a simple twitch carried out by a limited portion of the cord; to the imitation of speech and gesture exhibited by a hypnotised person. The character of the action depends not upon the particular group of cells by which it is reflected, but upon the extent of the connection between the primary centres of the sensory nerve, up which the afferent impulse passes, with other sensory and motor centres. Everywhere throughout the grey matter, nerve-cells communicate with one another by a network of processes, and it would appear that there is less resistance to the passage of impulses up sensory tracts than to their immediate transference from sensory to motor ones. Only when the road is blocked does this transference take place. This is, in many instances, the meaning of inhibition; as long as the sensory connections are open, the impulse travels up this tract instead of being reflected across to the adjoining motor cells. As in the well known experiment of dangling three frogs, from the first of which the cerebral hemispheres, from the second the corpora bigemina, and from the third these structures and the medulla also have been removed, with their feet in sulphuric acid, the farther the sensory impulses have to travel, the longer the time that elapses before they are reflected, and the greater the possibility of their being directed to motor cells other than those which will remove the injured foot from the acid.

The fact that the complexity and the purposeful character of reflex action is more marked the less the nervous system has been mutilated, depends, not upon its being carried out by higher centres, but upon the more extensive connections of the primary receptive cells. Physiologically, the conception that the basal ganglia serve as intermediate projection-areas, does not in any way facilitate the explanation of the different varieties of reflex action. Nor is it justifiable to place the optic thalami and corpora striata together in a division by themselves on anatomical grounds. They are developed from different cerebral vesicles, and grow in a somewhat different way. More distinctive, however, is the fact, that the nucleus caudatus remains permanently connected by its head and tail with the cortex, of which it seems justifiable to regard it, with Wernicke, as forming an involuted part. The nucleus lenticularis is inseparably connected with the nucleus caudatus, and, therefore, if Wernicke's view be correct, also a part of the cortex system. The correctness of this view has been strongly impressed upon the lecturer by a careful examination of the nucleus amygdaleus, which, with the claustrum, although almost everywhere separated from the cortex by white fibres, is always regarded as forming a part of this system.

Dr. Alex. Hill then observed that he proposed to lay before his audience evidence of an entirely new kind in proof that the corpora striata cannot possibly be middle-men between the cortex and the cord. In a microhydrocephalic brain (the anatomical report of which the lecturer proposed to publish in conjunction with Mr. De Lisle's clinical notes) he had particularly examined these ganglia, with a view to determining if there was any alteration in their size coincident with the diminution of the cortex. The whole brain, after soaking in spirit, only weighed $10\frac{1}{2}$ ounces, and since it was not put into spirit until some days after death, it could not, the lecturer thought, have weighed more than 15 or 16 ounces when fresh (as against 49 ounces, the normal weight). The cortex was reduced to not more than one-fifth of its normal size. The brain was cut, by means of a specially constructed macrotome, into sections one-sixteenth of an inch thick. At the same time, a normal brain, similarly hardened, was cut up with the same machine. Dr. Hill also used the photographs in Luys' *Iconographie* for comparison.

Without entering into details as to the method of measurement, he stated that the head of the nucleus caudatus was a trifle larger than in his control brain; the nucleus lenticularis was almost identically the same size. Both were a little smaller than in Luys' photographs, owing to the contraction produced by the spirit. This result is the more remarkable, inasmuch as all the cranial nerves, the crura, and the spinal cord, were considerably reduced in size. Except for the remote possibility of the corpora striata exercising vicarious functions, it is inconceivable that they can be normally connected with the cortex by the fibres of the corona radiata, and yet not diminished in size when the cortex is congenitally deficient.

The optic thalami, on the other hand, appear to the lecturer to belong to the central grey tube, with the sensory part of which they agree, with certain modifications, in the manner of development, in minute structure, and in connections. Anatomically, it is impossible to distinguish them from the rest of the grey matter surrounding the third ventricle. Their prominence and comparative isolation depend upon the absence of motor nuclei in this region. Unless they belong to the æsthesodic part of the central grey tube, it is impossible to find primary metameric centres for the optic and olfactory nerves, a result for which neither the development of these nerves (Marshall

has shown that, in the chick, the olfactory nerves arise, like any other, from the dorsal ridge of the fore brain before the budding out of the cerebral vesicles), nor what we have already learnt of the mechanical construction of the central nervous system, justifies us in anticipating.

