INFILTRATION.

THE NEW PROCESS

FOR THE

Preservation of Meat for Food,

INVENTED BY

JOHN MORGAN, F. R. C. S. I.,

Professor of Anatomy in the Royal College of Surgeons in Ireland,

AND PATENTED IN THE UNITED STATES, SEPTEMBER 27TH, 1864.

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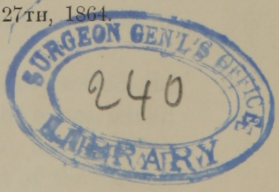

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In drawing up the following brief account of Dr. Morgan's process of "Infiltration," I have borrowed largely from his own original pamphlet on the subject, published by Fannin & Co., of Dublin; but as he has there entered somewhat minutely into the discussion of questions of science, I have endeavored to offer a simpler and more elementary view of the practical advantages it presents.

I shall be happy to furnish further information on the subject, with fuller particulars as to the nature and results of the operation, to any who may desire it.

COURTENAY ATWOOL, M. D.,

Graduate of the Royal College of Surgeons in Ireland,

Sole Agent for the Inventor in the United States.

New York, 1st April, 1865.

"INFILTRATION."

As the scientific advantages of Dr. Morgan's process, with regard to the health of the consumers of meat prepared by it, have been fully treated of in his original phamphlet, I shall not now attempt any minute discussion of them. It will be sufficient to state, on the authority of Baron Liebig, (in his "Letters on Chemistry," "Chemistry of Food," &c.,) Dr. Macleod (in his Notes on the Surgery of the War in the Crimea,) and other eminent writers, that the nutritive qualities of the meat "cured" in the ordinary way are considerably impaired by the abstraction of the juice, holding in solution many important constituents, as *albumen*, *fibrin*, *phosphoric acid*, *lactic acid*, phosphate of potash, &c., &c. This impairment is not due to the presence of salt in the meat, for, so far from being injurious in itself, the natural instinct of animals shows it to be necessary for health. "Some cause is in operation, which (*as the proportion of salt in the blood* never goes beyond a certain limit) opposes the increase as well as the diminution in its quantity. Consequently, salt is not merely an accidental but an essential and constant ingredient in the blood, and its quantity is fixed within certain limits." The fact of the impossibility of drinking salt water proves amply that the blood, having already its fixed amount, will not take in water containing salt disproportional to it.

In the preparation of meat, in tins hermetically sealed, the fluid necessary for the boiling, is extracted from the bones, which contain gelatine, as gelatine soup, and, of course, forms, and is intended to form, a considerable bulk and weight of the case or tin, but of a material valueless for nutrition, and even hurtful, as shown by numerous experiments. Contrary to general belief, gelatine is altogether *innutritious*, and the adoption of it as food, involves waste of money, space, and carriage, and still worse, is largely depended upon for the nourishment of the sick, at a great expense, and with positive injury, instead of benefit. The

Gelatine Commission of Paris, under Magendie, 1841, pursued a series of experiments for ten years, on gelatine made from Holland broth, bones, &c., and by different modes. Gelatine soup in abundance was supplied as long as the dogs, subjects of the experiments, would eat it; but by and by they refused, and, though amidst abundance of this soup, died of hunger, and in the same time as dogs of the same weights, &c., who ate *nothing*. Again, dogs supplied with water and *no food* lived six, eight, or ten days longer than those supplied with gelatine only. But the instance of M. Jules Lecœur, who voluntarily went through a series of experiments, is most complete. On the 22d June, 1842, he took at mid day *thirty five* ounces of gelatine, and three and a half ounces of bread. He was "*plus saturé que rassaisie*," more filled then satisfied; he felt uncomfortable and was very thirsty. At three o'clock was hungry; at six he took twenty-eight ounces of gelatine and three and a half ounces of bread; he felt more uneasy than before; was tormented with hunger in an hour, and at ten that evening, to satisfy his appetite, had to eat fifteen ounces of bread, though he had consumed the product of the evaporation of *thirty litres of bone broth*—about twenty-five quarts. So he continued for four days of experiments, suffering daily more uneasiness, having severe dyspeptic symptoms, perspiring much and feeling weak. M. Donné also experimented on himself, with similar results. Indeed, gelatine, so far from increasing, diminishes the nutritive value of food, as it does not disappear in the body without leaving a residue. (Liebig's Letters on Chemistry.)

