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The Plasma Proteins: Their Functions and Clinical Uses*

CHARLES A. JANEWAY, M.D.

Thomas Morgan Rotch Professor of Pediatrics, Harvard Medical School; Physician-in-Chief, Infants' and Children's Hospitals, Boston, Mass.; Chairman, Division of Blood and Blood Derivatives, Advisory Board on Health Services of the American Red Cross.

The subject of this lecture is a field in which knowledge has accumulated very rapidly in the last few years. The reasons for these rapid advances are manifold, but first among them is the fact that blood, the raw material for research, was made available in adequate amounts for study by donors of the nation through the Red Cross Army-Navy blood program during the war. Second, the stimulus of war led to the large-scale application to the fractionation of plasma of the methods of protein chemistry which had been developed meticulously over a period of years in laboratories in Scandinavia, England, and the United States. Finally, a pattern developed during the war under government auspices is now being continued under the leadership of the American Red Cross, whereby plasma protein fractions are made available to interested investigators so as to return to our people, who gave their blood voluntarily, as many benefits as possible from the therapeutic and preventive use of blood derivatives and from a better understanding of human physiology. This lecture will attempt to summarize the present state of our knowledge in this field. For purposes of brevity, it will be impossible to mention every individual who has made an important contribution, but it should be pointed out that this is a summary of the work of a vast army of investigators—chemists, immunologists, pathologists, physiologists, pharmacologists, and clinicians—to whom the author acknowledges his debt of gratitude.

*Presented as the Thirteenth Leo Loeb Lecture in honor of Dr. Leo Loeb, Professor Emeritus of Pathology, and sponsored by Mu Chapter of Phi Beta Pi fraternity at Washington University School of Medicine in St. Louis, March 19, 1948.
Plasma is the fluid matrix in which the cellular elements of the blood are suspended and transported about the vascular system. It differs from the interstitial fluids with which it is in osmotic equilibrium by its higher content of proteins. These plasma proteins consist of a complex mixture of multiple components (over 60 different physiological components have been identified in plasma already) differing in their source, fate within the body, chemical structure, and consequent physiological function. Moreover, the plasma proteins, present in 7% concentration in approximately 7% of the body water, are in a state of equilibrium with the large pool of proteins of the body tissues, present in concentrations of 20-30% in 72% of the body water. Between these two depots of body protein—the plasma proteins and the cellular proteins—stand the interstitial fluids representing about 21% of the body water. The plasma proteins obviously pass across the capillary walls into these fluids, in extremely low concentrations if at all through the glomerulus of the kidney, the choroid plexus, and the ciliary body, where the capillary wall consists of a double layer of cells; in relatively low concentrations (from 0.1%-0.3%) into the interstitial fluids of the extremities where the concentration has been measured; but probably in far higher concentrations in liver, spleen, lymph, and bone marrow where a sinusoidal structure predominates. There is no direct information available on this point, but the high protein content of lymph collected from lymphatics, particularly within the abdominal cavity, which return protein from tissues to the blood stream, is suggestive.

The importance of the liver in the production of plasma proteins is established very firmly. Serum albumin, serum esterase, prothrombin, and fibrinogen are all known to be derived from the liver, and their concentrations reflect the functional capacity of that organ except when other factors, such as malnutrition, plasma loss, or vitamin K deficiency, are present. The importance of the lymph follicles in the synthesis of serum gamma globulin and the antibodies associated with this fraction has recently been appreciated as a result of the beautiful work of White, Dougherty, Harris, and others. The derivation of many of the trace components of plasma—hormones, vitamins, and enzymes has been suggested by their behavior in disease. Thus the high serum amylase values found in mumps parotitis or in acute pancreatitis clearly point to the salivary glands and pancreas as the probable source of the traces of amylase normally found in the plasma. Fractionation of plasma and consequent concentration of components in plasma, such as the thyrotropic hormone, normally present in too small amounts in plasma for demonstration with available techniques.

Little is known of the factors which control the rate of production of
different plasma proteins so as to maintain a balance between various components. The role of vitamin K in the synthesis of prothrombin by the liver and the action of antigens in initiating the production of specific gamma globulin antibodies by the lymphoid tissues are two examples of known stimuli which enhance the production of individual plasma proteins.

The function of the plasma proteins in maintaining the volume of circulating plasma is somewhat better understood; at least, little evidence has yet been adduced to upset the validity of Starling's hypothesis that the oncotic pressure of the plasma proteins balances the filtration pressure exerted through the capillary wall, so as to maintain a relatively constant volume of circulating plasma. Recent studies have shown that this can be displaced markedly by the administration of large amounts of serum albumin or of sodium salts, the latter producing a marked expansion of total extracellular fluid. In conditions where the plasma oncotic pressure is greatly diminished, a marked decrease of the circulating plasma volume is probably prevented by high tissue fluid pressure due to the generalized edema, which tends to balance the filtration pressure.

A major advance in our knowledge of the plasma proteins has come from the development during the war of methods, based on the accumulated theoretical studies of protein chemists, for the large-scale separation of these proteins into fractions for therapeutic use. Such methods, unlike those in previous use in the serum industry, must be inclusive; that is, they should make it possible to recover all physiologically active components in the final fractions, not just one, as for example in the separation of pneumococcus antibody from hyperimmune horse serum. Moreover, the methods must be capable of application on an industrial scale at low cost, and must give rise not only to undenatured protein, but to protein preparations which can be injected in large doses without harmful reactions. The methods developed by Prof. Edwin J. Cohn and his colleagues at the Harvard Medical School have met these criteria and are beginning to have widespread application in the biologies and pharmaceutical industry wherever the basic problem is the separation of specific proteins from mixtures. Not only the fractionation of plasma, but the purification of toxoids, the concentration of viruses for vaccines, and the separation of hormones from organ extracts has been improved by this development. The new principles on which these methods are based are: first, the employment of volatile organic solvents as precipitants; and second, the use of a five variable system in which temperature, pH, and concentration of precipitant, of protein, and of ions can each be varied in order to develop conditions most suitable for the separation of each fraction. The use of an organic solvent (ethanol in the plasma fractionation methods) does away with the clumsy
dialysis procedure necessary if neutral salts are used to precipitate the protein, since it can be removed from the precipitate by drying from the frozen state. It also makes it possible to operate the whole procedure below the freezing point of water, thus minimizing the chance of protein denaturation or of the growth of contaminating bacteria. By separation of the plasma proteins into different fractions, conditions most suitable for the preservation of each active component can be developed, thus avoiding waste of valuable blood and permitting the storage of various components until they are needed.

Details of the procedures for plasma fraction are undergoing continuous modification as knowledge advances. These methods are of such a nature that the same number of chemists can handle the fractionation of 10,000 bleedings as easily as 200, provided suitable large-scale equipment is available. Thus, for economical operation, they should be carried out on a large scale. This is one of the strongest arguments in favor of a national blood program, such as is planned by the American Red Cross; otherwise blood will not be collected on a sufficiently large scale to make fractionation economically feasible.

The method now in use leads to an initial division of the plasma proteins into five fractions, several of which must be subjected to further fractionation for purification of their important physiological constituents. (See Table I).

Perhaps the most important outgrowth of the purification of the plasma proteins in sufficient amounts to permit both physiological and chemical studies with the same material is the insight which it is giving us into the relation between the chemical structure of the protein molecule and its function in the body. This chemical anatomical study of an important body tissue is only the beginning of a series of investigations which it is hoped may ultimately reveal the molecular forces at work in the tissues. Only two of the plasma proteins have been prepared in crystalline form—serum albumin and the $\beta_1$-metal combining protein—although fibrinogen, gamma globulins, $\beta_1$-lipoproteins and $\alpha_1$-lipoproteins have been prepared in sufficient purity to provide a good picture of their general molecular characteristics. These studies have revealed an extraordinary diversity among the plasma proteins. Thus serum albumin has a molecular weight of 69,000, and ellipsoidal shape, and a high net charge; fibrinogen has a molecular weight of 500,000, a needle-like shape with consequent viscosity in solution, and a low net charge; while $\beta_1$-lipoprotein has a molecular weight of over one million, a round symmetrical molecule, and a structure into which 75% of lipoid is incorporated in water-soluble form. Such studies began to make the abnormalities of the plasma proteins in disease
like nephrosis more intelligible and lead to a far better understanding of
the properties of the different proteins in solution: their viscosity, solu-
bility, and osmotic effects.

