there is a period during which naked-eye diagnosis is possible before anything definite is discovered by the microscope, is, I think, well proved by the following fact. In at least three cases in which different microscopists, who examined the specimen after its removal, reported that there was nothing definite, the disease yet recurred in the glands. I, therefore, always trust to other signs for the diagnosis. A careful microscopic examination ought always to be made, but it should follow and not precede a liberal excision. In one of the very few cases in which I have known the disease return in the tongue itself, most valuable time had been lost before I saw the patient in the vain hope of establishing a diagnosis by the microscope.

If it be asked whether the doctrine of a precancerous stage and the habit of trusting to the aspect, etc., of the sore for diagnosis, do not occasionally lead to errors and to premature operations, I must answer candidly, yes. A gentleman to whom I had, after consultation with an eminent surgeon, advised excision of part of his tongue, was quite cured by a liberal use of the acid nitrate of mercury as a caustic, and several under similar conditions have been cured by the actual cautery. One very obstinate patient who refused my urgent recommendation that he should have the whole tongue removed because there were several separate places which looked very suspicious, lived for at least three years without any malignant development. He visited many of my surgical friends and always expressed his satisfaction, that by disregarding my recommendation he had saved his tongue. His fate found him, however, at last. He never consulted me again, but one morning a medical friend acquainted with the facts drew my attention to a newspaper notice of his death, and I found on inquiry that he had died after an operation for cancer of the tongue. He would have been a gainer by what some might deem a premature operation for (let alone the final result), his tongue had been a trouble to him during the whole interval.

REMARKS

ON

THE VARIOUS SURGICAL PROCEDURES DEvised FOR THE RELIEF OR CURE OF TRIGEMINAL NEURALGIA (TIC DOULOUREUX).

By VICTOR HORSLEY, F.R.S., F.R.C.S.,

Surgeon to the National Hospital for the Paralysed and Epileptic;
Assistant-Surgeon to University College Hospital, etc;

ASSISTED BY

JAMES TAYLOR, M.D.,

Pathologist to the National Hospital for the Paralysed and Epileptic;

AND

WALTER S. COLMAN, M.B.

(Concluded from page 1193.)

Operation for Removal of the Gasserian Ganglion and the Division of the Fifth Nerve behind the Lateral.—In considering the possibility of relieving cases of inveterate neuralgia where recurrence of the pain had taken place, I thought one might be able to remove the Gasserian ganglion or divide the fifth nerve behind it, and I made, some years ago, dissections³⁸ to see how far the Gasserian ganglion could be separated from the cavernous sinus. On first exposing the ganglion from the pterygoid fossa and opening the middle fossa of the skull freely following up the inferior division of the fifth nerve, I found that one could raise the inferior division and so the lower half of the ganglion from its bed in the dura mater without damage to the carotid artery in the canal or to the cavernous sinus, but that when one attempted to strip up the upper half of the ganglion from the cavernous sinus it invariably tore the wall of that cavity. For this reason I believe that the operation of complete removal of the Gasserian ganglion is not possible, but that in the operation

which Mr. Rose has subsequently described only a portion of it can be taken away.

Finding this to be the case, I then considered the possibility of dividing the fifth nerve behind the ganglion. It is well known that the fifth nerve enters the dura mater just beneath the edge of the tentorium, and that it runs afterwards in a small but roomy canal in the dura mater, joining the Gasserian ganglion, which lies in a similar cleft on the upper surface of the petrous bone and on the roof of the carotid canal. Some experiments on the monkey to expose the crura had shown me that it was possible to expose the temporo-sphenoidal lobe, and then, by raising the brain carefully with a broad retractor, to lay bare the floor of the middle fossa of the skull. On trying this on the dead body I found that it was perfectly possible in man also, the only trouble being the small veins which come from the temporo-sphenoidal lobe and which enter the petrosal sinuses. If these be ruptured the hæmorrhage is very free, and, although not dangerous to life, nevertheless very effectually hinders the performance of the operation.

