milli-equivalents per liter. Added to this alkali deficit from loss of base is the increased demand for base from the increase of 2.2 milli-equivalents in phosphate, 2.3 milli-equivalents in protein and 4.5 milli-equivalents in lactate, totalling 9.0 milli-equivalents. The combined alkali deficit from loss of base and from increased demand for it amounts to 23.1 milli-equivalents. This alkali deficit is shared by bicarbonate and chloride. Chloride, being a fixed acid, is decreased only 7.0 milli-equivalents, leaving the greater part of the burden to bicarbonate, which is decreased 15.9 milli-equivalents, giving as a result marked acidosis.

6508

Nature and Result of Animal Tissue Reactions to Cellulose.

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(Introduced by C. M. Van Allen.)

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Experimental evidence of the biological decomposition of cellulose was first presented 80 years ago,[1] and many articles have since been written concerning this phenomenon. The amassed knowledge has been well summarized.[2, 3] We will therefore stress a few salient points.

The bacteria and fungi that live on cellulose exist for the greater part in soil, dung, or ensilage. Several saprophytic bacteria, as *B. cereus* and *B. mesentericus* have been reported as acting on cellulose,[4] but this has not been substantiated.[5] At first it was thought that symbiosis was necessary for the dissolution of cellulose, but further work demonstrated the ability of pure strains to perform this task. The action in any case is the result of a cellulase, and this has been repeatedly isolated.[6, 2, 3] It has been claimed that cellulase has only a slight effect on untreated cellulose but reacts

[1] Mitcherlich, (Quoted in Bradley & Rettger and in Kellerman and McBeth, references Nos. 2 and 3).

[2] Bradley, L. A., and Rettger, L. F., *J. Bact.*, 1927, **13**, 321.

[3] Kellerman, K. F., and McBeth, I. G., *Centralbl. f. Bakt.*, 1912, **34**, 485.

[4] Thaysen, A. C., and Bunker, H. J., *Biochem. J.*, 1926, **20**, 692.

[5] Spies, J. W., Mandeville, F. D., and Awdziewicz, F. J., unpublished studies.

[6] Belehrádek, Jan, *Arch. Int. Physiol.*, 1922, **17**, 260.

vigorously with that which has been subjected to the action of some chemical, especially a copper ammonium salt.[7]

The invertebrates[8] which digest cellulose are those capable of utilizing it as a food, such as certain Sarcodina, Mollusca, and Flagellata. No enzyme has been found in the vertebrates that will digest cellulose, but the process is apparently accomplished with the aid of intestinal bacteria. The opinion is commonly held that tissue responses to trauma, regardless of the presence or absence of infection, are unable to affect the integrity of cellulose.

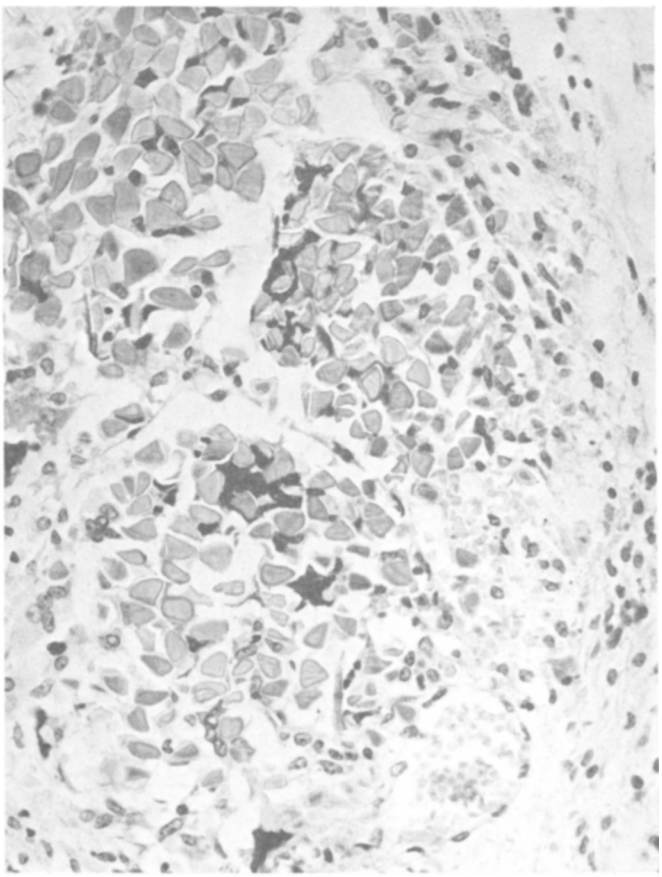

FIG. 1.

Mag. = x-295. Cotton imbedded subcutaneously for 50 days. This illustrates an early phase in the absorption of cellulose. There is some giant cell reaction, but the cotton remains intact. The swelling and hyalinization of the fibers has not begun.

[7] Karrer, P. u. Illing, H., *Kolloid-Z.*, 1925, **36**, (Spec. No.) 91.

