The extension is then tightened up and a few straps are applied over all to keep the leg firm at times when the patient may be rolled on his side (Fig. 3).

In the first weeks of the treatment of compound injuries any accessory splints will be found merely an encumbrance. When the wounds are in a satisfactory state they can be applied if the fragments do not fall into good position.

After-Treatment.

When the patient is in bed the splint can be conveniently hung from a cradle. For transport the stirrup of the splint should be raised on a small sandbag, so that the leg remains slung in the splint.

The extension must be kept taut. A regulation screw tourniquet, in place of a strap, gives a very excellent method of applying traction (Fig. 4). The crutch will probably want re-covering with jaconet every two or three weeks.

The two parts exposed to friction are the skin over the tuber ischii and (if the extension slips) the skin over the tendo Achillis. No soreness should result if the buttocks are kept clean. If plaster-of-Paris is used as recommended for attaching the extension, pressure is evenly distributed over the foot, and no sore will form.

If the position of the fragments should render some flexion at the knee and hip joints desirable, the splint can

Fig. 4.—Knee splint, in use for a case of fractured tibia and fibula. The foot piece was fitted to control a tendency of the foot to rotate. Note screw tourniquet extension on stirrup.

be bent into a form like a Hodgen. The self-contained extension will still operate to a sufficient degree.

The Arm Splint.

The Thomas's knee splint may be adapted to the upper extremity, and is most useful in treating severe compound injuries of the upper extremity, but is only suitable for use when the patient is lying in bed. The arm splint I have used is bent at a right angle, and is therefore more compact and suitable for transport.

This splint is adapted for the treatment of fractures of the lower two-thirds of the humerus, injuries of the elbow, and fractures of the forearm.

It is made from one full length piece of aluminium, and is completed by a short piece. The figure sufficiently shows its form (Fig. 5). This type is suitable for either

Fig. 5.—Arm splint. The axillary strap is covered by rubber tubing. The long white belt passes round under the opposite axilla. The hand padding is in position for supination of forearm.

side and for any fracture below the upper third of the humerus. The projection beyond the hand is only wanted for applying extension in forearm cases.

The shoulder arch of the splint may be padded by slipping a stout piece of rubber tubing over it. Rubber tubing covers

Fig. 6.—Arm splint applied (diagrammatically). The prolongation in front of the hand is only of use in cases of fracture of the forearm where extension is required.

in the same way the axillary strap, which is attached to two rings made of aluminium ribbon. This strap bears on the two axillary folds, and exerts no pressure on the vessels. The pad for the hand is fixed to the upper limb of the splint if it is desired to put the arm up in supination, to the lower if in the prone position.

For fractures of the humerus long axis extension is obtained as follows: After the shoulder piece has been strapped in place the hand is fixed to its pad, traction just below the elbow to the lower convexity of the splint is made by a belt of webbing or elastic; a short length of Martin's bandage is useful. In Fig. 6 extension is diagrammatically applied with a narrow band of webbing. A piece of composition splinting supplied in the field fracture box is useful if placed on the upper surface of the forearm in order to distribute the pressure.

For fractures of the forearm the humerus is fixed to the posterior limb of the splint, and extension maintained from the extremity of the splint through the plastic loop fixed to the wrist and hand.

A modification of this splint which often proves useful is the substitution of a crutch under the arm for the arch passing over the shoulder. The crutch is kept in place by two straps or bands—one passed over the shoulder, the other passed round the body and under the axilla of the opposite side.

I am indebted to my commanding officer, Major A. F. Steele, for permission to publish these notes.

THE TREATMENT OF MALIGNANT DISEASE BY X RAYS:

ITS PRESENT LIMITATIONS, AND THE LINES
UPON WHICH THEY MAY BE OVERCOME.*

By J. A. CODD, M.D.,
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THE selective action of x rays and radium on cancer and sarcoma cells has been a matter of controversy. But though some extravagant claims may have been made, the fact remains that radium and x rays destroy malignant cells and leave healthy adult cells relatively intact. This is simply an inverse way—and perhaps an awkward way—of expressing the relative vulnerability of the cells. We administer strychnine or physostigmine, and find that these drugs in a widely different way act on the anterior cornual cells of the spinal cord, and leave the other cells of the body comparatively unaffected. We administer atropine and find it acts on the acini of the mammary and salivary glands, the centre for and the fibres of the sphincter iridis, and a few other cells, but leaves the others intact. It is not unusual to speak of these drugs as having

* Read before the Staffordshire Branch of the British Medical Association February 25th, 1915.

a selective action on these particular cells. When, therefore, the expression "selective action" is used, we are thinking rather of the different natures of the things selected than of the specific action of the selecting agency. The selection really lies in the cells themselves.

