backwards until it reaches the posterior wall of the nasopharynx, and withdrawn after being left there for a few seconds. The other side is swabbed in the same way.

4. Without the slightest delay each swab is carefully rubbed on a warm blood-agar plate, which is placed in the incubator.

Let it be made perfectly clear that this test can only be performed with the patient near the incubator; if it is not done in this way it ceases to be the test on which this paper is based.

It happens sometimes that the patient is not well enough to come to the laboratory, and in that case the incubator and media must go to the patient. For this purpose Messrs. Chas. Hearson and Co., Ltd., of Regent Street, London, have made me a little warm box just large enough to hold a few Petri dishes. Its water-jacket can be filled with warm water at the patient's house and will remain at about body temperature for several hours, long enough to get the cultures safely to the laboratory.

Bacteria such as pneumococci and influenza bacilli will usually live for some hours in warm sputum, but they are likely to die on a tiny swab even if it is kept warm; hence the advisability of making cultures immediately. Such cultures often show such a profuse growth of pneumococcus, influenza bacillus, Friedländer's bacillus, or *S. mucosus* that a vaccine can be made immediately; but if in small numbers any of the above germs are worth subculturing and using.

Diphtheroid bacilli are very common in the nose; rightly or wrongly, I have never attached any importance to them nor used them in a vaccine. I have also ignored small growths of *M. catarrhalis*, streptococci, and staphylococci, but profuse pure growths are of some importance and should be used.

It is instructive to compare the result of cultural examination of the sputum with that of the nasal passages in 128 cases in which both examinations were made.

Table showing Percentage of Various Organisms found on Cultural Examination of Sputum and the Nasal Passages of 128 Cases.

	In the Sputum.	In the Nose.
Pneumococcus ...	30.0	47.0
M. catarrhalis ...	27.3	23.5
B. influenzae ...	34.0	20.0
Friedländer's bacillus ...	7.0	15.0
S. mucosus ...	4.7	6.25
Streptococcus ...	17.0	10.0
Staphylococcus aureus ...	1.0	4.0

Surely these findings show an extraordinary similarity between the bacteriological state of the bronchi and the nose; one is forced to one of three conclusions—either that these catarrhal germs have nothing to do with bronchitis (in which case we must explain the good effects of vaccines by assuming the presence therein of something more than the known catarrhal germs), or that the nasal passages are infected from the bronchial tubes, or the bronchial tubes from the nasal passages.

I do not hesitate to believe that the last explanation is the correct one, seeing that it is an everyday occurrence for a cold in the head to spread to the chest, that nasal cultures are purer and more profuse than those from the sputum, and that the nasal infection persists during the intervals of freedom from any signs of bronchial infection.

All the patients upon whose cases this paper is founded have been sent to me by their doctors, who have given the inoculations and reported their effect.

I have not made vaccines for patients when I found the bronchitis to be associated with advanced renal and cardiac disease, tuberculosis, or mediastinal tumours. Examples of bronchiectasis are not included in this paper.

The aim of the treatment is to cure those who suffer from frequent attacks but are free during the intervals, to relieve cough and asthma and reduce expectoration in those cases in which a cure is obviously impossible, and to improve the general health and reduce the liability to and severity of acute exacerbations in all.

The vaccines are sterilized by heat, their strength estimated chiefly by the amount of culture used and checked by a count of a stained film. Fifteen doses are prepared and given at intervals of a week, starting with a small dose but increasing steadily as long as the patient gets no unpleasant reaction. Such a course appears to confer a definite immunity lasting a year or more in the case of those who continue to be carriers, and for an indefinite period in the case of those who cease to be infected.

A vaccine does not succeed because it rids the patient of his germs, but because it renders him unassailable for a

certain period; during this time his symptoms may clear up completely though he may continue to harbour his germs in undiminished numbers.

Conclusions.

Recurrent and chronic bronchitis can be cured or relieved by treatment with autogenous vaccines.

When sputum is available it should be sent immediately by messenger to the bacteriologist, and not allowed to get cold.

From such a sample it may be possible to make a good vaccine.

Patients suffering from bronchitis usually have an infection of the nasal passages, which is largely responsible for the bronchitis.

Cultures made from these nasal passages according to the method described in this paper show the same sort of germs as are found in the sputum and make better vaccines.

Nasal cultures should be made in every case of bronchitis in which a vaccine is required, and cultures should be made from the sputum also when it is obtainable; in this way one gets a true picture of the underlying bacterial infections and can prepare a more efficient vaccine than if sputum alone is used.

