principle does not neutralize in the least the staphylococcal lytic principle, and vice versa. This result cannot be brought into harmony with the view of d'Herelle, that there exists only one type of lytic virus capable of adapting itself to different bacteria. Were such an opinion correct one and the same antilytic serum should annihilate this virus whatever might be the bacterial species under experiment. On the other hand, the result agrees with the opinion that the lytic principle is in reality derived from the bacteria themselves. In fact, principles elaborated by widely different bacteria should likewise be distinct and distinguishable by means of the corresponding specific serums; such is, indeed, the experimental result.

When two conflicting theories are to be tested, it is convenient to follow them in their logical consequences under certain experimental conditions. For example what is likely to occur when an extremely slight amount of lytic principle is mixed with a very large quantity of living *Bacillus coli*? Logically, if the agent be not a virus but a substance, it may be anticipated that in such a case it will not be regenerated. The very slight amount of lytic agent will indeed be distributed between so many microbic individuals that each of them, being not sufficiently touched, will not reproduce the principle. This is exactly what is shown by the adequate experiment—the principle wholly disappears and cannot be recovered. Were the principle a virus, it could not be satisfactorily explained why this living being cannot multiply under such conditions, when a large number of microbes are present—that is, when the virus is supplied with a large quantity of food. Of course, in a control experiment, the same amount of principle is mixed with a rather thin bacterial suspension; then its quantity obviously increases.

But what shall we observe if, in a similar experiment, the number of the microbes, although still considerable, is somewhat lessened, the dose of principle remaining the same? Then the quantity of principle absorbed by each microbe, although still very slight, is somewhat larger than before. Then the influence of the principle will be not strongly, but perceptibly, felt, the consequence being that the microbe, moderately touched, reproduces a principle which, correlatively, is endowed only with a moderate potency. The principle is reproduced, but the properties of this reproduced principle are not identical with those of the original principle. And the difference is not of a quantitative but of a qualitative nature. The new principle thus obtained may be unceasingly and very abundantly regenerated by means of passages through successive bacterial suspensions, but it shows special characteristics, and henceforth keeps them permanently. It is a weak principle. When added to broth inoculated with *Bacillus coli* it only prevents the growth during a short period; the liquid becomes turbid after some hours, and the opacity is not markedly clarified afterwards. The weakness of such effects is not due to the fact that henceforth the liquids obtained only contain a slight amount of lytic agent. Those liquids, indeed, still work when extremely diluted. In this respect the new principle is in no way different from the strong original principle. But it works always feebly, even when present in a large dose. It actually is attenuated.

Quite similar results are obtainable by means of somewhat different procedures. For instance, if a droplet of strong lytic principle is deposited on an agar surface which has just before been inoculated on all of its points with *Bacillus coli*, the spot touched by the lytic fluid remains bare, whereas around it a normal abundant growth occurs. But after several days one may perceive that through a slow process of diffusion traces of principle invade the margin of the thick bacterial layer, thus causing there a faint clarification, a partial lysis. Of course, the amount of principle thus brought by diffusion into this zone is extremely slight in proportion to the number of microbes. Now, if some of the latter germs are removed by means of the platinum needle and inoculated into broth, a very weak principle is obtained which subsequently remains such when reproduced. Were the lytic agent a parasite, it would appear that among those parasites only the less virulent ones are capable of penetrating gradually into the bacterial layer surrounding the clear spot. This is not very likely.

A weak principle may yet be obtained even when the amount of principle is somewhat larger in proportion to the number of microbes, provided that the contact of the microbes with the surrounding fluid containing the principle be only very short, a condition which is easily performed by removing after a proper interval a droplet of the mixture and spreading it on an agar surface. Some translucent spots showing a

partial lysis soon appear, from which a culture giving a weak principle may be obtained.

Without dwelling longer on the details, we may state that from the primary strong principle new types of principle may derive, different as regards the energy of their action, and that the virus theory does not account readily for the occurrence of such modifications, the conditions under which they appear being taken into consideration. From this point of view, as well as in many other respects, the virus theory is open to criticism. But far from asserting that the problem is solved, I frankly confess that the other views, even the one which I deem the most probable, still lack indisputable demonstration. Many efforts will still be necessary; the mystery is not disclosed. I hope that this interesting problem will attract the attention of many biologists, especially of British scientists, since the study of the subject originated in your own country.

MALIGNANT DISEASES OF THE BREAST:

WITH SPECIAL REFERENCE TO THE SUPRACLAVICULAR
EXTENSION OF THE OPERATION.