In a financial point of view the disadvantages of the ordinary method of cure are obvious, setting apart the important consideration of the intrinsic value of the meat as an article of food. The amount of labor and time now expended is considerably greater than will be required hereafter, and the new process possesses the advantage of being so rapid and efficacious, that it can be used in the heat of summer, with an immense saving in ice, while the simple apparatus required is so portable that it can be used at any place, and under any circumstances which occasion may require. In regard to the saleable properties of the meat so cured, I can state that I have tried the process

myself on hogs in the city of New York, and the bacon has been pronounced by competent judges to be superior to any they had before tasted.

In January and February, 1864, Dr. Morgan was allowed to prepare fifteen oxen for the Admiralty at Deptford. In twenty-four hours some of the meat was packed as usual in barrels, and some pieces put to dry, in the most convenient situations, at the victualling yard. With part, a very great heat in the biscuit-drying loft (about 120°) was used successfully, and the drying accomplished in a few days. Other pieces were hung in the cooperage chimney, and dried after a few weeks time. By the report of the officers, both these meats, having been packed dry in ordinary barrels till August 30th, 1864, when opened and examined at that date, were pronounced perfectly preserved, showing that so far, after the lapse of several months, the material was sound and capable of preservation through the hot summer months, in barrels, and that without the erection of any special apparatus, in the first instance, as would be desirable for the drying.

In June and August, 1864, Dr. Morgan operated before a Commission at Rochefort, appointed by the French Government, and prepared both sheep and oxen, in the height of a continental summer, with perfect success, though with but extemporized apparatus. When dried for some time the meats were prepared as ragout, beefsteak, chops, the latter, of course, grilled. Nothing could be better, particularly, than the beefsteak. Soup was also prepared of excellent flavor and appearance, thus showing the value of this material for invalids, while, from the artificial addition of sugar, phosphoric acid, potash, &c., it is manifestly particularly suited to the requirements of the sailor—invalid or in health.

Most important testimony in favor of this method has been given by Dr. Parkes, Professor of Military Hygiene, British Army Medical School, in his work on Practical Hygiene, recently published. At page 215, it is remarked, with reference to the process, "This is an excellent plan, and will, undoubtedly, supersede the old system;" and again, under article "Sieges," "If food threaten to run short, the medical officer should remem-

ber how easily Dr. Morgan's process of salting meat can be applied, and in this way cattle or horses which are killed for want of forage, or shot in action, can be preserved."

Dr. Morgan has had meat preserved in Australia and South America, which has been delivered in England in good order and condition. In the first week in January, 1865, I preserved some bacon, parts of which were subjected to the most rigorous tests, being hung for days over the vat in which fat is boiled. The meat passed safely through this ordeal, and a portion of it is still in my possession and perfectly sound, though it has hung in the closet of my office all the time exposed to a high temperature.

Extract of a Letter received from Baron Liebig, Professor of Chemistry, &c.

Munich, Nov. 17, 1864.

Dear Sir,—I knew already your paper on your new process for the preservation of meat for food, by the *Journal of the Society of Arts* (vol. xii., p. 595), and I have greeted it as the long-sought-for, and the most important improvement of the usual method of "cure" or salting.

Your process is based on correct scientific principles; it is simple, rapid, economical, and, if after the operation *the flesh be put to dry*, most perfect, and will prove a blessing to the Army and Navy. Packed in dry salt, in the fresh-cured state, would certainly injure its good qualities by the formation of brine.

Yours very sincerely,

LIEBIG.

John Morgan,
Professor of Anatomy, Dublin.

TABULAR COMPARISON OF THE OLD AND NEW METHODS.

BY THE METHOD NOW IN USE.	BY THE NEW PROCESS.
In the rubbing and laying in salt the meat is deprived of its nutritive qualities to the extent of one-third (according to the calculation of so eminent an authority as Baron Liebig); so that, apart from the injury done by the absence of these qualities, the financial loss is enormous.	There is no rubbing or laying in salt, and therefore no abstraction of nutritive materials or financial loss.
The meat is then packed in salt and brine, and a further abstraction of the nutritive and essential elements thus takes place, proportioned to the length of time in cask.	An entire ox can be preserved in ten minutes, and at a merely nominal cost.
When thus injured and rendered difficult of digestion by being hardened, the meat can only be prepared for the table by boiling, any remaining soluble elements being thus, as far as possible, taken away and rejected.	The flesh is put to dry as soon as convenient, and when dried, is packed in barrels or cases with sawdust or some dry material, and is therefore more portable than by any other method.
In consequence, a further expense is incurred in endeavoring to supply the natural elements taken away, by using lemon juice, &c.	The meat can be eaten either uncooked, or as beefsteaks, roasts, hashes, soup, &c., thus admitting of a suitable nutriment for invalids, and also of variety.
From the necessity of curing in the winter season, the price of the meat is considerably raised, and a large quantity of stores must be prepared at the same time.	The elements of vegetables as antiscorbutics can be artificially added to the flesh, thus presenting meat and vegetable at the same time.
	Wherever a ship touches, and at all seasons, meat can be prepared for stores on the spot with great economy.
	The apparatus necessary for preserving any number of animals is portable by one man, and costs but a few dollars. No special machinery or building is necesary.