When no sputum is obtainable a successful vaccine may be made from the nasal cultures alone.

Vaccines do not effect a permanent cure, except in those who cease to carry their nasal infection. But in carriers they confer a useful period of immunity.

It is probable that in many instances a rhinologist could throw light on the real nature of these associated nasal infections and suggest some useful local treatment. In the majority of cases the persons so infected are not conscious of any nasal catarrh, though a post-nasal discharge is often obvious to the physician.

The 300 cases upon which this paper is built were just ordinary private patients sent by their doctor to consult me, there was no preconceived plan or idea in the investigations, which extend over eight years, and any merit these observations possess is due entirely to the painstaking work of my two bacteriological assistants.

SURGERY ON THE HIGH SEAS.

BY

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The following is a short account of an operation performed on board ship.

The patient, a pantryman of the ship's crew, an old and seedy-looking man of 70, reported sick with retention of urine. At the age of 25 he had contracted gonorrhoea, and showed a healed chancre on the glans penis. For nine months previously he had been troubled with frequent and difficult micturition. There had never been any pain or haematuria, but for the last three months there had been constant dribbling.

He was pale, anaemic, and very wasted. His vessels were very thick and atheromatous, the liver was small, the superficial abdominal veins dilated, and the tongue was furred and dry; he complained of headache. There was no tenderness over the kidneys, but the bladder reached up to his umbilicus. The urine was pale, specific gravity 1004, acid; it contained no blood, but showed a slight haze of albumin, and had a somewhat fishy odour, suggestive of *B. coli* infection of the urinary tract. For three days previously he had vomited at night. On rectal examination the prostate was found to be irregular and definitely enlarged, more so on the right side. It was hard but not fixed.

For ten days his condition was relieved by the passage of a silver prostatic catheter. There was always difficulty in passing the instrument through the membranous and prostatic portions of the urethra. It would stick and then suddenly plunge into the bladder with a corkscrew-like action, but no sense of grating was ever detected. Finally one morning it was impossible to pass the catheter, and suprapubic cystostomy was performed.

The operating theatre was a double-bunked sick bay right over the propeller. It was a rough windy day. The stern rolled and pitched vertically up and down, and to this was added a lateral vibratory movement when the propeller came up into surface water. An electric hand torch proved very useful, as the light was cut off by the fixed bunks overhead. The patient being considered too bad for a general anaesthetic, stovaine-billon was successfully injected intrathecally. No rubber tubing being available, a 1½ in. bore hose-piping, sterilized and stitched into the bladder, proved an efficient if not too liberal means of drainage. An improvised Hamilton Irving receiver was made out of an inverted soap dish.

All the holes were plugged with cork except one in which a thin rubber tube was inserted to siphon off the urine.

The patient stood the operation well, but died two days later, within sight of land.

A modified *post-mortem* examination was performed. The aorta showed very marked atheroma, the lumen being almost obliterated. The liver was small and adherent to the anterior abdominal wall. The left kidney was small and tough, most of its substance being flattened by a large hydronephrotic sac. The right kidney was larger, with a lesser degree of hydronephrosis than the left. The bladder wall was thick and trabeculated. The prostate consisted of a mass of small stones embedded in tough fibrous tissue with practically no gland substance present.

As a sequel to the *post-mortem* examination, which of necessity was performed without gloves, the operator pricked himself in sewing up the wound. No local reaction asserted itself, but within twenty-four hours he experienced "shivery muscular pains," which were followed by a rise of temperature to 103°, and profuse sweating, on three successive evenings, and then the passage of pus in the urine. The latter showed *Bacillus coli* on bacteriological examination.

NINETIETH ANNUAL MEETING

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PROCEEDINGS OF SECTIONS.

SECTION OF MICROBIOLOGY (INCLUDING BACTERIOLOGY).

ROBERT MACNEIL BUCHANAN, M.B., F.R.F.P.S., President.

DISCUSSION ON SOME SIMILARITIES AND DISSIMILARITIES BETWEEN PLANT AND ANIMAL DISEASES.

WITH SPECIAL REFERENCE TO IMMUNITY AND
VIRUS DISEASES.