THE POST-MORTEM APPEARANCES IN A CASE OF DEATH FROM THE ACTION OF ELECTRICITY.

By MARMADUKE SHEILD, M.B., F.R.C.S., and SHERIDAN DELÉPINE, M.B., B.Sc.

(For permission to publish this case we are indebted to Dr. Cavafy.)

A HEALTHY strong man, aged 21, engaged at the electrical department of the Health Exhibition, was observed to suddenly fall back insensible from a machine which he was manipulating. He was at once brought to St. George's Hospital, on the evening of September 27th, 1884, and was found to be quite dead on admission. No alteration was perceptible in the texture of his clothes or the metallic substances on the person.

The necropsy was performed forty hours after death. The body was that of a muscular healthy man; rigor mortis well marked. Great cutaneous congestion was present, curiously limited to the head, neck, upper part of the chest, and arms. On the outer aspect of the left index finger was a small elongated blister, about half an inch in length by one-eighth of an inch wide. This had the appearance of a burn, but there was no congestion of the skin round it, and no smell of charred epidermis.

On opening the body, the muscles of the thorax were noted to be very firm and resistant to the knife. All the internal viscera, with the brain and spinal cord, were, to the eye, perfectly healthy. A striking feature in the investigation was the extreme fluidity of the blood; there was not a trace of a clot even in the right side of the heart. The viscera were much engorged with dark fluid blood; the heart was large and muscular, but quite uncontracted. Under the microscope, the fibres were normal in appearance. The blood was also examined with the microscope, but nothing abnormal could be discovered. The median nerve, and portion of blistered skin, were submitted to prolonged and careful microscopical investigation.

Nothing of importance could be discovered in the median nerve; this, however, does not exclude the idea that some abnormal coagulation, or other changes, may have been present, but these were of such a nature as not to be revealed by the methods of observation used.

DESCRIPTION OF THE MICROSCOPICAL APPEARANCES OBSERVED IN TRANSVERSE SECTIONS THROUGH THE SKIN OF THE LEFT INDEX FINGER IN THE REGION OF THE BLISTER.

One part of the specimen was hardened in osmic acid, and another in chromic acid and spirit.

The sections were cut in a plane perpendicular to the surface of the skin and to the long axis of the blister.

A. EXAMINATION UNDER LOW POWER.

The epidermis is raised from the cutis vera in the portion of skin corresponding to the blister; thus a small elongated cavity is formed, which, at the time it was opened, contained no fluid.

The roof of the cavity is depressed in the centre, this depression corresponding to a longitudinal groove, observed on the surface of the blister, and running in the direction of its long axis. On cutting through this raised epidermis, it is noticed that it is very brittle and hard, generally breaking in the region of the median depression; in that region the epidermis is much thinner than elsewhere. The floor of the cavity is almost flat, and the transverse measurement of the cavity, in the middle of the blister, is about $\frac{1}{2}$ inch, the width diminishing at both ends. The depth of the cavity is from $\frac{1}{8}$ to $\frac{1}{4}$ inch at the sides of the median depression of the roof, but just under that depression it often measures less than $\frac{1}{10}$ of an inch.

For the sake of clearness, it will be necessary to describe the various parts of the epidermis, cutis vera, and subcutaneous tissue in the following regions: 1, the middle of the blister; this will be called the central region, or zone; 2, the border of the blister; this will be called the marginal region, or zone; 3, the immediate vicinity of the blister will be called the external region, or zone.

It must be, however, understood, that there is no sharp line of demarcation between these zones, and, moreover, that if these zones were determined in each layer, according to the degree of intensity of the lesions, they would not have the same extent in each stratum, so

that a series of planes perpendicular to the surface of the skin could not separate them accurately from each other all through.

