nerve connections of the gland may be severed without apparent disturbance of function has been shown by the successful cases of transplantation.

The kidney seems to be the best structure for the reception of the grafts. The method of removal of the kidney, with the graft, in the third stage of our experiment, has, we believe, in no instance, been a disturbing factor, since those animals which had accessories survived, with apparently no ill effect, the removal of one kidney.

Whether the graft alone, in any of these cases, would have been sufficient to carry on the suprarenal functions indefinitely, we can not say. The longest period of graft survival which we have recorded is 247 days.

With improved technic and more uniform success in animal experiments, it does not seem unreasonable to attempt suprarenal transplantation as a therapeutic measure in Addison's disease.

In conclusion we wish to thank Dr. James A. King and Dr. W. Ward Plummer for valuable assistance in some of the earlier operations.

DISCUSSION.

DR. W. M. L. COPLIN, Philadelphia: An interesting fact in regard to implantation is the suggestion, which has been accentuated by Dr. Busch's admirable communication, that transplantation in the presence of an adequate, normal suprarenal body, or where suprarenal secretion is sufficient, is followed by hyperplasia of the transplanted suprarenal. A very interesting and highly suggestive phase of this work was brought out two years ago by French workers, during attempts to induce hypernephromata by transplantation of the suprarenals. Some times the graft takes and a tumor results; in other instances no neoplasm is produced, although the transplanted tissue survives; of course, in most cases the graft dies, autolyzes and disappears. When the graft remains and its cells proliferate without evidence of suprarenal intoxication, we at once think of Professor Adami's suggestion that when cells are no longer required to maintain their secretory functions they revert to a more highly manifest hyperplastic and productive activity.

DR. H. G. WELLS, Chicago: In 1900 I performed a small series of experiments with the object of transplanting the suprarenal into the kidney in young guinea-pigs, with the object of seeing if from such misplaced adrenal tissue a hypernephroma might develop, but the results were negative. I never got any tumor formation, and only occasionally evidence of survival of adrenal cells. The results were so negative that they were never published.

DR. A. J. CARLSON, Chicago: Is there any explanation for the fact that the graft takes only in the kidney? Why should it not take in other tissues in the vascular supply?

DR. W. B. CANNON, Boston: Have grafts been placed in the spleen and other organs? Why not make use of the spleen also in these cases?

DR. F. C. BUSCH, Buffalo: The point brought up in regard to hyperplasia is interesting, but one on which I am not competent to speak. In these animals, at the first operation, only one adrenal was removed, a part of this or a similar portion of the gland from another animal, being used for transplantation. The remaining adrenal was sufficient to carry on the function until the second operation, even if the graft was inactive. I have not seen any instance of overgrowth or new growth on the part of the transplanted cells.

It is interesting to note that in those animals in which the graft became necrotic, death occurred soon after the removal of the remaining suprarenal, eight to fourteen hours after the second operation. This was due, I believe, to suprarenal insufficiency, and not to the operative procedure alone. In those subjects surviving the removal of all other adrenal tissue, we have nothing but the graft to account for such survival. After the removal of the graft itself, at the third operation, death occurred later, within two to four days, with progressive

symptoms of suprarenal insufficiency. It would seem that there had been some adaptation of the animal to the small amount of functioning suprarenal of the graft.

The questions of Dr. Carlson and Dr. Cannon as to the reason for success of transplantation into the kidney and failure in other organs, I can not answer definitely. We did not attempt transplantation into the spleen, partly because, in the rabbit, the spleen is much too small for the purpose. The kidney was chosen because of its ease of access, its vicinity to the suprarenal, its vascularity, ease of handling and control of hemorrhage, and because of its close developmental relations to the suprarenal. I have no explanation of the failure of transplantation into thyroids and testes. Survival of suprarenal cortex after transplantation into the testis has been recorded.

The difficulties involved in the three stages of the experiment I have not specifically mentioned. One of these has been the close relation between the adrenal and the vena cava or renal vein, or both. In attempting complete removal of the gland there is great danger of fatal hemorrhage from wounding these veins.

THE PRESERVATION OF ANATOMIC DISSECTIONS WITH PERMANENT COLOR OF MUSCLES, VESSELS, NERVES AND ORGANS, BY A NEW METHOD.

A PRELIMINARY NOTE.*

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Since all times, anatomists have tried to preserve dissections with permanent color of muscles, vessels, nerves and organs, but, as far as I know, they have failed in securing permanency of color.

