face presentation abdominally, while the diagnosis is easily made from the rectum as soon as the face is within reach of the examining finger; I have seen it so made by a pupil midwife on several occasions.

Let us consider the position of the midwife with regard to vaginal examination, in view of the four indications for it which I have already given.

1. If one of her patients bleeds ante partum, her duty is to summon medical aid; vaginal examination should be done, not by her, but by the doctor who is going to treat the patient.

2. If she has a case of breech presentation, she should again obtain medical aid. By the existing Central Midwives Board rules she is allowed to treat the uncomplicated breech, but who can be certain that a breech will be uncomplicated until delivery is in progress?

The third and fourth indications are not applicable to the midwife.

I therefore hold that it is not necessary for midwives to make vaginal examinations, and very desirable that they should be forbidden to do so.

Lastly, I should like to point out that if a doctor makes no vaginal examination on a given patient, and she subsequently develops puerperal sepsis, he can be quite clear in his own mind that he has not introduced the infection.

I am indebted to the honorary staff of the Leeds Maternity Hospital for their permission to make use of the records of cases under their care in compiling this paper, and particularly to Mr. William Gough for suggesting the investigation.

THE MICROSCOPICAL EXAMINATION OF MATERIAL CONTAINING FILTERABLE VIRUSES, AND THE LIMITS OF VISIBILITY.

BY

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THE term ultra-microscopic applied to the filter-passers seems somewhat unfortunate, and this expression, together with the idea that they could only be studied by means of ultra-violet photomicrography, and the erroneous idea of the limit of the ordinary microscope, is perhaps responsible for the meagre account of the actual appearance of some at least of these bodies.

THE EXTENT OF VISIBILITY WITH THE ORDINARY MICROSCOPE.

The size of a minute organism or particle that is visible with the microscope depends on several factors, amongst which are: the numerical aperture of the objective; the wave-length of the colour by which it is illuminated; the method of illumination, whether by transmitted, oblique, or dark ground; the refractive index of the medium in which it is mounted; and the depth of the stain. The numerical aperture (N.A.) of the objective and the wave-length of the colour used are by far the most important elements, and, speaking generally, the higher the N.A. and the shorter the wave-length of light the smaller the particle that can be seen.

In stained preparations the depth or the duration of the staining makes a very considerable difference in the apparent size of an object. For example, if a film containing *T. pallidum* be stained for only five minutes with Giemsa, and then examined dry, without a cover-glass, with an 8 mm. objective, using dark-ground illumination, it is possible to find a spirochaete. If this be examined with 1/12 inch oil immersion with ordinary illumination it will be very difficult to see the spirochaete, but when seen it will appear as the most delicate spiral that can be imagined. Let the film be stained for twelve or twenty-four hours, and the spirochaete will appear as a thick spiral cord. Even greater differences will be found in the apparent size of an object when faintly stained with one of the aniline

dyes, when compared with one stained or impregnated with one of the flagella stains.

It is often stated in the literature dealing with filter-passers (Boycott, Martin, Cowdry) that organisms of the size of 0.2 or 0.25 μ are "somewhat about the limit of direct microscopic vision" (Boycott¹), and that anything smaller than that would be invisible with the highest powers of the microscope. But this is very far from being correct.

It would seem that the limit of resolution or separation has been confused with that of visibility, whereas they are totally different things. The resolution of an object glass is its power of dividing or separating a certain number of lines or dots to the inch, and our present limit of resolution of two lines or dots with ordinary light and axial illumination is generally given as 0.25 μ , and for oblique light 0.2 μ . The limit of visibility, or extinction limit, is the size of the smallest isolated dark particle that can be seen with transmitted light on a bright field with a given numerical aperture.

Whilst the limit of resolution with a lens of N.A. 1.4 is about 0.25 μ , the limit of visibility of the same lens employed at full aperture would be considerably greater; and with this object glass, using white light, a dark isolated germ or particle just over 0.074 μ in diameter will be visible, whilst with green light a germ just over 0.0673 μ should be seen.

Mr. Edward Miles Nelson, who has devoted the whole of his life to the microscope, and who is undoubtedly the greatest authority on the subject, more than twenty years ago communicated a paper to the Royal Microscopical Society² "On the measurement of very minute microscopical objects." He states: "Briefly, then, the method is to bring the object just to the point of invisibility by reducing the W.A. (working aperture), and then the correction for antipoint will be the measure of the object." A full table of the values of the N.A. is given in the paper. I may add that one can determine the minimal visible of any objective by the following calculation: for white light of 43,000 waves per inch divide 1.041 by the N.A.; for green light of 50,000 waves per inch divide 0.942 by the N.A. of the object glass. These figures assume that the objective is used at its full aperture, and not, as is so commonly the case, by using, or rather degrading, say a 1/12 inch lens of N.A. 1.3 or 1.4 with an ordinary Abbé condenser.