BY

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In 1902 I published, in the *Bristol Medico-Chirurgical Journal*, a paper on "The results of operation in 54 cases of cancer of the breast." The paper I now publish is based on a study of all my cases of operation for malignant tumours of the breast (including the first series of 54). Of the 251 cases, 242 were cases of glandular cancer, and most of them were of the scirrhus form; 3 were cases of the very much less malignant duct cancer; and 6 were cases of sarcoma. In order to ascertain the late results I have investigated the records of 120 consecutive cases, operated on during the ten years preceding October, 1921, so that any non-recurrence would have extended over at least three years.* There were 120 operations for ordinary glandular cancer of the breast in this period—October, 1908, to October, 1918. The 120 cases do not include one case of duct cancer which I operated on during this period, for the reason already mentioned.

How the Investigation was Conducted.

I found in my records of these 120 cases a note as to the late results in 66. I wrote to the remaining 54 (or their doctors) to inquire as to the late results. What I have endeavoured to discover is the proportion of cases with local recurrence, because it is only this form of recurrence which could be prevented by a more extensive operation. I regard as local recurrence—recurrence in the pectoral region† (including that area of the chest wall), the axilla, the supraclavicular region, and growth attached to, but not starting in, the sternum, and even growth in the skin of the back of the chest, on the side of the operation. I have never seen any recurrence towards the upper abdomen. Recurrence in the other breast, or the opposite supraclavicular region, or axilla, or one in the mediastinum, I have not regarded as a local recurrence, as no operation short of removing both breasts, or the fatty and glandular contents of both axillae, and supraclavicular regions, could prevent it.

I have been able to trace the late results as to local recurrence as above defined in 80 of the 120 cases. Of the remaining 40 cases some died with distant metastasis without local recurrence before the end of three years after the operation, others died also during this period of intercurrent disease, and in some cases the cause of death was unknown. In many cases, as I expected, the post office returned my letter of inquiry, as they could not trace the persons to whom they were addressed. This of course most often happened with the earlier cases in the ten years' series. But I was glad to find that a considerable number of those of whom I had no note of late results did receive my letter of inquiry, and were able to reply that they had been free from recurrence for many years. And I am grateful to several medical men

* The statistics on which this paper is based were prepared early in 1922.

† By pectoral region I mean not only the area originally occupied by the breast, but the infraclavicular, the lateral aspect of the chest below the axilla, and the region over the sternum.

who were good enough to make inquiries for me as to the condition of their old patients. Amongst these 40 cases which I have eliminated is also counted one case in the 120, in which I could not remove the entire growth at the operation.

Nine patients died within three years of the operation, probably or certainly of distant metastases without local recurrence (or were so ill when I last heard of them that they almost certainly died later). In one case the growth was in the liver and bones; in another in the other breast with general dissemination; two had symptoms suggesting growth in the spine; one had growth in the stomach, another in the mediastinum and abdomen; two had symptoms that might have been due to intrathoracic growth, and one had symptoms that seemed likely to be due to an abdominal growth. I have included amongst the 40 eliminated cases one case of death soon after the operation with disseminated growth, but I could not ascertain if this included any local recurrence; and also another case of death with symptoms of spinal growth, which appeared after three years from the operation, and here again I am not sure whether there were any local recurrence or not.

Results as to Local Recurrence in 80 Traced Cases.

There were 37 cases free from recurrence three years or later after the operation, or 46 per cent., and 43 with local recurrence. Of the 37, 25 had no recurrence five years or later after the operation, or 31 per cent.

It is necessary to mention a few details with regard to some of these 37 cases. One died ten years after the breast operation, of cancer of the pelvic colon causing obstruction, with numerous secondary growths in the liver. It was certainly a primary and not a secondary growth in the colon; it had the appearance of a small typical constricting growth of that nature, and there is no doubt the growth in the liver was secondary to it. One patient three years after the operation suffered from laryngeal paralysis, presumably due to a mediastinal growth, and there was a nodule the size of a small shot in the supraclavicular region, on the side of the operation; but it had not enlarged for six months, and it is therefore very doubtful if it was a nodule of recurrent growth. In another patient a small nodule was present in the supraclavicular region; it had only very slightly increased in size in eighteen months, and could not be definitely diagnosed as a recurrent nodule of growth.

In another case growth was found in the remaining breast five years after the other had been removed. One woman who was operated on in April, 1907, wrote in answer to my recent inquiry saying that I had examined her in November, 1908, and had then said "that the old trouble was making its appearance again," but that she had been cured by a herbalist, and was then (four and a half years after the operation) quite well. I have no note of the examination in November, 1908, and I have included her in the list of non-recurrences after three years, notwithstanding her story, and I think most readers of this paper will agree that I am justified in doing so.

Of these 37 cases of non-recurrence after three years, one was known to be free from recurrence four years after the operation; 5 five years; 2 six years; 2 seven years; 4 eight years; 7 nine years; 2 ten years; and 3 eleven years.

