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LINCOLN, NEBRASKA
An Inquiry into Compensatory Blood-Pressure Mechanisms

BY C. F. CHARLTON, LINCOLN, NEBRASKA

INTRODUCTION

The vaso-motor nerves are those of the nervous system which have to do with the regulation of the caliber of the blood vessels of the body—a physiological rôle of probably the greatest importance. The first experiments pointing to the existence of such fibers were made by Claude Bernard as early as 1851. His method consisted simply in severing the cervical sympathetic nerve of a rabbit and observing that the blood vessels of the ear became very much dilated. Later, Brown-Séquard, on stimulating the peripheral end of the same nerve, showed that the caliber of the blood vessels was diminished, thus demonstrating the existence of vaso-constrictors. Vaso-dilator fibers, or those which when stimulated cause a widening of the vessels, were surmised by Schiff in 1855 and demonstrated by Bernard in 1858. The latter found that when the chorda tympani nerve is stimulated the arteries supplying the submaxillary gland become very much dilated and a greater quantity of blood flows thru them. Other nerves have been found to give this same kind of a result, i. e. a flushing of the part supplied. Most prominent are the nervi

1From the physiological laboratory of the University of Nebraska.
erigentes to the penis and nerves in the glossopharyngeal and cervical sympathetics to the buccal and pharyngeal regions. Such an action (dilation of the vessels) is not easily explained when we consider the musculature of the vessels. The circular coat evidently brings about vaso-constriction. It is not clear how any action of the longitudinal coat could materially affect the diameter of the vessels. We know that the dilator fibers are not in tonic activity, for sectioning of one of these nerves gives no marked result. Another manner in which they might possibly act is by an inhibition of the tonic contraction of vaso-constrictor muscles. Such an action would be very similar to the inhibitory action of the vagus on the heart musculature. The vaso-constrictors are, on the contrary, in a state of tonic activity and keep the circular muscles in a condition of tone. When any large nerve trunk is stimulated, such as the sciatic, variable results are obtained. The usual effect is a constriction when the peripheral end is stimulated by a strong current. This vaso-constriction is often followed, however, by a vaso-dilation. Stimulation with a weak current gives a vaso-dilation. This has been taken to show the existence of both kinds of fibers in the nerve, and the assumption is made that the vaso-constrictors are the more readily excited but are finally overcome by the stronger action of the dilators.

The relation of the two sets of fibers to the central nervous system is partly revealed by a section of any portion of the cervical region of the cord. Such a section is followed by a loss of tone of practically all the blood vessels. The latter become very much dilated and the arterial pressure falls from a level of 100-150 mm. Hg. to 20-30 mm. Hg. or less. In such a condition the blood is collected mainly in the skin and splanchnic areas. Consequently the arterial blood-pressure resulting in part from the tonic constriction of the arterioles of the regions mentioned is dependent upon the integrity of the cervical cord, and a rational conception of the function of the cervical cord is that it serves as the pathway for constrictor impulses which come from higher levels. The location of a center controlling these vaso-motor impulses was determined by Dittmar. By sectioning the medulla at various levels he found its location to be about the middle of the fourth ventricle in the tegmental region. Sectioning below this point gave a complete loss of tone of the vascular system. This vaso-
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motor center is considered as being normally in a state of tonic activity and constantly sending out impulses to the musculature of the vessels, which keeps them in a more or less contracted condition. This is easily shown by dividing a nerve supplying a vascular area, whereupon the area supplied, being removed from the tonic influence of the center, becomes flushed with blood. The vaso-motor center is very susceptible to reflex stimulation. By stimulating certain definite nerves its tone is greatly increased, the arterioles are constricted, and we get a corresponding rise in arterial pressure. Afferent nerves which give this result have been given the name of pressor nerves. But it has also been shown that when other, likewise definite nerves are stimulated there is a dilation of the arterioles and a fall in the arterial pressure, and these fibers are supposed to exert an inhibitory influence on the tone of the center and are given the name of depressor nerves. Nearly all the prominent sensory nerves act as pressor fibers, especially the anterior crural nerves. Other nerves, such as the sciatic, may contain both kinds of fibers and upon stimulation give variable results. The best example of a depressor nerve is the so-called depressor nerve of the rabbit. It is an entirely distinct nerve in this animal and invariably gives a pure depressor effect when it is stimulated. By its connection with the heart and aortic plexus it forms an admirable mechanism for the regulation of aortic pressure. With a rise of blood pressure in the aorta inhibitory influences are sent over this nerve to the vaso-motor center, causing a general vascular dilation. In the dog this nerve does not exist as a separate nerve, but is incorporated with the vagus, which includes likewise the constrictor fibers for the head running in the cervical sympathetic nerve. Finally, it is important from the present standpoint to mention the fibers in the dog's vagus which influence the respiration and, indirectly, in this way affect blood-pressures. Stimulation of the central end of the cut vagus produces, therefore, complex results, which is not surprising in view of the afferent fibers which are contained in it.

Porter and Beyer² limit the function of the vaso-motor center to raising or lowering the general blood-pressure, and do not give it the power of localizing an increased blood-supply to a particular area. Such a function is left to a still higher center (cerebral)

or to a definite reflex path to particular cells of the center. They base their assertion on the result of repeated stimulation of the depressor nerve with the invariable result of a flushing of the splanchnic area, showing a definite connection between this nerve and the splanchnic vaso-motor fibers.

No vaso-dilator center such as we have for vaso-constriction has been located, and it is the belief that there exist numerous secondary centers in the cord which act in this capacity. When the thoracic portion of the cord is divided in the dog, the power of erection of the penis is not lost. This can only be explained by the existence of a secondary center in the lumbar portion of the cord. This particular center is also under cerebral control and may be stimulated by psychical activities.

The vaso-constrictor center is the vital point in the maintenance of arterial pressure, and its physiological condition has a practical application in surgical shock. Shock, as is well known, is usually accompanied by a great fall in blood-pressure, so much so, in fact, that Crile places the cause of death during shock to an insufficiency of this center in maintaining its tone, and thus allowing so great a fall in arterial pressure that the vital centers cease to function thru lack of blood-supply. The two factors that play the most important part in any alteration of this center would be its blood-supply and the possible effect of over-stimulation. With this in mind experiments were made to determine, (1) the effect of stimuli of great intensity applied to afferent nerves; (2) alterations of the blood-supply to the center.

It is not the purpose of this paper to give in detail the results obtained thru stimulation of afferent nerves. It will suffice to say that the usual effect obtained on applying a strong, interrupted, induced current for ten seconds to the central end of the cut vagus of a dog, the other vagus having also been sectioned, was a marked rise in carotid blood-pressure, which, after the stimulus had ceased, rapidly gave way to a fall of pressure below the normal, followed, in turn, by a complete recovery. Repeated stimulation in this manner for hours showed no decline in the vigor of the vaso-constrictor center. With prolonged, continued stimulation all apparent changes in the center which appeared were easily referable to alterations at the point of application of the electrodes, since a slight shifting of the point of stimulation
immediately restored the pressure to its high level. The experiments point in the direction of the conclusions expressed by Porter, that the endurance of the vaso-constrictor nerve cells under stimulation is very great.

It was during the investigation of the effects of alteration of blood-supply to the brain that certain peculiar variations in blood-pressure became strikingly apparent and demanded an explanation in order that the prosecution of the more general problem might go on. These variations form the basis of this paper. They can be presented most easily by outlining a typical experiment.