Mr. Eliot Merlin, also a very great expert on both the microscope and telescope, has stated the case very clearly in *Watson's Microscope Record*, 1929, No. 17.

"The separating limit of any given N.A. should not be confused with its visibility limit for an isolated particle, such as a stained coccus viewed by transmitted light on a bright field. Unfortunately such confusion is common, it being frequently assumed that the minimum diameter of an isolated particle, or germ, observable under such conditions in the ordinary microscope must exceed about 0.25 μ , this being really only slightly beyond the limit for an object glass of only N.A. 0.4 (that is, about that for a low-apertured cheap 1/2 inch objective) employed at its full working aperture in white light (5,607 wave-lengths), while the visibility limit for the same object glass with a screen (5,080 wave-lengths) is 0.236 μ . That the separation and visibility limits are different can be quite easily demonstrated. Select on a virus preparation two cocci, the diameter of which happens to be about their distance apart. Reduce the aperture of the object glass until no interval between the two cocci can be detected. This is the separation limit for that aperture for germs or particles of similar diameter, but the joined-up pair of cocci will still be quite visible. Of course, it will be borne in mind that two distinct just-in-contact images of the two equal-sized (in reality well separated) cocci are being dealt with. It will require a considerable further reduction in the N.A. of the object glass to cause the images to completely fade away, which they will be found to do at a certain very definite aperture, this forming the visibility limit. Any selected single isolated coccus of accurately estimated (or otherwise measured) similar size will be found to exhibit a like visibility limit."

In an earlier number of the same journal³ Mr. Merlin says:

"Apparently the difficulty of demonstrating living filter-passing cocci is in most cases merely due to their transparency in aqueous media, and not to their minute dimensions being beyond the defining power of the ordinary microscope. This difficulty can be readily overcome by observing them on dark ground."

In conclusion he says:

"In the writer's opinion it is of paramount importance that the true optical capacity of the ordinary worker's microscope, furnished with ordinary glass and fluorite achromatic or apochromatic object glasses, should be clearly understood and not underrated, this being the tool in exclusive use by thousands of

laboratory and technical workers all the world over. It cannot therefore be too emphatically maintained that it is an experimentally absolute fact that an object glass of 0.4 N.A. will, in white light of wave-length 45,300 per inch, just render visible a particle of 0.262 μ in diameter; and similarly the 1/12 oil immersion of 1.30 N.A., in common laboratory use, should, if properly used to its full defining capacity, reveal particles of not less than 0.08 μ diameter in white light, of 0.0724 μ diameter with a screen wave-length of 50,000 per inch, and of 0.0571 μ diameter with the photographic wave-length of 63,500 per inch."

METHODS.

The material containing viruses that I have examined has been taken from the skin or mucous membranes—for example, herpes, vaccinia, etc. The part is well washed, dried, and then gently rubbed with a swab moistened with spirit. Vesicles and bullae, if present, are punctured, and in some cases the base is rubbed, and the resulting exudation, as free as possible from blood, is spread uniformly either on the cover-glass or more usually on the slide.

In the case of papules, etc., the cleansed surface is scraped with a sharp scalpel till some serum is present, just as one would do for the examination for *T. pallidum*. The film is usually exposed next to the vapour of iodine for about half a minute, allowed to dry in the air, and then fixed in alcohol for half an hour to an hour. In some cases the air-dried films are fixed in lucidol. They are subsequently stained in Giemsa all night, or from twenty-four to forty-eight hours, and the stain renewed once or twice. After washing, and when thoroughly dry, they are mounted in Gurr's mounting medium, in which less fading occurs than in any medium I know up till the present. Films are also made by the process of relief staining—that is, one drop of the serum and one drop of Indian ink, or of a saturated aqueous solution of nigrosin, are thoroughly mixed with a needle, and the resulting mixture spread on the slide in as uniform a film as possible. The Indian ink I use is either Gunter Wagner's "chinchin" or "pelican," and the process is that well known as Burri's method. In the preparation of the commercial chinchin or pelican ink some workers recommend the addition of tincture of iodine, about one part to twenty-five parts of ink, and the mixture, after being well shaken, is allowed to stand for twenty-four hours, and then centrifuged. The German writers generally advise diluting the ink with five to ten times the amount of distilled water, centrifuging, and finally sterilizing the diluted ink.