B. EXAMINATION UNDER HIGH POWERS (= 250 to 1,000).

1. *Horny Layer of Epidermis.*—*a.* External zone. There is little to notice here; the cells appear somewhat swollen, and more distinct than usual; their outline is very wavy; in many of them a nucleus is stained pretty distinctly. *b.* Marginal zone. The horny layer in this region is little thicker than in the last; the cells are more swollen, and in many places adjacent layers of cells are separated by small spindle-shaped or irregular cavities, as if they had been pulled apart by some force acting in a direction perpendicular to the surface of the skin, or as if some material had accumulated or expanded between them. *c.* Central zone. In the centre of the blister, where the epidermis looks dry and burnt, the horny layer is much thinner than in the neighbourhood, the thickness being less than half that of the normal stratum corneum. It looks as if it had been compressed or

superficial parts of the horny layer in the external and marginal zones, and the whole of the horny layer in the central zone, the state of things normal in the superficial layers of unaltered epidermis having apparently prematurely invaded the whole thickness of this membrane in the centre of the burn, and this in an excessive manner.

Before leaving the stratum corneum, it may be added that the staining reagents affect differently this layer in the various zones. The external zone shows the ordinary reactions. The marginal zone takes the pigments more deeply, and in a somewhat modified manner; thus, with carmine, it becomes dark pinkish-red, and, with logwood, almost of a lilac-colour, or, at any rate, much more pink than normal. The central zone stains, so to speak, in a negative manner; thus, with picrocarmine, it becomes bright yellow, showing a small red patch here and there; whilst with logwood it hardly stains at all (when not left in too long). This part can be well stained with eosin, which stains the marginal zone in a lesser degree, and the external zone still less.

2. *Stratum Lucidum.*—*a.* This layer cannot be very distinctly recognised in the external zone. *b.* It gets very conspicuous and broader at the margin of the blister. *c.* It becomes still more marked in the central region, except at the very centre, where it is difficult to recognise it from the other parts of the stratum corneum.

3. *Stratum Granulosum.*—This is most distinct in the immediate neighbourhood of the marginal region, whilst in the central region it becomes almost entirely fused with the superficial parts of the rete Malpighii, and there, with the latter, it forms a kind of colloid looking, lobulated and vacuolated irregular mass, lining, in many parts, the roof of the blister-cavity. These altered masses, when stained with picrocarmine, take a bright yellow colour, as well as the stratum lucidum; with logwood, they take various shades of violet; the stratum granulosum itself has its normal dark look in the external and marginal regions.

4. *Rete Malpighii.*—*a.* In the external zone, the layer shows little alteration. In the immediate neighbourhood of the marginal zone, the nuclei seem rather contracted within the cavities containing them (that is, within the nuclear wall).

b. In the marginal zone, very peculiar changes are observed. Generally speaking, the depth of the layer becomes greatly increased at the border of the blister-cavity; it measures, in many places, fully twice its normal thickness; moreover, here and there, it seems more or less separated from the subjacent papillæ. The nuclear cavities are much distended. On closer examination, it can be seen that, at the periphery of the marginal zone, the nuclear cavities are less distended than in the more central portions of the same zone, with the exception of the part immediately bordering the blister, where it is generally difficult to recognise any trace of the nuclei. The nucleus itself is much contracted, but less so at the periphery than towards the centre; in most cases, it is quite flattened or plate-like, the direction of the plate being perpendicular to that of the long axis of the nuclear cavity (which is generally elliptical); the contracted nucleus showing an appearance not unlike that of the so-called equatorial plate observed during the process of karyokinesis.

Between the distended nuclear cavities are seen numbers of more or less distinct fibrils, running from the superficial part of the cutis vera to the deep aspect of the horny layers; these fibrils at the border of the blister-cavity are densely crowded together, leaving here and there a narrow space in which a very elongated nucleus may be occasionally seen towards the external border of the marginal zone; these fibrils are less abundant, and are evidently taking the place of the protoplasm of all the cells of the rete mucosum which are more or less completely fused together.

Here and there, in the external zone, small groups of cells show a slight tendency to fibrillation, but not to such an extent as in the marginal zone.

The impression given by this appearance is that it is due to some violent stretching of the cellular protoplasm, which, on account of its internal structure, or owing to certain changes of consistency only (or more probably owing to the two combined), forms a continuous mass of soft, elastic, or glutinous material. If this were not the case, the separation of the superficial layers from the deeper layers of the skin would cause a solution of continuity somewhere.

The fibres just described show a marked waviness, and this is most noticeable at the border of the blister-cavity. This will be better understood when the central portion is described.