**METHOD**

Altogether fourteen dogs were used in these experiments. Ether was used as the anesthetic preceded by a hypodermic injection of morphine (0.04 gms. per kilo). In each case an attempt was made to have the depth of the anesthesia more or less uniform by permitting the action of the corneal reflex. The blood-pressure was determined by the use of a mercury manometer and the cannula was in each case placed in the left common carotid. Three writing points marked on the drum surface. Two were electric signals showing the duration of stimulation and the time record in seconds respectively, while the third gave a blood-pressure tracing. The time record was in each case placed at the zero pressure line. A median incision was made in the neck, and the vagi, the common carotids, and the internal and external jugulars were isolated on both sides from the point where they leave the upper edge of the thorax to a point very close to the skull. The vertebral arteries were exposed at the point where they pass between the longus colli and the scalenus anticus muscles. A thread was passed under them to facilitate their handling. In all cases the tissues were kept moist with normal saline.

**EXPERIMENTS**

When a dog has been prepared as indicated above and the left common carotid is properly brought into connection with the manometer, there results a blood-pressure tracing showing both cardiac and respiratory waves. As long as the conditions remain

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unchanged the height of the pressure remains at the same average level. If then an artery clamp is suddenly placed on the right common carotid, the blood-pressure, as indicated by the mercury manometer, which for convenience will be called body-pressure, rises about thirteen and one-half millimeters. Average of four readings in two animals. Upon removal of the clamp the pressure returns to normal if it has not already done so. Without the anesthesia the return might possibly be more prompt. Figure 1 gives a typical experiment of this kind and is described by the accompanying legend. At 6 the clamp was put in place. The pressure in the artery rose immediately, showing, however, a tendency to diminish, so that at 7, when the clamp was removed, the curve was already on its descent. Simultaneous clamping of the verteb rals, with open carotid, produces unimportant changes, if any. This can be seen in figure 1 at 5. The irregularity in the tracing preceding 5 is due to mechanical causes which arise from the difficulty of getting at the verteb rals in order to put the clamps on them. Clamping the external and internal jugulars in rapid succession with open arteries causes a slight fall (14 mm. Hg.) and return to normal (see figs. 1–3), while unclamping of the veins gives a rise above normal (8 mm. Hg.) and then back to normal. (See figs. 1–4.)

In all cases mentioned above an interference with the normal supply of blood to the head of the animal shows but unimportant changes of blood-pressure in the body region. Such an interference, it would seem, should affect the vaso-motor center. That it does not finds an explanation in the existence of a compensatory mechanism which at all times tends to maintain the blood-pressure at a constant level.

If now, both vagi are sectioned, the most prominent effects of such a section are these. The blood-pressure usually rises thru an increase in the rate of heart beat; the respiration becomes deeper, slower, and shows pronounced pauses at the end of both inspiration and expiration. When the blood-pressure has again reached a constant level the above experiments may be repeated with the following results: A clamp placed upon the right common carotid brings about an enormous rise of body blood-pressure. This can be seen by referring to figure 2. At 17 the pressure rises from 136 mm. Hg. to 176 mm. Hg. in twenty-four
Fig. 1 (reduced $\times \frac{1}{2}$). Blood-pressure tracing from a dog with cannula in left common carotid. Vagi intact. 3, Clamping in rapid succession external and internal jugular veins; 4, unclamping of the veins; 5, clamping of vertebals; 6, clamping of right common carotid; 7, unclamping of carotid. Time tracing in seconds.

Fig. 2 (reduced $\times \frac{1}{2}$). Blood-pressure tracing from a dog with cannula in left common carotid. Vagi cut. 16, Clamping of external jugulars; 17, clamping of right common carotid; 18, unclamping of jugulars; 19, unclamping of right carotid. Time tracing in seconds.
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seconds. The rise is, therefore, rather abrupt. After this the pressure continues to rise at a much slower rate during the next five minutes when it reaches a height of 220 mm. Hg. At 19 the clamp was removed, resulting in a rapid fall of pressure to normal. The fall occupied just twenty seconds.

Clamping of the external and internal jugulars, with cut vagi and open arteries, gives a fall of body pressure (16 mm. Hg.) not differing markedly in extent from that obtained with uncut vagi. With closed arteries and divided vagi these oscillations in pressure become more extensive (20 mm. Hg.) as can be seen at 18, figure 2. Such variations of body-pressure as are obtained by clamping of the veins, whether the vagi are intact or are cut, whether the carotid supply is open or not, are most readily explained thru the variations in the amount of blood supplied to the right auricle. An increase in the quantity of blood supplied to the right auricle permits a greater output from the left ventricle and so raises the pressure, while a diminution in the quantity supplied diminishes the pressure. Clamping of the vertebrals is inefficient in modifying the body blood-pressure because of the relatively small amount of blood carried by them in contrast with the amount carried by the carotids. The striking differences come out in clamping the carotids with vagi cut on the one hand, and with the vagi uncut on the other hand.

It is quite obvious that this difference is immediately due to the cutting of the vagi, and, furthermore, the compensatory mechanism which normally keeps the blood-pressure constant must have been rendered inactive by the same procedure. As a matter of fact, we have in the depressor fibers of the vagus a means by which impulses due to an increased pressure in the root of the aorta may be transmitted to the vaso-constrictor center in the medulla and lead to an inhibition of its tonic activity. This brings about a diminution of the impulses from the vaso-motor center which make their way down the cord and pass to their terminations by way of the fibers of the autonomic system. The effect is a dilatation of the arterioles of the body generally, but mainly of those of the splanchnic area. There follows a decrease in general blood-pressure. Simultaneously, there may take place an inhibition of the heart thru vagus fibers, also leading to a diminution of body-pressure. There is no evidence that the latter method
of lowering blood-pressure was active in the experiments made for this paper. Such evidence would be an alteration of heart beat either in rate or force.

The increase in pressure so strikingly shown in figure 2 is, then, a phenomenon which results from damage to the normally compensating mechanism. The question which arises and which must be answered in a study of the vaso-motor center is whether the rise of pressure on clamping the carotid is due to a stimulation of the vaso-constrictor center. Since a rise of pressure in the aorta leads to an inhibition, may not a diminution of blood-pressure lead to an excitation, thus causing a vaso-constriction generally? When the clamp is placed on the carotid the pressure in the brain is suddenly lowered, and when the clamp is removed the pressure is restored. Simultaneously, or nearly so, the body pressure varies in an inverse direction. In addition, it has been determined that an anemia of the vaso-constrictor center gives rise to its excitation. Clamping of the carotids might diminish the blood supply in extent equivalent to anemia. On the other hand, it is conceivable that the rise in body pressure shown in figure 2 may be largely or entirely a mechanical effect, for clamping the carotid suddenly produces a great increase of peripheral resistance, which would also raise the body pressure.

Various methods of procedure were adopted to answer these questions. Owing to the great collateral venous circulation to the head, it was found impossible to stop the flow of blood by clamping of the jugulars. The latter remained clamped for fifteen minutes in one experiment without the slightest increase of body blood-pressure. It is impossible to tell how much such a procedure raises the pressure in the arterioles of the head, but later experiments, during which simultaneous tracings of the pressure in the head end of the right external jugular were taken, show that it does rise. Such variations in head pressure were augmented in a number of experiments by connection of the head end of the left common carotid with a reservoir of 0.7 per cent saline under varying pressures. The latter varied from 140 to 150 mm. Hg. pressure and showed immediately in an augmented venous pressure in the right external jugular.
TABLE I

Showing the effect of injection of 0.7 per cent saline at 140-150 mm. Hg pressure into the peripheral end of the left common carotid.

