Infirmaries, and those of such institutions as the Glasgow or Edinburgh Royal Infirmaries. To this argument, I will allow Mr. Lister himself to reply. He says (in the discussion at St. Thomas's Hospital), regarding Mr. Savory's statistics: ".....We cannot regard these statistics, excellent as they are, as statistics of a hospital where no antiseptic treatment is adopted.....Even if Mr. Savory had used no antiseptic means whatever, he would, nevertheless, have benefited by the antiseptic practice of his colleagues." Further on, he says: ".....The effect of strict antiseptic treatment by three surgeons, and non-antiseptic by the fourth, is simply to convert a large hospital into a small one, with reference to the question of hospital disease." Now, it is an obvious deduction that, if the benefits to the septic wards are so great as to make them practically similar to a small hospital, the ward or wards of any one of the antiseptic surgeons must enjoy even greater advantages. Hence, on the whole, the Kilmarnock figures are very fairly comparable with Dr. Cameron's. And if the not very great amount of antiseptic treatment in St. Bartholomew's were of so much benefit to Mr. Savory, the greater amount in the Edinburgh Infirmary would be of still greater benefit to Mr. Lister's wards, and to the septic cases treated in them. Therefore, Dr. Borland's .45 per cent. of blood-poisoning is obtained in, perhaps, as unfavourable surrounding conditions as Mr. Lister's 1.3 per cent.—three times that of Dr. Borland—in the 292 septic operations. In fact, the allegations of antiseptic surgery are so great that, instead of septic surgeons requiring to produce long lists of the most "tremendous" operations, the burden of proof lies with those who practise the new treatment. They ought to be able to show not merely equal, nor even slightly better results, but statistics as much superior to those of simple surgery as the claims of the new system are superior to those of the old.

I may state that the Kilmarnock Fever Hospital and Infirmary is capable of containing 120 beds. The main building is arranged for 106 beds. It is a three-storeyed structure. The upper storey contains the fever-wards; in the mid flat, ordinary medical cases are treated; and on the ground flat is the surgical department. The number of cubic feet to each bed is a little over 800. The surgical wards are small, containing from six to ten beds each; and, when patients are few, one or two of the wards are kept closed, so that the inmates do not get full advantage of the extra air-space.

In conclusion, I agree with the opinion that the value of statistics may very easily be overestimated. But that they have a value, and a considerable value, cannot be denied. And the fact that the discussion of the rival merits of the two systems of surgery has lately taken a statistical form, is a sufficient reason for publishing an account of the work done in the Kilmarnock Hospital by an old surgeon, working according to the old methods.

THERAPEUTICAL EXPERIENCES WITH THE DIGESTIVE FERMENTS.

By F. ARNOLD LEES, L.R.C.P., M.R.C.S., F.L.S.;

WITH A REPORT OF EXPERIMENTS,

By GEORGE BROWNEN, F.C.S.

At the present time, when the physiological rôles and therapeutic values of diastase, pepsine, and pancreatine, are being traversed afresh on new bases of use, by some of the leaders of the profession, the report by Mr. Brownen, with which I shall conclude my remarks, can hardly fail to be interesting. The experiments which the report relates—undertaken by Messrs. Savory and Moore for my information and satisfaction more especially—I believe to be of no small value, as tending to cast doubt, at the very least, upon the at-present-accepted theories in regard to salivary and pancreatic digestion in presence of acid; and upon the assumed necessity for the administration of an alkali, such as bicarbonate of soda, with a dose of pancreatine—when intended to digest fatty and starchy matter in the upper bowel after passing the pylorus—for the purpose, or with the intention rather, of guarding it from destruction in its transit through the stomach. I am not denying, of course, that nature provides a neutral or slightly alkaline secretion, after the chyme has crossed the pyloric portal; but I hold that, so far from imitating nature by giving soda with a dose of pancreatine, we only succeed in retarding epigastric digestion of albumen, gluten, or casein.

The contrariety of opinion expressed by different observers, with respect to the efficacy or inutility of pepsine "wines", pepsine powders, "lactopeptine", "ingluvin", etc., in the vomiting often connected with the earlier months of pregnancy, first led me to inquire whether or not more than was generally supposed depended upon the preparation used. The digestive potency of the market varieties clearly differed widely. Professor Tuson demonstrated this, and established the superiority of

Bullock's pepsina porci, in 1870; but, of late years, many new preparations have been put before the public as well as the profession; some of them compounds of more than one digestive ferment, and others derived from the gizzard of the fowl—popularly supposed to have a digestive apparatus capable of dissolving anything. With the view of reconciling, if it should so hap, these conflicting statements, and (at first) for my own information entirely, I determined to ascertain their relative values by submitting each one to tests of artificial digestion. My simple experiments were made without the slightest bias in favour of one maker or another, and under equal conditions as to temperature during the process, and the task set each preparation.