Whatever theory we may hold, the fact is incontestable that the action of x rays and radium upon malignant and healthy cells is profoundly different, especially in sarcoma, which in many cases will melt down before the rays, while the surrounding tissues are unaffected. The reason of this difference is that one set of cells is embryonic and the other adult. This distinction is demonstrated by the fact that the radiologist, however well he may protect himself and is immune from all other x -ray lesions, yet is bound to suffer from azoospermia, because the spermatozoa are embryonic cells, and are killed even by x rays of high penetration. In other cases—notably hard cartilaginous and fibrotic tumours—the growth is often unaffected in size or appearance, while the skin may be burnt, though it is possible that better results might have been obtained if the penetration and quantity had been greater, and the filter thicker.

There is no treatment for malignant disease (other than complete excision) that gives such good results as that by x rays and radium. The results are so good that one feels that if only the technique could be vastly improved the long-hoped for cure might be realized, and yet they generally fall short to such a degree as to demand progressive endeavour.

There have been alternative rises and fall in the relative estimation in the eyes of the profession and the public of x rays and radium. At first x rays had it all its own way, then soon after its isolation radium held sway. Then once again x -ray treatment was in favour; then, with the filtration method of Wickham and Degrass, radium bounded into favour again. But its limitations were eventually realized, and with the advent of better tubes, especially the heavy target and water-cooled tubes with tungsten targets, we got massive doses of x rays with greater penetration, and for accessible growths x rays are in greater favour than radium.

The two factors necessary for effective treatment are penetration and quantity, and if only both could be secured in abundance in one apparatus the ideal might be obtained. But radium has penetration and very little quantity, while x rays have comparatively little penetration and much quantity. These two factors are comparable to volts and ampères of an electric supply. To get an efficient economic electric supply we must get a product of many volts by many ampères. With the old high tension apparatus we got many volts and very few ampères. With the old batteries we got very few volts and many ampères, but with modern dynamos we get many volts multiplied by many ampères, which produces many watts.

If we could get the penetration of the gamma ray and the quantity of the first-class x -ray tube in one apparatus, we would then get a product equivalent to the watt of our electric supply system, and such an efficiency as we can as yet only dream of. Perhaps a kilogram of radium might do it. I believe 30 grams represents the total quantity of prepared radium now in the world. The therapeutic efficiency of radium depends not on alpha, soft or hard beta, but on the hardest gamma rays, which have a penetration very many times that of the hardest x -ray tubes. They penetrate the body so easily that the bones and solid organs do not stop them, and there is no shadow on the fluorescent screen, which glows almost as brightly as if the body had not been interposed. On the other hand, even when we are dealing with several thousands of pounds worth, the quantity is very minute, a minute fraction of that given out from an ordinary x -ray tube. So that it appears to be along the lines of improvements in x -ray tubes that the solution may come. We have now tubes with tungsten anodes that are capable of standing currents of 3 milliamperes or more for quite long periods, and with a high penetration capable of giving a pastille dose or more through 3 mm. of aluminium. There is, however, a limitation to the practicable hardness of an ordinary tube, for when it reaches a certain hardness (about 10 Benoist), no current will flow through it but sparks pass over it, and eventually pierce the tube.

This difficulty appears to have been overcome in the

case of the Coolidge tube, in which the vacuum is a thousand times more attenuated than an ordinary first-class hard tube; no current could pass through it under ordinary conditions, but the cathode consists essentially of a fine tungsten spiral wire like that of an ordinary metal filament incandescent lamp; it is connected to a battery outside the tube, so that it can be heated to any desired extent, and, when heated, throws off electrons and allows the high-tension current to flow through the tube. The more the voltage of the coil current sent through the greater will be the penetration. The more current sent into the cathode spiral from the battery the greater the quantity of rays got out of the tube, so that both penetration and quantity can be regulated to a nicety. So far the hardest rays yet produced by it fall very much short in penetration of gamma rays. Dessauer of Frankfurt-am-Main claimed that a tube he had produced actually evolves gamma rays, but we have not heard much of it since the war broke out. But, whatever future developments may show, we have theoretically in the Coolidge tube an engine of far greater power than we have had before, and it remains yet to be seen whether in practice its promise will be fulfilled.