In 34 of these 37 cases a microscopic examination showed carcinoma. In the two cases in which no such examination was made (both private cases) the growth was absolutely typical naked-eye; one of these was the case I have already referred to, in which four years after the operation paralysis of one recurrent laryngeal nerve developed—one presumed from some recurrent mediastinal growth. In the third case the growth was a very interesting but a very malignant one. It was a soft tumour of white friable tissue, and the skin was so red and oedematous over it that it suggested a pointing abscess. Microscopic sections showed what might be regarded as a round-celled sarcoma, but one pathologist, of large experience, regarded it as an endothelioma. The usual complete operation for cancer of the breast was performed, and she was free from recurrence nine years later. I have included the case with the carcinomatous growth, rather than the sarcomatous growth, as its exact pathological classification was not easy. The rapid way in which it grew, with signs of inflammation of the overlying tissues, shows that it was a very malignant growth.

It should be clearly understood that the 43 cases of recurrence out of the 80 cases in which the late result was known represent only local recurrences—that is, recurrences which are suggestive to the surgeon as to the advisability of a more extensive operation, recurrences which possibly might not have taken place if the primary operation had been even more extensive than it was. To get the percentage of recurrence which affects the outlook of the patient we must, of course, add to these 43 all the cases of distant metastasis occurring in the 80 cases in which there was no local recurrence, and therefore are not included in the 43. They were eliminated as fatal within three years of the operation, without any local recurrence, and therefore useless for ascertaining the proportion of local recurrences after three years. They were 9 in number, and details of them have already been given (p. 178). If we add them to the 43, and the

80, we get 52 recurrences in 89 cases, or 57 per cent., which leaves 37 out of the 89 as free from recurrence after three years, or 43 per cent.; this means that not quite half, but nearly half, the cases remained free from any form of recurrence after three years.

It is also necessary to mention a few details with regard to some of the 43 recurrent cases. One apparently recurred after five years. I presume this was really a local recurrence, and have counted it as such. The patient wrote, in answer to my recent inquiry, that a small lump had formed in the pectoral region eight years after the operation, and had lately slightly discharged, and had scabbed. She now lives far from Bristol, and I have had no opportunity of examining her, but the presence of a discharging lump certainly sounds very suspicious. In another case recurrence was noticed five years after the operation, and in yet another four years after. Eight years seems a very long time for cancer cells to lie latent in the tissues. This recurrence took place after the complete operation for a small peripheral growth. I have removed a recurrent nodule of typical scirrhous (naked-eye and microscopic) from a pectoral scar, due to removal of the breast twenty years before by another surgeon. At the same time I removed the thyroid gland which was full of cancerous nodules, probably also secondary. One case counted amongst the 43 local recurrences was only a local recurrence after the other breast had been involved and was probably secondary to it. At three and a half years after the operation the patient was quite free from any form of recurrence.

I should perhaps say that I have not included amongst the 43 cases of recurrence one in which, eighteen months after the operation, a nodule the size of a pea appeared in the supraclavicular region, but one year later it had only doubled in size, and no other nodules had appeared. I was doubtful if it could be a cancerous nodule. Nor have I included a case in which a very small nodule appeared in the supraclavicular region four years after operation, but was only very slightly larger eighteen months later, and by that time the disease had appeared in the other breast.

The 120 cases the late results of which I have specially investigated included quite late and unpromising cases. So long as it seemed probable that I could remove the whole disease I have always undertaken the complete operation. Within the last three years (and therefore not included in these 120 cases) I removed the whole disease in a woman who had been discharged from another hospital as suffering from a disease too far advanced for operation. I certainly feared an early recurrence, but it seemed to me a distinct advantage to remove a large growth which would soon have been an ulcerating one, if the whole visible and palpable disease could be removed at the same time.

Position of Locally Recurrent Growth.

I have investigated the position of all the local recurrences I have myself observed and noted in the 185 cases of cancer of the breast included in the present series. I find that recurrence has been most frequent in the pectoral region (31 instances). In 8 the recurrence was in the skin of this region, but this skin may have been dragged into the exact position in which it was left after the operation, after its extensive undermining, to close in the large gap left by the removal of skin around the growth. Yet it was skin from some part of the pectoral area, defined in the comprehensive way I have done in the earlier part of this paper. In 26 cases growth recurred in the deeper parts of the pectoral region; in 15 of these it was not fixed to the chest wall, and in 11 cases it was so attached (ribs or intercostal muscles). In 8 additional cases, not included amongst the pectoral ones, it was attached to the sternum. There were 20 cases of supraclavicular recurrence—two-thirds of the number of pectoral ones. I was surprised to find that even with the very complete axillary clearance there were as many as 7 axillary recurrences. One of these was in the skin (which may not have been originally axillary skin) and 6 in the deeper part of the axilla, but these did not appear to be glandular. There were two recurrences in the skin of the back, between the scapulae, and one in the latissimus dorsi muscles. In no case did I ever meet with a recurrence in the downward direction—that is, between the original position of the breast and the upper abdomen—and I have never made a practice of any special clearance of the tissues in this direction. In my first series of 54 cases (not included in these 185) I did not specify the exact locality of the recurrence, but I said: "The great majority of the recurrences have been in the skin, subcutaneous tissue over the great pectoral muscles, or in the surfaces of the muscle itself." That corresponds to the result of my investigations in these 185 cases—that most of the recurrences are in the pectoral region, but there has been no recurrence in the remains of the pectoralis major or in the minor. In this first series I also noted occasional recurrence in the supraclavicular glands, and I wrote: "The fact that