The specimens I have seen in the northern and European museums have all the tissues bleached.

It is not so very important to preserve permanently the actual color of muscles, which varies from one subject to another, but it is essential that there should exist permanently a marked contrast between the fleshy parts of muscles and the tendons, fasciæ, bones and other white tissues, which must remain as white as possible. A dark brown color of the fleshy parts of muscles is satisfactory. The more red the brown is, the better and the prettier.

The specimens should retain their color at least five or six years or else the result would not compensate for the labor and expense. We have specimens with color that are over eight years old. Since the color has kept that long I believe it will keep indefinitely, provided the solutions are changed as soon as they become cloudy.

In my work I have used no newly-discovered chemical. I employ the old arsenic and alcohol, to which I have added carbolic acid, formalin and glycerin. These are the compounds used in colleges all over the world, but it is the combinations and proportions that make all the difference between success and failure.

I started by determining the properties or action of each combination in all the proportions I could think of and letting them go on to do their best or their worst without interfering with them beyond changing the solutions when they became cloudy or discolored. I also experimented to determine the action on color of the lapse of time when the specimens were placed

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in closed empty jars, without any solution in the jar. Altogether I have seventy jars, representing as many experiments. At the end of a year each specimen was examined critically for color, and it was found that six had turned a good color. All the specimens that lost their color did so within two or three months. A new set of experiments was then undertaken, to determine which of the six methods was the best, cheapest, quickest and simplest. I finally came to the conclusion that the following method was, so far, the best in all respects:

1. Lean, male adult subjects should be used. Fat, however small in quantity, makes bad preparations.

2. The subject should be embalmed with the following formula: A. Water, $1\frac{1}{4}$ gallons; arsenious acid (saturated solution), $1\frac{1}{4}$ gallons; nitrate of potash, 1 pound; formalin (formaldehyd, 40 per cent.), 6 ounces. B. Alcohol, 16 ounces; carbolic acid, 6 ounces; glycerin, 16 ounces; creosote (beechwood), 2 ounces. The two solutions, B and A, are to be mixed. I tried seven different formulas and used forty subjects before finding this formula, which seldom fails to give a satisfactory color, dark brown, for the muscles. The color may show only a few days after the embalming, but it is seldom that it disappoints. This sometimes happens, though due, I think, to the fact that the chemical composition of the tissues is not the same in all subjects. If, before dissecting, one waits three to six weeks after the embalming, the color is better; but after more than five or six weeks the white tissues often become of a dirty, whitish yellow.

3. The arteries and the veins may now be injected, if desired. This is done with hot tallow, colored with vermilion for the arteries and ultramarine blue for the veins.

4. Now the subject is partitioned off, that is, divided into a number of pieces according to the preparations that it is desired to make.

5. Each piece is placed in a glass jar filled with a solution of 1 ounce of formalin to the gallon of water (F. 1). This is changed as often as it is discolored by the blood.

6. When the specimen has been purged of its blood, it is suspended in an empty glass jar with a lid on, and is left to drain off its superfluous water. This requires ten days, more or less.

7. The dissection is then made. It should be done with the parts in the position in which they will stand when exhibited or used in demonstrating. There should be a separate specimen for each layer. In order not to destroy their situation, direction, course and relations, the structures in one exposed layer should not be raised from their beds.

8. When the dissection is completed, if the muscles present a satisfactory color (dark brown), the specimen should be immersed in a strong formalin solution, after the idea of Kaiserling, using 10 ounces to the gallon (F. 10), and leaving the specimen in for three days. When after the dissection the muscles present an unsatisfactory color, especially if they present a raw appearance in part or in totality, the specimen should be immersed in a weak carbolic solution, 1 ounce to the gallon (C. 1). The solution should be changed as soon as it becomes cloudy and the specimen should remain in the C. 1 until the solution stays clear. This distinction in the use of a strong formalin or of weak carbolic is important, because if the muscles are not truly dark brown, especially if they are of a raw color, the formalin turns them into a brown gray or bronze color that no later treatment will change. C. 1 used in place of F. 10 when the muscles present a satisfactory color, often gives good results. Sometimes the results are better than with F. 10. It is all, I think, according to the chemical composition of the tissues of the various subjects. Usually the muscles pale somewhat or change color, when placed in any one of these solutions, but later on in the process the color returns.