It is not desirable to quote any large number of cases. Many of them, especially hospital cases, present a long series of absolutely hopeless lesions, huge fungating, rapidly-growing tumours, sent in the hope of making the remainder of their life more tolerable. Also, owing to the great pressure of work at the hospital produced by war conditions, I have not been able to collate the notes of the hospital cases. The reports given are almost exclusively of private cases, fairly typical of the others, except the very bad cases mentioned above.

The cases that have yielded best results have been those of rodent ulcer. I have had very many of these, and all have speedily yielded, except one in which the floor of the ulcer was formed by the cartilage of the nose. It would heal and break down readily; he came to me from York several times, but each course was far longer than usual, sometimes supplemented by CO_2 snow, but there did not appear to be any finality, and I advised him to have radium, which Dr. Rowden of Leeds applied; he has had no further trouble. But the usual course of treatment is so certain and uneventful that no description is needed.

Large superficial epitheliomata have been found very amenable. In three cases large fungating ulcers of the temple, considerably larger than a crown piece, cleared up quickly. In one case of epithelioma of the upper lip, with infected submaxillary glands, Mr. Deanesly removed the glands and I applied x rays to the lip, with the result that the growth sloughed away and left a harelip, but without any signs of growth; no recurrence took place.

Epithelioma of Lip.

CASE I.—T. H., aged 50, an engine attendant, sent to me by Dr. Clendinning, presented an epithelioma of the lower lip on the left side. Mr. Deanesly thought the condition more suitable for x rays than operation. A few applications cleared it up. A year later it recurred on the other side, about the same size. This again cleared up, leaving a perfectly healthy scar. One month later there was a growth about the same size, one inch behind the angle of the mouth on the mucous surface of the cheek. I gave him x rays by cross fire, inside and outside the mouth, using in each case a silver plate on the far side from the tube, according to the Herniman-Johnson method. There was slight improvement at first, but after twelve months' treatment of this growth it got larger and penetrated the cheek, and he grew rapidly worse.

Sarcoma of Tonsil.

CASE II.—J. B., aged 60. A case of sarcoma of the tonsil was sent to me by Dr. Ashley Smith and Dr. Bolton of Nottingham. He had had continual swelling and sloughing of the right tonsil. Surgical opinion as to the advisability of excision differed, and Dr. Bolton was against excision and proposed x -ray treatment. I was convinced that it was sarcoma, and snipped off a projecting piece; the report was that it was apparently inflammatory, but was not inconsistent with sarcoma. With a few applications of x rays with cross fire it cleared up. I then told him that in spite of the apparent cure he must have an occasional dose to prevent recurrence, but he did not return for five months, when he had a recurrence, far larger than the original growth had ever been. It freely invaded the soft palate and cheek. I again gave him x rays by cross fire, without, however, any hope of clearing it up. It spread steadily in spite of the rays, until he could no longer admit the funnel into his mouth. Then I abandoned the treatment but advised radium, which, however, he refused. In spite of the great increase of the growth he did not die for nearly a year.

Cases of Enchondroma.

CASE III.—Mrs. L., sent by Dr. Carter for recurrence after an operation by Mr. Cholmeley; the original growth appeared to be fibroma. There was a large projecting growth, about 3 in. long, in the parotid region, probably of lymphatic gland, firmly bound down. Under the treatment she improved in general health and the tumour became quite free from subjacent tissues, but did not perceptibly decrease in size or hardness. Later she developed lung recurrence and died.

CASE IV.—Mrs. C., sent by Dr. Galbraith, had first undergone operation five years ago; a second operation was performed two years ago. There was a hard cartilaginous growth in the neck, 2½ in. long, firmly adherent to the subjacent tissues. She was still under treatment. So far the only effect has been slight softening of the tumour, which has become free from subjacent tissues.