In many places, the fibres of connective tissue of the papillæ seem to be continued into the epidermic covering; and in the regions where the fibrillation of the rete Malpighii is very marked, it is difficult not to believe that such is the case, but the appearance is probably

Section through the skin of the index-finger in the region of the blister.

C. Central zone.

M. Marginal zone.

V. External vicinal zone.

The outlines are accurate; the shading partly diagrammatic. The black portions of the epidermis and cutis vera indicate the places where the tissues had taken an almost homogeneous appearance.

N. One of the small nerves which seemed affected; there is another showing analogous changes a little below and to the right.

dried up. The scaly strata are very thin, and in many places are quite fused together, forming an homogeneous waxy looking mass; however, in most places the stratified arrangement, and even some individual cells, are quite distinguishable. Separating these strata, and often interrupting them, are found many irregularly rounded or elongated spaces; some of these spaces are very large, and occupy more than half of the thickness of the stratum. These spaces are analogous to those described in the last zone, but much larger. This central zone has in an exaggerated degree the same characters as those of the superficial portions of the horny layer. In fact, in the specimens observed there can hardly be found a line of demarcation between the

fallacious, and due to the fact that, in papillæ cut obliquely, the fibres of the corium and those of the rete Malpighii running in the same direction, and being partly superposed, it is difficult to say where one set begins and the other ends. This view is supported by the fact that, side by side, one can see papillæ, the surface of which is separated from the rete Malpighii by a sharp line, just as if there were there a basement-membrane, and other papillæ (generally shorter) showing the appearance above alluded to.

c. In the central zone, the rete Malpighii presents various modifications.

At the sides, the elongated fibres just described, instead of extending between the stratum corneum and the cutis vera, as was the case in the marginal zone, are broken asunder; in most places, the greater part of the rete Malpighii remains attached to the raised cuticle, but, in other places, a considerable amount remains attached to the cutis vera. In some other places, the skin and its papillæ are left perfectly bare.

The arrangement of this portion of fibrillated rete Malpighii is most interesting to study. The fibres composing it are generally arranged in bundles, which have a broad basis, and a free end projecting into the blister-cavity. These fibres, and bundles of fibres, are bent in various ways; thus, those which are attached to the raised superficial layers are generally bent towards the centre of the cavity; at a very short distance from their point of attachment, they are generally bent at almost a right angle to their first direction, so that from perpendicular that they were, they become almost parallel to the cutaneous surface, with the exception of their free end, which is seen projecting more or less into the cavity. The fibres remaining attached to the floor of the blister show a course quite different. At first perpendicular to their surface of attachment, they soon bend towards the periphery of the blister, but generally not so sharply as the fibres just described.

Quite at the margin of blister, where the fibres still extend from cutis vera to stratum corneum (or, more accurately, to stratum granulosum), they show a remarkable double bend, allowing them to take the two directions above described, thus following them from the cutis vera to the stratum corneum. They are first bent towards the marginal zone, then towards the centre of the cavity, then again towards the margin, becoming finally attached to the raised cuticle, as has already been described.

This arrangement is not perfectly constant, but is sufficiently so to deserve notice. In some preparations these fibres, instead of converging to or diverging from the centre of the blister only, seem to do so in relation to one or more secondary centres.

Where the cutis vera is not entirely denuded, but very nearly so, the fibrous looking remains of the Malpighian layer form a kind of short fur, covering the papillæ, and lying between them. However, close to the centre, and corresponding to the depression in the cuticle, there often remains a tract of unbroken fibres, extending obliquely between the separated strata.

The fibrous looking cells of the rete Malpighii, which remain attached to the cuticle in the central part of the blister, are generally altered in many points, having taken a homogeneous colloid look, and forming more or less a continuous, lumpy, vacuolated layer just under the stratum lucidum and stratum granulosum, with which it seems to have become entirely fused.