This exposure of the temporo-sphenoidal lobe in man I have carried out by making a large temporal flap, starting from the anterior extremity of the zygomatic process, and running upwards to the temporal ridge, following that line and descending along it to the asterion. The temporal muscle, after being separated from the bone, is then best removed, so far as its posterior half is concerned, and then the whole of the squamous portion of the temporal taken away by means of a trephined hole and suitable bone forceps. Anteriorly the middle meningeal artery may be dealt with where exposed, being simply ligatured in the dura mater. The dura mater is then to be opened along the full length of the area of bone removed, and the temporo-sphenoidal lobe thus laid bare. A broad copper retractor, with smooth and everted edges, is then gently slipped underneath the lobe and slowly but steadily raised. The lobe is partly moulded partly lifted upwards, and the floor of the skull is then easily seen and illuminated with the electric light. The guide to the fifth nerve now is the upper border of the petrous bone. The lobe being raised a little more, the edge of the tentorium will be defined and the point at which the fifth nerve passes beneath it could, in the first case I operated upon, be seen. The position of the canal in which the nerve is lying just above the ganglion must then be estimated, and a small puncturing incision made into it. As it is about a quarter of an inch in diameter, it can be recognised as soon as the puncturing instrument passes into it, and the dura forming its roof should then be further slit open. The nerve in this way is exposed, and is found to be freely lying in the little passage.

The first case on which I operated in this manner was the patient No. 5 in the table, in whom I had, as is shown there, previously removed a portion of the inferior dental and of the infraorbital. The recurrence of pain, for which she then desired further operative relief, began in the auriculo-temporal nerve, the only branch remaining of the inferior division which had not been cut. As the pain, however, also ultimately invaded apparently the stump of the middle division, I thought it best to attempt the operation of dividing the nerve behind the ganglion. The patient had not eaten any solid food for several months, and was not in a good condition to undergo the operation. However, as her state was a very desperate one, I agreed to perform the operation, warning the friends that there might be fatal collapse even on the table. As a matter of fact, the operation presented no special difficulty beyond that of being very tedious. I resected the zygoma in order to have more room, but I feel sure now that that was a useless complication—that it was quite possible to have reached the nerve without it, and I regret having done it, because I think it of course aided in producing the shock which caused a fatal termination to the case. On opening the dura mater the brain bulged moderately into the opening, but as soon as the effect of the shock began to show itself it of course sank. On exposing the nerve in the canal behind the ganglion I passed a small blunt hook around it, and it then occurred to me that the small branch of the basilar artery which accompanies the nerve might give some trouble. I therefore thought one might safely attempt avulsion of the nerve from its attachment to the pons, and on gently drawing on it with a hook this was easily accomplished, and without

³⁸ By the kind help of Drs. Savill, Lunn, and others.

Table showing the Results of Removal of the Branches of the Fifth Nerve.