<table>
<thead>
<tr>
<th>Vagi cut, carotids clamped</th>
<th>BLOOD-PRESSURE PREVIOUS TO INJECTION OF SALINE</th>
<th>BLOOD-PRESSURE JUST AFTER INJECTION OF SALINE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Body-pressure 180 mm. Hg.</td>
<td>Body-pressure rises at same rate</td>
</tr>
<tr>
<td></td>
<td>Venous pressure 17.5 mm. Hg.</td>
<td>Venous pressure 29 mm. Hg.</td>
</tr>
</tbody>
</table>

The results shown in table I show conclusively that an increase in pressure in the arterioles of the head does not influence the vaso-motor center. Indirectly they show, likewise, that the diminution of pressure produced by clamping the carotid is not responsible for the increase in body-pressure because such a diminution of pressure to the arterioles was counterbalanced by the pressure of the injected saline, a procedure which in no way altered the rise in body blood-pressure. There remain, then, two factors. One of these is the anemia which results on cutting off the blood supply to the head; and the other is the peripheral resistance to the body circuit when the clamp is suddenly placed on the artery. Both factors, it appears, enter into the production of the results. Thus in figure 2 at 17 the first immediate rise may be looked upon as mainly due to the increased peripheral resistance, while the latter more gradual rise may result partly, at least, from an increasing asphyxia. It must be said, however, that all curves do not show this abrupt change in rate of rise. On this view the abrupt fall at 19 on removal of the clamp is self-evident.

CONCLUSIONS

1. The abrupt rise of body blood-pressure on clamping the carotids is mainly due to the increased peripheral resistance, which, owing to the section of the vagi, is uncompensated.

2. The experiments indicate that a moderate diminution of pressure in the common carotid above its point of origin does not affect the vaso-motor center.

3. That a moderate increased pressure in the arterioles of the head does not affect the vaso-motor center.
Recent Prominent Advances in Physiology

BY A. E. GUENTHER, LINCOLN, NEBRASKA

It is no simple task to present in brief but adequate outline the advances made in physiology during recent years, even when the presentation is to be limited to the more striking advances only. So great have been the changes in some directions that they have revolutionized former conceptions, have given entirely new aspects to certain physiological mechanism, and have brought about, as a consequence, alterations in many practical questions and applications. The influence of a new science, physical chemistry, is largely responsible for this vigorous growth and forms a brilliant instance of what has been noted repeatedly—that any great advance in one science leads directly to marked advances in the related sciences. For physiology is nothing more nor less than the application of physics and chemistry to living things, and physiological conceptions are determined and fixed by the conceptions of physics and chemistry. There are now only isolated instances in which prominent thinkers dealing with the phenomena of life take refuge in vital forces. The attitude of the great majority of investigators is, at the least, one of abeyance. They see the inadequacy of present known forces in the explanation of the more recondite problems of physiology, but, knowing the progress that has been made, they set no definite limit to the possibilities of explanation thru physical and chemical forces when the conditions under which the latter act will be known.

There is no department in physiology which during recent years has not been able to point to numerous concrete evidences of advancement. These discoveries are sometimes interesting or important or the reverse. In the physiology of the blood, as an example, there are to be considered, on the one hand, the relatively unimportant discovery that the red corpuscles are not biconcave discs, as has so long been thought to be the case, but are, while in the intact circulation, bell-shaped; and there are, on the other hand, the incalculably important discoveries dealing

1 Presented to the Nebraska Academy of Science, Dec. 27, 1907.
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with hemolysins, agglutinins, precipitins, opsonins, etc. Apart from its value in throwing light on the possibilities or limits of the transfusion of blood from one individual into another, our knowledge of hemolysins aids in giving insight into the nature, production, and action of toxins and anti-toxins; knowledge of precipitins has given the best test for human blood that has thus far been devised and is of tremendous value in medico-legal cases in the identification of blood stains; knowledge of opsonins is finding practical application in the diagnosis and treatment of disease. The chemical composition of the blood, it is clearly evident, is one of very great complexity and at present lies largely outside of the ordinary methods of chemical investigation. The marvelous adaptation which the body displays of protecting itself by forming in the blood hemolysins, agglutinins, precipitins, anti-toxins, etc., are processes not explainable chemically and are therefore designated in toto as biological reactions.

By the term biological reaction is meant, of course, something entirely different from the ordinary chemical reaction of the blood. The latter, determined by some indicator as litmus or lacmoid, is said to be alkaline, and there is no doubt that blood has the power of turning red litmus blue. As ordinarily estimated the alkalinity of the blood is equal to a 0.2 or 0.3 per cent solution of sodium carbonate. In such an estimation the alkalinity is determined by titrating the plasma with a weak solution of tartaric acid equal about to a 1-200 to 1-400 normal solution, using, perhaps, litmus as an indicator. It has been found that this degree of alkalinity, properly called the titration alkalinity, does not correspond with the degree of alkalinity determined by the methods of physical chemistry, or, in other words, the true alkalinity. In accordance with present conceptions, whenever a solution or liquid is acid, the acidity is the result of the fact that there exist in it free hydrogen ions, and an alkaline liquid is alkaline because in it there exist free hydroxyl ions. Blood plasma contains no more free hydroxyl ions than does pure water, consequently it is neutral. The discrepancy between the titration alkalinity and the true alkalinity is due to the fact that the salts in the plasma exist not only in the form of intact molecules but are partly dissociated into corresponding ions. The dissociation of molecules
into ions and the union of the latter into molecules are going on continually, and these processes sooner or later come into equilibrium when the action in one direction is equal per unit of time to the reaction in the reverse direction. The condition of equilibrium is dependent upon the relative numbers of ions and molecules in solution and is upset whenever the number of particles of one kind or the other, as the case may be, is altered. Dissociation or association then sets in and the equilibrium is restored at a different level. In such a solution as plasma, where a strong base (sodium) is in combination with a weak acid (carbonic), the alkalinity can not be determined by titration with an acid stronger than carbonic. If tartaric acid, for example, is used, it yields its own hydrogen ion to combine with the hydroxyl ion, while its own anion will combine with the sodium. As a result the equilibrium is upset and more sodium carbonate dissociates. The titration method, therefore, gives the amount of sodium in the blood which can unite with the acid employed in titrating.

Another notable change, bearing on the chemical composition of the blood, exists in the uncertainty which has arisen regarding the individuality of several of the proteins of the plasma. Not only do the three separate coagulations of serum-albumin at 73, 77, and 84 degrees Centigrade indicate the possibility of three separate proteins, but an unsatisfactory state of affairs has arisen from the statement made recently that under certain conditions of temperature and reaction serum-albumin may be converted into a globulin body that precipitates upon one-half saturation with ammonium sulphate. Paraglobulin, a second protein of the blood, has been definitely shown to be a mixture of at least two separate globulins. One of these, euglobulin, is precipitated upon one-third saturation with ammonium sulphate, and the other, pseudo-globulin, comes down upon one-half saturation with the same salt.

In the physiology of the circulation the greatest recent advances have evolved about investigations into the causation of the heart-beat, the properties of the auriculo-ventricular bundle of His, and the elaboration of blood-pressure measuring apparatus. Howell in the Journal of the American Medical Association, June, 1906, summarizes with reference to the causation of the heart-beat in the following words:
Recent Prominent Advances in Physiology

“In order to picture the relations of the inorganic salts to this process the hypothesis which I have adopted as a heuristic principle to guide my own investigations may be stated as follows: The well-nourished heart contains a large supply of energy-yielding material, which is in a stable form, so that it neither dissociates spontaneously, nor can be made to do so by the action of external stimuli. It is possible that this stable, non-dissociable form consists of a compound between it and the potassium or the potassium salts, and that herein lies the functional importance of the large amount of potassium contained in the tissue. This compound reacts with the calcium or with the calcium and sodium salts, and a portion of the potassium is replaced and a compound is formed which is unstable. At the end of the diastolic period this compound reaches a condition of instability such that it dissociates spontaneously, giving rise to a chain of events that culminates in the normal systole. Before spontaneous dissociation occurs it may be hastened prematurely by an external stimulus, as we know to be the case when a mechanical or electrical shock is applied to the heart at any time after diastole has begun.