9. When the dissection has ceased to purge it is placed in an empty glass jar with a lid on and is allowed to cure. This curing stage is of great importance, second only to the embalming formula, as it develops or brings out again the

color, without darkening the tendons or other white tissues. It also smoothes the surfaces, which may be shreddy and ragged; it sharpens the edges of the muscles, thus giving better definition. It fixes the color so as to keep it from being perceptibly affected when the specimen is put up permanently in a solution of alcohol. Even a weak solution of formalin will not affect it much. This curing stage should last until a satisfactory color is attained, but not less than one month. It sometimes requires two or three months, or more, for the muscles to acquire a satisfactory color (dark brown).

10. The arteries must be painted with a vermilion red and the veins with a cobalt blue. The best material is the moist colors (gouache colors), originally used by Dr. Gwilym Davis. They should be allowed to dry thoroughly before the dissection is placed in the following solution.

11. Finally, the specimen is placed in a glass jar filled with a solution of 20 ounces of alcohol to every gallon of water (A. 20).

12. The solutions should be changed as often as they become slightly cloudy or discolored. This is essential to the permanent beauty. Otherwise the impurities in the cloudy or discolored solutions will settle on the white tissues, stain them and destroy their whiteness and brilliancy.

13. Some specimens are refractory to redeveloping color. If after ten or twelve weeks of curing the color has not become satisfactory, place them in A. 20 notwithstanding. If after six or eight weeks in A. 20 there is still no satisfactory color, put them up again to cure for eight or ten weeks or more. The tendons sometimes become horny, but they usually regain their whiteness after they are re-immersed in A. 20. If even then no satisfactory color has redeveloped, put them up in C. 1 until they do. There is here some risk of the tendons and other white tissues acquiring a red gold tinge. As soon as there is any positive sign to that effect, the specimen should be drained for a few days and then immersed permanently in A. 20. Very often the A. 20 will pale the red gold color of the tendons. Thus may be saved some valuable specimens which have cost much time and labor. If this fails the specimen should be made over again with the hope of securing a more favorable result.

That uniformity of color and results does not invariably follow uniformity of procedures is due, I believe, to the fact that the chemical composition of the tissues varies with the subjects. It must be well understood that these two processes are recommended only in cases of refractory specimens which presented a satisfactory color after the dissection was completed. Those specimens which presented an unsatisfactory color after being dissected will seldom respond. I estimate so far, that 85 or 90 per cent. of the specimens turn out satisfactorily. The remainder are merely good, but not good enough to be placed in a museum. Some specimens have to be done over two or three times before one is obtained that is good and pretty enough to be put in a museum.

The colors in specimens that no chemical or other treatment will improve are gray (dark or light), bronze, brick (uric acid color), coffee and milk (medium or light), and pale pink.

14. The other solutions employed for temporary immersion, instead of C. 1 or F. 10, are alcohol, 20 ounces to the gallon (A. 20); alcohol and carbolic acid (A. 20, C. 1); alcohol and glycerin (A. 20, G. 10); and glycerin and carbolic acid (G. 10, C. 1). They give fairly good results often enough, but not as often as C. 1 or F. 10, nor as good.

15. When specimens become too dark they should be placed in a solution of 20 ounces of alcohol and 1 ounce of formalin (A. 20, F. 1) to each gallon of water. As soon as they have attained a satisfactory color, remove them and put them back in A. 20.

The great practical value of this new method is to give us the means of building study museums composed only of real dissections placed in large glass jars in

spacious rooms, flooded with light, on tables so that students can come right to them and study them. Each structure in each specimen is marked by a number and on an appended card the name of the structure is opposite the number. Thus the students can prepare for the dissecting room; they see the innumerable things they never see in a dissecting room; they are able to review and fix in their minds what they have already dissected themselves; the practitioners can in a few moments relearn much anatomy. Such is the study museum that I am now building for the Medical department of Tulane University in New Orleans. Its full usefulness, however, will be brought out only by allotting on the lecture card one hour three times a week for students to study the preparations and by letting them understand that a quiz on these preparations will be a part of their final examination in anatomy.

The same method gives similar results for pathologic specimens, provided the subjects are embalmed with the foregoing solution before the postmortem examination is made.

However, this solution often affects the color of the stomach and intestines. A weaker one will not do so and will assist materially in preserving the color in making pathologic specimens. It will also delay the decomposition of the body for several days in this New Orleans climate in August, when subjects decompose in a few hours. On making the postmortem of such embalmed subjects the embalming passes unnoticed. The solution is composed as follows: A. Arsenic (saturated solution), one and a half gallons; nitrate of potash, one-half pound; formalin, two ounces. B. Alcohol, sixteen ounces; carbolic acid, four ounces; glycerin, sixteen ounces; creosote, two ounces. The two solutions are to be mixed.