No.	Sex and Age.	Duration.	Presumed Exciting Cause.	Nerve Distribution Affected.	Trophic Changes.	Previous Treatment.	Operative Treatment.	Mode of Healing.	Notes.	Result.
1	M., 60 yrs.	7½ yrs.	Worry	Left 2nd division; pain also in supra-orbital region	None	Extraction of all teeth; usual drugs, and opium in large doses	Mar. 2, 1886. Removal of 2nd division through antrum	First intention	—	Pain in upper gum remained.
a*	—	—	—	Left upper gum	—	—	Apr. 16, 1886. Removal of posterior palatine nerve	First intention	—	Complete relief for 7 months.
b	—	—	—	Left inferior dental	—	—	Dec. 21, 1887. Removal of inferior dental and lingual	First intention except where tube introduced	—	—
c	—	—	—	Left 2nd and 3rd divisions	—	—	Nov. 15, 1888. Division of 2nd and 3rd divisions inside cranium	Cellulitis; necrosis; small piece of bone; sinus for one year	—	Relief 18 mnths.; return from local abscess; relief when this opened, and complete so far. Complete cure.
2	M., 65 yrs.	7 yrs.	Exposure to cold	Left 2nd division	None	All usual drugs	Nov. 19, 1886. Removal of 2nd division	First intention	—	Complete cure.
3	F., 55 yrs.	3½ yrs.	Worry	Right inferior dental	—	Usual drugs	Dec. 14, 1886. 1 in. inferior dental removed	First intention	Collection of serum; aspiration 3 weeks after operation	Complete relief; slight temporary return during illness in 1890.
4	M., 61 yrs.	4½ yrs.	None	3rd division; also supra-orbital pain	None	Teeth extracted	Aug. 24, 1887. Excision of 1 in. of 3rd division	First intention	—	Complete relief when last heard of.
5	F., 66 yrs.	8 yrs.	Cold and cleaning teeth	Right 2nd and 3rd divisions	Swelling of right cheek and lower lip	Extraction of all teeth; usual drugs	May 24, 1887. Removal of inferior dental	First intention except for small salivary fistula closing in a few days	Fed by rectum for 1 month before operation	Complete relief for two years.
a	—	—	Cold	Right 2nd division	Swelling of right cheek & upper lip; herpetiform pustules; conjunctivitis	—	Nov. —, 1889. Removal of 2nd division at spheno-maxillary fissure	First intention	—	Disappearance of trophic change, and relief for 1 year.
b	—	—	—	Right auriculo-temporal, July, 1890	Herpes and swelling of lower lip	—	Dec. 11, 1890. Avulsion of 5th nerve from bulb	—	Liquid food 6 months before operation	Death from shock.
6	F., 55 yrs.	27 yrs.	None	Right lingual inferior dental and auriculo-temporal	None	Various drugs; caustic to tongue	Jan. 13, 1888. Excision of part of inferior dental and lingual	First intention	—	Complete cure.
7	M., 38 yrs.	6 yrs.	Exposure to cold	Right inferior dental and lingual; pain over vertex	None	Drugs; baths at Aix	Aug. 8, 1888. Removal of inferior dental and lingual	Partly granulation	—	Cure.
8	F., 58 yrs.	2 yrs.	Movement excites pain	Infra-orbital	—	All teeth on affected side extracted	Aug. 7, 1888. Nerve cut in infra-orbital canal	First intention	—	Cure.
9	M., 64 yrs.	7 yrs.	Cold	Left 3rd and 2nd divisions	—	Usual drugs	Aug. 21, 1888. Removal of inferior dental and lingual	First intention	Brother and sister melancholic	Relief for a year.
a	—	—	—	Left 2nd division	—	—	Aug. 13, 1889. Removal of infra-orbital	First intention	—	—
b	—	—	—	Left 2nd and 3rd division; also supra-orbital	—	—	Jan. 6, 1890. Removal of 2nd and 3rd divisions inside cranium	First intention	—	Temporary relief; recurrence in 1st division; dementia. Complete cure.
10	M., 63 yrs.	6 yrs.	Exposure to cold	Right inferior dental; lingual once in upper jaw	Swelling of lower lip	All drugs; some teeth removed	Nov. 22, 1888. 1 in. of inferior dental and lingual removed	First intention except small salivary fistula for three weeks	Herpes zoster 4 years before on right shoulder	—
11	F., 68 yrs.	15 yrs.	Getting wet	Right inferior division, right 2nd division	Occasional swelling of right lower lip	Quinine, etc.	Jan. 23, 1889. Removal of inferior dental and lingual	First intention	—	Temporary relief, vide infra.
a	—	—	—	Severe pain in 2nd division	—	—	March 26, 1890. Removal of infra-orbital	First intention	—	Relief so far.
b	—	—	—	Severe pain in inferior division; recovery of sensibility in this region. June, 1891	—	—	Aug. 10, 1891. Removal of inferior division at foramen ovale	First intention	—	Relief so far.
12	F., 54 yrs.	5 yrs.	—	Right 2nd division	Swelling of right upper lip; unilateral furring of tongue	—	Jan. 15, 1889. Excision of part of right infra-orbital	First intention	—	Relief so far
13	M., 69 yrs.	12 yrs.	Pressure or movement excites pain	Left infra-orbital; pain supra-orbital	—	—	May 8, 1889. Removal of 2nd division at foramen rotundum; antrum opened	First intention	Sloughing of cornea from using strong carbolic	Cure.
14	F., 53 yrs.	6 yrs.	—	Left infra-orbital, occasionally supra-orbital	—	Various drugs, relieving temporarily till 3 months ago	May 13th, 1889. Nerve twisted off at spheno-maxillary fissure from orbit	First intention	Blunting of smell, taste, and hearing on affected side	Cure.
15	M., 65 yrs.	22 yrs.	Exposure to cold	Left 2nd division	None	All usual drugs	May 22, 1889. Removal of 2nd division	First intention	Marked emaciation	Complete cure.

