fectant properties of iodoform. First, it was ascertained that iodoform was not infective. Dusted on the surface of broth, it floated for days at a temperature of 23° C., but soon mingled with the broth at 37° C. Tubes which had been treated in this way were good culture media for staphylococcus aureus.

Next, plate cultures of gelatine and of agar-agar were infected, some with staphylococcus aureus, others with skin microbes, such as staphylococcus albus, diplococcus albus, and diplococcus citreus. Broth cultures inoculated from these after intervals of five, ten, fifteen, and twenty minutes, were infected, as were others which were inoculated after three weeks. Iodoform did not disinfect, it merely inhibited the growth of the microbes. We obtained the same results with boracic acid and with quinine. Salicylic acid did not kill in five minutes, but was efficacious in ten. However, this drug seems too strong to apply pure to the skin. We propose to continue these experiments, and great encouragement is derived from the circumstance that inasmuch as our present methods almost invariably prevent the growth of bacilli in wounds, so antiseptics may be found which may prevail against other varieties. The difficulty is, of course, to find one which is potent, but which will not injure the skin when left in contact with it. Sir Joseph Lister's double cyanide gauze and powder seem to be suitable, but, owing perhaps to want of skill in their use, I have had severe blistering in three cases treated with them.

The last case was a Syme's amputation, which has been mentioned at p. 1130. Its recovery was merely delayed.

Although a knowledge of the microbes of the skin is so essential in aseptic surgery, our principal surgical authors hardly mention them. Even works on bacteriology, such as those of Baumgarten, Cornil and Babes, and Flüge, briefly allude to them. Much information can, however, be obtained from scattered papers, and especially from those which Dr. Unna has written in conjunction with Von Sehlen, Gründler and Tazner, and Tommasoli.¹⁶

In conclusion I wish to say that I owe my best thanks to my friend Mr. Cosens for all the trouble he has taken to produce the microphotographs.

PRELIMINARY REPORT ON EXPERIMENTS UPON INTESTINAL ABSORPTION WITHOUT OSMOSIS.

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THE evidence in favour of the processes involved in intestinal absorption being other than osmotic has of late years steadily advanced. Especially have the researches emanating from the Breslau Laboratory (Heidenhain, Röhmman, Gumilewsky) pointed to the scant basis upon which the older theory of osmotic absorption rests. Heidenhain himself, in a paper published in 1888, in speaking of the fluid current through the epithelial cells, is of opinion that "die wirksamen Kräfte seien an den lebenden Zustand der Zelle gebunden." The fact, too, that chemical changes (such as regeneration of albumin during peptone absorption, and synthesis of fat, when fatty acid is supplied) occur in the wall of the living gut, shows that vital actions on no mean scale are there present. The experiments upon which the theory of vital absorption stands at present have shown *negative* results as regards osmotic absorption rather than *positive* results for vital absorption. Solutions of substances have been introduced into loops of gut in living animals (a Vella's fistula being usually established), allowed to remain for certain periods of time, then withdrawn, and any difference in their composition determined by chemical analysis. The difficulty of addition of water by secretory action upsetting an absorption calculation has been got over by the observation of Gumilewsky, that the percentage of sodium carbonate in the succus entericus secreted into the fistulous loop is remarkably constant, so that the amount of water secreted may be fairly calculated from the amount of sodium carbonate

found in the fluid withdrawn from the loop at the end of the experiment.

If two substances of unequal osmotic equivalent are introduced into such a loop of gut, and it is found that that of lower equivalent disappears more slowly than that of higher, it is concluded that the absorption is not governed by the ordinary laws of physical diffusion.

There is still lacking, however, definite positive proof that living intestine can "absorb" when osmotic action is absent. To prove this, the fluids on the two sides of the epithelial barrier must be of identical composition, a condition that can only be realised by using exsected gut, and taking advantage of the *post-mortem* life of the tissues.

It is the object of this preliminary communication to detail how it is possible actually to demonstrate vital absorption in the intestine apart from osmotic action. In a recent paper in the BRITISH MEDICAL JOURNAL of February 13th, 1892, I have shown how the existence of vital absorptive action may be demonstrated in exsected and still living frog's skin. The same method there described can be applied to the intestine, even of mammalia.

Without recapitulating in full the construction of the apparatus, I may state that it consists of two glass cylinders closed with *baudruche*, which has soaked for days in normal saline solution. The experimental membrane is held vertical between the layers of *baudruche*, the fluid pressure on the two sides being equal. Any transfer of fluid from one side of the membrane to the other is gauged by variation in the volume of fluid in the cylinders, measured by rise or fall of fluid in a tube thereto attached.

For experiment I have chosen rabbits, chiefly because their villi are short, and hence are not so distorted by contact with the *baudruche* as is the case in animals with larger villi. As is to be expected, the success or failure of the experiment as demonstrating absorption depends upon the state of digestion in which the animal is at the moment of death. Both secretion and absorption are possible for the intestinal wall, hence it is possible that the two may balance one another or both processes be in abeyance so that no transfer of fluid occurs at all. The rabbit, therefore, must be in *full intestinal digestion* at the time of death—a condition of which the observer may convince himself by the state of the lacteals, the state of the blood vessels, and the presence of digesting material in the lumen of the loop of gut selected. A loop, therefore, full of chyle and with white lacteals and turgid blood vessels is always chosen.