DESCRIPTION OF THE PROCESS.

The method introduced by Dr. Morgan is based on anatomical principles; taking advantage of the means nature has already used in supplying the circulating fluid to every *most remote and minute tissue* of the body. The difficulties hitherto were, that if the animal was killed as usual, the fluid introduced into the circulatory organs, capillaries, &c., would escape at the incisions in the vessels by which the animal was bled to death, and therefore not enter or saturate the flesh; and if, on the other hand, the incision in the vessels was *not made*, and the blood not let to escape, it would remain in the capillaries, &c., coagulated or otherwise, and prevent the fluid entering, and so attaining the very parts required; and once a small portion of meat would become decomposed, it would speedily propagate itself to the mass.

Endeavors have been made to force brine and preservative fluids into meat by atmospheric pressure, but without success; and even still the method of "squirting" meat with a syringe, introduced into the mass here and there, is practised with imperfect results naturally. For if the millions of channels afforded by the circulatory tree for reaching in the natural way all the flesh be not made use of, *no other humanly devised method* of doing so can be as successful. Yet a very simple, rapid, and most inexpensive method can be attained, by rightly availing ourselves of the means offered. The following is a brief description of the new process Dr. Morgan has invented: "The animal is killed by a blow on the head, piercing the brain and causing instantaneous death. The chest is then at once opened, and the heart exposed. An incision is made into the right side of it, either the right ventricle or auricle,—and directly another into the left side (the left ventricle); the blood from the right

side (venous), and from the left (arterial), immediately rushes out. When it has ceased flowing, a pipe is introduced into the incision in the left ventricle,—and so into the aorta, or great vessel leading through the body, *i. e.*, the trunk of the circulatory tree, and is there firmly retained. This pipe can be connected by a coupling with a stop-cock fixed to a flexible tubing, twenty to twenty-five feet long; and this tubing communicates with a tank raised the height of the length of the tube, into which brine and a little nitre is put when well strained (about one gallon to the cwt.) The stop-cock is connected to the pipe in the aorta, and the fluid let on; it will rush out at the incision in the right side of the heart, after traversing all the circulatory organs, in four or five *seconds* in sheep, swine, and such like,—and in nine or twelve *seconds* in oxen,—and in two minutes or so in the latter, and proportionately less in the former, will have all run through—thereby clearing the vessels and capillaries, and preparing for the second stage, which is performed simply by closing the incision in the right side with a strong sliding forceps, and thereby rendering the circulatory system perfect, as originally—but with the vessels free and ready to receive the preservative fluid.

Into the tank above alluded to, the final materials to be used are introduced, and turned on as before, when rushing through and thus filling the circulatory tree, the opening in the right side being *now stopped up*, the fluid over-distends the hitherto empty vessels; the flesh around the capillaries takes up the fluid in every part; and it, as well as every tissue in the body, will thus be saturated with preservative fluid; whatever may be used, a few minutes suffices for the whole operation. It is no exaggeration to say that, with proper arrangements, an entire ox could be preserved with ease in ten minutes—and this without labor or anything worth calling machinery, and with nominal expense. The perfection of the process is *proved* by the fact, that when the animal has lain about three-quarters of an hour, to let the tissues be thoroughly saturated, it may be cut into pieces of suitable sizes—not too thick, to prevent a reasonable escape of the water by evaporation, and hung up at once to dry in a chamber with a good current of air, and a little smoke; or without it if preferred. Failing these arrangements,

it should be dried, if on board ship, by suspending in the air or aloft; if on land, in a chimney or some convenient situation dry and well ventilated.

The amount of drying, smoking, and size of pieces, and the appearance given to them, are of course matters of detail and taste, as well as are, to some extent, the materials. I would use, as far as possible, those adopted in ordinary means, applied differently, but in accordance with the scientific view of presenting a perfect material. Such substances may be added as will supplement those ordinarily obtained from the vegetable kingdom, and also improve the meat by adding to it, as a plastic or nitrogenous element of nutrition, a carbonaceous or respiratory constituent in the shape of sugar, which at the same time improves the taste, gives softness, and acts as a preservative, while it supplies a normal respiratory material for forming lactic acid, the importance of which has been fully demonstrated in the works before alluded to; but it is necessary to notice that, as the meat prepared by this process is cut directly from the animal, it contains, of course, all the fat natural to it, being the normal respiratory food or "producer of heat," combined with the meat, which is the plastic, *i. e.*, building-up food for the organs and structures, or "producer of force."