The reasons for feeling that the fractionation of human plasma is
sufficiently worth-while, apart from the scientific information so obtained,
to justify its continuation as an essential part of any complete blood pro-
gram deserve documentation. Fractionation makes it possible to concen-
trate a specific activity for therapeutic use and to distribute the product in a
state which will preserve this activity. This is a tremendous convenience
to the physician. In the case of gamma globulin, the injection of 2 cc.
from a vial in his bag to prevent measles in a baby, a very simple pro-
cedure, is the equivalent of a transfusion of 50 cc. of pooled plasma, a
relatively major and inconvenient operation. Moreover, there is an element
of safety, in that homologous serum jaundice has not been observed after the
injection of gamma globulin, whereas it follows the use of pooled plasma
in approximately 4-5% of cases. The factor of concentration makes it
possible to transfuse amounts of substances such as fibrinogen that would
not be possible with whole blood or plasma. The use of specific proteins for
specific purposes is not only more effective, but more economical of blood,
since after fractionation the donation of a single individual may take part
in the treatment of a considerable number of patients.

CLINICAL USE OF PLASMA FRACTIONATION PRODUCTS

A. Proteins Concerned with Coagulation.

The complexities of the coagulation mechanism are far from solved. Most
of the important coagulation factors circulate in the form of inactive pre-
cursors which are converted to the active form by a chain of events which
leads through a series of steps to the formation of a clot, and then to its ul-
timate lysis. Because conversion apparently takes place at a slow rate
even in the circulation, a series of antagonists, such as antithrombin,
likewise circulate in low concentration, preventing intravascular coagula-
tion under normal conditions.

The matrix of the blood clot is provided by fibrinogen, the long needle-
like molecules of which are polymerized to a system of tangled fibrils by
the action of thrombin in the process of coagulation. Fibrinogen is
available for clinical use in Fraction I, which contains between 60 and
70% fibrinogen, and a mixture of other globulins, among which is found
“the antihemophilic globulin.” The nature of this substance is not known.
It is not fibrinogen, but has not been concentrated in a fibrinogen-free
fraction. It is highly unstable, losing activity very rapidly when plasma
stands in contact with cells and fairly rapidly in plasma alone. Prothrombin,
the precursor of thrombin, to which it is converted by the action of a tissue extract, thromboplastin, in the presence of Ca++ ions, is found in Fraction III-22 which contains predominantly $\beta_2$-globulins. So far it has not been possible to stabilize prothrombin sufficiently to justify its distribution for therapeutic injection, since the danger of its spontaneous conversion to thrombin is too great. A fourth protein of importance in coagulation is plasminogen, the precursor of plasmin, the proteolytic enzyme of plasma, to which it is converted spontaneously, at a slow rate, but rapidly by an activator, streptokinase, produced by Group A beta-hemolytic streptococci. This activation of a plasma enzyme by this organism accounts for its well-known fibrinolytic activity. This enzyme not only will dissolve preformed clots but will also destroy the coagulability of fibrinogen solutions. Fraction I has been used in the replacement therapy of two diseases—hemophilia and afibrinogenemia. The intravenous injection of from 200 to 600 mgm. of Fraction I will lower the coagulation time of most hemophiliacs to within normal limits. It has been used as a convenient method for controlling hemorrhagic episodes and in preparing patients for dental and surgical procedures. The effect of a single injection only lasts for roughly 8-12 hours, hence must be repeated frequently. Recent reports of the appearance of anticoagulants in the blood of certain hemophiliac patients after repeated transfusions of blood or injections of Fraction I require further investigation.

In afibrinogenemia, a rare clinical condition, the high concentration of fibrinogen in Fraction I makes it possible to bring a patient's circulating fibrinogen from zero to normal levels, something which would be absolutely impossible with blood or plasma without a complete replacement transfusion.

Fibrinogen has been used with thrombin as a physiological glue to promote the adherence of skin grafts. By clotting fibrinogen with thrombin under controlled conditions, it has been possible to develop products of human proteins which have the great virtue of eliciting minimal reactions when left in situ at operations. Fibrin foam, a sponge which, when soaked in a solution of thrombin serves a very effective hemostatic agent, has been of great value particularly in the control of bleeding from the major dural sinuses in war wounds. Fibrin film, a transparent pliable membrane of fibrin, can be used as a replacement for the dura mater and will serve as a bridge across which a new membrane will grow without the formation of adhesions and consequent neurological sequelae.

B. Antibodies to Infectious Agents.

Quantitative recovery of those antibodies present in pooled human plasma
has been obtained in Fraction II and III, in which, however, gamma globulins only comprise about $\frac{1}{3}$ of this protein. Further purification leads to a 25 fold concentration of these antibodies in Fraction II, which contains 95% gamma globulin, with a yield of 55% in the original method and about 75-80% in the final modification.

Solutions of concentrated gamma globulin from pooled normal plasma might be expected to protect passively against those diseases to which the infant is not susceptible in the early months of life and to be ineffective in the prevention of those diseases which the infant readily contacts in early life, since this early immunity is thought to be due to antibodies received from the mother. This prediction has been borne out where it has been studied, with one clear-cut exception, mumps. Injections of concentrated gamma globulin do not protect susceptible children against either chicken pox or epidemic infantile diarrhea. On the other hand, gamma globulin, injected into susceptible children after exposure, has been shown to exert a protective action against both measles and infectious hepatitis. Careful studies throughout this country over a period of several years have established the reliability and safety of gamma globulin in the control of measles. Doses of at least 0.1 cc/lb. of body weight administered within the first week after exposure will protect the great majority of children completely against the disease. This has led us to abandon quarantine of a hospital ward where measles breaks out. Doses of one-fifth this amount (.02 cc/lb.) administered in the same period after exposure lead to modification of the disease in most children and only prevent its occurrence in 5-10% of the patients. This reliability makes routine use of this preparation possible the safe development of active immunity in exposed children. Over a million doses of gamma globulin have been distributed by the Red Cross for this purpose.

In the case of mumps, it has been demonstrated that one factor in the failure of normal serum gamma globulin to protect against the disease may be a deficiency in quantity of antibody present. When a gamma globulin preparation derived from convalescent mumps plasma was compared with normal serum gamma globulin in the treatment of mumps parotitis in an outbreak at an army camp, the incidence of complicating orchitis was markedly reduced in the group receiving convalescent material, but not in the other group. The possibility of using antibody preparations derived from convalescent plasma in the handling of certain diseases where high levels of antibody develop is something which deserves further study.

One mystery about normal serum globulin which has defied explanation is its toxicity on intravenous injection. Although reactions have been practically non-existent on intramuscular injection for measles prophylaxis, in-
travenous injection of the most highly purified preparations into normals in moderate doses and into patients ill with acute infections in much smaller doses has led to acute vasomotor reactions followed by severe chills and hyperpyrexia. This has occurred so regularly that one wonders whether it has genuine physiological significance.

C. Blood Groups Globulins

Since whole blood is used more than any of its derivatives, the necessity for potent, accurate, and well-standardized blood grouping reagents is obvious. Present practices in this regard, although practical, are none too satisfactory. When plasma from donors of a single blood group is used for fractionation, it is possible to concentrate in Fraction III-1 the iso-hemagglutinins for bloods of the incompatible groups. Group A bloods, comprising slightly over 40% of all donations, yield satisfactory anti-B agglutinins. Group B bloods occur with much less frequency, and it has been shown that a better anti-A agglutinin preparation can be made by fractionation of the common group 0 blood and absorption of its anti-B agglutinins with group B cells. Anti-Rh preparations can similarly be prepared from pools of anti-Rh plasma obtained after pregnancy or incompatible transfusions. Although isoagglutinin preparations of this type have not yet been widely used they have the virtues of ready standardization, packaging in stable form, easy production as a by-product of a blood program, and the availability of highly potent blood grouping material without the necessity for titration of the serum of each donor until a suitably potent one is found.