[8] Trotman, S. R., and Sutton, R. W., *J. Soc. Chem. Indus.*, 1924, **43**, 190T.

Cellulose of cotton, linen, or artificial silk sutures has always been considered insoluble in the human tissues.[9] Such material has been found at the bottom of intestinal ulcers following operations.[10, 11, 12] Unimpaired linen sutures have been reported 120 days following their placement in dogs. Intact gauze sponges have been recovered years after insertion in patients. Artificial silk sutures have been found unabsorbed in infected wounds weeks after introduction. It has been reported that artificial silk sutures are not absorbed by the tissues of the guinea pig and that little tissue reaction follows the incorporation of this material.[13] It was, therefore, considered that this artificial silk was an excellent suture material for plastic operations.[14]

Our interest in this problem arose from accidental findings in experiments[5] in which cotton pledgets enclosing tubercle bacilli disappeared from the subcutaneous tissues of guinea pigs and rabbits without leaving any discoverable trace as to the mechanism by which the disappearance was effected.

A cotton pellet and a strand of cotton were sutured loosely to the

TABLE I.

Cotton Imbedded in and Removed from the Tissues of Guinea Pigs.

Animal No.	Days in Peritoneal Cavity	Days in Muscles of Back	Days in Muscles and Subcutaneous Tissues of Thigh	Wound Infection
1	24	24		Abdominal Wall*
2	111		50	"
3		86	50	"
4	96		50	"
5		88	50	"
6		58	50	Back
7		8		"
8	58		50	None
9		111	50	"
10		3		"
11	86		50	"
12	1			"
13	58		50	"
14	21			"
15	58		50	"

* No infection of peritoneal cavity.

In compiling the above data, only those guinea pigs were used from which the cotton could be recovered, thus eliminating 9 of the animals.

[9] Keen, W. W., *Surgery*, W. B. Saunders, Philadelphia and London, 1914, **5**, 601.

[10] Mall, F., *Johns Hopkins Hosp. Rep.*, 1896, **1**, 76.

[11] Mitchell, A. B., *Ann. Surg.* 1911, **54**, 806.

[12] Soresi, A. L., *Ann. Surg.*, 1915, **61**, 328.

[13] Durck, H., *Deutsche Z. f. Chir.*, 1924, **189**, 31.

[14] Roith, O., *Deutsche Z. f. Chir.*, 1924, **189**, 46.

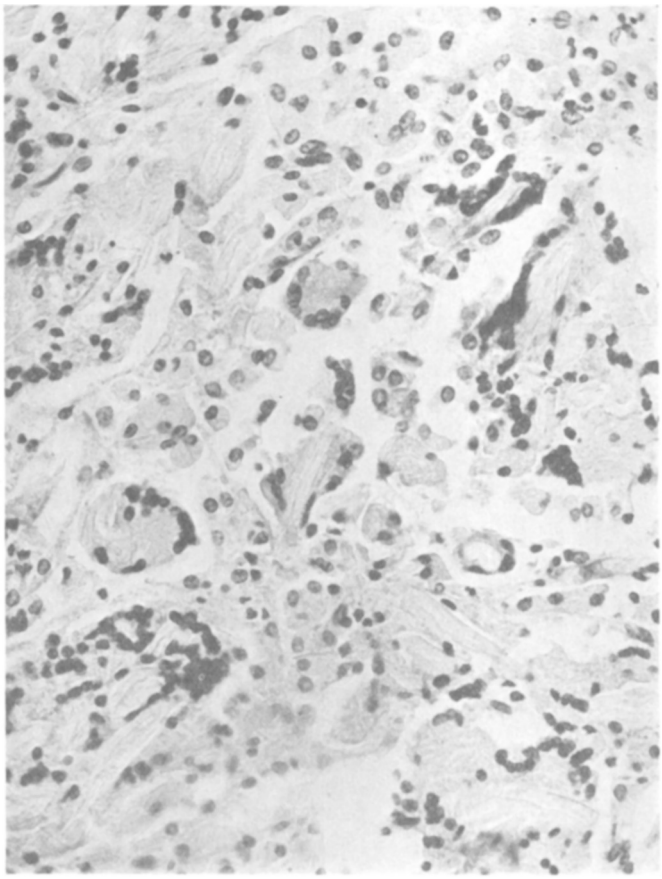

FIG. 2.

Mag. = ×-295. Cotton imbedded intraperitoneally for 111 days. Giant cells have engulfed and partially destroyed the cellulose. In some areas the cotton fibers are distinct; in others they have disintegrated through swelling and hyalinization.

inner surface of the parietal peritoneum in 8 guinea pigs. Cotton strands and pellets were inserted into the muscles of the back in 6 other animals, and placed in the peritoneal cavity in one animal. Nine guinea pigs were inoculated subcutaneously in the thigh with a cotton pellet. The cotton pellets were enclosed in a single layer of gauze, the open end of which was tied across with black silk; and the strands of cotton were in the form of loose bundles, the ends of which were also tied across with a single black silk thread. Scrupulous aseptic technic was employed throughout the procedures.