At first, I experimented with twelve "makes" only; but later, I have had experience of ten other more recently introduced preparations.

The fact that comparisons are generally said to be odious and invidious makes me somewhat unwilling to give the distinctive names; and yet I do not know that any injustice is likely to result from so doing, since the "makes" I have examined are all well known, and may be taken to represent something more than favourably the host of other (unexamined) preparations in the market. The price, too, at which they can be sold to remunerate the maker differs widely, and should, I think, not be altogether lost sight of in one's final choice; for no one, I suppose, expects for an instant that pepsine in the cake, or pepsine *B. P.*, which can be made and sold at about three shillings the ounce, is nearly so energetic as pepsina porci at twelve shillings the ounce. If it proved to possess one quarter the potency, that would be quite as much as could be expected of it. Again: uniformity in strength, if that be any more than a minimum, cannot be guaranteed, since much more than is generally supposed depends, I believe, upon the intensity of hunger felt by the animal previously to death. The length of fast enjoined upon the animal should doubtless be exactly such as ensures a maximum of activity as to gastric secretion: to kill a beast four hours or two days after its last meal would be equally a mistake. And yet the manufacture of digestive ferments must have considerably improved since Professor Tuson's experiments in 1870; for only one of the twenty-two preparations I examined proved practically devoid of digestive power. Again: there seems little room for doubt that preparations of pepsine (in dry, powdery form especially) deteriorate with keeping, however carefully they may be preserved from atmospheric influences. Fluid preparations remain active much better and longer, for some reason which, however, it is difficult to explain; although, in all the alcoholic ones I have seen, there is a tendency towards turbidity and deposit. Chloride of sodium and glycerine seem the best preservatives. On the other hand, pancreatic preparations are said to increase in activity for some time—an increase which, so far as I can speak from a limited acquaintance, appears to be coincident with the formation of lactic or sarcocollactic acid.

The twenty-two preparations examined were as follows.

Of *Pepsine*.—In powder, six: Pepsine, *Brit. Pharm.*, 3s. per oz.; Boudault's pepsine, 4s. per oz.; "ingluvin" (Warner's), 4s. 6d. per oz.; saccharated pepsina porci (Wyeth's), about 8s. per oz.; Morson's pepsina porci, 8s. per oz.; Bullock's pepsina porci, 12s. per oz. In fluid form, seven: "Pepsin-Essenz" (Corbyn's), 3s. for five ounces; liquor pepticus (Burgoyne's), 6s. per lb; liquor pepticus (Benger's), 10s. 6d. per lb; pepsine wine (Morson's), 5s. per lb; acid glycerine of pepsine (Bullock's), 12s. 6d. per lb; saline essence of pepsin (Savory's), 10s. 6d. per lb; and vinum pepsinae (Burgoyne), 3s. 8d. per lb.

Of *Pancreatine*.—In powder, two makes; Savory's, about 7s. per oz.; and another 3s. per oz. In fluid form, three: Pancreatine wine (Savory); saline essence of pancreatine (Savory); and liquor pancreaticus (Benger's), the latter about equal in price.

Of combination preparations, three: Lactopeptine (Richards's), 4s. 6d. per oz.; peptonic tablets (Wyeth), about 10s. 6d. per oz.; and in fluid form, "peptocolos" (Richardson), costing about 7s. per lb.

In regard to each of the *pepsines* enumerated above, the point I set myself to ascertain was the quantity of the preparation required to completely dissolve one hundred grains of albumen, in the form of thinly sliced hard boiled white of egg, the substance recommended in the *British Pharmacopœia* as affording the easiest observed and estimated test of the activity of its pepsin. Two grains of the official product are stated to be able to dissolve one hundred grains of albumen, digested for four hours at 98° Fahr. in an ounce of water with five minims of hydrochloric acid.