in several cases the supraclavicular glands were involved* points to the advantage of a systematic removal of the glands from above the clavicle at the first operation, as Halsted now does, even though they cannot be felt to be enlarged."

I have further investigated the exact position of the pectoral recurrences which were not in the skin, to see if they frequently took place in any special locality, that could in the future be even more thoroughly cleared out than is done at the present time, or which would make it desirable to leave a tube of radium in the special locality, as has been advised should be done in the upper interspaces close to the sternum, a part which has been considered specially liable to recurrence. I have not found recurrence specially common in any particular area of the pectoral region, and indeed have only twice met with growth in the upper intercostal spaces close to the sternum. The following list will show the exact locality in the pectoral region in which growth recurred. It does not include growths on the sternum. Recurrence might be in any part of the skin; in the deeper parts it was situated as follows:

- 1, Deep tissue of chest wall just below axilla.
- 2, Two small subcutaneous nodules just below the inner end of the clavicle.
- 3, Deeper tissues in various directions.
- 4, Nodule attached to first rib just below clavicle, but only attached to rib by scar tissues, and easily dissected away.
- 5, Cartilage of third rib (and sternum).
- 6, A few subcutaneous nodules just under clavicle.
- 7, Diffuse subcutaneous recurrences.
- 8, Subcutaneous tissue.
- 9, Second and third interspaces close to sternum (and over sternum); this was removed, but it was necessary to resect the second costal cartilage, and it recurred again in six months.
- 10, This was not a recurrence, but an extension of the disease found at operation and not removable; it was in the intercostal muscle of the first interspace close to the sternum. An overlying nodule of growth attached to the first rib was removed and disclosed the deeper growth.
- 11, Nodule in intercostal space where nipple had been, and shot-like nodules in deep tissue below inner end of clavicle (removed).
- 12, Nodule under remaining strip of great pectoral, below clavicle and towards axilla.
- 13, Nodule just below clavicle, fixed to ribs.
- 14, Nodule fixed to fifth costal cartilage at junction of sternum.
- 15, Nodule on third rib close to sternum.
- 16, Nodules in region of scar, some movable, and others fixed to ribs.
- 17, Nodules fixed to chest wall under scar.
- 18, Diffuse nodules in pectoral region, some fixed to chest wall.
- 19, In subcutaneous tissues of pectoral region.
- 20, Nodule fixed on chest wall between third and fourth ribs, below axilla.

Mortality in the 248 Cases.

Four patients died from the operation (1.6 per cent.), and two not directly from the operation but within three weeks of it. Of the deaths due to the operation one was from sepsis in the wound. This was certainly most regrettable, but, as usual when sepsis does occur in a wound that should run an aseptic course, it was impossible to detect the flaw in the antiseptic precautions. It was a hospital case. Another of the deaths was due to an obscure condition. There was marked pyrexia, which commenced the day after the operation, and redness and swelling of the skin of the loin appeared, and the patient died on the fourth day. The wound was opened up and examined after death, and there was no trace of suppuration in it. There was one death from the anaesthetic (ether). The patient ceased breathing while I was making the first incision, and the pulse, which up to that time had been good, also failed. At the necropsy the heart was found to be the seat of fatty degeneration and there was emphysema of the lungs and granular kidneys. She was aged 66. The fourth case was a very remarkable one. The patient had great deformity of the chest, from scoliosis, and she became very cyanosed during the anaesthesia, but improved with the administration of oxygen; but the cyanosis recurred after the operation without any physical signs of disease in the chest, and proved fatal at the end of the second week after the operation, when the wound had soundly healed. This case should more correctly be regarded as a death from the late result of the anaesthetic than from the operation—if, indeed, it was really the result of either.

Of the two cases of death within three weeks of the operation, but not directly due to it, one was a woman aged 72 who died on the tenth day with primary cardiac failure, after the wound had healed. Valvular disease and degenerative changes in the heart muscles were found *post mortem*. In the other case, a woman of 62, death occurred on the nineteenth day after the operation from an obscure abdominal condition. The wound had soundly healed.

THE SUPRACLAVICULAR EXTENSION OF THE OPERATION.