“From this point of view the role of the calcium, or of the calcium and the sodium salts consists in replacing the potassium and converting a part of the store of stable material into an unstable, easily dissociable compound. We are not obliged, therefore, to assume the existence of any specific inner stimulus.”

In 1903 His, Jr., described a band of muscle fibers, which, running up and back in the septum of the ventricles into the auricles, formed a muscular connection between the auricles and the ventricles. This auriculo-ventricular bundle of His, as it is called, forms in man a structure eighteen millimeters in length, two and one-half millimeters in breadth, and one and one-half millimeters in thickness. It was a discovery which had an important bearing on a controversy which has been going on for years regarding the manner in which the wave of contraction is propagated over the heart. Those holding to the neurogenic doctrine maintained that the transmission took place thru the nervous system, while the advocates of the myogenic doctrine assumed that the excitation wave propagated itself from muscle cell to muscle cell. The discovery of His was distinctly in favor of the myogenic doctrine. The most interesting physiological study of this bundle is that
of Erlanger, who, by means of a special clamp, was able to show that pressure exerted upon this bundle brought about an incoordination in the beat of the auricles and ventricles. With a gradually increasing pressure upon the bundle of His the disturbance took a definite sequence in that, instead of each auricular beat being followed by a ventricular beat, some of the latter dropped out, resulting in a ratio, possibly, of one ventricular beat to every two, three, four or so auricular beats. Finally, there may result a complete independence of ventricular and auricular beats, the ventricle taking on a much slower independent rhythm. The bearing of these experimental facts on a form of heart disease, long known as Stokes-Adams syndrome, was recognized immediately. As Erlanger states, the main symptoms of Stokes-Adams disease are explained by the effects of heart-block. The epileptiform attacks may be looked upon as due to anemia of the brain, analogous to those that follow hemorrhage in warm-blooded animals, or in the case of apoplectiform attacks the trouble may result from venous congestion of the brain, a condition which is associated with an altered respiration. Erlanger has recently, as a logical continuation of his experiments, shown that the physiological properties of the bundle of His do not differ essentially from those of auricular tissue. By crushing the auricular tissue along convenient lines he has succeeded in establishing the same disparity of beat between different regions of the auricle as are brought out between auricle and ventricle.

Not least among the interesting developments concerning the heart is the remarkable vitality which it manifests under experimental conditions. In 1901 Locke maintained the beat of a rabbit's heart for practically five days by the use of the solution which bears his name. Kulibako succeeded in reviving a part of the heart seven days after the death of the animal, and the same investigator made the heart of a child beat twenty hours after death from pneumonia.

In the development of measuring blood-pressures in human beings we are again principally indebted to Erlanger. The Erlanger sphygmomanometer is, no doubt, the most accurate, convenient, and reliable blood-pressure machine that is in existence and has the additional advantage of giving both systolic and diastolic pressures and of yielding a permanent record. Knowing the diastolic and
systolic pressures, the mean pressure may be calculated, but the reverse process of calculating the diastolic and systolic pressures from the mean is impossible. It has been shown by Dawson in particular that the high and the low pressures may vary independently so that the determination of each is desirable. The pulse pressure, or the difference between diastolic and systolic pressures, there is much reason to believe, has a special significance. In this regard it is sufficient to refer to Erlanger's case of orthostatic albuminuria and to the experiments of Mall and Welch on infarct formation in the intestine. Another application of the Erlanger sphygmomanometer is seen in its use in the continuous determination of blood-pressures as used recently by Eyster in the study of Cheyne-Stokes respiration. The instrument is set so that the mercury reading is midway between the systolic and diastolic pressures when the oscillations due to the pulse are of medium extent. Any increase of blood-pressure would cause an increase in the height of the oscillations since the diastolic pressure would then be closer to the pressure in the instrument.

It is a well-known fact that food placed in the mouth leads to the appearance of a liquid, the saliva, which is a secretion of the salivary glands. It is the first of the digestive juices with which food is brought into contact and serves mainly in breaking down the carbohydrate food-stuffs. It is also a common experience that under certain conditions the mouth "waters," by which is meant that saliva appears in appreciable quantities without the ordinary procedure of actually putting food in the mouth. The thought of the taste of a lemon, for instance, will in many cases make the mouth "water." To distinguish the latter from the former it is called a psychical secretion. The thought of food, induced by the sight of a palatable morsel or of its mention, brings about an activity of the salivary glands by the passage of nerve impulses from higher centers of the brain to the secreting cells. It is to the credit of the Russian physiologist Pawlow that he was the first to make clear the usual participation of the psychical secretion in salivary secretion whenever food is taken into the mouth. He showed, furthermore, that there is an adaptation of the character of the saliva to the work which it has to do. Dry, solid food stimulates a large flow of saliva such as is necessary in masticating properly, while food containing much water excites
but little flow. If a handful of clean stones is placed in the mouth of a dog he will move them around with his tongue for a while and then drop them, very little saliva being secreted. If the same material is given as fine sand a rich and abundant flow of saliva follows, a reflex evidently necessary in this case, otherwise the material could not conveniently be removed from the mouth. Such adaptations are special reflexes depending upon some difference in the nervous mechanism set into action, and the extent to which these adaptations are, at times, operative is surprising. Thus, in the experiment of putting pebbles or sand into a dog’s mouth it was found that the same differences in the salivary secretion follow when it is merely pretended that they are thrown into the mouth. So, in general, with other processes concerned in digestion it has been found that they constitute minute detailed adaptations to the work at hand.

Contrary to a very general belief, the mechanical stimulation of the gastric mucous membrane by food lying in the stomach does not excite the gastric glands. During a meal the secretion is first started by the sensations connected with eating, by the odor, taste, sight, or thought of food. It is primarily a psychical secretion which is continued later by other processes taking place in the stomach. Some foods, meat extracts, meat juices, soups, etc., contain substances designated as secretagogues which are able to cause a secretion of gastric juice. Others, bread and white of eggs, have no effect of this kind at all. For these facts we are again indebted to Pawlow. Pawlow divided the esophagus of a dog in the neck and sutured the two ends to the skin of the neck so as to form two fistulous openings. All food fed to an animal in this condition passes down into the esophagus but re-appears at the upper opening and is lost, not entering the stomach at all. The dog may eat a prodigious amount, experience the enjoyment of eating, but does not fill his stomach. This Pawlow calls a fictitious meal. Observation upon the stomach during this time reveals an abundant secretion which continues for some time after the stimulus (eating) has ceased. By proper operative procedures pure gastric juice may be collected, and this method of obtaining the gastric secretion stands in striking contrast to the older methods where the juice is collected, for instance, by swallowing a sponge tied to a string.
It is the preliminary psychical secretion that prepares for the continued digestion of foods, like bread and the white of an egg, which contain within themselves no active secretogogues. But the digestive changes brought about by the psychical gastric secretion yield secretogogues that by absorption into the blood probably maintain the activity of the gastric gland cells for some time. The white of egg introduced thru a fistulous opening into the stomach of a sleeping dog, or of one whose attention is purposely being distracted, lies there inactive and unacted upon. No psychical secretion is present, and consequently no secretogogues. But if the dog in any way is made aware of the presence of food a psychical secretion immediately sets in. It might be assumed by some that secretogogues act upon sensory endings in the mucous membrane lining the stomach. If so, the reflex must be thru intrinsic ganglion cells, since the effect is obtained after complete severance from the central nervous system. Edkins has recently suggested a more probable explanation. He has shown that decoctions of the pyloric mucous membrane made by boiling in water, acid, or peptone solution, when injected into the blood, cause a marked secretion of gastric juice. These substances when injected alone have no such effect, nor when the decoction is made from the fundic end of the stomach. Edkins therefore suggests that secretogogues, whether preformed in the foods or formed during digestion, act upon the pyloric mucous membrane and form a substance which he calls “gastrin,” and this substance, after absorption into the blood, is carried to the gastric glands and stimulates them to activity. Many instances of this method of control have been found in the body and have led Starling to propose the introduction of a new term, hormones. This is a general term for such substances as gastrin, which, carried by the blood, control physiological processes in distant organs.