D. Normal Human Serum Albumin (Salt-poor)

Half of the plasma protein is recovered as 98% pure albumin in Fraction V. As now distributed this preparation consists of a 25% solution of normal human serum albumin in a diluent buffered to pH 6.8, containing approximately one-seventh as much sodium as an osmotically equivalent volume of citrated plasma and 1% acetyl tryptophanate as a stabilizing agent. This solution is heated 10 hours at 60° C. in the final containers, a procedure which seems to inactivate the virus of homologous serum hepatitis, and which has made it possible to omit the mercurial preservatives which are still used in plasma under ruling of the National Institute of Health.

During the war, the usefulness and safety of serum albumin as an emergency blood substitute was clearly demonstrated. In cases of shock with adequate hydration each gram of albumin can be expected to add approximately 17cc. of fluid to the circulation within an hour, which is close to
the amount predicted by osmotic pressure measurements in vitro. On the other hand, in severe shock, with dehydration, the average is only 12 cc. and marked variation in response may occur. Hence albumin should be followed by additional fluids (400 cc. of saline per 25 grams to give a solution isosmotic with plasma) in shock cases whenever possible. The convenience, compactness, ease of administration, and safety of albumin make it preferable to plasma in most instances as an emergency blood substitute.

The use of albumin in the treatment of hypoproteinemia is under active investigation today, and hence much of what is recorded here may have to be revised when more data is available. The causes of hypoproteinemia are multiple: in most instances, particularly where edema is a prominent symptom, there is principally a reduction in the amount of circulating albumin. This may come about as a result of plasma loss with inadequate caloric and nitrogen intake to meet the drain on body reserves, as a result of the catabolism of protein in infections, or as a result of inadequate albumin synthesis, due to hepatic insufficiency.

The importance of an adequate protein and caloric intake for the repair of body protein deficits cannot be overemphasized; it is most properly met by oral feeding, but parenteral alimentation with protein hydrolysates and dextrose solutions, as shown so clearly by Dr. Elman of this University, is a very useful supplement in those cases where an adequate intake by mouth is impossible. The place of serum albumin in the treatment of nutritional hypoproteinemia would seem to be in those cases where one cannot afford to wait for the relatively slow formation of serum albumin in response to food. This is a situation met relatively frequently in the surgical ward, as for example, when a patient must be operated on promptly to relieve intestinal obstruction or when edema develops at the stoma of an anastomosis of two portions of the gastro-intestinal tract. In cases of burns, exfoliative dermatitis, and severe diarrhea, frequently the protein loss is so rapid that it can only be met with injections of preformed protein, particularly since there is apt to be increased protein breakdown and nitrogen loss under these circumstances.

A second set of conditions under which serum albumin should be useful is in cases of hepatic disease where the actual synthesis of this protein is impaired even in the face of a strongly positive nitrogen balance. Cirrhosis of the liver as seen recently has been divided into two main types, the rare coarsely nodular cirrhosis secondary to the progression of an infectious hepatitis and the finely granular Laennec’s type of cirrhosis. Demonstration that some cases of the latter group can be put into lasting remissions by prolonged dietary therapy makes an even stronger case for relieving
their disabling edema with albumin during the course of dietary therapy. It has been possible to relieve edema and ascites in some of the first type as well, but the administration of albumin apparently has no influence on the course of the underlying hepatitis. In some instances of cirrhosis of the liver, which are far advanced, administration leads to elevation of the serum albumin concentration but there is a concomitant rise in the concentration of albumin in the ascitic fluid and hence failure to deliver the ascites.

No aspect of albumin therapy has been subject to a greater misunderstanding than its place in the treatment of the nephrotic syndrome. The administration of serum albumin to patients with nephrosis has proved conclusively that the nephrotic kidney is unable to retain normal serum albumin. This puts the burden of proof on those who say that the primary defect in this disease is a production of abnormal albumin rather than a change in the kidney itself. Prolonged albumin therapy leads to a slow diuresis in many of these patients, to very slightly increases in plasma albumin concentration, and to massive proteinuria which accounts for a large portion of the injected protein. The benefits of diuresis are transitory in many patients. The serious problem requiring further investigation is to what extent this marked increase in proteinuria is harmful to the kidney per se. Some patients have shown hematuria during the course of injections. Thus albumin must be considered a symptomatic remedy to be used with caution in a disease, the fundamental nature of which remains obscure.

There are many other potential uses of albumin under investigation. It is a physiological hyperosmotic solution which may be useful in the reduction of local edema, particularly within the cranial cavity. It has been a very useful tool in physiological research upon shock, cardiac failure, renal function, the control of water balance in various types of edema, the control of the level of protein-bound iodine of the serum, and the control of calcium and phosphorus balances in osteoporosis.

**SUMMARY**

This brief review of some of the recent accessions to our knowledge of the chemical structure, physiological functions, and therapeutic applications of the plasma proteins serves to emphasize three important elements in medical progress—scientific curiosity, the humanitarian impulse, and effective social organization. We have had the privilege of summarizing the work of hundreds of investigators, whose studies are giving us new tools for the investigation and treatment of disease. Their work has only been possible because the magnificent response of a free people to the call for
blood donors by a voluntary philanthropic agency, the American Red Cross, was coupled with a technical triumph, the development of practical methods for the large scale separation of the plasma proteins, itself the culmination of highly theoretical and seemingly impractical investigations by protein chemists in various countries for many years.
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<th>Fraction</th>
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<th>Major Chemical Components</th>
<th>Major Physical Constituents</th>
<th>Subfractions</th>
<th>Major Chemical Components</th>
<th>Major Physiological Constituents</th>
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<td>IV-7 $\beta_1$-Globulin</td>
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<td>Metal-binding protein</td>
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<td>Albumin (98%)</td>
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*Knowledge of the lipoproteins which comprise approximately 25% of the proteins of normal pooled fasting human plasma is still in its infancy. It is known that these fractions contain steroid hormones, Vitamin A, cholesterol, phospholipids in actual combination with protein in a definite molecular structure.*
Proceedings of the Washington University Medical Society

The second meeting of the Washington University Medical Society was held on Wednesday evening, March 31, in the auditorium of the School of Medicine with Dr. Carl V. Moore presiding. Four papers were presented, abstracts of which are printed below.

The final meeting for the 1947-48 school year was held on Thursday evening, May 20, in the auditorium of the School of Medicine. The program consisted of the three papers considered to be the most meritorious of those submitted by members of the senior class for the annual Borden Award. The three students who presented papers were: Robert P. Gibb '48, Seymour Reichlin '48, and James F. Nickel '48. (Abstracts of their papers will be published in the October issue of the Quarterly.)

A large and enthusiastic audience of students and faculty members participated in the stimulating discussions which followed each paper. Following the presentation of the papers, Dr. W. Barry Wood, Jr., professor of medicine and chairman of the Borden Award Committee, of which Dr. Carl F. Cori and Dr. Dr. Alexis F. Hartmann are also members, made the $500 Borden Award to James F. Nickel.

Alpha Omega Alpha keys were given to the following new members: Miss Helen Estelle Clark, Robert H. Friedman, Bernard T. Garfinkel, Milo L. Heideman, Jr., Robert H. Lund, Daniel L. Morgan, Frank B. Norbury, Gerald T. Perkoff, Stanley N. Rokaw, and Arthur H. Stein, Jr. Dr. Thomas H. Hunter, assistant professor of medicine and assistant dean in charge of students, awarded the Nu Sigma Nu Awards of $25 to J. Max Rukes and Milo L. Heideman, Jr., as the outstanding members respectively of the first and second year classes for the school year 1946-47.

Abstracts of Papers Presented before the Washington University Medical Society on March 31, 1948:

Anatomical Factors in the Etiology of Heterotropia

BY RICHARD G. SCOBEE, M.D.
Department of Ophthalmology

Crossed eyes have been noted since antiquity, but it has been only during the last century that surgical treatment of the condition has been used. The usual approach in the correction of crossed eyes is to assume that the patient has a defect of the fusion faculty which is inherited and
which allowed the eyes to cross in the first place. Recent investigations have shown that the concept of defect of the fusion faculty is no longer tenable, but that organic anomalies which are inherited probably play an important underlying role in the etiology. These anomalies may be of four types: (1) anomalies of the check ligaments, (2) anomalies of the insertions, (3) anomalies of the intramuscular membrane, and (4) anomalous muscle slips. Slides were shown demonstrating each of these.