Some time ago, after long experimenting with various methods of relief staining, I wrote an article, "Relief staining of bacteria, protozoa, infusoria,"⁴ in which I stated that, after trying various methods, I came to the conclusion that nothing was equal to a saturated aqueous solution of nigrosin, which gives magnificent pictures of many flagellates and spirochaetes; but I now find, to my surprise, that the old Burri's Indian ink method gave much better results with the "virus bodies." I therefore look forward to any suggestions for improving the preparation of the ink, or a good substitute for it.

I am of opinion that any method of relief staining is of little use for diagnostic purposes, but when the organism is known no other method will give as fine an insight into the shape and external structure, but it must always be controlled by a stained preparation, and also by a film of the ink, or nigrosin alone, used as a control.

As to the microscopic outfit, I generally use Leitz 8 mm. 1/3 inch apo-objective of N.A. 0.65, and 1/10 inch. of N.A. 1.33, or 1/16 inch fluorite, and either Watson's parachromatic dry or their holoscopic oil immersion condenser. In all cases I employ a green colour screen, generally Wratten's No. 15 and 60 used together. For dark-ground illumination one of three methods is in use: (1) the parachromatic condenser, used without oil, with a stop; (2) the holoscopic condenser, used with oil and a stop; and (3) Leitz dark-ground illuminator, with fixed stop.

I generally find that the ordinary paraffin lamp with half-inch wick gives sufficient light, but for the most brilliant dark-ground effects nothing is as convenient or as cheap as the Mazda pearl electric bulb of 60 candle-power, or the Osram bulb of the same candle-power, as first suggested by Mr. Nelson. Of course, these must be placed in a dark box, with only a small hole at one side.

As a matter of fact, all the filterable virus bodies that I have up to the present examined are distinctly seen with

the apochromatic 1/3 inch objective by dry dark-ground illumination, and this is the method I use in the first instance to determine whether these bodies are present, and, when present, in what part of the film they are most numerous or well defined.

GENERAL MICROSCOPIC APPEARANCE OF BODIES SEEN IN MATERIAL CONTAINING VIRUSES.

The bodies are Gram-negative, and they are not easily stained with any of the ordinary aniline dyes. With Giemsa they stain a red to reddish-violet colour, practically the same tint as most of the spirochaetes and many of the Rickettsia bodies. On microscopical examination exceedingly numerous minute granules of varying sizes, of unequal depth of stain, and generally of a round or an oval shape, are to be seen. They may roughly be recognized as having three or four different sizes. The largest are generally round, more rarely oval in form, and with Giemsa they stain a deep red-violet, much darker in colour than the smaller bodies. Their outline is not sharp like a coccus, but is somewhat ragged and ill defined. By careful focusing many of them seem to have a projection, tag, or spike, and in some a distinct, very fine flagellum-like structure can be seen. They are usually single, but not infrequently are attached or closely joined to one of the smaller bodies, which is, however, more faintly stained. Very seldom are the two larger bodies joined together like diplococci, but two, three, or four may be arranged in a straight or curved line at considerable distance apart, and they are apparently connected to one another by a very delicate thread; but this is difficult to see in Giemsa-stained films. The smaller types stain less deeply and more reddish in colour, are generally much more numerous, but not nearly as conspicuous as the larger bodies. They may be arranged singly, in pairs, or in short chains. All the virus bodies appear more deeply stained when they are seen lying over some stained background than when seen in a clear space. Their most characteristic features are: their inequality in size, their arrangement in loosely connected chains made up of bodies of unequal size, unequal density of stain, unequal distance apart, and, if they are oval in shape, the long axis may lie at a different angle from the rest.

If the preparation be examined by dark-ground illuminatives, by any of the methods previously described, they will be quite easily seen, shining brilliantly as very definite and distinct golden grains, of unequal size and somewhat irregular arrangement, often lying two, three, or more in a chain. Indian ink preparations—made as described—show them, in parts at least, extremely well. The inequality of the size, the arrangement, and the spiked or flagella-like projections, and at times the very delicate filaments connecting two, three, or more bodies in loose irregular chains, are much more easily made out than in stained films. Relief staining with nigrosin is inferior to the Indian ink for these particular minute structures; the larger bodies are well seen, but the smaller ones seem to be somewhat lost in the stain, and are not at all conspicuous objects.