Until the wound was healed, it was necessary to isolate each animal, because cage mates would almost always rapidly bite out

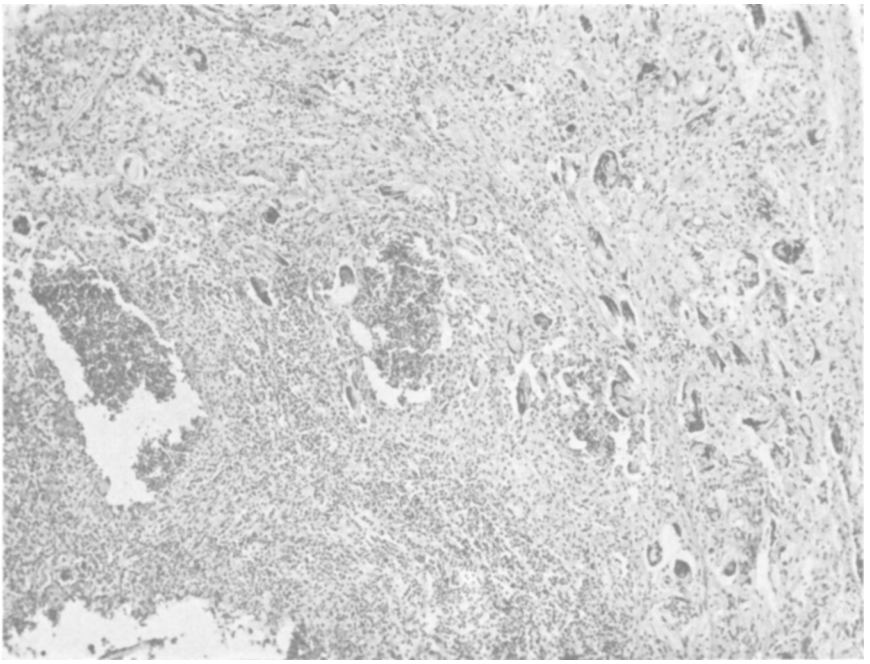

FIG. 3.

Mag. = x-68. Cotton imbedded intraperitoneally for 86 days. In the lower left hand portion giant cells are absent, and the tissues are infiltrated with polymorphonuclear leucocytes and unidentified round cells. This demonstrates that the cellulose has disintegrated in the infiltrated area.

each other's sutures. Before isolation was rigidly enforced, some of the abdominal wounds were bitten open, in several instances requiring debridement with repair of the fascia and skin. Apparently the peritoneum was never injured. The wounds of the back were more satisfactory, only one being seriously infected. None of the wounds of the thigh suppurated.

The pellets were recovered at the end of one to 111 days. In every case, when the pellet had been imbedded 50 or more days, there was encapsulation of the mass with fibrous tissue, varying from being barely discernible to 2 mm. in thickness.

Summary. Cotton pellets and strands were placed intraperitoneally, subcutaneously, and intramuscularly in 24 guinea pigs and were recovered grossly intact in 15 animals after one to 111 days. In the remaining 9 guinea pigs it was thought that the cotton was removed from the wound and eaten by the animals, since no trace of it was found either before or after death.

Microscopic examination of the removed cotton and adjacent

tissue demonstrated a moderate phagocytosis of the cellulose by giant cells and a dissolution of same in the areas of inflammation. A marked hyalinization of cotton fibers was frequently noted, and this was interpreted as denoting partial disintegration. The destruction of the cellulose was greater in the peritoneal cavity than in the muscles or subcutaneous tissue. Studies are now in progress to determine the absorbability of natural silk before and after treatment with various substances.

6509

Reconstruction of the Ureter by Means of Bladder Flaps.

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(Introduced by C. M. Van Allen.)

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After operations on the lower one-third of the ureter, strictures usually form despite the most careful efforts to prevent them. Considerable clinical and experimental data indicate the difficulties of securing a satisfactory ureterovesical anastomosis and describe methods which it was hoped would solve the problem.

It seemed to us that a modification of the Janeway gastrostomy would offer a procedure for replacing the resected lower portion of the ureter with a tube constructed from the bladder. The literature revealed that Boari conceived a similar idea but his observations were limited to one dog which lived in apparent good health for 4 years after the operation but was never autopsied.[1]

Various procedures were tried, each consisting essentially in turning a flap of bladder wall and constructing a tube of it into which the ureter was placed. The most satisfactory type for the preservation of blood supply to the bladder tube or pouch was to turn a flap from the fundus downward, having its broadest portion attached to the base of the bladder and preferably at a point entered by large blood vessels. Likewise, it was desirable to have the base of the flap slightly broader than the free end.

In dogs, this procedure afforded an easy transplantation of the ureter even after a resection of about 5 cm. of the lower part. If

[1] Boari, A., *Chirurgia dell' uretere. Con prefazione del Dott I. Albaran,* 1900, **14,** 444; *Contributo sperimentale alla plastica dell uretere, Atti della Aecad. delle scienze mod. e naturali di Ferrara. Seduta* 27 *maggio* 1894.