The labors of Pawlow and his pupils seem to show that the properties and quantity of the gastric secretion vary with the character of the food. The quantity of the secretion varies, other conditions remaining the same, with the amount of food to be digested. Different kinds of food call forth secretions varying not only as regards quantity but also in their acidity and digestive power. The secretion brought out by bread, tho less in quantity than that caused by meat, possesses a greater digestive action.
Pawlow is convinced that the secretion of the stomach on a given diet is not caused normally by general stimuli all affecting it alike, but by specific stimuli contained in the food or produced during digestion, whose action arouses the secretion best adapted to the food injected.

At this point it might be well to mention, parenthetically, the doubt which has been cast upon the existence of rennin, the enzyme which brings about the curdling of milk. Rennin has been found elsewhere than in the gastric mucosa, for instance, in the pancreatic juice and even in the tissues of plants. Wherever a proteolytic enzyme is to be found there can be found some evidence of a curdling action on milk. For this reason the view has been taken that milk coagulation is not due to a specific enzyme, but is an action of the pepsin.

Our views with reference to pancreatic secretion are likewise very much more complex than they were formerly. These later views had their origin in a discovery made by Dolinsky in 1895 that acids brought in contact with the inner lining of the duodenum are quickly followed by a secretion of the pancreatic juice. This occurs even when every nerve connection with the central nervous system has been separated. It is, therefore, the general belief that the hydrochloric acid of the gastric juice, in some way, starts the flow of pancreatic juice. Bayliss and Starling have succeeded in showing that an extract of the mucous membrane of the duodenum in 0.4 per cent hydrochloric acid when injected into the blood causes an active secretion of pancreatic juice. Neither acid alone nor an aqueous extract of the mucosa have this effect, so that it is believed the hydrochloric acid of the gastric juice upon its entrance to the intestine leads to the formation of a special substance, secretin, which, after absorption into the circulation, is carried to the pancreatic cells and excites them to activity. Secretin, like gastrin is not an enzyme. Both may be boiled without loss of their characteristic properties.

Another new discovery which complicates the action of the pancreatic juice may be mentioned at this point. It was found by one of Pawlow's pupils, Chepowałnikoff, that pancreatic juice obtained by means of a fistula has little, if any, effect in digesting proteins. As ordinarily obtained the pancreatic juice is, thru its ferment, trypsin, a most powerful proteolytic agent.
By some process the inactive trypsinogen or precursor of trypsin, after leaving the duct of Wirsung, is made active. It has been found that if the inactive trypsinogen is brought into contact with the mucous membrane of the duodenum it at once acquires active power in breaking down proteins. The mucous membrane, then, yields a body or substance which can be extracted readily, which converts the inactive into active trypsin, and since this substance shows the characteristics of enzymes, i. e. is an enzyme and activates another enzyme, "a ferment of ferments," Pawlow called it enterokinase. The value of this adaptation is perhaps to be found in the fact that the pro-enzyme, trypsinogen, is relatively resistant to injurious influences, and active trypsin is quite readily destroyed.

One other enzyme has been added to the list of digestive ferments, one discovered by Cohnheim in his attempt to find in the intestinal mucous membrane a ferment which would reconvert the split products of protein digestion into the characteristic proteins of the blood. Instead of finding such a body he established very clearly the existence of an enzyme which he named crepsin and which acts particularly upon proteoses and peptones, breaking them down into the still simpler amino-acids. The old scheme of proteid digestion established by Kühne, which set up in the proteid molecule two groupings which led respectively to the formation of an anti- and a hemi-peptone, is no longer thought to represent the true course of events. The separation into anti- and hemi-peptones, as is well known, lay in the fact that hemi-peptone was supposed upon further action of the trypsin to be broken into leucin, tyrosin, and other amino-bodies while anti-peptone resisted such disintegration. However, even pepsin-hydrochloric acid digestion will, if given sufficient time, lead to the formation of bodies simpler in structure than peptones, while trypsin and erepsin are very active in converting peptones to amino-bodies. Different views exist at present as to the extent to which this process is normally carried. In the minds of some observers the breaking-down of the protein molecules is complete. Abderhalden has recently suggested a more interesting view. According to this author the many amino-bodies, such as leucin, tyrosin, arginin, etc., are split off from the protein molecule, leaving behind a nucleus of the original molecule which serves as
the starting point of the synthesis of a new protein, which is like those characteristic of the blood. This nucleus is a substance or a number of substances intermediate between peptone and the amino-acids and is called a peptid, a peptoid, or a polypeptid. This reconversion of the polypeptids and other split products into protein or, at least, more complex bodies, is attributed to the same agents that originally led to the breaking up of the proteid, namely, the enzymes like erepsin. For it is well recognized that the action of enzymes is, in many cases, reversible and the tendency is to make this peculiarity of action universal. This has been beautifully shown by Kastle and Loevenhart in the action of lipase upon the simple ester, ethyl butyrate. Lipase brings about a hydrolysis of the ethyl butyrate according to the following reaction:

\[ \text{C}_6\text{H}_{12}\text{COOC}_2\text{H}_5 + \text{H}_2\text{O} \rightarrow\rightarrow \text{C}_6\text{H}_{12}\text{COOH} + \text{C}_2\text{H}_6\text{OH} \]

The double arrow combining the two members of the equation indicates that the reaction takes place in both directions. Not only does water combine with ethyl butyrate to form butyric acid and ethyl alcohol, but the latter bodies, when once formed, reunite with the formation of ethyl butyrate and water. As a result there comes about an equilibrium of reaction between the four substances in question which lasts as long as the conditions remain unaltered. A removal of one of the substances leads to a disturbance of this equilibrium with a consequent acceleration of the reaction in one or the other direction as the case may be, until a new equilibrium is established. In the digestion of fats, then, it is believed that the lipase of the pancreatic juice acts upon the fatty foods, converting the fat to a corresponding fatty acid and into glycerine. The fatty acid and glycerine are absorbed and get into the central lacteal or into the blood, where, under the influence of the same enzyme, lipase, they are reconverted to neutral fat. In this way can be explained the disappearance of a non-diffusible fat from the interior of the intestine and its appearance as neutral fat again in the blood, and it is believed that most, if not all, of the fat undergoes this process and is not absorbed in the form of minute globules as was the older view.

Exactly the same process of reasoning may be employed in explaining the synthesis of body proteins from the split products
of digestion—polypeptids and amino-acids—and, with some modification, sheds light upon the constant presence of peptone (so-called anti-peptone) in a digestive mixture. The action of the proteolytic enzymes is reversible so that peptone is no sooner broken down into simpler bodies than these simpler bodies, or some of them, reunite to form peptone.