In 1922 Mr. Nelson first noticed the flagellum-like structure on the "virus bodies" of vaccinia, and says "it is the smallest germ on which I have seen a flagellum, and in spite of their smallness these were not at all difficult to see; the medium-sized germs measure about 0.3 μ by my extinction method."

Later in the same year he writes: "The vaccine virus germs are not isolated, but are fixed to a very delicate mycelium, just like tubers on a rhizome." Mr. Eliot Merlin a little later confirmed both these findings. I was able to see the flagella-like processes on many of these bodies. (By the by, it is still a little uncertain whether the filter-passers possess the power of motion, or whether what is seen is merely Brownian movement. The majority of observers incline to the latter theory.)

I could not distinctly make out the connecting threads, at least not convincingly, and I was at that time of opinion that what these skilled observers had seen were merely very delicate fibrin filaments underlying these bodies. Only quite recently in films made from herpes labialis with Indian ink have I abundantly satisfied myself of the existence of these very delicate threads.

The existence or not of these connecting filamentous structures might be regarded as merely of academic interest, but I think that if the bodies I have described are indeed the virus, their presence might explain one of the peculiar attributes of the virus—that is, their marked difficulty, in some cases at least, of passing through the pores of a filter.

My friend Mr. Eliot Merlin has very kindly examined stained preparations of many virus bodies which I have submitted for his opinion. I here add his quite independent view of the appearance and size of some of them.

"It appears to me that the 'virus bodies' only differ from ordinary cocci in point of smallness and variations in size.

"*Shape*.—Some of the larger bodies are markedly oval, but most of the average and smaller-sized germs appear quite round. Deeply stained Giemsa forms, large and small, appear well defined in most cases. Some exhibit a projecting knob, and a few have apparent flagella, but not much attention has been given to the search for flagella.

"*Size*.—Observation has been mainly concentrated on accurately measuring the diameter of the large and small forms. A seeming peculiarity of 'virus bodies' is their numerous gradation in size.

"On the slide of *herpes labialis*, stained Giemsa, measurements of the virus bodies on a bright field show:

	Diameter.
Largest bodies	0.83 μ
Large bodies	0.73 μ
Numerous average bodies	0.52 μ
Small bodies	0.3 μ
Smaller bodies	0.26 μ
Smallest, but quite numerous, grade	0.21 μ

"The measurement of the germs has been carefully done and may be relied upon within small limits of error. The probable error is within a trifling amount (say less than one unit), in the second decimal place of a micron. Thus there are, in this preparation, about six well-marked grades of size easily seen, and well within the visibility capacity of an 8 mm. objective of N.A. 0.65.

"*Vaccine virus*.—Here are my measurements for this:

Large bodies	0.8 μ
Medium, numerous common size, same as herpes labialis	0.52 μ
Small	0.44 μ
Smaller	0.32 μ
Smallest	0.26-0.21 μ

"Practically the vaccine virus germs are about the same in variations of size as the herpes.

"By the way, re shape. All bodies so small that their diameter would be beyond the separation limit of the N.A. employed would be imaged as round, even if really square or oblong. Thus a germ that is imaged as square-shaped, such as a tetraspore, must be truly so shaped, and therefore within the resolving (separating) limit of the optical combination employed. But a minute germ imaged as round may be any shape—square, triangular, or oval—should its diameter happen to be below the resolving limit of the N.A. available to reveal its true shape."

The following is a list of the morbid conditions in which I have found definite "virus bodies": vaccinia, varicella, herpes labialis, herpes zoster, pemphigus, psoriasis, lichen planus, dermatitis herpetiformis, verruca plana, conjunctivitis, influenza, and the common cold. There is little to be said about any of these conditions.

The influenza bodies were found associated with pneumococci in films made from the lung of a child, and my experience is in agreement with Mervyn Gordon, that the bodies met with were coccoid rather than bacilloid. The only obscure case was that of chronic conjunctivitis, the film being sent me by my friend Dr. Maddox.

The association of herpes zoster and varicella is always of interest, and I have seen a case of an adult with typical herpes over the right shoulder, in whom within a few days an equally typical attack of varicella occurred.

What are the criteria which suggest that the small bodies seen with the microscope are indeed the viruses? It is not easy to answer this question definitely, but after the eye has been accustomed to the appearance of these minute organisms—say in a film of vaccine—there is little difficulty with other specimens. Their small size, the faintness and colour of the staining reaction, the occurrence in enormous numbers, the numerous gradations in size, the arrangement in two, three, or more at long and often irregular distances, and their connexion in some cases by very fine filaments, are together very suggestive, and, as experience is gained, diagnostic. As Arkwright⁵ says:

"The differentiation of colloid particles of about 0.2 μ in size by means of the microscope is often extremely difficult, and requires

attention, especially to their arrangement and the range of size and shape, rather than to the appearance of individual particles."