Since I began to clear out the supraclavicular space in 1902, I have removed the fatty tissue and contained glands from

*By recurrent growth.

this region in 126 cases in which no glands could be felt there before operation, and in 10 cases, or 7.8 per cent., I discovered and removed cancerous glands, or at any rate cancerous nodules. This is a slightly lower percentage of cases with cancerous growth than I gave in my letter to the *BRITISH MEDICAL JOURNAL* (1921, i, 173) for the smaller number of 30 cases. I was not at that time able to search through a larger number of my records, but took 30 consecutive cases, and in these 30 cases I found 3 of supraclavicular growth, undiscovered until the supraclavicular region was opened up. A more extended search through my records (126 cases) reduced the percentage from 10 to 7.8. In one case, in which I found cancerous glands above the clavicle, I was doubtful as to their presence before operation, and therefore I have not included it amongst the 10.

In one case in which the supraclavicular space was cleared out, although the disease recurred in the other supraclavicular region, after first recurring elsewhere, yet it did not do so on the side where the supraclavicular region had been cleared. This was in a case in which the growth recurred on the sternum, and in the upper intercostal spaces on the side of the original operation, and in the other breast, and the supraclavicular region of that side. In several cases in which the supraclavicular region was cleared out at the primary operation, although a few small glands appeared there later on, yet the proportion of the recurrence then was very small compared to the recurrence elsewhere. This was so in one case of extensive recurrence in the opposite axilla and supraclavicular region, and in the pectoral region on the side of the primary growth, but only one small gland could be felt in the supraclavicular region of that side. In another case in which the growth recurred two years and three months after the operation as a mediastinal growth, and in the opposite supraclavicular region, it did not recur in the supraclavicular region on the side on which the supraclavicular tissue had been removed at the breast operation. In a third case there was recurrence, a year and nine months after operation, on the sternum and in an intercostal space in the pectoral region on the side of the primary growth, and in the supraclavicular glands on the opposite side, but not in the supraclavicular region on the side which had been cleared out at the last operation.

But when the tissues of the supraclavicular space have been cleared out, even in cases in which no growth is found there, as well as those in which cancerous glands or nodules have been removed from this region, yet growth does recur there. Out of the total of 126 supraclavicular extensions of the operation, 90 were in the 120 cases specially investigated as to recurrence. In 6 of these cancerous growth was discovered to be present above the clavicle before operation, and in the remaining 84 cases it was not discovered before operation. Out of these 84 cases, in 20 growth recurred above the clavicle. This seems very discouraging to those of us who perform the supraclavicular extension of the operation, but it is not really as bad as it seems, for if the 20 cases are analysed it is found that in 13 out of the 20 the growth was either removed (5) or was almost certainly removable (8), and could have been removed but for irremovable recurrence elsewhere; and in some of the remaining 7 cases the recurrence could, I think, possibly have been removed. So that the important fact which is evident is that in 7 of the 20 cases there was a supraclavicular recurrence which was very likely not removable, but even if so, no doubt most of the growth could have been safely removed, and a buried tube of radium might very probably have removed what was left. In the cases in which the growth could almost certainly have been removed it recurred in the form of small movable glands. In one of the cases in which it was removed I had to remove the lower end of the internal jugular vein with it, as it was firmly attached to it.

Analysis of Recurrent Growth in the Supraclavicular Region.

1. Some hard growth above clavicle.
2. Deep fixed growth.
3. Fixed deep nodules.
4. Cancerous gland, size of small marble, easily removed.
5. Very extensive, but just removable.
6. Small nodules which probably could have been removed except for irremovable recurrence elsewhere.
7. Nodule attached to internal jugular vein, but excised with portion of vein.
8. Hard fixed mass.
9. Several small glands which could probably have been removed, and would have been but for recurrence elsewhere.
10. Only one small gland, which could certainly have been removed, but recurrence elsewhere.
11. Growth that was removed.
12. Nodules which could probably have been removed, but recurrence elsewhere.
13. Several hard glands, probably removable, but recurrence elsewhere.

14. Numerous small hard glands, possibly an extension of mediastinal growth, of which there were suggestive signs and symptoms; probably removable.
- 15 and 16. Fixed nodule behind inner end of clavicle.
17. Deep nodule, removed.
18. Very small and very slowly enlarging glands, that could almost certainly have been removed.
19. Two small removable glands, but recurrence elsewhere.
20. Gland, size of small marble, under outer border of lower end of sterno-mastoid; could quite possibly have been removed.

