

TABLE II.
Serological Similarity of the Dextrin-derived Polysaccharide of *Acetobacter capsulatum* to the
Sucrose-derived Dextran of *Leuconostoc mesenteroides*.

Kind of serum	Dilution of serum	Highest dilution of antigen that gave precipitation*	
		<i>Acetobacter capsulatum</i> polysaccharide	<i>Leuconostoc mesenteroides</i> dextran
Antipneumococcus, type 2 (Led)†	1:50	4,000,000	4,000,000
" " 2 (rabbit S5)	1:25	2,000,000	2,000,000
" " 20 (" 02)	"	4,000,000	4,000,000
" " 12	"	50,000	10,000
" " 1, 3, 5, 8, 14 (Led)†	1:25, 1:50	0	0
Normal, pre-immunization (rabbits S5, 02)	1:12, 1:25	0	0
Levan-reactive, <i>Bacillus</i> N9	1:12	0	0

* 0 = no precipitation with 1:10,000 or any higher dilution of the polysaccharide.

† Refined, or concentrated, rabbit antisera kindly supplied by Dr. H. D. Piersma, Lederle Laboratories, Pearl River, N.Y.

serum with either polysaccharide removed the antibodies reactive with both polysaccharides.

The enzyme system in *A. capsulatum* responsible for the conversion of dextrin into material serologically like dextran is readily obtainable in solution, free from bacterial cells. Using the fluids from glucose broth cultures as starting material, we have been able to prepare potent concentrates by a method previously described.⁵ When "bacteriological" dextrin, Lintner's soluble starch, or certain hydrolysates made either from amylopectin or from crystalline amylose are incubated with such enzyme preparations, amylase-resistant polysaccharide material that gives serological precipitation with dextran-reactive antisera is formed. These results suggest that the action of the *Acetobacter* enzyme is to transfer 1:4 linked glucose units to new polysaccharide material in which the units are linked in some

other fashion, very likely 1:6. Although proof of the exact mechanism of the reaction must await the results of systematic chemical study, recognition of the enzymatic convertibility of amylaceous to non-amylaceous polysaccharide by itself is of biological significance.

Summary. Cultures of certain acetic acid bacteria from "ropy" beer, when grown with dextrin but not when grown with other common carbohydrates, produce abundant amounts of polysaccharide material which has serological properties like those of the dextran which is produced from sucrose by *Leuconostoc mesenteroides*. A cell-free enzyme system, capable of causing the conversion of dextrin to material serologically like dextran, has been obtained from one of the cultures.

Received April 19, 1949. P.S.E.B.M., 1949, 71.

17184. Anoxic Diversion of the Renal Cortical Blood Flow.

K. J. FRANKLIN, L. E. MCGEE, AND E. ULLMANN. (Introduced by J. F. Fulton.)

From the Department of Physiology, St. Bartholomew's Hospital Medical College.

During 1947-8 Trueta, Franklin, and Amoroso laid plans for the joint solution of various renal problems, and the research to be described, though in fact of more fortuitous origin, is to be regarded as part of that cooperative effort. Briefly, it was thought

probable that the renal cortical blood flow is diverted whenever more important, or temporarily more important, organs are rendered too anoxic. Experiments were, therefore, begun with a view to testing this hypothesis, and in those to be described the whole body was

subjected to anoxia in the expectation that some parts would be more sensitive than the renal cortex, and that in consequence the latter would be, reflexly or otherwise, deprived of some or all of its blood supply, the portion of the total circulating blood volume so diverted being added to the quotas allotted to more needy organs. At the time the work of Toth¹ was not known to the writers; it will be referred to below in the discussion of results.

Methods. The animals mainly used were rabbits, anaesthetized by intravenous injection of Nembutal solution, followed by administration of open ether as required; in earlier work Trueta *et al.*² found that anaesthesia, maintained by such means for several hours, produced no appreciable change in the renal blood flow. To exclude specific peculiarities, some tests were also made on the cat, dog, rat, and mouse.

Anoxia was produced (1) by occlusion of a straight glass cannula tied into the trachea, and (2) by administration of a lethal dose of carbon monoxide (mixture of air and coal gas).

The renal effects were observed either with both kidneys made visible by laparotomy, or with one or both kidneys exteriorized. The left kidney was exteriorized by bringing it out between the lumbar and abdominal musculatures, the right as seemed best according to the individual circumstances. To determine if the renal effects were nervously intermediated, the left kidney was denervated (usually by division of the nerve or nerves accompanying the renal artery, but on occasion by splanchnic section), and the right kidney was left intact. When desired, the state of the renal blood distribution was precisely ascertained by injecting warmed India ink in a proximal direction through a cannula tied into

the distal aorta, the mesenteric artery having first been ligated. The injection was made at a pressure just above that in the aorta, and ligatures previously passed round the renal vessels were tied while the injection was at its height. Thereafter, both kidneys were excised and placed in fixative for a day or so before being cut open and prepared for subsequent histological section.

In a few cases a 16 mm color film record was made of the anoxia production and its results. Details of the published films are given after the references at the end of this paper.