**Antibody Formation in Early Infancy against Diphtheria and Tetanus Toxoids**

*BY JEAN V. COOKE, M.D.*

Department of Pediatrics

A study was reported of the development of antitoxin after two injections of combined diphtheria and tetanus toxoids in a group of young infants. It was found that the production of tetanus antitoxin is as good in the early months of life as later, and this finding denotes that the mechanism for the production of antibodies is well-developed in young infants. With diphtheria antigen the development of antitoxin is definitely defective in a considerable number during the first six months of life. This impairment of antibody formation is related to the presence of passive immunity in the resistant infants and appears specific for diphtheria. The application of these findings to the practical immunization of infants to diphtheria, tetanus and whooping cough was discussed.

**The Glucose Uptake by the Isolated Diaphragm of Hypophysectomized Rats**

*BY CHARLES R. PARK, M.D., AND MAURICE E. KRAHL, PH.D.*

Departments of Biological Chemistry and Pharmacology

The hexokinase reaction,

\[
\text{hexokinase} \\
\text{glucose + adenosine triphosphate} \rightarrow \text{glucose-6-phosphate} + \text{adenosine diphosphate},
\]

is the initial recreation in the utilization of glucose by skeletal muscle and is irreversible. The rate of glucose uptake by diaphragm is therefore a measure of hexokinase activity.

The pituitary was removed from young male rats by the parapharyngeal approach, and, at varying intervals after operation, the glucose uptake of the diaphragm in vitro was determined. The effect of insulin added to the medium in several concentrations was measured. In a series of normal animals the uptake was 2.7 mgm per gm. of wet tissue per hour, whereas
in the operated series the uptake was significantly increased to 4.3 mgm/gm/hr. The maximum effect on glucose uptake after pituitary removal was not observed until three to four weeks after operation at which time nearly maximal atrophy of the adrenal cortex had occurred. Glucose uptake gradually decreased toward normal levels in the period 30 to 120 days after operation. When insulin in a concentration of 1 unit/ml was added to the medium, the uptake rose to 4.5 mgm/gm/hr. in the control series and to 5.6 mgm/gm/hr. in the hypophysectomized series. The diaphragm was not more sensitive to low concentrations of insulin in the hypophysectomized than in the normal rate.

These results indicate that hypophysectomy leads to increased hexokinase activity in skeletal muscle.

**Pressor Substances in Blood of Hypertensive Patients**

*By Henry A. Schroeder, M.D., Norman S. Olsen, Ph.D., Melvin L. Goldman, M.D., and Mary J. Kinsella, A.B.*

*Departments of Medicine and Biological Chemistry*

Alcoholic extracts of hypertensive and nonmotensive arterial blood were prepared, concentrated, extracted with petroleum ether, and purified by subsequent alcoholic extraction. They were further purified by adsorption on anionic cationic exchange resins and by the formation of picrates. These extracts were tested for pressor activity in the intact anesthetized rat. Their adsorption spectra and their ability to potentiate the topical action of epinephrine on the rat’s meso-appendix were also determined. The color formed by Richter’s method for amine picrates was likewise measured. Fifteen patients exhibiting arterial hypertension with renal disease, either primary or secondary but without nitrogen retention, were found to contain in their blood substances which gave a prolonged pressor response in the rat. In extracts made from the blood in all but three, or fifteen, exhibiting “neurogenic hypertension” no such response was found. The extract of the blood of only one normotensive subject out of fifteen gave the response. The picrate color was found to be usually increased in the blood of hypertensive subjects, the average being three times as much as was found in most normotensive subjects. The extract from hypertensive subjects almost uniformly potentiated the topical action of epinephrine on the rat’s mesoappendix, while that from normotensive subjects usually did not. It can be concluded that pressor substances can be demonstrated in the blood of some hypertensive individuals.
250 Attend Alumni Reunion Banquet; Dr. Samuel B. Grant Elected President

Almost 250 persons, including alumni and the seniors from Washington University School of Medicine, attended the annual Reunion and Banquet of the Medical Alumni Association on May 12 at the Sheraton Hotel in St. Louis. As guests for the occasion, the seniors entertained with a futuristic satire on “What it will be like to attend medical school in 1968.”

New officers were elected at the dinner to head the Alumni Association for the coming year. They are: Dr. Samuel B. Grant ’20, president; Dr. Alfred Goldman ’20, first vice-president; Dr. P. D. Stahl ’23, second vice-president; and Dr. George W. Ittner, Jr., ’37, who was re-elected secretary-treasurer. Elected to the Executive Committee for three years with terms expiring in 1951 were: Dr. Guy Magness ’28, Dr. Delevan Calkins ’31, Dr. Sim F. Beam ’32, and Dr. Oscar C. Zink ’21. Dr. Dalton K. Rose ’15 was re-elected as representative from the Medical Alumni Association to the Board of Directors of the Corporation.

Speaker for the evening was Mr. Raymond F. Buckley, St. Louis attorney, who advised both alumni and seniors that the medical profession has a big job to do in selling to the public the true facts about what is being done in order to dispel the prevalent idea that the physician makes too much money and has little interest in his individual patients. The physician, he said, can carry the truth directly to his own patients and emphasize his sincerity by actively taking part in cultural, educational, or charitable affairs in civic life.

Special tables were reserved for the classes of 1908, 1923 and 1928 in honor of their 40th, 25th and 20th anniversaries respectively. Three of the four living members of the 1894 class were present: Drs. A. G. Schlossstein, Horace W. Soper, and George B. Tuttle.

Pictures of the members of the classes of 1898 and 1923 who gathered for their anniversary meetings will be found in the Alumni News section of this issue.

Ninety Graduates from Medical School

Ninety senior medical students received their degrees of doctor of medicine at Commencement Exercises of Washington University on the morning of June 8 in Francis Field House. Chancellor Arthur H. Compton delivered the principal address on “Educating for Peace in an Atomic Age.” A record number of 1618 graduates from various divisions of the University received their degrees before a crowd of almost 6,500 persons which filled all galleries in the Field House.
Among the recipients of honorary degrees was Dr. Leo Loeb, professor emeritus of pathology in the School of Medicine, who received the degree of doctor of science. In presenting Dr. Loeb for the degree, Dr. Robert A. Moore, Dean of the School of Medicine, cited him for his investigations which "have extended over a broad domain of biology and medicine, with emphasis on hormones, cancer, the individuality of tissues, and the aging process." Dr. Moore added that Dr. Loeb's presence on the faculty "has added substantially to the prestige of Washington University."

Dr. Philip A. Shaffer, distinguished service professor of biological chemistry, presented for the degree of doctor of laws Mr. Edward Mallinckrodt, Jr., board chairman of the Mallinckrodt Chemical Works in St. Louis. Mr. Mallinckrodt and his father, said Dr. Shaffer, "have given to St. Louis and to the world two generations of intelligent and generous philanthropy, stemming from an abiding faith in the advancement of human knowledge through research and in education for citizenship." The Mallinckrodt family has endowed the Edward Mallinckrodt Institute of Radiology, the Henry Elliott Mallinckrodt Professorship of Anesthesiology, and many other gifts to the University.

Others receiving honorary degrees were Archibald MacLeish, former Librarian of Congress, doctor of humane letters; George D. Stoddard, president of the University of Illinois, doctor of laws; and Lee A. DuBridge, president of the California Institute of Technology, doctor of science.

Harry B. Wallace, president of the Corporation, announced at the exercises that gifts totaling $2,405,715 were made to Washington University during the current academic year. This amount is more than three times the total donated during the 1946-47 school year. Among these gifts, the School of Medicine received: $113,600 from the estate of Daniel N. Kirby, St. Louis attorney; $101,002 from Edward and Elizabeth Mallinckrodt; $90,750 from Wallace and Lucille K. Renard (Mr. Renard is board chairman of the Renard Linoleum & Rug Co. in St. Louis); and $405,929 from foundations and others for research and instruction.