The question arises: Can we, during the performance of the axillary part of the operation, obtain any indication as to whether or not there is cancerous growth present above the clavicle? I have examined my records of 20 cases in which growth was found above the clavicle at operation (10 in which it was not detected before operation, and 10 in which it was), and I find that I have noted that in 13 of these cases one or more glands of the subclavicular group—the glands lying above and internal to the inner border of the pectoralis minor, just below the clavicle, and around the commencement of the axillary vein—were obviously to the naked eye cancerous. In the other 7 cases my notes do not say if this was the case or not; in all these cases but one, however, there was extensive affection of the other axillary glands, and probably the subclavicular group were also affected. In some of these cases the growth had actually invaded the axillary vein, and a portion of the vein had to be removed with it. But in one case, though a typical small hard cancerous gland was found above the clavicle, there were only a few cancerous glands in the axilla, and those were of no great size. On the other hand, I have met with at least two cases in which there was a cancerous gland in the subclavicular group, and none above the clavicle. But it is certainly a significant fact that in 13 of the 20 cases in which I found growth above the clavicle the highest axillary glands were affected, and may have been in 6 of the other 7. Halsted, however, has said:¹

"The axilla affords no criterion from which we might draw inferences as to the condition of the supraclavicular fossa. Sometimes with an axilla which is involved chiefly in the lower or arm part, and apparently not at all in the upper or subclavian part, we have a neck involved solely at the junction of the internal jugular and subclavian vein."

He also says:

"It sometimes happens, on the other hand, that the neck is not involved although the axilla is a solid mass of cancer. Hence it would appear that for the present our rule should be to operate on the neck in every case."

Professor Rodman of Philadelphia, in a paper he read in this country in 1904,² refers to a set of lymphatic vessels described by Poirier and Cunéo, which drain the upper part of the breast, and pass directly over the clavicle, emptying into the supraclavicular glands, and he says that in all cases in which cancer affects this part of the breast, if situated near its margin, the supraclavicular region should be explored.* Dr. Willy Myer of New York, writing in the *Annals of Surgery* in 1918 (vol. lxviii, p. 22), says he is guided as to whether to clear out the tissue above the clavicle or not by an immediate microscopic examination of the highest infraclavicular glands—the glands lying "very near the angle, between the subclavian vein and the chest wall." If on microscopic examination there is evidence of cancerous infection in these glands, he then clears out the tissue above the clavicle. But he regards, as Professor Rodman did, the situation of the growth in the upper part of the breast as an indication for the supraclavicular extension of the operation, but only if it involves the skin. It seems to me we must be very careful how we are guided by the presence of what may seem to be cancer elements in the glands, remembering the misleading findings in cancer of the rectum, which seemed to indicate at one time that the growth involved such a considerable length of the bowel that it was necessary to excise a very great length of it.

I cannot help thinking that the pathological findings of cancer in 5 out of 6 of the supraclavicular glands examined in Mr. Parry's cases³ does not indicate that in 5 out of 6 cases cancer would have developed in those glands. If so, only 1 out of 6 cases in which the supraclavicular extension of the operation is not performed would be free from supraclavicular recurrence. Halsted, who first practised the supraclavicular extension of the operation, had a very thorough microscopic examination made of the tissue removed from the supra-

clavicular region. Indeed he says: "Only those familiar with the work can understand the amount of labour implied in the statement that a given mass of fat does not contain a cancer alveolus." And yet he found no evidence of cancer in 30 out of 67 cases. But the remaining 37 did not certainly contain cancer cells, for he says that in 14 out of the 67 the exhaustive examination of the tissue had yet to be made to determine this, and that in 14 cases glands were detected in the supraclavicular region before operation; so we must deduct 28 from the 37, and this leaves only 9 cases in 39 in which, with the most exhaustive microscopic examination of the tissue, and without any enlarged glands being palpable before operation, cancer elements, or more fully developed growths, were present, or rather more frequently than 1 in 5 cases.

Having regard to my own experience of finding a cancerous gland or glands (macroscopic) in the highest (subclavicular) group of axillary glands in 13 cases in 20 in which the supraclavicular glands were also infected, and possibly (even probably) in 6 of the other 7—but certainly in these 6 very extensive axillary gland infection—I should be inclined to limit this extension of the operation to cases in which cancerous glands are found in the subclavicular group, or to cases with very extensive gland infection, even if the subclavicular group were not involved; but looking at Halsted's experience (as quoted), which does not refer to very marked axillary involvement, I should hesitate to limit the extension of the operation to the supraclavicular region only to such forms of axillary involvement as my own experience teaches me are usually associated with supraclavicular growth. In cases of small growths in the breast with very slight axillary gland enlargement, as found on opening the axilla, I have in some cases abstained from extending the operation to the supraclavicular region; but, even in cases in which only the lower axillary glands were markedly enlarged or hard, and certainly in cancerous infection of the subclavicular group, from which efferent lymphatic vessels pass to the supraclavicular glands, I shall continue to perform the supraclavicular extension of the operation. It seems to me that if by an extension of the operation—which in the majority of cases does not add to its risk—actual growth can be removed, it is better to do so rather than trust to burying in the part a tube of radium; and tubes of radium would have to be much more plentifully distributed about the country than at the present time if that is to become the routine operation for the hundreds of cases of cancer of the breast that are operated on. If, however, the condition of the patient is such that an extension of the operation is contraindicated, then the burying of a tube of radium may be indicated. I must confess that I have in some cases abstained from performing the supraclavicular extension of the operation, when the growth has not been advanced or the axillary infection marked, if the patient has had a very short fat neck, for in this condition the clearing out of the tissue in the supraclavicular region is by no means easy, and there is also a great difficulty in keeping the bandages which fix the neck dressing in good position.