* The letters a, b, and c signify second, third, and fourth operations respectively.

Table showing the Results of Removal of the Branches of the Fifth Nerve (continued).

No.	Sex and Age.	Dura-tion.	Presumed Exciting Cause.	Nerve Distribu-tion Affected.	Trophic Changes.	Previous Treat-ment.	Operative Treat-ment.	Mode of Healing.	Notes.	Result.
16	M., 55 yrs.	13 yrs.	Wound of face with chisel four years previously. Pain began in scar	All left side of face	None	Usual drugs; division of nerve (buccal?) in cheek	Aug. 18, 1890. Removal of part of inferior dental	First intention	Free bleeding	Relief for 1 month.
a	—	—	—	—	—	—	Feb. 6, 1891. Incomplete operation for intracranial division of nerve	First intention	Diffuse ossification of petrous; operation abandoned	Relief for 2 months.†
b	—	—	—	—	—	—	Sep. 11, 1891. Modified Pancoast-Salzer operation	First intention except small point in front	Free bleeding	Relief so far.
17	M., 27 yrs.	1 yr.	Influenza	Right side of cheek from socket of right lower 1st molar	None	Usual drugs	Jan. 15, 1891. Removal of parts of inferior dental and lingual	First intention	—	Relief so far.
18	M., 57 yrs.	4 yrs.	Cold	Right supra- and infra-orbital	Scaling of right side of face; occasional swelling	Usual drugs	Aug. 6, 1891. Excision of supra- and infra-orbital from face; antrum opened	First intention	—	Complete relief.
19	F., 46 yrs.	10 yrs.	?	All right side of face.	None	Usual drugs, electricity, etc.	Jan. 26, 1891. Removal of parts of inferior dental and lingual	First intention	—	Complete relief in inferior division so far.
a	—	—	—	Right supra- and infra-orbital	—	—	Sep. 22, 1891. Excision of supra-infra-orbital from face	First intention	Great quantity of chloroform required.	Complete relief in whole face so far.

† At this operation a notable (pathological) bulging of the brain was observed when the skull was opened, and pressure thus relieved.

even any noteworthy oozing. The wound was closed in the usual way. Unfortunately the patient never rallied from the operation, and died seven hours afterwards, obviously from shock.

At the *post-mortem* examination—which I obtained with some difficulty, and further details of which will be given in a paper on the pathology of the disease shortly to be published—I found that there was no cause of death except that already mentioned. There had been a slight amount of oozing into the subarachnoid space, but nothing to produce any compression at all, and of course of that there were no symptoms during life. At the moment when the fifth nerve was separated from the pons, although the patient was well under the anæsthetic, there was arrest of the respiration and the pulse could not be felt. This lasted for probably not more than three to four seconds, and then the respiratory movements and the pulse became normal. On reviewing the result of this operation I am satisfied that the unfavourable termination was due to the special circumstances of the case, and the considerable series of experiments on the lower animals which have been made involving the division of the fifth nerve show clearly that the mere exposure and section of the nerve is not of itself dangerous to life.