OPENING PAPER

BY

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In common with the study of the human diseases due to foreign organisms, the study of the parasitic diseases of plants has made very great strides during the last few decades. The question, then, naturally arises as to how far the discoveries made in one of these fields are of service in the other—that is, as to how far comparative pathology of animals and plants is a help in future work. On the animal side the greatest advances have been in two fields—those of the exact determination and characterization of the causal organism, and of the physiological study of the basis of immunity. From the last has arisen the vaccine and serum therapy which are the most striking triumphs of modern animal bacteriology. On the vegetable side also very great advances have been made in the study of the etiology of disease, and a very large number of parasitic fungi and bacteria have been described. In the field of disease resistance, however, the advance on the vegetable side no longer runs parallel with that of the animal. Our knowledge of the physiological basis of the resistance to disease of plants is still very rudimentary, and our methods of disease control have been directed mainly to the prevention of the entry of the foreign organism into the host plant, rather than to the destruction by a reaction of the plant body of the organism after invasion.

One of the difficulties that face the plant pathologist in any attempt at broad generalizations concerning parasitic diseases is the very great range in the degree of closeness of association between host and parasite. In the case of most bacterial diseases of man the parasite is definitely internal and produces a marked physiological reaction. In the case of fungal diseases of plants, however, we find very various degrees of closeness of association between parasite and host.

We have the simplest cases where the fungus lives solely on the surface of the leaves, sending down no sucking organs into the host tissues and absorbing no nourishment directly from the host. The injury done is purely mechanical by blocking the stomata and intercepting the light which the leaf requires for its proper activity. Again, we have parasites which live mainly on the surface of the host, yet send down minute absorbing organs into the tissues below. Then there are parasites which confine themselves to the intercellular spaces of the plant, living between and outside the cells and obtaining their nourishment by the diffusion of nutritive substances from the host cells with which they are in contact. A closer degree of association is also to be found in which the main body of the parasite, as in the case just described, lies inside the plant body, in the intercellular spaces outside the cells, but special absorbing organs are present which penetrate the host cells and absorb nourishment from them. Finally, we have parasites like those of wart disease of potato, and finger-and-toe disease of cabbages, which live entirely within the host cells. The degree of structural association of host and plant parasite is thus seen to exhibit a wide range of complexity. The angle from which the plant pathologist can obtain the most illuminating view of the problems which confront him is, however, not the structural but the physiological. The plant pathologist, like the animal pathologist, is mainly concerned with the effect of the parasite on the function of the host—that is, with the interrelation of the physiological processes of the host and the parasite. Disease is abnormal physiology, and its further analysis lies in an adequate knowledge of the physiological processes of the foreign organism and of the plant on which it is parasitic. Just as we find various degrees of closeness of anatomical association, so we find various degrees of physiological relationship.

The different physiological classes exhibiting these various degrees of association are numerous and merge insensibly into one another. At one extreme we have the well-known parasite *Botrytis cinerea* (producing a rot of grapes and numerous other plants), where the relations of host and parasite are comparatively simple and well understood. *B. cinerea* is a very common fungus and is able to live as a saprophyte on dead material as well as parasitically. A tissue attacked by the organism is rapidly killed and reduced to the condition of a soft mush. A closer examination shows that the death of the host cells occurs at some distance in front of the advancing threads (hyphae) of the fungus. This action at a distance is brought about by the diffusion from the fungal threads of a powerful enzyme which dissolves the interstitial substance between the cells and brings about their separation and death. This enzyme can be extracted from an active culture of the parasite when grown on artificial media, and its injection into the host plant will bring about all the phenomena of disintegration and death associated with the attack of the living fungus. There is one marked difference, however: the spores of the fungus, when placed under proper conditions on the *outside* of the leaf of an appropriate plant, can enter and bring about the disintegration of the tissue. An extract containing the enzyme has, however, no action when placed on the surface of the leaf or stem; it is necessary to inject it into the intercellular spaces before it can exert any destructive action. The difference is due to the protecting layer of cuticle which covers the surface of the aerial parts of the plant. Upon this cuticle the enzyme has no action and it cannot diffuse through it, so that it is only when this layer is passed that the fungus can exert any lethal action.

The cuticular barrier is found to play a very important part in many cases of disease resistance. The germ tubes of a parasitic fungus which infects the cuticle-clothed stem or leaf must either force the cuticular barrier directly or turn the barrier by entering the plant through the stomata. We find, then, that the question of penetration through uninjured surfaces plays a larger part in the plant diseases than in animal diseases, where entry through the various body opening is comparatively easy. Whether the fungus chooses the easy course through the stomata or the more difficult passage through the epidermal cells is generally characteristic of the fungus, or at least of a particular stage in its life history.* It has been pointed out above that the enzymes of *B. cinerea* have no action on cuticle, so that the passage of the fungus through the cuticularized epidermis of the host

* Why so many fungi should find their way through the cuticle when entry by the easy part of the stomata is open to them is still an evolutionary puzzle.