The existence of polypeptids is not so hypothetical as might be assumed. The work of Fischer of Berlin and of Curtius of Heidelberg in this first step in the synthesis of proteins marks probably the most important fundamental advance in biology in many years. The first insight into the composition of a protein molecule is obtained by splitting it up, which can be done by means of digestive ferments, by the action of boiling acids, superheated steam, etc. In this splitting, which is a hydrolytic change, there appear successively and simultaneously proteoses, peptones, and a variety of simpler bodies, amino-acids, which, twenty or so in number, differ markedly from the original protein molecule. Those which have been longest known are leucin and tyrosin. These are elementary components of the protein molecules from which the latter are built up. They are said to exist as such in the intact protein molecule, and the action of the hydrolytic agent lies simply in separating them from each other. An examination of their structural formulas reveals that each possesses an amino-group \((\text{NH}_2\)) substituted for a hydrogen atom on the carbon nearest the acid radicle \((\text{COOH})\). The name amino-acids is derived from this fact. The rest of the radicle may be simple chains as in leucin, members of the aromatic series as in tyrosin, or may contain sulphur as in cystin. Each constituent of the protein exhibits strongly basic properties thru the \(\text{NH}_2\) group and likewise thru the \((\text{COOH})\) grouping manifests strong acid properties. They unite, therefore, in indefinite numbers and owing to their great variety in an infinite number of combinations. Their artificial combination has been surprisingly successful. Glycocol is one of the simplest of the amino-acids. A union of two glycocol groups gives a substance designated glycy1-glycin. Glycyl-glycin is a di-peptid. It is possible to make two, three, four, five, six or more amino-acid molecules enter into combination with each other so as to obtain tri-, tetra-, penta-, hexa-, and poly-peptids. The following examples of such combinations may be
mentioned: Glycyl-alanin, alanyl-alanin, glycyl-tyrosin, leucyl-prolin, leucyl-glycyl-glycin, tetra-glycin, dialanyl-cystin, leucyl-tetraglycin, etc. As these combinations of amino-acids become more complex they begin to exhibit the reactions characteristic of proteins. While the di-peptid glycyl-glycin and the tri-peptid tri-glycin give no biuret reaction, this is positive in the tetra-peptid tetra-glycin. Higher peptids, such as leucyl-penta-glycin, give a red biuret test which seems identical with some peptones. Phosphotungstic acid, which is used as a precipitant for the digestion products of proteins, will precipitate many synthetic peptids. Further, certain amino-acids having a sweet taste when banded together become bitter, thus resembling peptones. Finally, polypeptids are split into simple amino-bodies by the action of trypsin, which in view of the specificity of action of enzymes is very significant.

The breaking down of proteins, then, during digestion is much more complete than was formerly thought, and the experimental evidence at hand sheds more or less light upon the mysterious disappearance of the split products of digestion during absorption. This leads naturally to a consideration of the further history of protein food in the body. That protein is absolutely necessary to the maintenance of life was recognized very early and under the influence of Liebig's ideas was looked upon as the source of all bodily energy. Altho the celebrated experiments of Fick and Wislicenus later showed most definitely that in their mountain ascent the energy which they liberated was greater than could be accounted for by the proteid broken down and that the energy must, therefore, have been derived from other food-stuffs, yet in general the idea continued to prevail that protein is of pre-eminent value. Pflüger maintained that all protein injected was built into the living matter before undergoing disassimilation. Later, with the growth of increased detail of knowledge of metabolic processes, Voit proposed a second theory. A portion of the absorbed protein material, after passing to the tissues, is destroyed waste of the tissues and to provide new material for growth. This portion is designated as tissue protein and can not be replaced by non-nitrogenous food-stuffs. The larger portion of the absorbed protein material, after passing to the tissues, is destroyed under the influence of the activity of the living cells without
becoming a part of the really living matter. This portion Voit called circulating proteid. While it can not be said that Voit's theory has been discarded, modern work, in yielding a greater insight into the details of protein metabolism, has given a truer conception. The trend of modern opinion may be summed up as follows. The split products of protein digestion are not entirely built up into the living tissue of the body. This is the fate of some of the material and very probably, as stated by Abderhalden, it is the more or less complex polypeptid that forms the nucleus for this synthesis. It is well known that many of the split products of digestion, like leucin and tyrosin, when circulated thru the liver are converted to urea, and since the products of protein digestion pass thru the liver, the possibility is open and probable that this is the fate of many proteins. It is believed that when the nitrogen has been removed the rest of the molecule, in many cases, remains as a carbohydrate residue which is subsequently oxidized and yields energy. Folin has lately shown that the proportions of the different nitrogen compounds in the urine vary with the amount of protein food. Upon a diet of 100 to 106 grams of usable protein the urea forms 87 to 88 per cent of the total nitrogen of the urine, while when the ingested usable protein equals only three or four grams of nitrogen the urea forms 61 to 62 per cent of the total nitrogen. On the other hand, creatinin and the purin bodies are not altered in amount by such a change in diet. He assumes, therefore, that creatinin and the purin bodies represent the end products of the breaking down of living tissues and that the urea represents largely the protein food, most of which is converted to urea during the process of digestion and passage thru the liver.
The Value of Hospital Training for the Graduate of Medicine

BY PALMER FINDLEY, OMAHA, NEBRASKA

New hospitals are being created throughout the country; the old are being remodeled and enlarged. The demand for hospital accommodations for the sick and the injured is increasing daily. Nowhere is this more in evidence than in the city of Omaha and in the state of Nebraska. We have been sadly lacking in hospital accommodations. While good work has been done in our hospitals, there has been great embarrassment for want of good buildings and equipment. Happily these conditions will not long prevail, for we shall soon have hospital buildings and equipment equal to the demands.

Of what value will an internship be in these hospitals? And I have particularly in mind the graduates of our local medical institutions. I will venture the assertion at the outset that there is no hospital, however small and wherever located, that is well managed and in possession of a medical and surgical staff of acknowledged ability, that is not worth a year or more of service in the capacity of house physician and surgeon. Furthermore, there is no graduate of medicine who can afford to forego the opportunity. I say this advisedly, because there is no substitute to compare with an internship. Post-graduate courses at home and abroad, private practice in the city or country, and assistantships to able men—these have their value in their time and place, but not as substitutes for a hospital service. The logical order of events is an internship immediately following graduation; this to be followed by special courses, assistantships and private practice. I have yet to see the man who regretted having had a hospital service, and I have been told repeatedly by men who threw away the opportunity for such a service that it was a serious mistake.

What are the values of an internship? They are many.

First of all, the time spent in the service is one of whole-hearted and whole-minded devotion to scientific work, free from the countless distractions of private practice. Time is, therefore, utilized to the best advantage. Contrast the interne, who from early to
late is at work in the wards, the operating room, the laboratories, and the dead-house, directed by men of experience and ability, with every facility at hand for the doing of scientific work, with the young graduate in private practice waiting for days, weeks, and possibly months for the opportunity that is the daily privilege of the interne. He has time in which to meditate on things, but too-often they are not things of science, but rather of finance. The all-absorbing question is the ways and means of establishing himself on a safe financial basis. With the interne the passion is for the acquirement of experience in things medical and surgical; with the novice in private practice, it is of necessity largely the acquirement of a livelihood.