II. *Cutis Vera*.—a. In the external zone, the papillæ show their structure with great clearness, the bundles of fibrous connective tissue, the capillaries, the nerve-endings (Meissner's corpuscles), all being almost abnormally clear. This is true, also, of the deeper layers, where some ducts of sweat-glands show their structure very well. b. In the marginal zone, some of the papillæ are smaller and more rounded than normal, their structure is pretty well marked. However, the connective tissue-bundles are less distinctly fibrillated. The lumen of the capillaries is apparently narrowed, whilst their walls are altered, being formed of short thick plates, evidently made of contracted, thickened, endothelial scales. It will be noticed that, owing to this, the walls of the capillaries are not continuous, but must present a number of openings or fissures between the cells. The most superficial parts of the capillaries in the papillæ show here and there a peculiar striation, which is also observed in the neighbourhood of the vessels a little deeper down; in some places a few spiral fibres seem to run round the capillaries. Here again Meissner's corpuscles are remarkably distinct.

c. In the central zone, the papillæ are more or less flattened and rounded. Some of them have almost entirely disappeared; others have taken an almost spherical shape, remaining attached to the rest of the cutis vera by a thick neck. As has already been said, many of them are quite bare, and project into the cavity of the blister. The

most striking change observed here, besides this flattening, is the homogeneous look presented by the ground connective tissue, in which the bundles of fibres have almost entirely fused together, their fibrillation having generally almost disappeared. A few small, triangular, branched or elongated, spindle-shaped cells, which seem to correspond to much altered connective tissue corpuscles, are embedded in this homogeneous matrix. The change is observed all along the floor of the blister—that is, in all the region which is here named central zone; but it extends deeper into the cutis in the central parts than at the margin of the blister, where this altered stratum gets thinner, and gradual transition is observed; but nowhere does this change extend deeply into the skin. About twice the height of a normal papilla seems to be the greatest depth observable in this case; and this renders this peculiar change still more remarkable, giving it a sharpness which is seldom observed in pathological lesions. The capillary vessels have in this region an appearance very much like that already described in the marginal zone; but, in addition, their contents are apparently coagulated; at least, the whole lumen of the vessel seems to be filled with some homogeneous material. In some places, the walls are hardly distinguishable from this substance. In many of these capillaries, another thing is noticed; namely, a peculiar striation or fibrillation of the vessel and its contents. This striation, which is parallel to the axis of the capillary, becomes very conspicuous at the apex of some papillæ, where the fibrillæ separate from each other, forming a kind of brush. These fibrils in some cases seem to extend up to the deep layers of the epidermis; and in some places, where the papillæ are denuded, these fibrils seem even to extend beyond the surface of the true skin. Owing to the alterations above described, it is in many places impossible to be quite sure that what are here described as capillaries may not be partly made up of some nerve-fibres. However, in most cases, the connection with unmistakable vessels can be traced. The touch-corpuscles are here also very distinctly seen; but their structure is, perhaps, less distinct than in the marginal zone; and they are less elongated, being apparently flattened in the direction of their long axis. This, of course, corresponds to the flattening of the papillæ themselves.

In one preparation, the duct of a sweat-gland opens almost in the middle of the blister, and that duct shows almost the same appearance as that described above regarding blood-capillaries. The fibrillation and complete destruction of structure can be observed to extend over the greater part of the duct as it passes through the cutis vera, and at the surface of the cutis the fibrillated contents project and expand in a fan-like manner.

III. *Subcutaneous Tissue*.—This layer presents but few changes; the ground connective tissue does not seem altered; the adipose tissue shows nothing abnormal. The coiled part of the sweat-glands does not seem much affected, with the exception of a few portions of dilated tubes, where a number of cells seem to be destroyed, and the few remaining *débris* have collected in the centre of the tube, being separated from the basement-membrane by a clear space containing some transparent or vacuolated cells. Two or three small nerves, situated in the part of the subcutaneous tissue corresponding to the central zone, show also an uncommon appearance; a considerable space exists between the bundles of nerve-fibres and the perineurium; this seems to have been due to some expansion or swelling of the endoneurium. However, the nerve-fibres do not seem more separated from each other than in the normal state. A few small arteries seem to be contracted to an abnormal degree.

Conclusions.—It will be seen that, in this description, no attempt is made at giving the distinguishing features between this kind and other kinds of burns. This would imply not only a long discussion, but also the description of appearances not generally known, and requiring further study. All the points given here are given as facts, which everyone can ascertain by examining the specimens described. No explanation is attempted; not that the facts are devoid of suggestiveness, but because this will be better done in some subsequent and more elaborate paper. However, nothing that may be required for the recognition of such cases has been, it is hoped, omitted. And, to make this easier, it will be as well to recapitulate here the chief changes described above.