Postgraduate Courses in Pediatrics, Medicine and Surgery

The Division of Postgraduate Studies will offer three courses in advanced study during this summer and early fall as follows:

Basic Science in Medicine will begin July 1, but candidates may start any time, up to October 1. Tuition will be $62.50 per month.

The Department of Pediatrics will conduct a two-month refresher course starting in September, and a nine-month graduate course, September to June, 1949. The nine-month course will include all of the material given
during the refresher course and in addition will offer clinical work in
general and specialized out-patient clinics. Tuition for the eight-week
refresher course is $200 and for the complete nine-month course is $500.

Basic Science in Surgery will start October 1, with a tuition rate of
$62.50 per month. The basic science courses will provide information
from the pre-clinical sciences and other fields basic to modern clinical
medicine, and will assist the student in acquiring an inquiring attitude
toward science.

Medical officers who qualify for benefits under the G. I. Bill of Rights
may apply for allowance for tuition charges, books, and subsistence from
the Veterans Administration. Further information and bulletins describing
the courses in full may be obtained by writing to the Director, Division of
Postgraduate Studies, 4580 Scott Avenue, St. Louis 10, Missouri.

**Biochemistry Gets $13,000 Ultracentrifuge**

The first analytical centrifuge in this section of the country was in-
stalled in the basement of the South Building at the School of Medicine
during April. Cost of the instrument, which will be used by the de-
partment of biological chemistry, was approximately $13,000.

Weighing more than two tons, plus 800 pounds of crating, the delicate
machine was shipped from Belmont, Calif., where it was manufactured
by the Specialized Instruments Corporation. It was installed under the
supervision of Dr. John F. Taylor, assistant professor of biological chem-
istry, and Mr. Robert Loeffel, research assistant. Dr. Taylor will be in
charge of the use of the machine, and Mr. Loeffel will be engineer in charge
of operation.

The ultracentrifuge, which measures about five feet high, six feet long,
and two feet wide will be used mainly for the study of various proteins.
Dr. Carl F. Cori and Dr. Gerty T. Cori, co-winners of the 1947 Nobel
Prize in medicine and physiology, will use it to continue the study of
phosphorylase, the enzyme which begins the conversion of animal starch
into sugar, and which they first isolated. Various enzymes isolated re-
cently by other members of their staff also will be studied through this
medium.

This new model ultracentrifuge has a maximum speed of 60,000 revolu-
tions per minute, or 1,000 each second, which produces a force equal to
about 250,000 times that of gravity. Special features of the machine in-
clude a photographic unit with automatic exposure devices, a refrigeration
unit, and two-inch armor plate protection for the vacuum chamber
containing the rotor. Solutions are held in a quartz cell placed in this
rotor. Less than fifteen minutes are required to bring it to top speed.
Photographs are taken by ultraviolet light from a mercury arc, which is directed through the revolving solution at a particular spot in the revolution, then through a series of lenses and a camera to photographic film. A second rotor with special plastic tubes may be substituted when it is desired to separate larger quantities without the photographic record and observation.

Two on Faculty Chosen to Science Academy

Out of 30 American scientists elected to the National Academy of Sciences last April 27, two were members of the faculty of the School of Medicine. They were Dr. Gerty T. Cori, professor of biological chemistry, and Dr. Hallowell Davis, research professor of otolaryngology and professor of physiology. Dr. Davis also is director of research at Central Institute for the Deaf in St. Louis. With her election to the Academy, Dr. Cori is the fourth woman in the history of the N. A. S. to be so honored. Also elected was Dr. Francis D. Schmitt of the Massachusetts Institute of Technology, who received his Ph.D. degree here in 1927.

Bequest from Kirby Estate Wills School $113,600

The School of Medicine will receive a bequest estimated at $113,600 from the estate of Daniel N Kirby, alumnus of the University and former director of the Corporation. The bequest is for aid and maintenance of the School. A total of about $585,093 will be received by the University, the major share of which will be used in establishing the Charles Nagel Chair of Constitutional Law and Political Science. A sum equal to that awarded the School of Medicine is set aside as an adjustment of the construction and operation of the Nurses’ Home.

$5,866 Loan Fund Established by Will of Dr. G. H. Reinhardt, ’07

A loan fund of $5,866.56 has been established at the School of Medicine under the will of an alumnus, Dr. Gustave H. Reinhardt of Mira Loma, California, it was announced on May 18. The fund, to be known as the G. H. Reinhardt Memorial Scholarship Fund, constitutes the residue of Dr. Reinhardt’s estate and will lend a maximum of four hundred dollars each year to deserving second-year students in the Medical School. No more than one hundred dollars is to be loaned to any one student. The loans are to be repaid by the students within five years, but will bear no interest or other charges.

Dr. Reinhardt was graduated from the School of Medicine in 1907
and was living in Mira Loma until the time of his death on February 2, 1946.

**Orthoptics Course Announced for September**

A ten months' course in orthoptics will be given starting in September by the School of Medicine in association with the St. Louis Ophthalmic Laboratory. Orthoptics is concerned with the visual education of children with ocular muscle abnormalities such as crossed eyes. The course, which is given each year, is open to graduates of a recognized School of Nursing or to those who have a background in college anatomy, physics, and psychology. Many excellent opportunities exist for well-trained orthoptic technicians. For further information, inquiries should be sent to Miss Anita Stelzer, St. Louis Ophthalmic Laboratory, 634 North Grand Blvd., St. Louis 3, Mo.
Departmental News

Anatomy

Dr. Mildred Trotter, professor of gross anatomy and consultant in anatomy to the department of radiology, has been granted a one-year leave of absence to take a position as anthropologist for the United States Army, assigned to Schofield Barracks, near Honolulu, Oahu, Territory of Hawaii. Dr. Trotter recently returned from Lexington, Ky., where she was briefed on her duties by Dr. Charles E. Snow, who served in a similar capacity for the army and returned last March. Leaving St. Louis on May 28, Dr. Trotter flew from Fairfield, Calif., and reported to Fort Shafter near Honolulu.

Dr. Edmund V. Cowdry, professor of anatomy, represented Washington University at the dinner given for the opening of the new Sloan-Kettering Institute for Cancer Research, a division of Memorial Hospital in New York City. Dr. Cowdry recently spent three weeks in Mexico helping prepare plans for the October meeting of the International Cancer Research Commission in Paris, France. He is United States representative on the Executive Committee of the Commission, which has headquarters in Mexico City. While in Mexico, he was elected an honorary member of the Sociedad de Cancerologia de Guadalajara and received his certificate of membership at a special dinner given in Guadalajara.

Bacteriology

Dr. Jacques J. Bronfenbrenner, professor of bacteriology and immunology, addressed a group at the Southwest Medical College in Dallas, Texas, April 28 on the subject, “Mechanism of Desensitization.” On Saturday, May 1, he inaugurated the newly-established I. M. Lewis Lecture at Houston, Texas, addressing the local branch of the Society of American Bacteriologists. “Relation Between Blocking and Classical Antibodies (Unitarian Hypothesis)” was his topic.

Biological Chemistry

In addition to her election to the National Academy of Sciences, Dr. Gerty T. Cori, professor of biological chemistry, recently received three other awards. It was announced on April 19 that she would receive the American Chemical Society’s Francis P. Garvan Medal for women in chemistry. She was a recipient of an Achievement Award given by the Women’s National Press Club in Washington, D. C.; and on May 18 she
received an American Brotherhood Citation of the National Conference of Christians and Jews at a meeting in Chicago.

Hospital Administration

The University awarded for the first time degrees of master in hospital administration during the recent Commencement Exercises to the following seven students: Ted Bowen, Alto, Tex.; Victor E. Costanzo, Stamford, Conn.; Harold L. Hutchins, Cambridge, Mass.; Howard B. Lehwald, Canton, Ohio; Charles M. McLean, Oregon City, Ore.; Frank J. Moore, Lansing, Mich.; and David C. Reynolds, Jacksonport, Wis.