In preparing meat for army and navy use, the addition of a small quantity of phosphoric acid, half an ounce or so to the hundred weight, is strongly recommended; and in the form found in the flesh of fowl, namely, the monobasic, or metaphosphoric acid, as when prepared in this form it has the power of coagulating albumen. Its use is obvious, by retaining this very desirable "force-producing" element in the flesh, at the same time giving a phosphatic supply, which, from analysis of the usual articles of food is proved to be most requisite. It is to be explained that the addition of phosphoric acid is *not necessary* to this process, though to some extent useful as a preservative of albumen, but it is recommended for the sailor and soldier in campaign *as a dietetic addition*, of great importance in the absence of vegetables. Lemon juice, at present issued at much expense, I believe only serves in making amends for the injury done to the meat in the ordinary process of "cure," and that in this way it acts chiefly as an antiscorbutic, for as the meat has

lost, acording to the estimate of Liebig, *one-third* of its properties for sustaining the vital process, and as a scorbutic patient, *though still* subsisting on this meat, with the addition of lemon juice, will recover strength, it is evident that the meat is injurious not by its *positive* but its *negative* qualities; so that scurvy and various forms of debility arise from malnutrition, and not from the addition of salt, as has been generally supposed; for even salt water has been given to scorbutic patients without aggravation of the symptoms.

The addition of spices—pepper, cloves, and condiments; also such flavors as may be desired, lactic acid itself, &c., can be made at a trifling expense, in this way pleasing all tastes and requirements.

Though any preservative fluid may be infiltrated, it is proposed at present to use that in most general use, such as pickle with sugar, saltpetre, nitrate of soda, phosphoric acid, spices, &c. Pickle and saltpetre, or nitrate of soda suffice for the mere cure, so that an entire animal may be cured at the cost of a very few cents. If the other materials recommended are added, they of course increase the expense, but make a much more agreeable and useful food, and are, therefore, in reality a saving.

The fluid can be used either cold or boiling, which latter state is desirable in some circumstances, where, for instance, it is determined to pack the meat in brine afterwards. The boiling fluid, on admission to the flesh, coagulates the albumen and gives a "set" to the meat, so that this albumen cannot separate from it in the casking.

When the meat has been dried and smoked according to taste, it can be packed in the ordinary way, in cases of sheet iron, in barrels, or tins, either protected from any accidental moisture which would harm them by dipping each piece in melted fat, so as to make a coating, or by packing in dry sawdust, either alone, or with powdered charcoal mixed in equal parts. This packing material should be sufficient to thoroughly cover the pieces.

When about to be used the meat should be washed, to free it from the packing dust, and steeped for a few hours in water, or not, according to taste, and it admits of being prepared for food in any way the ingenuity of the *cuisine* may determine, thus of

course presenting advantages not to be obtained by any other known process.

By the present system, the meat, already deficient in nutritive power, is boiled, and the fluid *thrown away;* whereas the "hung" or "dried" meats can be prepared in ragouts, hashes, soups and roasts; so that the fluids containing the soluble elements would be taken along with the meats. If for roasting or grilling, the meat may be steeped a few hours in cold water,—and if for making soup (which can be done even for invalids), after a little steeping it should be cut up in very small particles, and so gently heated—such farinaceous matters being added as are accessible.

Apart from the economy and efficacious nature of the process, there is presented this very great advantage, that nothing is done *in secret.* All the stages of the process can be inspected, so that the health of the animals and the wholesome quality of the meat could be certified; while meats can be prepared at all seasons, and equally well in summer and autumn, when the animals having recently been fed on the fresh grasses, are nearer to their natural condition, and their flesh better food, being supplied with the earthy salts, &c. The price is also less in the summer and autumn—for in winter, by the great demand on the market for the "curing" months, the price is considerably raised.

In countries where animals are all but valueless, and where labor is scarce or unavailable, this process is peculiarly valuable, and will undoubtedly be the means of introducing here a suitable, wholesome, and agreeable meat for the million, at a most reasonable price, and containing all the nutritive properties, while, at the same time, the hides will be preserved by the process which cures the meat.

Though at first sight prejudice, or the natural objection made to any innovation or change, may present difficulties, I am sure that experience and enquiry will satisfy both as to the mechanical applicability and scientific correctness of the method; while as to details of flavors, appearances, and size of pieces, experience alone on an extended scale of trial can decide what may be the most generally suitable, convenient, and pleasing.