing fully some of the dangers that confront us, it will lead me to take a conservative position upon some of the points that I shall put forth in this paper.

I will now present some facts that I have been able to obtain from the study of a clinical case. I believe observation made in this way may in some respects be more valuable than experiments upon dumb animals in a laboratory, from the fact that we have an intelligent being to convey to us many valuable points, especially when it comes to the interpretation of sensations.

The following is a brief history of the case, as near as I have been able to ascertain:

In the summer of 1888 a man in Laporte County, Indiana, while trying to fix a binding pole on a load of hay, suddenly fell to the ground, striking with the greatest force upon what corresponds with the twelfth dorsal region. As a result the man was totally paralyzed below the point of injury both as to sensations and movement. He remained in this condition for ten months, when he was taken to Chicago and was operated upon by a distinguished surgeon. I have never been able to obtain the nature of the operation. At any rate the patient recovered to a certain extent. After this, however, there was no improvement up to the time the case came under my observation, which was four years after the accident and about three years after the operation.

The first time that I visited the patient I obtained all the data possible of the past history, and made quite a thorough examination to find the condition as it then existed. As a result I obtained the following facts:

There was total paralysis below the point of injury, except the inner side of both thighs as far down as the knees, and in the left limb down to the ankle; also, on a portion of the right side of the abdomen below the navel.

I did not see the patient again for about four weeks. In the meantime I consulted a physician, and we decided to try the effect of massage upon the paralyzed portions of the body. This treatment was kept up daily for about two weeks, when marked improvement was noted. The next time I investigated I found that the sensation of touch and temperature had been restored to the outside, as well as an increased amount on the inside of each limb. The sensations, however, were below the normal; as, for instance, the points of the dividers had to be placed from four to five inches apart in order to bring about a double sensation.

Power of movement was also partially restored, so that he was able to lift his limbs quite a distance from the bed; his toes, however, were still lax and possessed no sensation nor power of movement. Although the application of massage was continued for several weeks, the improvement seemed to be most marked during the first two weeks.

Let us now turn to the problem, and, if possible, ascertain its solution. I am, however, forced to confess that the more I look into the case the more complicated it appears.

In the first place it is very generally believed by physiologists that there are quite definite paths for the transmission of sensory and motory impressions in the cord. I do not intend to discuss here the disputed question of the position of these tracts, but it is sufficient to say that we are confident in this case that there were some obstructions at first in the cord, so that impulses could not pass from the brain to the limbs and *vice versa*.

It would seem at first sight that either this obstruction was removed, perhaps by the regeneration of the nerve tissue, or that the impressions had been educated into new paths.

The laboratory has given us quite undisputed evidence to show that abnormal paths are sometimes brought into use. For instance hemisection in the thoracic region of the right side of the cord of a dog will cause paralysis of the right limb. But, however, after the effect of the shock is passed, recovery is soon noted. Likewise hemisection a little higher on the left side of the cord brings about similar phenomena for the left limb. Again, if the experiment is tried still higher on the right side the story is again repeated. This compels us to believe that impulses would have to take a zigzag path. While this may be true of the dog we must not be too hasty in concluding that the impressions can take new paths in the human cord. It is a universal law that the higher we ascend the animal scale the greater is the precision of these paths, and injury to the most definite ones is more apt to have a permanent effect.

As to formation of nerve tissue we know it is more likely to take place in the lower than in the higher vertebrates. And if there was degeneration resulting from an injury then there might be grave apprehensions in regard to regeneration in so high a form as a human being, while it might be true in some of the lower forms.

The suggestions given above hardly make it clear. We are still left in doubt as to the virtue of the application of friction. It makes it more complicated when we think of the length of time that the man was paralyzed and how sudden was the recovery after the application of the remedy. It certainly would lead

one to think that the recovery would have been more complete if the case had been treated soon after the accident.

There is another way of looking at the problem, and perhaps it comes nearer if not quite to the solution. We said in the above that there was at first some obstruction, whatever that may have been, at the point of the injury in the cord, and as a result it caused the muscles below the point of injury to degenerate from disuse. The obstruction in the cord perhaps after awhile was removed, and it may have been at the time of the operation by the surgeon.

Let us now look to the laboratory and see if we can find evidence to aid us in solving the problem. It is a well known fact that there are nerve fibers that have a controlling effect on the calibre of blood vessels, or to state it more exactly, they hold the unstriped muscles in a certain state of contraction. It is known to physiologists as tone. This may be demonstrated by cutting the branches of the sympathetic system that supply the blood vessels of the ear of a rabbit. As a result the ear becomes flushed with blood, showing that the tone of the vessels is lost. It makes it more certain if the end of the severed nerve that supplies the ear is stimulated artificially, when it once more returns to the normal. If the stimulant be strong enough, it will so contract the coats of the vessel that the ear will appear pale. When we turn to the skeletal muscles, it does not appear quite so clear that they are influenced by the tonic effect of nerves. The observations of different investigators are at variance on this point. I believe that the preponderance of evidence goes to show that there is a tonic effect, or at least nerves which control the nutritive functions, or have what is known to physiologists as a trophic action. Taking, for instance, the severance of the sciatic nerve of an animal, and we will find that the muscles become flabby and that they do not possess the resistance that is noticed when the nerve is intact.

Time will not permit me to go into the argument showing that trophic centers exist in the cord. But assuming that these centers do exist, let us see how they carry out their work. In the first place, reasoning from the analogies of the action of the heart and other centers, we might with some reason suppose that the trophic centers, by virtue of their own metabolism, send out *de novo* efferent impressions to the muscles, thus having a nutritive effect. If we carry the analogy farther, we will have as good a reason for assuming that there are afferent impressions that pass to these centers and, as it were, modify the efferent impressions. There is experimental evidence to show that this is true. For instance, if the posterior root of a nerve is severed, while the anterior root is intact, it results in a loss of tone to certain muscles.

Let us turn back to our clinical case. We have tried to show that as a result of the injury there was a loss of tone, and, we shall now try to show that its return to the muscles was due to the remedy that was applied.

It does not seem improbable that the application of massage caused the afferent impressions which acted upon the trophic centers of the cord; and this in turn sent out efferent impressions to the toneless muscles, and by that means they were restored to a condition so that they were able to respond to certain motory impulses.

Such an investigation of necessity has its limitations. The most essential facts needed will, of course, be in the dark as long as the patient is alive. An examination of the cord, in order to obtain the extent of the lesions, would make it more clear. Even had we the opportunity of examining sections of the injured portions, there might still be some doubt as to the revealing of all the facts in the case. We do not know to what extent the injured parts affect those which are apparently healthy.

Although the citation of this interesting case may not settle definitely the great problem whether there is skeletal tone, it will at least shed some light on the subject.

Does High Tension of Electric Current Destroy Life? By J. L. Campbell.

The Purdue Engineering Laboratory Since the Restoration. By Wm. F. M. Goss.

A little less than a year ago, Purdue University lost by fire, the larger part of its mechanical laboratory. The building was a fine one, only just completed, and was occupied by the Departments of Mechanical Engineering, Civil Engineering and Practical Mechanics; it had more than an acre of floor area, and was filled with an expensive equipment. The disaster was a trying one. Not only was the property loss apparently irrecoverable, but fear was felt that the uncertainty and delay in restoration would result in a loss of the prestige so honorably won by the University and a diversion of its student constituency in other directions. In this emergency the wisdom and courage of President Smart were quick to assert themselves. In a few weeks after the fire new machinery was running