Preventive Medicine

Dr. George Saunders, assistant professor of preventive medicine and branch section chief in tropical medicine for the Veterans Administration, gave a series of talks to staff members of V. A. hospitals in Springfield, Mo., Fayetteville, Ark., and Muskogee, Okla., during April. Subjects discussed were amebiasis, the diagnosis of leprosy, and recent developments in malarial treatments. He also attended the Fourth International Congress of Tropical Medicine and Malaria in Washington, D. C. on May 10 and 11.

Medicine

A paper on “Cardiolipin,” prepared jointly by Dr. Gustave Dammin, assistant professor of medicine and of pathology, and Dr. Virgil Scott, assistant professor of preventive medicine and of medicine, was read by Dr. Dammin before the laboratory section of the Missouri Public Health Association which met in St. Louis on May 12.

Dr. Henry A. Schroeder, associate professor of medicine, spoke on “The Effect of Low Salt Diets on Arterial Hypertension: A Comparison of the Effects of Low Salt and Rice Diets in the Treatment of Arterial Hypertension,” before the Section on Internal Medicine meeting with the Section on Experimental Medicine and Therapeutics during the A. M. A. Convention in Chicago during June.

Dr. Gustave Dammin and Dr. Samuel C. Bukantz gave a lantern demonstration on “Immunologic and Morphologic Alterations in Hypersensitive States” before the Section on Miscellaneous Topics at the A. M. A. Convention.

Neuropsychiatry

The annual meeting of the American Psychiatric Association in Washington, D. C., from May 17 to 20 was attended by Drs. Edwin F. Gildea, Margaret Gildea, Ernest H. Parsons, Samuel R. Warson, George Saslow,
Frank O. Shobe and Mr. A. D. Buchmueller. Dr. Parsons, Dr. Saslow and Dr. Shobe gave papers at the meeting.

Dr. George Saslow, associate professor of psychiatry, gave a paper on "Psychologic Aspects of Arterial Hypertension" before a joint meeting of the Section in Internal Medicine and the Section on Experimental Medicine and Therapeutics during the A. M. A. Convention in June at Chicago.

Ophthalmology

Dr. Lawrence T. Post, professor of clinical ophthalmology, spoke on "The Diagnostic Significance of Failing Vision" before the Section on the General Practice of Medicine during the A. M. A. Convention. Dr. Paul O. Hageman, assistant professor of clinical medicine, opened the discussion which followed the presentation.

Otolaryngology

Dr. and Mrs. D. J. Roux, visitors to the department from Capetown, South Africa, for two weeks during May, were guests at the annual departmental picnic, which was held May 8. They were particularly interested in watching their first American softball game, to which the postgraduate students had challenged the staff members. The postgraduates lost, 16-12.

A three-week visit to the department was made by Dr. George C. Halliday of Sydney, Australia, during May. He was observing special work under Dr. Theodore E. Walsh, professor of otolaryngology.

Pathology

Dr. Robert A. Moore, Dean and professor of pathology, gave three talks at the third annual meeting of the Ogden Surgical Society in Ogden, Utah, between May 19 and 21. He spoke on "Tumors of the Testis," "Peculiar Problems in Diseases of the Aged," and "Endocrine Relations in the Male." Alumni of the School of Medicine who are in the Ogden area gave a cocktail party in honor of Dr. and Mrs. Moore on the afternoon of May 20. On May 12, Dr. Moore spoke before the Illinois State Medical Society in Chicago, and from May 31 to June 3 he was a guest of the pathology department of the University of Texas in Galveston, and spoke there on "Evaluation of the Newer Methods of Diagnosing Cancer."

Physical Medicine

Dr. Sedgwick Mead, assistant professor of physical medicine, spoke to the Session on History of Medicine of the American Medical Association during the annual convention in Chicago during June. His subject was "Physical Treatment of Peripheral Vascular Diseases."
Physiology

Dr. Hallowell Davis, research professor of otolaryngology and associate professor of physiology, has been promoted to professor of physiology, effective July 1.

Radiology

Dr. Sherwood Moore, professor of radiology, gave a fifteen-minute discussion June 23 in Chicago on the coding of radiological diagnoses which will be used in the Standard Nomenclature of Disease, reference book published by the American Medical Association.

Dr. A. Norman Arneson, associate professor of clinical radiology and clinical obstetrics and gynecology, attended the 30th annual meeting of the American Radium Society, of which he is president, in Chicago, June 20 through 22. He gave the presidential address to the society on July 21. Special celebrations in recognition of the 50th anniversary of the discovery of radium were part of the program. Dr. and Mrs. Arneson were hosts to more than 200 persons at a cocktail party given June 20 in the South Ballroom of the Stevens Hotel in honor of special guest speakers from abroad who were attending the meeting.

Dr. Wendell G. Scott, associate professor of clinical radiology, has been appointed a member of the Committee on Radiology of the Division of Medical Sciences for the National Research Council. The Committee will act in an advisory capacity to the Veterans Administration and other Federal agencies.

Surgery

Dr. Lauren V. Ackerman, assistant professor of pathology, joined the full-time staff in St. Louis as associate professor of pathology and of surgical pathology on July 1. He has been pathologist to the Ellis Fischel State Cancer Hospital in Columbia, Mo., since 1940, and has been a part-time staff member of the School of Medicine for the past several years.

Dr. Robert Elman, professor of clinical surgery, was appointed one of a nine-man medical group which is visiting Poland and Finland this summer on a teaching mission. The group left July 1 by plane for Stockholm, Sweden, proceeding from there to Poland, where they will remain until August 10. They will be in Finland from August 10 until September 1, and then return to the United States. The mission is sponsored by the Unitarian Service Committee, the United Nations World Health Organization, and the U. S. State Department. Valuable equipment, medicine, and literature were shipped to both countries in connection with the mission.

Professor Wolfgang Denk of the Surgical University Clinic in Vienna,
Austria, was a visitor in the department of surgery during the week of May 17. He was reviewing recent advances in surgery under Dr. E. A. Graham and other staff members. Prof. Denk went to the University of Iowa from St. Louis, then on to Quebec, Canada, for meetings of the American Surgical Association and the American Association for Thoracic Surgery.

A visitor to the department of surgery during the first part of April was Dr. Alfred Weiss, professor of surgery at Strasbourg University in Strasbourg, France. Dr. Weiss was conferring with Dr. Graham on advances in surgery and in arterial hypertension, on which he is writing a book. This was actually a re-visit for Dr. Weiss, who came at the invitation of the Rockefeller Foundation. Twenty years ago he was here for a six-month period of study under Dr. Graham.

Dr. Eugene Bricker, associate professor of clinical surgery, and Dr. Thomas Burford, associate professor of surgery, attended the Third National Cancer Congress in Havana, Cuba, from May 2 to 7. Dr. Bricker gave a talk on “Cancer of the Intestinal Tract,” while Dr. Burford spoke on “Cancer of the Lung.” Dr. Burford and Dr. Edward M. Kent of Pittsburgh, Pa., opened a discussion on “Empyema” during a session of the Section on Surgery at the A. M. A. Convention in Chicago during June.
Faculty Changes and Appointments

Eighteen promotions and 120 appointments to the faculty of the School of Medicine became effective on July 1 in the various departments as follows:

Anatomy

Edward L. Kuff and Miss Elsie M. Shaw, appointed assistants in anatomy; Mr. Edgar P. Jayne appointed research assistant.

Biological Chemistry

J. Oliver Lampen, promoted to rank of assistant professor; Graham T. Webster and Sidney Udenfriend, appointed instructors; Theodore Z. Posternak, appointed Rockefeller Fellow in biological chemistry; Mr. Lionel A. Manson, resigned as assistant in biological chemistry effective April 30, 1948 and appointed National Institute of Health Fellow in Biological Chemistry effective May 1, 1948.

Medicine

Cyril M. MacBryde, promoted to associate professor of clinical medicine; Reubenia Dubach, Miss Virginia Minnich and Miss Mary Ruth Smith, appointed research associates; Grace Bergner, appointed instructor in clinical medicine.