I have examined very many controls, such as fluid from blister, the exudation from many cases of dermatitis, etc., but I have not found anything like these minute yet definite bodies. My impressions seem to indicate that they are fairly easily recognizable in films from the skin or mucous membrane in the diseases mentioned and known to be due to filterable viruses, but I should not expect to detect them in films of the peripheral blood.

The next obvious question is, Can you differentiate the virus bodies of one disease from those of another? At present I should say this was very difficult, and in many wellnigh impossible, but I put the problem to Mr. Merlin, who writes:

"*Herpes Zoster*.—The germs are rather markedly of one uniform size, measuring 0.35 μ , many being diplococci, but some also single.

"*Conjunctivitis*.—Resembles vaccine virus, size of germs varying, large forms rather plentiful; medium-sized forms measure 0.35 μ .

"*Influenza* (from lung).—Quite typical virus-like vaccine, consisting of many grades in size. Medium forms 0.3 μ .

"*Lichen Planus*.—Varying grades of size, but the largest forms in this preparation that are numerous only run at about 0.52 μ , while the medium small equal about 0.3 μ .

"*Common Cold*.—Typical range of size, large forms seemingly more numerous than smaller grades. Medium small 0.35 μ .

"*Varicella*.—Medium-sized bodies numerous at 0.3 μ , and so greatly preponderate as to perhaps constitute a feature by which this virus can be recognized.

"In reply to your query as to whether any of the virus bodies could be distinguished from each other, I certainly think, with practice at least, some of the preparations exhibit sufficiently marked differences, such as uniformity of size of bodies. In some large bodies are numerous, in others not.

"Then, too, the exceptionally numerous large bodies in the cold slide serve to distinguish this virus from the others, whilst on the varicella slide the very numerous 0.3 μ forms might serve a like purpose."

So far I have only had an opportunity of examining fairly common filter-passing diseases, but our experience of these leads me to think that the statement made by Martin, that "he preferred to consider the dimensions were not of the small order suggested by some observers," as being very near the truth.

I should very much like to be able to examine preparations of other diseases due to filter-passers, such as variola, molluscum contagiosum, dengue, etc. Films could easily be made from variola, molluscum, and the vesicles of foot-and-mouth disease, and I should be most grateful if those working on any of these diseases would be kind enough, as opportunity occurred, to forward me air-dried films from any of these.

What part ultra-violet photography will play in the further elucidation of virus diseases remains to be seen, but I am mindful of a statement made to me some time ago by a great microscopist and scientist. He said that laboratory microscopists remain unchanged from the old days when they commonly used an oil immersion objective to show objects quite within the range of dry lenses; so now may it not be that ultra-violet light is sometimes considered necessary when the ordinary microscope is really fairly adequate?

I have taken sixteen photomicrographs at a magnification of 1,500 diameters of ten different virus bodies on one quarter-plate, but am afraid this hardly lends itself to reproduction. I have therefore made a very diagrammatic drawing of the general appearance of these minute bodies (see figure).

I take this opportunity of expressing my very sincere thanks to Mr. Eliot Merlin, who, though he is neither a pathologist nor a bacteriologist, is *facile princeps* at the microscope, for the very valuable help he has given me.

Diagrammatic sketch showing appearance of the virus bodies.

YELLOW FEVER: PRELIMINARY NOTE.

I have had the opportunity, since the above was written, of examining films containing the virus of yellow fever. Dr. Edward Hindle, whose very successful work with this dangerous disease is well known, kindly sent me films of the blood, liver, and spleen from four rhesus monkeys infected with yellow fever, and later blood films from one bitten by infected mosquitos, from the first to the last day of illness. I would here express my heartiest thanks to Dr. Hindle.

In these films, when stained with Giemsa, I have found certain minute bodies which closely correspond with those I have already described from other filterable diseases. On microscopic examination a large number of very faintly stained bodies were found lying in the space between the tissue cells or corpuscles. At first glance they were regarded as probably minute precipitates of stain, but on closer and more prolonged examination they were found to have definite form and shape. In the majority of cases they were minute round or oval bodies, stained a faint red colour with Giemsa, irregularly arranged, of somewhat unequal size, and unequal depth of stain. Most of them were single, many arranged in pairs, and a few in lines. The individual particle may have a distinct flagellum-like process, others have a bud- or spike-like projection, giving the organism the appearance of a comma. Rarely filaments are seen connecting two, three, or four together, as was noted in other virus diseases.