In each of my pepsine experiments, I likewise used one ounce of water, acidulated according to the *Pharmacopœia*, and digested the albumen where necessary (for some of the more active preparations dissolved it in less time) for four hours. I, however, kept up by water-bath a temperature of 100° F., somewhat higher than the *Pharmacopœia* directs, as being more likely to bring out quickly whatever digestive energy the "make" used might possess. The heat in the stomach, too,

during animal digestion never falls so low, I believe, as 98°; and a temperature of two degrees higher could be but an error on the right side, favouring fermentation of the digestive kind rather than the acetous or putrescent.

Commencing with the three powder pepsines which head my list, I found little to choose between them, save that the maximum dose recommended by the makers of the third (ten grains) much more correctly indicates its relative potency than that ordered of pepsin *B. P.* (five grains). None of them came up to the required pharmacopoeial standard; and, for my part, I must say that I doubt very much whether one in twenty samples of the pepsine sold as "*B. P.*" will do so. Three, from different houses, with which I successively experimented, failed to do so. In one case six grains, in another nine, in another eleven, were required to satisfactorily deal with one hundred grains of albumen. Were I, therefore, unfortunately restricted to the use of pepsine *B. P.*, in the future, to secure the digestion of a sensibly sufficient amount of nutriment, it will not surprise any one to learn that I should administer it in at least drachm-doses. And this is, I doubt not, the experience of the majority who have not given up its use altogether, disappointed at the unsatisfactory results to be got from the insufficient doses ordinarily employed.

The three makes of pepsina porci next on my list are not so disappointing, and yet one of them (Wyeth's), purporting to be a concentrated and pure (saccharated) preparation, states upon the label of the sample-bottle that *ten grains* will digest three hundred (or more) grains of coagulated albumen, *i. e.*, not as much as the official pepsine, the test for which it honestly enough does not even profess to attain. The price, however, at which all these pepsines from the pig can be sold is much more than double that of pepsine *B. P.*; and in the case of the most active of them all (Bullock's), which alone satisfactorily surpasses the official test, the cost is three times as great. The other pepsina porci is good; but in my opinion the average dose of all of them requires to be restated at from five to ten grains for the best, down to from fifteen to thirty grains of the least active of the three.

Of the liquid preparations of pepsine, it was wearying to detail the comparative values *seriatim*. The cheapest proved undoubtedly the least powerful, although how far the presence of alcohol (12 to 18 per cent.) in some of the wines modified the result I am not prepared to say; probably to some extent it retarded the solution of the albumen, as, for instance, when four to six times the specified dose (6 to 8 drachms) of the wine had to be added to the ounce of water to secure the satisfactory solution of 100 grains of albumen. Of the vinous preparations, I found "pepsin-essenz" to be the most energetic; but none of them answered the test so satisfactorily as the glycerinal and saline extracts: *viz.*, Bullock's acid glycerine of pepsine and Savory's saline essence. The latter did not prove quite so active as the former; but, as I shall presently state, for adult administration I found it preferable. Liquor pepticus (Benger), however—of which I have recently examined a sample—I found to be likewise a most satisfactory preparation so far as digestive energy is concerned.

The five preparations of *pancreatine* were, of course, treated in a different manner. Here it seemed desirable to ascertain their relative potency, in regard both of fat-emulsification and starch-transformation. Although the pancreatic (like the intestinal) juice may be alkaline when first secreted, there is no room for doubt that it will emulsify fat and dextrinise starch in the presence of acid. Dr. Dobell long ago gravely questioned its alkalinity, however, remarking that the change which fat underwent from admixture with it was in no degree a saponification. Hence, in experimenting on the five samples of pancreatine mentioned—all the fluid ones gave acid reactions with blue litmus paper—I neither used acid, nor added any alkali to the water and fat used. I did not find emulsification frustrated by the omission. The fat used was water-washed fresh butter, half an ounce, kept agitated at 100° Fahr. for as long as seemed necessary (up to three hours) with half an ounce of water. Of the five samples, the "saline essence" of Messrs. Savory proved to be a trifle more powerful than the bitterish liquor pancreaticus (Benger), which, as well as the saline essence, gave an acid reaction previously to use—in each case a fluid drachm, or a little over, proving sufficient for complete emulsification of the half ounce of fat. The "wine" was not nearly so powerful. The two pancreatine powders differed widely, Savory's being the best; but even in that sample, 45 grains were needed to emulsify the 240 grains of fat; and in the other "make" (much cheaper, however) 120 grains were required. These results disappointed me, but seemed to show that, bulk for bulk, pancreatine is not so active an agent as pepsine, or else that the mode of preparation and preservation has not yet reached such a high standard of perfection. I believe there is no glycerole or acid glycerine of pancreatine in the market; but, further on, Mr. Brownen's report mentions such an extract, the capabilities of which were found to be double anything I have observed.