The method is as follows: A rabbit is kept without food till it evinces a decided desire for it; it is then supplied with a rich repast; after about twenty-four hours it is killed by pithing, the abdomen opened, a loop of small gut selected, exsected, slit up, the peritoneum stripped off, washed in normal saline at body temperature, a piece of the exact size of the opening in the cylinder cut with a steel punch and rapidly placed in the apparatus in the manner already described in my previous paper. Rapidity of manipulation is desirable, for the saline in the apparatus is at room temperature, and therefore *post-mortem* tissue life cannot be of long duration. Experiments conducted in the warm chamber at 40° C. are vitiated at the start by temperature error, and it is at the start that the best results are to be looked for. I have therefore discarded the warm chamber. Again, any attempt to remove the musculature has more to be said against it than for it; there is manipulation of delicate structures, time is occupied, and I do not find any error from imbibition by the muscle during the early periods of the experiment. It is possible to start an observation in from eight to ten minutes, if one apparatus only be used; but since I have so far nearly always been working a control experiment at the same time, observations have not been possible under fifteen minutes after death.

It is found if an absorbing loop of gut has been selected that there is a marked transfer of the saline from the inner to the outer side, gradually slowing down as the tissue dies, but distinct as a rule till about one hour after death. A period then arrives at which the fluid in the tubes is stationary for a short time, and finally both columns descend as the result of imbibition.

This appears to be a true case of vital absorption, and is all the more striking when one considers that the resistance of a

¹⁶ *Flora Dermatologica, Monatshefte für praktische Dermatologie*, vol. vii, et s.

layer of *baudruche* on either side has to be overcome by the fluid as it is moved across. That the action is epithelial is made probable by the fact that scraping the inner surface does away with or greatly diminishes the stream.

Fig. 1 reproduces curves obtained from the ileum of a rabbit.¹

Fig. 1.—Curves of vital absorption from ileum of rabbit bathed in normal saline. Piece of gut taken for experiment, situated 80 centimetres from caecum and 165 centimetres from pylorus. Superficial area of piece, 452 square millimetres; 1 millimetre of tube has a capacity of 1.64 cubic millimetres. Temperature variation during experiment, 15° to 15.75° C. Record starts 16 minutes post mortem. Abscissæ.—One division=5 minutes. Ordinates.—One division above zero=Rise of 1 millimetre in column of fluid in tube of cylinder connected with outer surface of gut. One division below zero=Fall of 1 millimetre in column of fluid in tube of cylinder connected with inner surface of gut. The asterisk in each curve marks the point of commencement of post mortem imbibition. Rabbit fed 24 hours before experiment.

I have, furthermore, found that it is possible to reverse an absorption stream by adding a drug stimulating secretion to the normal saline contained in the apparatus.

Fig. 2 reproduces curves from such a case.

It will be noticed that while in the normal (A) there is a flow of fluid at first from the inner to the outer surface, in the other case (B) where pilocarpin has been added to the saline the flow is in the opposite direction, that is from the outer to the inner surface. The total fluid transfer during the absorbing and secreting periods in these curves is far less than in those shown in Fig. 1. The reason is twofold. In the first place the rabbit that gave Fig. 2 was fed only 5 hours before experiment, while the rabbit of Fig. 1 was fed 24 hours before; in both the lower part of the gut was used for experiment, hence the rabbit of Fig. 1 had the advantage as regards absorption of its meal. In the second place the temperature in the case of Fig. 2 was far below that in Fig. 1.

Another point of interest in these curves is the period at which imbibition makes itself evident in the two cases.

¹ The slight irregularity in the curves noticeable at about 25 minutes after the start was produced by the tube not being absolutely clean at the point at which the meniscus stood at this period, the slight resistance so interposed produced an effect upon the rapidity of rise and fall in the two tubes. The tubes were cleaned with the following fluids in succession: Hot 10 per cent. soda, water, nitric acid, water, absolute alcohol, ether, absolute alcohol, and finally water.

Taking the outer surfaces (continuous lines) it is seen that imbibition makes itself evident later in the absorbing (A) than in the secreting (B). In the absorbing the two currents due respectively to imbibition and absorption output at the outer surface are opposed, while in the secreting they are in the same direction, hence in the former case there is retardation.

Fig. 2.—Reversal of vital absorption current in rabbit's ileum by pilocarpin (0.025 per cent.). Piece of gut taken for experiment, situated 105 centimetres from pylorus. Area, 452 square millimetres. The continuous line indicates the motion of fluid in connection with outer surface. The dotted line indicates the motion of fluid in connection with inner surface. Record starts 20 minutes post mortem. Temperature 8.5° C. All other data as in Fig. 1. Rabbit fed 5 hours before experiment.

Turning to the inner surfaces (dotted lines) the reverse obtains; imbibition makes itself evident sooner in the absorbing (A) than in the secreting (B), for in the former the two currents are in the same direction, while in the latter they are opposed.

The fact, too, of it being possible by suitable treatment to get streams in either direction from pieces of gut contiguous in the body, dispels any objection that might be raised with reference to osmotic action between the fluid in the cylinders and the blood lying in the capillaries of the gut, and shows that it is not necessary to waste valuable time in washing out the vascular system with normal saline before commencing work.

There is one drawback to my method in that, seeing that vital action is possible only for a short time in a piece of excised tissue, it is not open to one to investigate any difference in percentage composition of the fluids at the end of the absorbing period. Gumilewsky and Röhmman have shown that in the dog with fistulous gut, salt and water are absorbed in varying amount according to the percentage of the solution. My purpose has, however, rather been to get clear evidence of the fact of absorption of purely physiological nature than to attempt to determine the relative rapidities of absorption of various substances.

Further details of the experiments must be left over till the publication of a full account. It would appear meanwhile that it is possible by this method to gain distinct, positive, evidence of vital absorptive action in the intestine.