The following is a formula which is best suited for embalming subjects to be used in the dissecting room; A. Water, one and a half gallons; arsenious acid (saturated solution), one gallon; formalin, eight ounces. B. Alcohol, sixteen ounces; carbolic acid, eight ounces; creosote, two ounces; glycerin, sixteen ounces. B. and A. are to be mixed. The arteries are distended with cornstarch colored with crimson anilin, the diffusibility of which is regulated by a solution of tartar emetic.

I have worked out the formula used at Tulane for subjects for operative surgery: A. Arsenious acid (saturated solution), two and a half gallons; nitrate of potash, two pounds; formalin, four ounces. B. Alcohol, sixteen ounces; carbolic acid, eight ounces; creosote, two ounces, glycerin solution. B. is to be mixed with A.

The foregoing is only a preliminary note. I shall proceed with the work for some time. Then I propose to publish another note in which I shall mention the improvements, if any, and in which I shall give numerous technical details useful to those who may wish to engage in such work and build also study museums for their universities.

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DISCUSSION.

DR. PETER POTTER, Butte, Mont.: Over half the value of some of the greatest anatomic work which has ever been done is lost because we have only a written record of the work. For instance, Pirogoff, the Russian surgeon and anatomist, was able to get an unlimited amount of material, and climatic conditions were such that he could do much work which could not be done in a warmer climate. The result of his work is contained in five volumes of text and figures. His method was to freeze the body and cut into sections, but the

moment his studies were completed and drawings made, the material was destroyed. If we had that material to-day, preserved as Dr. Souchon would preserve it, together with his text and figures, it would be of incalculable value.

Braune of Leipsic reproduced his drawings in a manner that has never been equaled; still his work is incomplete because his material was destroyed after his book was published. The proper preservation of material would enable us to correct mistakes and complete unfinished work of other observers. Even Braune is said to have made mistakes, but this can not be proved or disproved, because his material can not be replaced, and we have nothing but his record and charts. If the material had been preserved an anatomist could go over the work and correct an error, if there was one, or confirm Braune's observations.

Something should be done in this country along the line suggested by Professor His of Leipsic toward establishing an anatomic and histologic institute which would be a central depository for material, microscopic and macroscopic, anatomic or surgical, which has been the basis for original work of merit. The material could be deposited there, and afterward studied and examined by anatomists and surgeons, or any one capable of doing the work, not only to correct errors, but to complete work which even our foremost men are often unable to finish in a lifetime. There is one institution in this country which, I suppose, is looking toward that end, although I have no authoritative information on the subject. It is my impression that we ought to encourage the Wistar Institute of Philadelphia to take charge of such work and material preserved as is done by Dr. Souchon. If the Wistar Institute is not in a position to take up this work, this Section should be.

Whatever solution is used, it must be a solution that is permanent. Another method of preservation is the use of formalin. A 50 or 100 per cent. solution of formaldehyd is the best for preserving specimens, but it does not retain the original color. If we can get a solution that will preserve the specimen as well as formalin does, and retain the color of the tissues as Dr. Souchon's method does, we shall have an ideal preserving method.

MY PRESENT POSITION ON APPENDIX QUESTIONS,

AND REFERENCE TO THE DAWN OF THE FOURTH OR
PHYSIOLOGIC ERA IN SURGERY.*

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The time has arrived when we may, at least tentatively, classify four separate and distinct kinds of appendicitis: 1, Fibroid degeneration appendicitis; 2, infective appendicitis; 3, congestive appendicitis; 4, appendicitis by external invasion.

FIBROID DEGENERATION APPENDICITIS.

This is an irritative lesion rather than an infective one, and it seems to be the one, on the whole, which takes the largest number of patients to the physician.

It occurs during the course of normal involution of the vermiform appendix. In this process there is replacement of the various structures of the appendix by hyperplastic connective tissue. Nerve filaments persist for a longer time than most other structures in the appendix which is undergoing involution changes, and these nerve filaments are irritated by the contracting connective tissue in the same way as other nerve filaments are irritated in contracting connective tissue in

* Read in the Section on Surgery and Anatomy of the American Medical Association, at the Fifty-ninth Annual Session, held at Chicago, June, 1908.