It might be thought that, recognizing the fact that I have had 20 cases of recurrence in the supraclavicular region after clearing it out at the primary operation, I should abandon the extension of the operation. But we must remember that in 5 cases the recurrence could be removed, and in 8 other cases it was almost certainly removable, and would have been removed but for the presence of irremovable growth elsewhere, and that quite possibly in some of the remaining 7 cases it might have also been removed. So that the really important fact to recognize is that in 7 cases there was recurrent growth doubtfully removable. But this fact would not prevent me from undertaking an extension which, in suitable cases, hardly adds an appreciable increase of risk. We must remember the undoubted fact that occasionally the surgeon leaves behind cancerous growth which would be visible and palpable if he explored the supraclavicular region, and could be quite easily removed. I therefore still think that the supraclavicular extension of the operation should be carried out as a routine procedure, and only omitted if there is some special contraindication to it, unless the growth is very small and the axilla remarkably free from secondary growth.

Unfortunately, it is only too evident that when the surgeon does clear out from the supraclavicular region all the fatty tissue and glands he can find, yet he leaves microscopic elements of cancer which eventually cause a recurrence in a good many cases. The lesson from this is that it is most important to make the clearance as thorough as possible.

* I have not been able to verify this reference. Is it possible it refers to the lymphatic vessels which are well known to pass from the upper part of the breast to the subclavicular group of glands?

I have always dissected away the tissue as far inward as the internal jugular vein where it lies under the lower end of the sterno-mastoid, drawn up the fatty tissue from under the clavicle, and removed the pad of fat lying under the inner border of the trapezius. It is not an easy dissection, as the space in which to work is so small. Before I finish the dissection I push up the tissue lying deeply beneath the clavicle into the supraclavicular space, with a finger in the cleared-out axilla to bring into view any fat or glands lying there.

The Extent of my Present Operation for Cancer of the Breast.

When I published the first series of 54 cases of this operation⁵ I did not remove the great pectoral muscle but dissected away the pectoral fascia only. I recognized that it was not easy to do this thoroughly as it was so intimately attached to the muscle, and, in order to make sure of its complete removal, in 1902 I excised the sternal portion (or the greater part of it) as a routine proceeding. I have never removed the pectoralis minor as a routine proceeding, for I see no object in doing so, though of course it is most important to take away the fat and glands lying above its upper border just under the clavicle (the subclavicular group). I have occasionally divided or removed it in cases of very extensive axillary growth, in some of which it was necessary to excise portions of the axillary vein with the growth, because division or removal of the muscle gives the best possible access to the whole course of the vessels. But if the pectoralis minor is retained it is, of course, important to spare also the internal anterior thoracic nerve, which supplies it.

In my first series of cases I was very fortunate in being able to trace every case but one. I had 30 cases in the 54 three years or longer after operation, and 9 had no recurrence, or almost 1 in 3, or 30 per cent. This is not as good as in my last series, but it must be remembered I was more fortunate in tracing my cases in the first series than in the last. Possibly the better results in the last series may have been due to the complete removal of the pectoral fascia with the muscle, possibly also to a more extensive removal of the surrounding skin and subcutaneous fat, though this seems doubtful, but certainly, I think, to the routine removal of the supraclavicular glands. In my first series of 54 cases I had no death, but I can confidently say no death in the later series was due to the supraclavicular extension of the operation.

As I have already stated, in dealing with recurrence I do not carry my incision towards the abdomen in order to remove the upper part of the sheath of the rectus or the fascia over the external oblique muscle. I have never seen a recurrence in this direction. Nor have I adopted the method of first clearing the axilla, and then later removing the breast and surrounding tissue. It seems to me that the chest wall, left exposed by the removal of the breast and surrounding tissue, can always be covered with a towel wrung out of hot saline while the surgeon is clearing the axilla; and I do not see any very decided advantage in dividing the small branches from the axillary artery which supply the breast before removing it. It is not as if one could tie one large vessel in the axilla, and thus render the removal of the breast almost a bloodless operation. The largest vessels are the perforating branches of the internal mammary artery, which are divided in the removal of the great pectoral muscle. I always begin the axillary clearance by dissecting out the fat and glands around the axillary vein above the upper border of the pectoralis minor, and as I do not remove, or even divide, this muscle in most cases, the space is best reached after the breast and great pectoral muscle have been removed.