With pancreatines as with pepsines, I believe the average dose much understated. I give double or even treble the quantities usually ordered. I wonder how much of the customary ten or fifteen grains often perfunctorily given in diseases associated with the malassimilation of fat, with the idea that its powers will remain in abeyance until the duodenum is reached, passes the pylorus unexhausted. It will, truly, convert such starch or fat-globules as it comes into contact with in the oesophagus or stomach into sugar or peptone; but how far will ten or fifteen grains go? If given by the mouth, either soon or three hours after food, it is, I think, clearly advisable to give sufficient to leave a presumable excess beyond what may be exhausted in the stomach; but how much more certain (and therefore scientific) a plan it is to peptonise prior to administration such fat as we wish to be absorbed, I need not say. The idea is new only so far as concerns its application to milk, milk-gruel, etc.; *i. e.*, to those simple nutritious aliments hitherto considered the most readily digestible of all, and therefore least needing peptonisation. With the more nauseous fats and oils, as instanced by "pancreatic emulsion", "hydroleine", and pancreatised cod-oil, it has long been done. But, for my own part, I must say that not until Dr. Roberts's able paper appeared was I aware that in peptonising soups, broths, milk-gruel, milk-posset, etc., with pepsine alone, or pepsine and pancreatine combined—a practice which I have pursued wherever it seemed desirable for at least four years—there was anything startlingly novel or sufficiently out-of-the-way to call for detailed description as a new plan of treatment. It is rather, I should have imagined, a procedure obviously expedient, that common sense (which the family adviser has constantly to exercise with kaleidoscopic variation in the sick-room) must have suggested and tried many times ere Dr. Roberts formulated it so felicitously for the profession at large. Nay, since the digestive ferments were isolated and sufficiently perfected in preparation for them to rank amongst *materia medica* at all, to have restricted their use to drug-like doses given by the mouth, and not to have used them on occasion for predigestion of food, would have seemed to be missing their grand use, and, when one thinks of it, would have been almost as inexcusable a *lâche* as that of an intelligent cook who, whilst appreciating the importance of the rupture of starch-granules by heat, etc., yet neglected to boil her rice or pearl-barley long enough.

With respect to the three combination-preparations—lactopeptine, peptonic tablets, and peptocolos—whose digestive energies I tested, I need say little. All of them proved fairly active, so far as they go—which, however, if bulk and dose be considered, is but a little way; and their use, in the hands of the physician who studies the meaning of symptoms and applies his remedies scientifically, is consequently restricted to ordinary or obscure cases of dyspepsia, when the diagnosis as to the special tract or function at fault has not been made very conclusively or clearly, and the desire is (consciously or not) to double-shot the curative weapon. Something of the kind is no doubt the secret of their popularity; but, as physiologically scientific agents, they must rank in the same category as liquor Donovanii, chlorodyne, Warburg's tincture, etc.—mixtures doubtless efficacious enough in certain senses, but compounded upon a principle of "If one miss, the other may hit", and the maskers, at best, of slipshod diagnosis. Out of the stomach, "peptocolos" seemed to possess the greatest power of digesting fibrine of lean beef and emulsifying fat; but, when given in half-ounce doses—quite as little as is necessary for appreciable results—the sherry wine with which it is prepared is apt to upset the stomach, producing so-called "acidity" and "heartburn". I have twice tried it upon myself, and on each occasion it has spoilt a good meal;* and I am inclined to reason that, if this intended help to digestion will do so in a healthy individual atop of a wholesome meal of soup, fish, joint, and dessert, it is unfit for many cases of disordered stomach. But I suspect that, in fact, in probably two-thirds of the cases of apesia and bradypepsia one sees, it is not the gastric glands that have "struck work", so much as a form of dilatation (with arrest of the rotary motion essential to easy digestion) and over-abundant secretion of glairy mucus. The catarrhal nerve-storms from which the epigastrium suffers or in which it partakes, are exceedingly common amongst a large class of the commercial or business public.

[To be continued.]

* The lighter "pepsin-essenz" hock will not do this, but it contains no fat-digester.

ROYAL COLLEGE OF SURGEONS OF ENGLAND.—At the preliminary examination in Arts, etc., for the diploma of Member and Fellow of the College, which has lately been brought to a close, there were 387 candidates, *viz.*, 106 for the fellowship and 281 for the membership.