It has been proposed by Mr. Rose to remove the Gasserian ganglion by removing a ring of bone around the foramen rotundum. I have already shown that the ganglion cannot be wholly removed from its bed, but only a small portion. This operation therefore resolves itself practically into section of the branches of the lower two divisions of the nerve just within the skull. In Mr. Rose's first operation the foramen rotundum was reached by resecting the upper jaw. It is quite easy, however, to reach the parts by the Pancoast-Salzer method without resorting to this procedure, and, moreover, in Mr. Rose's case the eye was lost—a grave consequence, which is avoided by the method I carried out in 1888 of trephining the middle fossa through the pterygoid region.³⁹

It may now be asked, do the results of the operation in those cases of inveterate facial neuralgia justify the procedure? This question presupposes a previous one, namely, what is the condition for which the operation is undertaken? In other words, how is the operation supposed to act? Bell long ago suggested that section of the nerve in these cases produced an alterative and tonic effect on the nervous system. Erb⁴⁰ agrees with Bell in thinking that the "strong peripheral stimulus of the operation is the cause of the disap-

pearance of the neuralgia." Tripter⁴¹ regards facial neuralgia as probably due to some central change, and that a temporary inhibition is caused by the operation. Some cases, he thinks, may be peripheral, and may disappear if the irritant be removed. Wagner⁴² also believed that the mischief is central. Carnochan attaches great importance to Meckel's ganglion in the production of neuralgia, and an essential in his operation was the removal of this. And even with this idea as to the origin of the pain and the consequently less radical operations undertaken for its relief, the success has been so marked as to convince many surgeons of the usefulness of operative procedures. But I hold very strongly the opinion that epileptiform neuralgia is a purely peripheral malady, affecting principally the small subcutaneous branches of the nerve, or possibly the nerve endings, as well as the trunks of the fifth nerve, as they run in the bony canals of the facial bones, and that complete removal of the pain in any given division of the nerve may be obtained by ablation of the nerve from the base of the skull, unless the stump of the nerve become the seat of neuritis. (*Vide* Case I in the accompanying table.)

All other measures, for example, stretching, simple division, destruction of the nerve in a bony canal by the drill or trephining, may, and undoubtedly do, give relief for a varying period, but the disease is extremely likely to recur in the stump or trunk as soon as the paralyzing effects of the operation have passed off. I do not believe there is such a thing as reflection of pain along other branches, and certainly no proof of its existence is to hand, although it is freely spoken of as occurring. If pain is felt in two branches, for example, infraorbital and inferior dental, that means, I believe, disease of both those nerves. It is true that after operation on the nerve most affected, drugs such as gelsemium, etc., may so reduce the irritation in the other nerve as to render life tolerable and efficient, but in the end the remaining nerve, so far as I have seen, usually has to be extracted before permanent relief is obtained.

In this opinion I am supported by several authorities, and the evidence which they offer I shall discuss in a subsequent paper in the *Practitioner* on the pathology of this condition, in which I also hope to advance fresh evidence from cases of my own. Holding then as I do this opinion, I believe that operative procedure in those cases is an imperative duty when all medical measures of relief have failed. It is true that in many cases operation is not followed by that permanent relief which is aimed at, and this no doubt arises from several causes. One of these I believe to be the

³⁹ In Mr. Rose's second operation (*vide Lancet*, 1891) he employed the Pancoast-Salzer method and opened the foramen ovale.

⁴⁰ *Von Ziemssen's Cyclop.*, xi, p. 95.

⁴¹ *Rev. de Chir.*, Paris, 1879.