Results. Occlusion of the tracheal cannula did not usually cause an immediate cessation of respiratory efforts; indeed, these might, for a time at least, increase in rate and/or intensity. Within 20 to 60 seconds, as a rule, the occlusion produced first a darkening, then patchy paling, and finally generalized paling (sometimes spectacular in its degree) of the kidney surface, together with diminution in size of the organ and wrinkling, often very marked, of its capsule. The diminution in volume, if one can judge from cubing linear measurements, was of the order of one-sixth; an oncometer was not used as it would have introduced complicating factors. Sections of innervated kidneys removed at the height of the anoxia effects showed anaemia of the cortical portions; in the denervated kidneys there was no such diversion of cortical blood flow, though it was possible to produce it in such organs by intravascular injection of adrenaline. In some of the former cases there was more blood than normal in the medulla; in others less. When re-entry of air into the lungs was allowed to occur, blood rapidly returned to the kidney surface, at first discretely, but almost immediately thereafter all over. In their rapidity, therefore, the renal changes after anoxia were more dramatic than those produced during its development. In contrast to the restoration of color was the disappearance of the surface wrinkling, which often took a minute or two for its completion. The whole tracheal occlusion experiment could be repeated at very short intervals and, at least in the case of the ex-

¹ Toth, L. A., *Am. J. Physiol.*, 1940, **129**, 532.

² Trueta, J., Barclay, A. E., Daniel, P. M., Franklin, K. J., and Prichard, M. M. L., Studies of the renal circulation, 1947; Franklin, K. J., Anoxic diversion of the renal cortical blood flow, Part I, 1948; Ullmann, E., McGee, L. E., and Franklin, K. J., Anoxic diversion of the renal cortical blood flow, Part II, 1949. Oxford: Blackwell Scientific Publications, Ltd.

teriorized kidneys, over a total period of several hours. Administration of carbon monoxide, in the dosage employed, produced equally marked diversion of blood from the cortex but the change was irreversible. Two final notes may be added to the above account. In the first place, partial denervation of one kidney, which was effected in a few cases, divided the single organ into a part which responded to anoxia and a part which did not; this was a convenience for some purposes. Secondly, if the stomach was over-full or the uterus seriously enlarged as a result of pregnancy, the kidneys tended to be found partially "shunted," if one may use the American expression for diversion of the cortical blood supply, from the outset.

Discussion. Toth's¹ anoxia experiments were carried out in dogs, and paling of the surface of the dog's kidney during diversion of the cortical blood flow is not readily detected because (1) the capsule is relatively thick, and (2) the cortical color changes are masked by superficial vessels which are unconcerned, or little concerned, in the diversion. Further, the findings of Trueta *et al.*, which showed the significance of such cortical diversion as opposed to an overall reduction in renal arterial inflow, were not begun until 1945. In a future paper two of the present writers (L.E.M., E.U.) will give quantitative details about the degrees of anoxia and of hypercapnia which are required for the production of the renal circulatory changes, and will describe the fluctuations of arterial blood pressure re-

corded during these changes, together with other features of interest. They may also give evidence about the urine flow as affected by anoxia, and offer a possible explanation for the time-lag between the return of color to the kidney surface and the disappearance of the wrinkling from that surface. In this preliminary account, however, the main object is to describe the more obvious features and to point out that the simultaneous use of innervated and denervated kidneys, with the completeness of the denervation shown by a tracheal occlusion test, allows one rapidly to determine if a poison, such as dioxan (see De Navasquez,³) or a bacterial toxin, affects the kidneys through nervous intermediation or otherwise. Publication of this present paper is, therefore, a necessary prelude not only to the communication of further finding about anoxia effects, etc., but also to the description of the results of experiments with a number of nephrotoxic substances.

Summary. 1. Acute anoxia, sufficient in degree, produces a marked diversion of the renal cortical blood flow in the innervated, but not in the denervated, kidney.

2. Simultaneous study of the reactions of the innervated and denervated kidneys is a simple way of distinguishing the mechanisms of action of different nephrotoxic substances.

³ De Navasquez, S., *J. Hyg.*, 1936, **35**, 540; De Navasquez, S., *J. Path. Bact.*, 1938, **46**, 47.

Received June 10, 1949. P.S.E.B.M., 1949, **71**.

17185. Effect of Elevated Body Temperatures on Cryptococcosis in Mice.

L. R. KUHN. (Introduced by G. M. Dack.)

From the Department of Bacteriology, Army Medical Department Research and Graduate School, Washington, D.C.

In a study¹ of the effects of temperature on the reproduction and viability of *Cryptococcus neoformans*, the number of viable cells decreased by 85% within 5 days at 103° F

(39.4°C), but increased regularly at 99°F (37.3°C). The writer postulated that differences in body temperatures of laboratory mice and rabbits might account for differences in susceptibility to cryptococcosis. Mice, with rectal temperatures averaging 99.1°F, died

¹ Kuhn, L. R., *Proc. Soc. Exp. Biol. and Med.*, 1939, **41**, 573.