Again, we find the interne in a medical atmosphere. His every environment is an inspiration. It is but natural that he should grow and grow rapidly in his knowledge of medicine and surgery. He accomplishes his work with the least possible effort, and this lends encouragement and enthusiasm. Not so in the early years of private practice, or rather, may I say, in the years of striving for a practice. The disadvantages are great, for there is usually a painful lack of clinical material, and the equipment in library and laboratory is not equal to the demands of modern medicine. Furthermore, we find the young practitioner thrown upon his own resources, and while this has its advantages, these resources are often inadequate and would be the better if reinforced by those possessed by men of large ability and long experience. He gains self-reliance, but too often this self-reliance is bred of ignorance. That I may not be misunderstood, permit me to give an illustration of one way in which the unguided practitioner of medicine may gain self-reliance in ignorance. In the daily routine of his work he gives thoughtful consideration to the complaints of his patients; he makes his physical examinations with the thoroughness of a conscientious worker, and he prescribes according to the indications as he interprets them. We will grant that his results are on the whole gratifying to him and his patients. Naturally he becomes more and more self-reliant as he gains confidence in his ability as a diagnostician and therapeutist. Is he justified in this self-reliance? How is he to know? There is no one of superior attainments at hand with whom to compare his findings and results, and above all the revelations of the laboratory, the
operating room, and the dead-house are denied him. And so it is possible for the young practitioner to unconsciously develop the "ego" for want of opportunity.

In advising the graduating class to take internships in hospitals before entering upon their life's work, all are impressed with the value of such a training, and while a goodly proportion accept the opportunity, there are those who feel, for one reason or another, that they must deny themselves of what they recognize to be a golden opportunity.

One says, "I can not take a hospital service because I must get out and make money; I am in debt." If such is his argument, let him remember that with the possession of a hospital training he will be equipped for greater work, and in proportion to the worth of his service so shall his reward be. In other words, he will be equipped for his work, and this will surely bring to him larger returns. I know of none so good an investment in time and service. But I would appeal to a higher ambition than that of money-making. If he is rightly inspired in his calling, he will value above all the self-consciousness that he is capable of giving to his patrons an honorable service. It is indeed sad to contemplate a life spent in the consciousness that the services rendered are inadequate.

Again the graduate says, "I can not take a hospital service because I am married." Here I am on dangerous ground, and I refrain from passing judgment beyond the venture of the statement that the sacrifice on the part of his helpmate will bring its reward.

"If I were younger I would take an internship," says one of the older members of the class. Does he stop to consider that a hospital service will gain him years of experience; that in one year spent rightly in a good hospital he will gain the experience in medicine of many years in private practice? I have often thought that the older a man is at the time of graduation the greater is the need of hospital training, because it will greatly abridge his period of development.

Another will say, "I will go into private practice for a few years, save my money, and then take a post-graduate course." I am altogether convinced that this is a serious mistake. His years in private practice are not of equal value in experience to
Hospital Training for the Graduate of Medicine

a service in the hospital, and his post-graduate courses, wherever he may take them, are a poor substitute for an internship. We learn how to do by doing, not by seeing others do. This is the difference between a hospital service and a post-graduate course as they are commonly taken.

I will admit of but one valid excuse for declining a hospital service—that of poor health. The service is hard in proportion to its value, and unfortunately the food and ventilation of our hospitals are not always as they should be.

The College of Medicine of the University of Nebraska urges every member of the graduating class to take a hospital service immediately after graduating. Every student is given this opportunity, and if his service has been satisfactory to the faculty the degree of Doctor of Medicine cum laude will be granted him at the end of a year's service.

I hold that no student in the possession of good health can afford to reject this proffer.
EDITORIAL

Constantly there comes to our notice the comparative importance in medical work of the clinician and the experimentalist. To get at the bottom of this matter we ought to investigate our methods of procedure in all kinds of scientific work. For the scientist there are two implements at his disposal—observation and experiment. As long as we attempt to solve the problems of medicine by clinical experience only, we must depend upon but one of these implements—observation. For in clinical work the range of experiment must necessarily be limited. In other words, if we employ observation alone, we must be satisfied with what nature offers us, but if we employ both observation and experiment we may wrest from nature her secrets. In no field is this so aptly illustrated as in physiology. For centuries past, medical men have been observing physiological phenomena in health and disease, but no advances were made in solving the causes of the latter until two or three decades ago when the experimenter began his work, and now we are appalled by the
extent of the knowledge which has been revealed. Furthermore, his work led to the experimental study of the cause of disease, which has given rise to bacteriology and experimental pathology. Thru the centuries, also, physicians have by observation attempted to find certain bodies which might be useful in the treatment of disease, and altho their recorded observations fill volumes they are of little value. It remained for the physiologist to show by experiment that certain chemical bodies which are the normal products of certain cells have an important and essential action in regulating and maintaining vital processes. And further he has shown us that other bodies, foreign to the organism, may be used for the regulating of certain functions. Thus he gave birth to pharmacology which is simply a department of physiology. The pharmacologist of today has increased and made rational our knowledge of the action of important drugs upon the physiological processes in the normal animal. There now remains to be solved a still more important problem of clinical medicine. We must devise some means to make the knowledge obtained by the pharmacologist of more certain value in the treatment of disease. This some have attempted to solve by establishing a clinical department in connection with the pharmacologic laboratory. But this plan is inefficient for here again we must rely upon observation. We may administer drugs to our patients and observe the results. But in the diseased condition the physiological processes are even more complicated than in the normal, and again we must take what nature offers us. But we can establish a laboratory of experimental therapeutics where not only the action of drugs but other methods of treatment may be investigated by experimental means upon animals in which a known diseased condition has been produced, and there is no restriction placed upon our methods of procedure as must necessarily be in the case of hospital work. This must and will be the policy of our University. It is evident, of course, that the busy clinician can not be the experimenter in the laboratory. But every medical student must go thru this process of development. His courses in physiology must be followed by courses in experimental pathology and pharmacology, and the latter must be rounded out by a course in experimental therapeutics. Then the student is in a position to reap the richest harvest when he enters upon clinical work.

R. A. Lyman.
Dr. E. D. Banghart, U. of N. '07, has located at Manley, Nebraska.

Dr. F. S. Owen recently returned from an absence of one month which, in company with Mrs. Owen, was spent in New York.

Dr. R. A. Lyman, the genial professor of pharmaco-dynamics, made a flying visit to Carthage, Missouri, during the holidays.

Dr. H. B. Ward has been elected a foreign member of the Russian Imperial Society for the Acclimatization of Animals and Plants.

Dr. F. J. Swoboda, '05, has located at Brainard, Nebraska, and is doing well. His wife presented him with a son and heir on November 9.

Dr. A. B. Kuhe, '03, of Walnut, Iowa, went east for post work. Dr. Robertson, '06, substituted for him during his absence of two months.

Dr. Winfield S. Hall, professor of physiology and Dean of the Northwestern Medical School, while in Lincoln recently, visited the University.

The last speaker before the University Medical Society was Dr. H. J. Lehnhoff, who addressed the students on the "Diagnosis of Perforation in Typhoid Fever."

Dr. Frank E. Osborn, of Beatrice, Nebraska, has been appointed by the governor to succeed Dr. Johnson as superintendent of the Feeble Minded Institute in that city.

The marriage of E. Don Skeen and Ethel Haynes, Alpha Omricon Pi, both of the class of 1906, took place at the central church of Christ, Decatur, Illinois, December 24.

Dr. Herzog, while in Omaha recently, spoke before the senior medical students on a very young human embryo, and later addressed the Douglas County Medical Society on Plague and Beri-beri.

Dr. McClymonds, '03, of Walton, Kansas, was recently married. Returning from his wedding trip he stopped in Omaha long enough to visit a number of friends and his uncle, Dr. J. H. Vance.

Dr. H. A. Reichenbach, of Pender, Nebraska, has disposed of his practice to Dr. John Buis, a recent graduate of the Medical Department of the U. of N. Dr. Reichenbach will relocate in Council Bluffs, Iowa.