⁴² *Langenbeck's Archiv*, vol. xi.

excision of too short a piece, permitting reunion of the cut ends. It is stated by Hütter¹³ that experiments show that not less than 5 inches must be removed to prevent reunion with certainty. Although I am inclined to think that this is an excessive length, there seems to be little doubt that a considerable gap between the divided ends can be bridged over, but I am convinced that in many of the cases in which a return of pain after neurectomy is ascribed to reunion, the result is in reality due to the occurrence of neuritis in the stump of the nerve, chiefly because the wound was not treated antiseptically. Another reason for a want of permanent relief after neurectomy is, I believe, because the nerve is not fully freed in the bony canal. If the neuritis does not frequently start in such a place, it is, I am sure, often very intense there, and the free removal of nerve in the canal, or the removal of bone so as to widen the aperture and prevent pressure, is essential. Then, too, if the neuralgia has persisted long, it is necessary to go far back, and a minor operation on the anterior portion of a nerve trunk may be followed by a recurrence of the pain within a short time. I believe it is necessary to divide the nerve as near its origin as possible, so as to sever it where it is still healthy.

It is exceedingly difficult to get statistics as to the duration of relief after operations for this affection. Many cases are reported as cured after a few weeks or months, but there is nothing to show that the relief lasted even for a year. In many cases it is known to recur within that time, but I think that if the principles I have laid down are followed, recurrence will occur far less often than it has hitherto.

The occasions on which I have obtained what may be regarded as absolute cure or have observed recurrence of pain are grouped together in the accompanying table, which has been constructed so as to exhibit at a glance not merely the direct effect of the operation, but also the surgical details of the procedure, and the success or failure of the same.

The conclusions I would draw from this table are, that as soon as drugs and electricity have definitely proved unequal to the task of controlling the pain, the branch of nerve affected should be excised. The rapidity with which the wound heals and the absence of a noticeable scar deprive the procedure of obvious drawbacks, while the genuine nature of the relief it affords, in contrast to other methods, is shown by the fact that patients once operated upon will hardly wait to hear of other treatment if some other branch become affected.

PRELIMINARY NOTE ON A NEW CHROMOGENIC MICRO-ORGANISM FOUND IN THE VESICLES OF HERPES LABIALIS. "BACILLUS VIRIDANS."

By WM. ST. CLAIR SYMMERS, M.B.

[From the Pathological Laboratory of the University of Aberdeen.]

Source of the Micro-organism.—It was found in great numbers in the lymph of herpetic vesicles which occurred on the lip of a boy suffering from typical acute croupous pneumonia. The lymph was gathered on the fifth day of the disease, the vesicles being then two days old.

Biological Observations.—The microbe grows luxuriantly on many nutrient media: on some it elaborates a beautiful pea-green pigment which permeates the medium, while the microbe itself is, when seen in mass, uncoloured, and has a greyish-white appearance. Light has no effect upon its growth or chromogenic powers. It flourishes well at ordinary temperatures, but grows somewhat faster when kept at a temperature of 100° F. It is aerobic to a certain extent, inasmuch as it flourishes best in contact with atmospheric oxygen, but still it is facultatively an anaërobe, and can grow, though slowly, in the absence of air—for example, in an atmosphere of pure hydrogen. Although, however, the microbe grows abundantly in absence of air, it cannot then produce its peculiar pigment.

Among other experiments the following was arranged. The microbe was inoculated on the sloping surface of a tube of Koch's nutrient gelatine, the whole being immersed in hydrogen gas, and care, of course, being taken that the air in the test tube was replaced by hydrogen. The gelatine slowly became liquefied, the whitish organismal mass sank to the

bottom of the now fluid gelatine, which remained a perfectly clear limpid amber in tint. Upon removing the test tube from the hydrogen, and thus readmitting air, the solution soon took on the usual green colour. From this and analogous experiments it was concluded, first, that the organism could live and vegetate apart from oxygen; secondly, that for the full production of the pigment oxygen is absolutely necessary; and, thirdly, that the green pigment is not secreted as such, but, in all probability, as an immature substance which easily gives rise to it on contact with oxygen.