Albert B. Eisenstein, Herbert C. Fritz, Samuel B. Guze, Laurence K. MacDaniels and Te-chang Tung, appointed fellows in medicine.

Bernard Bercu, appointed fellow in cardiology; M. H. Scheele; appointed instructor in clinical dermatology; Daniel C. Tweedall, appointed assistant in clinical dermatology; James T. Good and Herbert Wiegand, appointed fellows in hematology; Burton A. Shatz and James F. Tagge, appointed fellows in gastroenterology; William H. Daughaday, appointed research fellow in metabolism.

Palmer Futcher, resigned as assistant professor of medicine; Helen Gottschalk, resigned as instructor in dermatology effective May 1, 1948.
Neuropsychiatry

George Saslow promoted to associate professor of psychiatry; Arthur H. Chapman, Robert M. Counts, Wells Goodrich, Richard R. Lininger, Edwin F. Price, and Richard F. Schneider, appointed assistants in neuropsychiatry; Mr. Ivan N. Mensh, appointed instructor in medical psychology, effective Aug. 1, 1948; Alfred K. Baur, appointed instructor in clinical psychiatry; Pearl C. Ulett, appointed research assistant in psychiatry.

Obstetrics and Gynecology


Ophthalmology

William E. Shahan, status changed to professor emeritus of clinical ophthalmology; M. Hayward Post, promoted to professor of clinical ophthalmology; B. Y. Alvis, promoted to associate professor of ophthalmology; Philip T. Shahan, appointed instructor in clinical ophthalmology; George T. Stein and Max Baldridge, appointed assistants in ophthalmology.

Otolaryngology

Joseph H. Ogura, appointed instructor in otolaryngology; John L. P. Carney, appointed assistant in otolaryngology.

Pathology

Lauren V. Ackerman, promoted to associate professor of pathology and appointed associate professor of surgical pathology; Robert Stowell, promoted to associate professor of pathology; Frank J. Dixon, appointed instructor in pathology; Lewis S. Chase, Thomas L. Young, Ellis J. Van Slyck, Robert O. Lipe, Calvin J. Wegner, Ancel Earp, Jr., Clancence M. Pickard and Marvin D. Orrahood, appointed assistants in pathology; F. Bertoli, E. M. Nadel and Frank Stephens, appointed fellows in pathology; Mr. Victor E. Tinderhold, appointed research assistant in pathology.

Pediatrics

Adrien S. Bleyer, promoted to associate professor of clinical pediatrics; Paul Zentay, Park J. White and Joseph C. Jaudon promoted to assistant professors of clinical pediatrics; William G. Klingberg, appointed in-
structor in pediatrics; Mrs. Ruth B. Gerstung, appointed instructor in bacteriology in pediatrics; James Cravens, appointed assistant in pediatrics; Gene Grabau and Martin Calodney, appointed assistants in clinical pediatrics.

Physiology
Hallowell Davis promoted to professor.

Preventive Medicine and Public Health
Robert E. Shank appointed professor of preventive medicine; Miss Kathleen Roetto, appointed research assistant in preventive medicine.

Radiology
Wayne Simrill, Dallas Anthony, and Stuart Lippert, appointed assistants in radiology.

Surgery

Lee T. Ford, Jr., appointed assistant in clinical orthopedic surgery; Richard A. Lemmer, Mather Pfeiffenberger, Jr., and Richard W. Yore, appointed fellows in general surgery; Lewis H. Bosher, Jr., Harrison Black and R. Leonard Kemler, appointed fellows in thoracic surgery; Gerald A. Winokur, appointed fellow in neurosurgery; Dr. Cooper Johnston, appointed fellow in orthopedic surgery; Herbert E. Pedersen, appointed National Research Council Fellow in orthopedic surgery; Enrique Alvelais, Jr., appointed fellow in orthopedic surgery.

Miscellaneous
Frank H. Ewerhardt, status charged to assistant professor emeritus of physical therapeutics; Sven A. Kvorming, appointed research assistant in gerontology; Miss Marion Sizelove, appointed lecturer in dietetics; and Joseph Noah, appointed assistant physician to the student health service.
Publications of the Faculty

February - May, 1948


Gildea, M. C.-L. The social function and group therapy. Mental Hyg. 32: 203-216. April, 1948.


Alumni News

1885
Anthony F. Myers of Blooming Glen, Pa., died May 6 at Grand View Hospital, Sellersville, Pa., where he had been since April 13 after suffering an arm fracture at his home. Dr. Myers, who was 92, retired in 1935 after 50 years of active medical practice in Bucks County, Pa. At that time he was awarded a testimonial and certificate by the Pennsylvania Medical Society for his outstanding record. He was secretary of the Bucks County Medical Society for 40 years and editor of its monthly publication for 15 years.

1886
The new address of Augustus D. Cloyd is 5225 Cass St., Omaha 3, Neb.

1898
John Q. Roane of Carlyle, Ill., was honored at a testimonial dinner sponsored by the Clinton County Medical Society during the latter part of May. Dr. Roane, who has been a practicing physician for 59 years, 42 of them in Carlyle, was presented with a certificate of membership in the fifty-year club of the Illinois State Medical Society.

1905
Robert C. Strode passed away on April 5 after a sudden heart attack. For the past six years he had been director of District Health Unit No. 2 in West Branch, Michigan.

1907
Herluf G. Lund, practicing physician in St. Louis for 40 years, died at Lutheran Hospital in St. Louis on May 26. He was formerly chairman of the Lutheran Hospital staff and physician for Washington University athletic teams for many years. Dr. Lund was also one of the founders of the Grand Medical Clinic in St. Louis, where he conducted his practice.

1911
Arthur J. Wagers writes from Philadelphia, Pa., "Sometime I hope to be able to arrange to be present at alumni meeting time. Have been practicing in Philadelphia ever since graduation and am now associate professor of laryngology in Jefferson Medical College."

1918
Olof Sundwall, recently discharged from the U. S. Navy, is again in active practice with offices at 138 East—48 South, Murray, Utah.

1920
Lucius R. Wilson, superintendent of Episcopal Hospital in Philadelphia, wrote the following letter in June: "I have been in Philadelphia for nearly eight years and thoroughly enjoy living in the city of 'Brotherly Love.' My daughter, Anna Lou, who was born in Barnes Hospital in 1924, was married on May 8, 1948 to William W. Bintzer, a graduate of Drexel Institute in engineering. My son, who served in the air corps during the last war, is attending Temple University School of Business Administration. Mrs. Wilson and I are both well but have never gotten over missing our many St. Louis friends and particularly the group with whom I attended Medical School."

1923
J. H. Harris' new address is 1301a North Second Street in Harrisburg, Pa.

David E. Davidoff, son of I. Z. Davidoff of Milwaukee, Wis., is one of six students to receive a Jackson Johnson Regional Scholarship to the School of Medicine here. David was graduated
from Washington University in June and will enter the medical school in September.

Milo L. Heideman, Jr., son of Milo Heideman of St. Louis, received three honors recently in the School of Medicine. He was awarded the Sidney I. Schwab Book Prize in psychiatry.

Eight members of the class of 1898 gathered at Washington University Medical Center in St. Louis on Thursday, June 10, to celebrate the 50th anniversary of their graduation. Theirs was the last class to be graduated from the Missouri Medical College, which was merged into Washington University School of Medicine the following year. Through the work of Dr. John Q. Roane of Carlyle, Ill., who is class secretary, this group was gathered, with some of the members traveling long distances to be here. The doctors enjoyed reminiscing over their days at Missouri Medical and recalled several pranks for which they and their friends were responsible. Dr. Roane brought with him a collection of papers which were familiar to all. Among the items were schedules of class work, grade reports, commencement programs, newspaper accounts of graduation activities, and pictures. Dr. Walter E. Smith of Tulsa, Okla., was elected class president by the group, which later adjourned for lunch together at a nearby tea room. The members who attended are, from left to right standing: G. G. R. Kunz, Tacoma, Wash.; John Q. Roane, Carlyle, Ill.; J. Frank Harrison, Mexico, Mo.; Walter E. Smith, Tulsa, Okla.; and John A. Russell, Auburn, Calif. Seated left to right are: Herman L. LeSaulnier, Red Bud, Ill.; C. K. Caruthers, Pine Bluff, Ark.; and William J. Whitefort, St. Elmo, Ill.
try, was elected to Alpha Omega Alpha, and received the Nu Sigma Nu Award for the outstanding sophomore for the school year 1946-47, the award having been made only recently. Milo, Jr., will receive his medical degree in June, 1949, from Washington University.