Summary of the Lesions.—I. Epidermis.—1. Stratum Corneum. a. Cavities. b. Swelling of cells in the marginal region. c. Condensation and partial fusion of central cells. 2. Stratum Lucidum. More apparent and thicker at margin of blister. 3. Stratum Granulosum. Partly fused with the last in centre of blister. 4. Stratum Mucosum. a. Distension of nuclear cavities at margin. b. Peculiar contraction of nuclear substance. c. Fibrillation of protoplasm at margin, and breaking asunder of these fibrils in the central portion. d. Peculiar direction taken by fibrils in the cavity of the blister.

II. *Derma*.—1. Ground Connective Tissue. *a*. Papillæ flattened. *b*. Tissue of floor of blister almost homogeneous. 2. Capillaries. *a*. Contraction of capillaries. *b*. Contraction of endothelial cells. *c*. Coagulation and fibrillation of contents. 3. Nerves. Remarkable distinctness of Meissner's corpuscles.

III. *Panniculus Adiposus*.—1. Ground-tissue unaltered. 2. Fat-lobules unaltered. 3. Sweat-glands. Fusion of cells and fibrillation of contents of ducts near surface of cutis vera. 4. Nerves. Doubtful swelling of endoneurium. 5. Vessels. Doubtful excessive contraction of arteries.

The recorded morbid appearances of death from lightning are noteworthy in general, on account of the absence of obvious internal lesions; in this they agree with the present case. Although at least two fatal cases have been reported in this country from the action of the electrical fluid generated by machinery, yet we are not aware that the pathological changes have been placed on record.

Looking at the present increase in the application of electricity to various purposes, it seems quite probable that fatal accidents will increase among those who, from the nature of their vocation, are daily engaged among the complicated machinery. Important medico-legal questions may arise on the subject of a person found dead in the neighbourhood of electrical machines or conducting wires. So, too, it is sufficiently obvious that such an agent as electricity might be employed by murderers acquainted with the working of electrical apparatus, and with the absence of traces of violence left by the action of the current. It may, therefore, justly be said that a record of such cases is of importance, if only to serve as references for future comparison.

From the evidence of those who stood near, it would seem as though the man were instantly deprived of life. No doubt the vital spots at the base of the brain are, in such cases, markedly implicated. The fluid condition of all the blood, and the uncontracted state of the heart, were quite striking, but the naked eye appearances of injuries like these are sure to be obscure and negative in character, and it is only by the microscope that we can hope to appreciate any of the minuter changes that occur. The condition of the blistered skin is very peculiar, and differs from that of the ordinary burn-blister in several particulars. Such appearances would be quite recognisable on another occasion.

THE PREVENTION OF EPIDEMICS.

Read in the Section of Public Medicine at the Annual Meeting of the British Medical Association.

By EZRA M. HUNT, M.D., New York.

IN this brief paper, I only attempt a syllabus of the method in which we should conduct our inquiries in order to accomplish more in the prevention of epidemics. In dividing up and assigning this study of epidemics, the following are the chief inquiries and observations to be made.

I. What is the *contagium vivum*? As to this, we have to determine in what its entity consists; whether it be particulate or gaseous, whether it be so specific and singular in its character that it is always the same as to quality or quantity; or, if capable of modification, how it can be modified; whether it be always derived, or whether it be produced so as to be in a sense spontaneous. In a word, we must study the contagium, so as to know the most possible about it in its own individuality.

It is almost needless to say that the germ-theory of disease has immensely broadened this part of our study; but perhaps it is needful to say that the fact that we are probably nearer than ever before to the identification of certain or most contagia, does not clear up the question as to whether they are derived or spontaneous, or how the benign bacillus becomes malign; it does not settle their origin, and so as yet does not, by original dealing with the entity, assure us how we can prevent its existence, and so radically prevent epidemics.

Most contagia thus far seem identified with plant-life. We may get lessons as to modes of study from the fact that many communicable diseases seem to have to do with plant-life.