On the other hand, the microbe on some media grows most luxuriantly, and, notwithstanding the presence of oxygen, does not produce pigment; for example, on cocoanut, on potato, etc., it grows readily, but produces no pigment. Again, the usual media in which the pigment appears may, by the addition of an antiseptic, such as creasote, be rendered unsuitable for the elaboration of the pigment, while still affording a rich nutriment for the microbe. Thus, if 1 per cent. of creasote be added to bouillon the medium soon becomes cloudy after inoculation with the microbe, but no pigment appears; the cloudiness deepens into milky opacity in time, the fluid teems with well developed microbes, but the pigment is not present even in the faintest degree. These are merely temporary aberrations in its physiological activity, nor has it yet been possible, though many attempts have been made, to obtain the organism disassociated permanently from its chromogenic attribute. As soon as the organism has been placed in proper surroundings the pigment-forming power reasserts itself. The proper surroundings consist, then, in a suitable nutrient medium, such as Koch's gelatine, in the presence of free oxygen, and in the absence of such restraining influences as antiseptics. Given these conditions the microbe, no matter through how many generations its power of pigment formation has lain dormant, at once rises to its old activity and produces the green as beautiful as ever.

In the accompanying lists A and B are to be found the media which are best suited for the elaboration of the pigment, and also those which do not offer such occasion. It is understood, in both cases, that abundance of free oxygen has been supplied.

A. Pigment Formed.—On agar-agar (neutral), on agar-agar plus 6 per cent. glycerine, on agar agar (alkaline), on Koch's gelatine, on Koch's gelatine (alkaline), on bouillon, on blood serum, on milk, on cocoanut water, on cocoanut water and gelatine, on tuberculous sputum, on fish broth, on Wassermann's fluid,¹ on Wassermann's fluid plus 1 per cent. of milk sugar (very good), on Beyerinck's medium.²

B. No Pigment Formed.—On agar-agar (very acid), on Koch's gelatine (very acid), on potato (both acid and alkaline), on beetroot, on turnip, on carrot, on parsnip, on cocoanut, on urine.

Morphology.—The microbe occurs either as a rod or thread form. The threads are either in true or pseudo-filaments, that is either as long solid filaments or as strepto-bacteria. The filaments are mostly solid, without septae; they are sometimes very long, with tapering ends, often twist back upon themselves, curving in various directions, and are flexible. Neither cocci nor spirals have as yet been seen, although attempts have been made to obtain such forms artificially after the manner of Charrin, with bacillus pyocyaneus.³ Free spores do not occur as a rule, but by influencing the growth of the bacillus by means of antiseptic or other poisonous substances, cylinders filled with spore-like bodies have been obtained. Dumb-bell and drumstick forms have also been found in great quantity, the drumstick forms being similar to those of the bacillus of tetanus. The fact of the above being true spores is perhaps not beyond doubt. It may be mentioned that no green-producing organism hitherto described has been observed to form spores, the only exception being the bacillus pyocyaneus, in which Professor Ferrari, of Catania,⁴ has, contrary to many observers, described their formation.

The Pigment.—I have not been able to separate this in a pure form as yet. It is, as seen in solution of melted gelatine, dichroic, green by reflected, and straw yellow by transmitted, light. It is difficult to see it by gas light. When several weeks old it changes colour, gradually becoming like burnt sienna, and ultimately assuming a crimson tint in addition to the sienna colour. Both mineral and organic acids decolorise it without destroying it; on neutralising with an alkali the green colour returns. Boiling has no effect upon it. Liquor ammoniæ intensifies the normal green colour; and in media which do not appear to contain the pigment it

¹ *Annales de l'Institut Pasteur*, 1887, p. 591.

² SUPPLEMENT TO BRITISH MEDICAL JOURNAL, January 10th, 1891.

³ Charrin, *La maladie pyocyaneuse*, Paris, 1889.

⁴ *L'Ateneo Medico Parmense*, 1889, page 115.

¹³ *Grundriss der Chir.*, i, 144.