1925

Harold M. Behneman is chief of staff at the Desert Clinic which he founded in Palm Springs, Calif. He is president of the California Society of Internal Medicine and president-elect of the Riverside County Medical Society. He has three children and two grandchildren.

1926

Adam N. Boyd has his office at 2918 Caroline Ave., in Houston, Texas.

1927

L. N. Claiborn is associate clinical professor of surgery at Yale School of Medicine and has a private practice in plastic and general surgery in New Haven, Conn. He recently wrote to the Alumni Office that he wished the class of 27 would have a special reunion in the next year or two. His address is 303 Whitney in New Haven.

1930

Frederick L. Liebolt of New York City, received an honorary doctor of laws degree during Commencement Exercises at the University of Arkansas in Fayetteville on June 5. Dr. Liebolt is attending surgeon in charge of orthopedics and associate professor of orthopedic surgery at the New York

Silver Anniversary

Thirteen members of the class of 1923 posed for a picture during the Alumni Reunion and Banquet, Wednesday evening, May 12, at the Sheraton Hotel in St. Louis. Left to right standing are: Ben M. Bull, Ironton, Mo.; J. P. Frick, Kansas City, Mo.; William G. Becke, St. Louis; Paul K. Webb, St. Louis; J. William Thompson, St. Louis; and Roland W. Stuebner, St. Louis. Seated from left to right are: Oliver Abel, Jr., St. Louis; Max J. Bierman, St. Louis; George H. Klinkerfuss, Normandy, Mo.; Neva Skelton, Eldorado, Ill.; Dudley R. Smith, St. Louis; P. D. Stahl, St. Louis; and George V. Feist, Kansas City, Missouri.
Pendleton Tompkins has a new address—450 Sutter Street in San Francisco.

Calvin S. Drayer is in private practice of neurology and psychiatry in Philadelphia. His home is at 1104 Mason Avenue in Drexel Hill, Pa.

Arthur W. Hankwitz of Milwaukee has a hobby of flying, but uses his airplane for more than pleasure trips. He recently flew Frank Beaudry of Appleton, Wis., to his home from Milwaukee where Mr. Beaudry had suffered a fractured back and six ribs in a four-story fall down the elevator shaft of a hotel there.

The preceding issue of the Quarterly erroneously reported that Harold M. Williams, secretary of the State Medical Association of Texas, had his office and home in El Paso, Texas. He lives in Ft. Worth, Texas, and offices of the Medical Association are on El Paso Street in Ft. Worth.

Beginning August 1st, Edward R. Grose will be at the University of Kansas Medical Center in Kansas City, Mo. He has been in Los Angeles, Calif.

Leonard F. Bush is at Geisinger Memorial Hospital in Danville, Pa.

David V. Le Mone, associate professor at the University of Missouri and roentgenologist at Ellis Fischel State Cancer Hospital at Columbia, Mo., died unexpectedly of heart disease on June 11 at Colorado Springs, Colo., while on vacation. Dr. Le Mone, 43, had been connected with the University since 1935 and was on the staffs of hospitals at Boonville, Mexico, and Jefferson City, Mo.

E. H. Trowbridge, Jr., now practicing neurology, psychiatry and electroencephalography, recently moved his offices to the Plaza Balcony Building in Kansas City, Mo. He is in charge of electroencephalography at the University of Kansas Medical School and at the Research Clinic.

Kenneth E. Pletcher, a lieutenant colonel in the Medical Corps, is stationed at the Air University School of Aviation Medicine, 27th AF Base Unit, at Randolph Air Force Base, Texas.

James M. Foerster is radiologist to St. Mary’s Hospital at Wausau, Wis., and lives at 1024 Steuben Ave.

Robert E. Buck is practicing internal medicine at the Intermountain Clinic in Salt Lake City, Utah.

James G. Delano writes the following: “Still in psychiatry at the Institute of the Pennsylvania Hospital in Philadelphia. A son, Andrew, arrived on March 17 to join Stephen, Ann, and Philip.” His address is 3rd and Kirks Lane, R. F. D. 1, Media, Pa.

Practicing otolaryngology in Westwood Village, Los Angeles, is Paul Guggenheim, whose new address is 3152 Federal Ave. He reports that he is married and has a daughter, born last September.

Thomas L. Ozment is at present serving a residency in ophthalmology at the Eye and Ear Hospital, University of Pittsburgh Medical Center in Pittsburgh, Pa.

Anne Tompkins Goetsch is a research fellow in the department of medical physics at the University of California, Berkeley. Her daughter was born last December 15.

Bruce L. Canaga, Jr., has moved
from the Guam Naval Hospital and is now at the U. S. Naval Hospital in Philadelphia.

1942

Claude P. Callaway recently moved from Palo Alto, Calif., to San Francisco, where his address is 1342 Thirteenth Ave.

1943

Richard J. Spillane has moved to 1470 Beacon Street in Brookline, Mass.

J. R. Mallory is now associated with the Link Clinic in Mattoon, Ill.

Allyn McDowell can be reached at 5135 Vista Del Monte, Sherman Oaks, Calif.

From Washington, D. C., H. I. Firminger reports that his address is now changed to the Pathology Section, National Cancer Institute in Bethesda, Md.

Terrell Covington, Jr., was discharged from the army last February and began his residency in internal medicine at the Veterans Hospital in McKinney, Texas, on March 7.

1944

Virgil Loeb, Jr., is taking a year's training at Newington Veterans Hospital in Newington, Conn., starting July 1, upon completion of which he will return to St. Louis.

1945

C. H. Dabbs has a three-year residency in surgery at the U. S. Marine Hospital in Baltimore, Md., and reports that he is getting good training approved by the American Board of Surgery. He is a regular officer in the U. S. Public Health Service and was recently promoted to senior assistant surgeon, which corresponds to a captaincy in the Army. He now has two daughters—Beth, 4, and Ruth Ann, born last December.

John C. Herweg moved from Springfield, Mo. to St. Louis last April.

1946

The following was received from N. Balfour Slonim in Salt Lake City: "I am at present lecturer in physiology in the department of physiology at the University of Utah School of Medicine, and a research fellow in medicine in the department of medicine here, working in the Laboratory for the Study of Hereditary and Metabolic Disorders on the problem of muscular dystrophy. I have been supported by a U. S. Public Health Service Senior Research Fellowship and am also working for a Ph.D. in biochemistry. I completed my internship and six-month residency here."

1947

John E. Bechtold, who is interning at Baltimore City Hospital, has an assistant residency for the next year there.

George G. Wolf, now at Fresno County General Hospital in Fresno, Calif., writes: "Dear Fellow Alumni—Writing to let you know of the recent marriage of Dr. Kenneth R. Winkler, '45, on Easter Sunday, March 28 in San Bernardino, Calif. to Miss Darlene Hanson of that city. They are at home now at Arroyo del Valle Sanatorium in Livermore, Calif., where Wink is resident physician. He goes to Highland General Hospital, Oakland, Calif., in July to start a one-year surgical residency. Dr. Edwin E. Devereux, '42, is practicing here in Fresno now. They had a baby daughter born last December.” Dr. Wolf starts a surgical residency at Fresno County General Hospital in July.
WASHINGTON UNIVERSITY

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Thomas Edward Blackwell, Ph.B., M.S., J.D.,
Director of Business Administration

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Otto W. Brandhorst, D.D.S., Dean
The School of Nursing
Louise Knapp, R.N., B.S., A.M., Director
The School of Fine Arts
Kenneth E. Hudson, B.F.A., Dean
University College
Willis H. Reals, Ph.D., Dean
The Summer School
Frank L. Wright, A.M., Ed.D., Director

Mary Institute, a preparatory school for girls, located at Ladue and Warson Roads, is also conducted under the charter of the University.