Dr. H. Winnett Orr gave a paper on the Causes and Treatment of Painful Affections of the Feet before the Lancaster County Medical Society and later before medical gatherings at Scotts Bluff and Tecumseh.

Dr. Wigton was married on December 19 to Miss Jessie Mosher, of Lincoln, and they now reside at the hospital, where he is first assistant physician. He is a graduate of the Omaha Medical College, class of 1905.

Dr. A. B. Somers has suffered from a severe illness which disabled him from work for a short time prior to the holiday vacation. He is so far restored as to be able to visit his office each day and expects soon to resume his teaching.

Dr. A. F. Jonas was married in Denver on November 16, 1907, to Miss Jessica Maud Stebbins. They departed immediately upon a tour of the Mediterranean countries, and are expected to be in Omaha again by the middle of February next.

Dr. H. H. Waite has been made president of the Lancaster County Medical Society for the present year. A banquet on June 14, given in honor of the retiring officers of the society, served also in celebration of the installation of the new officers.
College Notes

Dr. Thos. Truelsen, of Omaha, Nebraska, and Miss Margaret Homeyer, of Council Bluffs, Iowa, were married in the latter city Saturday evening, September 14. They will be at home after November 1 at 81st and Leavenworth streets, Omaha, Nebraska.

Dr. E. N. Robertson, '06, late interne at Immanuel Hospital, Omaha, left during the holidays for Concordia, Kansas, where he is going to locate. Dr. Robertson received a bachelor's degree from the University in '04, and was associated with Dr. Gifford for five months.

Dr. H. M. McClanahan returned to his work in the College at the close of the vacation. He had been absent in Europe for a half year in study and recreation, being accompanied by his wife and daughter. He proposes in the future to devote himself exclusively to the practice of pediatrics.

Dr. I. S. Trostler, '04, formerly of Orleans, Nebraska, is now located in Chicago on the north side. He established himself in a settlement of Germans and is having much work. His address is 423 Garfield avenue. He was in Omaha a few days during the holidays to attend the funeral of his father.

A card has been received from Dr. David Isaacs, '03, who for the last two years has been abroad studying the eye, ear, nose, and throat. For eight months he worked in Glasgow, then in Vienna. At present he is working with Professor Axenfeld in Freiburg i/B, Germany. He has as yet set no date for his return.

A card has been received from Arkdale, Wisconsin, announcing the marriage there of Miss Elvlena Isabell Lecy to Dr. Josiah S. Davies of the class of '03. Dr. Davies located in Granville, North Dakota, shortly after graduation and has built up a very extensive practice; in fact, his practice got too large for him, so that last fall he formed a partnership with his classmate, O. D. Platt.

The coming meeting of the American Medical Association will be held in Chicago, June 2-5, 1908. This year a feature of the meeting will be the alumni reunions of the different medical schools in the United States, all of which are to occur on a special night reserved for that purpose. It is especially our desire that the University of Nebraska College of Medicine make a creditable showing. To do this much harmonious effort will have to be put forth by those interested.

Dr. G. C. Shockey, 1902, of Melrose Park, Illinois, will be the representative of our College on the local committee of the A.M.A. All will recognize the peculiar fitness in the appointment of Dr. Shockey. More definite announcements will be made later, but now it is appropriate that alumni and faculty note the fact to avoid making conflicting engagements. Let us bring out the greatest attendance that the College has ever gathered at an alumni meeting.

Since the last issue of the Bulletin the Pathological Club of the College of Medicine in Lincoln has been busy with its program. With few exceptions meetings have been held weekly, and before the end of the semester fully half of the program shall have been put into execution. Space forbids a description of the work in detail. To the members it is laborious, time-consuming but eminently valuable and even indispensable. It is essentially post-graduate work at a minimum expense save of time and energy.

Dean Ward has received from China, through the kindness of Dr. W. H. Jefferys, editor of the China Medical Journal, specimens of two intestinal worms which are of great importance in that country, with the request that a positive determination should be made of the species represented.
Dr. F. Creighton Wellman has also sent him a collection of parasites from Portuguese East Africa. It is expected that a report on these forms will be made to the American Society of Tropical Medicine at its annual meeting in March at Johns Hopkins University.

The following extract is taken from the *Daily Nebraskan*:
The Senior Medical class finished their election of officers today. They are as follows: President, D. B. Mullikin; vice-president, Clarence Rubendahl; secretary, B. B. Miller; treasurer, L. J. Kerr; sergeant-at-arms, J. B. Grinnell. J. C. Moore was elected associate managing editor for the Cornhusker. The Junior Medics elected O. W. Wyatt, president; C. D. Nelson, secretary; and H. L. Mantor, assistant business manager for the Cornhusker. Both medical fraternities have houses here this year. Phi Rho Sigma is at 1314 South Twenty-sixth street and Nu Sigma Nu is at 1509 South Twenty-sixth street.

December 18 Dean Ward went to Chicago on behalf of the University to participate in an official conference of college authorities and state boards with reference to conditions for medical licensure. The meeting included representatives of the Confederation of State Licensing, Examining, and Reciprocating Boards, of the Association of American Medical Colleges, and of the Councils on Medical Education from the various medical associations. Substantial progress was made towards the formulation of a workable plan to bring the states closer together and to remove petty obstacles which interfere with the movement of medical practitioners without at the same time affecting the real standards for licensure.

On this trip Dean Ward had the privilege of lunching with the Chicago Alumni Association of the University of Nebraska, and reported a most delightful noon hour spent in discussing University affairs with a generous bunch of old students.

There have recently been two special convocations for medical students of the College of Medicine in Lincoln, and it is the intention to hold others from time to time. Their management is in the hands of a committee of which Dr. Lyman is chairman. At the first meeting on October 31, Dean Ward addressed the students on matters of special importance to the College. It was the occasion of much surprise as to the number in attendance, for there is otherwise little opportunity to see all medical students congregated together. At the second medical convocation Dr. Maximilian Heruzog, formerly of the Government Laboratories in the Philippine Islands, spoke on “United States Medical Work in the Philippines.” Dr. N. P. Colwell, secretary of the Council of Medical Education, A.M.A., also addressed the class. Both were guests of the Pathological Club during the evening when the Club was further honored by the presence of Dr. J. E. C. Sward of Oakland.
FACULTY OF THE UNIVERSITY OF NEBRASKA COLLEGE OF MEDICINE  
THE OMAHA MEDICAL COLLEGE

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**Henry Baldwin Ward, Ph.D.**  
Dean, Lincoln.

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Arthur C. Stokes, B.S., M.D.  
C. W. McC. Poynter, B.Sc., M.D.

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Lawrence R. Pillsbury, A.B., M.D.  
Harley H. Everett, B.Sc., M.D.  
Rodney W. Bliss, B.S., M.D.

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Benton Dales, Ph.D.  
Mary Louise Fosler, A.M.

**Dermatology and Genito-Urinary Diseases**  
Alfred Schalek, M.D.

**Embryology, Histology, and Medical Zoology**  
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William Albert Willard, A.M.  
Franklin Davis Barker, A.M.  
Joseph Horace Powers, Ph.D.

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James Mills Mayhew, A.B., M.D.  
Paul H. Liddington, A.B., M.D.  
Rodney Waldo Bliss, B.S., M.D.  
Augustus Davis Cloyd, M.D.

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Charles W. Pollard, A.B., M.D.

**Ophthalmology and Oto-laryngology**  
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George Hamlin Bicknell, M.D.  
Henry Bassett Lemere, M.D.  
James McD. Patton, A.M., M.D.

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Burton W. Christie, B.Sc., M.D.

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**Surgery**  
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