These minute bodies were never found in dense groups or compact clumps as one so commonly sees in the Rickettsias, but they were fairly equally distributed in the blood serum. They were very numerous in the liver and spleen, but were fewer though quite distinctive in the blood. It was particularly noticed that many of them were in pairs, like minute diplococci—or, as I call them, diplogloboid bodies—and in the blood I regarded these as especially suggestive. When examined with dark-ground illumination these minute bodies shone out very brilliantly.

Mr. Merlin, who has confirmed these findings, has kindly taken the following measurements. In the liver and spleen their size varied from 0.9μ to 0.17μ ; intermediate sizes being 0.39 , 0.28 , and 0.22μ . The average size of the most numerous form was about 0.3 to 0.25μ . In the blood faintly stained bodies varied from 0.5 to 0.17μ ; the other grades being 0.3 , 0.24 , and 0.17μ in diameter.

"The variations in size," Mr. Merlin remarks, "approximate to the bodies in the vaccinia virus, except that the smallest in the latter only reached 0.21μ , whilst in the yellow fever preparations the most minute are 0.17μ or even slightly less in diameter."

The question naturally arises, What are these bodies, and with what may they be confused? They are quite easily seen with $1/3$ inch objective and dark-ground illumination, and are very fairly uniformly distributed in all parts of the films in which the corpuscles are not too close together. They could not, in my opinion, be confused with the contents of cells, or the granules from a neutrophile leucocyte which has been ruptured in spreading; but it may be very difficult to differentiate them from debris from stain.

All the filter-passing bodies that I have examined require fairly deep staining with Giemsa to render them at all conspicuous, and prolonged staining with Giemsa tends to the production of some debris, however carefully it is carried out.

In films of vaccinia, etc., we have to deal with almost a pure culture of the virus bodies, whilst yellow fever is the first disease in which I have looked for such bodies in the blood or organs. Notwithstanding these difficulties I am of opinion, after spending considerable time on the examination of them, that these very minute bodies, with such definite characteristics, are not artefacts or debris from stain. I have made controls by spreading films of normal blood on the same slides, and subjecting them to precisely the same fixing and staining.

I think it will be found that these bodies, if not the virus, may have some connexion with it.

DISTEMPER IN DOGS.

Sir Charles Martin and Professor J. C. G. Ledingham kindly sent me some unstained films labelled "distemper,"

and a piece of spleen from distemper in dog. I found in the former, and, after staining films from the spleen, in the latter, bodies which were very like those previously described. They were very numerous in films made from the spleen. They were on the whole somewhat smaller than those met with in vaccinia.

Much further work, however, must be undertaken before one can definitely express an opinion on the exact nature of such minute bodies.

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A CASE OF CARDIAC SYPHILIS WITH VENTRICULAR ANEURYSMS.

BY

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An unusual cardiac condition, the result of syphilitic processes, is here recorded.

The patient, a woman of 43, was admitted to University College Hospital in April, 1927, with a history of breathlessness on exertion for two years, epigastric pain on exertion for three months, and oedema of the legs for five days. A diagnosis of aortic syphilis with aortic incompetence was made. An electro-cardiogram taken at this time is reproduced in Fig. 1; it shows normal rhythm,

FIG. 1.—Time marks = $1/5$ sec.

sinus tachycardia, slight left ventricular predominance, and the T wave just negative in lead 1. The patient was treated with antisyphilitic drugs (sulfarsenol, novarsenobillon, bismuth, and iodides) for one month, and was discharged considerably improved.

Four months later she was admitted to the Middlesex Hospital in a very distressed condition. She was orthopnoic, cyanosed, and had oedema of the feet; she complained of epigastric pain, and vomited continuously. Sino-auricular rhythm with many extra-systoles was present, the rate being about 70. The heart was enlarged (apex beat in the fifth space five inches from the middle line); no murmurs were audible. Shortly after admission auricular fibrillation occurred, the ventricular rate being at first about 140. This was reduced by digitalis in the course of three days to 100, but the patient's condition got worse; vomiting was more frequent, and epigastric pain was still complained of. Death occurred suddenly five days after admission, while the patient was trying to defaecate.

The post-mortem findings were as follows (Bland-Sutton Institute of Pathology): The heart weighed 19 oz., and in