I do not find the operation I practise, even when to it is added the supraclavicular extension, though a lengthy proceeding, a shock-producing one; only very seldom has the patient suffered from shock, even with this extensive dissection. I have had no fatality from shock in the 251 cases. In a woman of 79 for whom the complete operation for cancer of the breast was performed on one side, and an innocent cyst was dissected out of the other breast, there was no shock, and it was also absent in several women over 70 years of age. In one case, in a woman of 66, I removed both breasts, both great pectoral muscles, and cleared out both axillae at the same operation, without shock.

None of the 120 specially investigated cases were treated by *x* rays after operation, and yet 46 per cent. were free from local recurrence after three years, and 30.2 per cent. after five years. This compares well with the statistics of a series of

cases treated by *x* rays, referred to in the BRITISH MEDICAL JOURNAL (1921, ii, 411). This treatment by *x* rays seems a most reasonable method, for if *x* rays can cause the disappearance of cancer nodules, as I know from my own experience they can, how much more likely are they to destroy those cancer cells lying in the tissues which will ultimately grow and form a recurrence? But as far as the statistics quoted in the BRITISH MEDICAL JOURNAL indicate, cases not treated by *x* rays seem to remain as free from recurrence as those treated by it.

REFERENCES.

¹ *Annals of Surgery*, 1903, vol. xxviii, p. 573. ² BRITISH MEDICAL JOURNAL, 1904, ii, p. 825. ³ *Ibid.*, 1921, i, p. 93. ⁴ *Annals of Surgery*, November, 1898, p. 571. ⁵ *Bristol Medico-Chirurgical Journal*, 1902, p. 305.

CATARACT EXTRACTION FOLLOWED BY SYMPTOMS SUGGESTIVE OF SYMPATHETIC OPHTHALMIA.

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On the same evening I happened to read two very suggestive papers: the first was that of Sir William Willcox which appeared in the issue of the BRITISH MEDICAL JOURNAL of January 13th, entitled "The clinical, pathological, and radiological aspects of inspection of the teeth and gums"; the other was by Professor Trug of Montpellier, entitled "Deux nouveaux cas d'ophtalmie sympathique," which appeared in the *Archiv. d'Ophthalmologie* for July, 1922.

Those two papers recalled to my memory a case which was under my care a few years ago.

The patient was a man well on in middle life who consulted me for defective sight. I found him to be highly myopic, and in each eye there were slight corneal opacities. In addition, however, he had a well marked cataract in one eye, and I advised extraction of the lens. He agreed to this and was admitted to a nursing home. On testing the eye by cultures on serum agar—a practice which I have invariably followed since 1891—I found no growth, and after a few days of systematic douching of the eye I extracted the lens. The operation passed off well, there being a slight escape of vitreous but no other untoward event. The eye was dressed in the usual manner with sterile cotton-wool and a roller bandage for the first few days, and after a period of fully a fortnight he was allowed to go home, wearing dark glasses and with instructions both to himself and to his medical attendant that the eye was to be bathed with sterile saline.

After the lapse of nearly three months I was informed by the medical man in charge that the other eye had become inflamed. I at once went to see him and found that there was a mild irido-cyclitis with adhesions of the iris to the lens capsule and a few deposits on the posterior surface of the cornea. All such inflammations are invariably the result of infection, and therefore the question at once arose as to the source of the infection in this case. I was satisfied that nothing had been introduced at the time of the operation. Everything had been carefully sterilized and no growth had been found on the culture media. On investigating matters I found that his mouth was in a deplorable condition. A number of the teeth in both jaws were much decayed and there were the usual symptoms of pyorrhoea alveolaris. It seemed to me that that condition might be the *fons et origo mali*.

He was at once removed back to the nursing home and each jaw was thoroughly cleaned; all the teeth were removed and a potassium chlorate wash prescribed. The symptoms at once began to ameliorate, and in the course of a few weeks he was able to go home entirely relieved of all acute symptoms and with good useful vision in each eye. That is some years ago, and there has been no recurrence of the acute symptoms; the only indication of the disturbance is the presence of one or two insignificant synechiae which were not broken down by the use of atropine.

Now I do not consider that this was in any true sense of the term a case of sympathetic ophthalmitis, although it presented the usual features of that disease, and I have no doubt would have ended in complete loss of vision had the source of the infection not been discovered and removed. I regard true sympathetic ophthalmitis as almost certainly due to a definite specific micro-organism which has not yet been discovered. Hence we sometimes have severe wounds of the eyeball not followed by this terrible disease, and in other cases we find it following a trivial injury. Such anomalies seem to me to depend on the absence or presence of a specific micro-organism.

Broadly speaking, septic accidents after cataract and other operations on the eyeball seem to me to be readily divisible into two groups. In the first I include suppurations, which mean the introduction of some pyogenic organisms at the time of operation or before the wound has healed.