It is not surprising that Hallier, Panum, De Bary, Cohn, Thomé, Darwin, and others who were early in these studies, were botanists; and it has seemed to us that we would have done well, in our study and classification of this infinitesimal life, to have followed still more closely in their methods. The botany and zoology of parasitic microscopic life will yet have a classification well nigh as extended as that which belongs to life in its more visible forms.

The worker in this field is in a garden of contending vegetations, in

which it is not enough to say that each spore or germ or seed will produce its kind. *Omne ovum ab ovo* is true enough in animal life, but this does not prove the impossibility of a mule, or of some other product, or of a disease equally unique in its way. It is a marvel to see how the same seed can be so cultured that its products may be very greatly varied, and how marvellous are the hybrids or sports that may result. To me, the views of Pasteur do not seem to conflict with those of Bastian, nor does the doctrine of a result in disease, so modified as to almost defy identification, or so crossed as to give a mongrel, or what practically as to treatment is new, at all lean to the doctrine of spontaneous generation, as formerly taught. Cholera, typhoid fever, diphtheria, etc., some day become existences amid intense disturbances of natural processes. Although now generally occurrent from derived source, this does not preclude the possibility of their occurrence locally and sporadically, without an antecedent case—the only antecedent being the same intense disturbance of natural processes. It is strange that nitric acid and glycerine—the one corrosive, the other emollient—should have been so long handled in the laboratory before nitro-glycerine should have begun to exist. So, from special relationship of ordinary filth and extraordinary atmospheric conditions, there probably have come, and will come, new diseases, the causation of which we do not define when we find a germ, however much it may aid us in diagnosis.

II. Our next study, although allied, is quite distinct. Failing in finding the seed or the contagium, or destroying it, how shall we make of its *vivum* a case of suspended animation? How shall we sterilise it? I will not here discuss its culture in order to enfeeble it, as this is going on well enough. But I allude to the study of how we may provide it a sterile soil, either in the surroundings or in the person. This involves a close study of the habits of each contagium, on what it flourishes best without or within.

While the name filth-diseases is a convenient generalisation, we are not exact in our study until we accurately define decompositions, putrefactions, associated animal or plant life, so as not only to affirm, for instance, that vegetable decay causes periodic fevers, and animal excretion typhoid fever, but also to carry the details of observation, of facts, and of experiment, to an extent which shall enable us to approach the exactness of the botanist, who says that the silkworm thrives best on the mulberry, and that the potato-bug has an especial relish for the egg-plant. For the prevention of epidemics, there is this special field of study as to all the minute conditions or surroundings outside the body. We shall have gained very much when these scientific or expert methods, which are applied by the skilful naturalist, for instance, to all harmful or poisonous plants or insects, are applied to all embarrassments to our lives productive of disease as found outside and about us.

While the first plan, that of discovering a germ, is radical, yet it is not necessarily indispensable, if we can so apprehend the necessary conditions for propagation as to circumvent these. Hence students of this second class are not discomfited, even if the first study be incomplete.

III. The study of the individual in his relation to the *contagium vivum*, and to his surroundings, is another distinct study, inviting to another class of skilled observers—a laboratory in which minute work is greatly needed.

1. Under what circumstances does a human being come to be the host of something inimical to him, and prepared for an invasion of something, perhaps, producing disease? It is not enough to say of it that it is its nature to seek or to be communicated to human beings, and to develop into a disease. The fact that some persons, without having had a disease, are proof against its invasion is a significant one, and worthy of great inquiry to those who would like to put all in the same resistful condition. The fact that once having had some diseases protects most from them afterwards, or does not protect some, or, while protecting all, does not protect all for an equal length of period, cannot but make the epidemiologist very inquisitive to find out the reason, and so put it into effective preventive operation. Watson and others have stated that it is because the disease exhausts its necessary pabulum in the system; but, if this be so, the statement is incomplete, until we find out what pabulum it has wasted and what it has exhausted. As in the old system of inoculation it was discovered that, by diet or certain preparative treatment, small-pox could be modified in its virulency, and the secondary fever aborted, the why and the wherefore ought not to be given up by the modern medical profession, as it apparently had to be in the former.

2. When, too, we find that, as in inoculation to prevent pleuropneumonia in cattle, we secure an inflammatory action, and a constitutional effect through a muscle, and so prevent the fatal attack on a vital organ like the lung by a sort of artificial metastasis, we need to