Breast Cases.

CASE V.—Miss B., aged 44, was the most successful case of this kind that I have had. She was sent to me by Dr. Dent in March, 1911. Nine months previously her breast was removed by Mr. Cholmeley; seven small nodules developed in and near the scar. After twenty-two weeks' treatment they all disappeared, and she went away for a month. Since then she has been in almost continual attendance, and the success of the case has been largely dependent upon her perseverance, her courage, and spirit. She has developed lesions at various places—in the fifth right costal cartilage, in the rib beneath the left breast, a gland below the middle of the right clavicle, a gland in the right axilla. Now these have all disappeared, save that on the bone and cartilage a little fullness may be detected, which, though not now malignant, may never get quite smooth again. Bone once expanded from any cause probably never gets quite its normal contour again even after the cause is completely removed. About two months ago she discovered a crop of new lesions—nodules on the right sixth and seventh ribs in the anterior axillary line, ill-defined gland below the middle of the left clavicle, and a gland in the left axilla. These lesions caused very severe lancinating pain, which kept her awake at night. They have been vigorously and assiduously treated, and now the pain has completely gone, the nodules are very much less, and the glands have disappeared. She has some irritable cough, and has a distinct shadow in the root of the right lung, doubtless some enlarged bronchial glands. These are now being treated. There was, however, no dissemination through the lungs, and the bronchial glands should be accessible to treatment, as the succeeding case shows. She has kept up her general health and weight very well.

CASE VI.—Mrs. L., aged 66, underwent operation for scirrhus of breast five years previously by Sir T. Chavasse. For a year she had had severe pain in the middle of the back, followed by the passage of "gall-stones," which she carefully washed out of her stools, and brought me a packet. They were scybala! With the fluorescent screen I found that there was a large growth in the root of the left lung. I gave her a dose of x rays three times a week and the lancinating pains cleared up entirely.

CASE VII.—Miss S., aged 45, sent by Dr. Cookson of Stafford, had undergone an operation for scirrhus of the breast in August, 1903. There was recurrence, followed by operation in August, 1910, and recurrence in July, 1911. She was sent to me in September. In the interval the growth had increased considerably. There was a fungating tumour about 1½ in. across. The pain and fetor were considerable. The treatment very speedily removed the pain and fetor, only a slight discharge of healthy pus taking place, but there was no appreciable diminution of the area of the tumour, though it became flat and level with the skin, and had more the appearance of a healthy granulating sore. In April, 1913, the sore was about 3½ in. across, the lungs had become affected, she had much dyspnoea and distress, and I advised her to discontinue treatment. Dr. Cookson, however, tells me that she is still alive, but in much distress.

CASE VIII.—Miss H., sent by Dr. Blumer, underwent complete removal of breast and glands by Mrs. Scharlieb for scirrhus in 1905; eighteen months before I saw her she developed a pea-sized lump in the scar, which remained stationary up to a month before I saw her, when Dr. Blumer removed it. I treated her with x rays as a prophylactic for six months, and she has had no recurrence.

CASE IX. Recurrent Scirrhus of Breast.—Miss H., aged 57. Kocher operation by Sir Thomas Chavasse in September, 1910. Recurrence in July, 1911, a lump forming in the left axilla, which was removed by Dr. Edge. She came to me in February, 1912. There was recurrence in the scar anterior to the anterior axillary line like a pea, and another 4 cm. by 2.5 cm. further along the scar of second operation. I tried Herniman-Johnson methods for obtaining secondary radiation, injecting on several occasions solution of strontium bromide and emulsion of precipitated metallic silver in oil beneath the growth, and applying x rays. There was some sterile suppuration around the collections of metallic silver, which had no definite effect upon the growth. This, however, gradually cleared up, and things looked very favourable; but she stayed away against my advice from May to September, and then again till December, and by this time there was a large patch of ulceration beneath the axilla, with the base impregnated with silver. I regarded this as a malignant ulcer. She went into an invalid home, and the ulcer healed; but later the arm began to swell, and when eventually she returned to me it was enormous; and upon my advice she consulted Mr. Deanesly, who did an operation for silk-thread drainage. It was not successful, and she refused to have the arm amputated. I have not seen her since, but have

heard that she is now much in the same condition, and is able to walk about. If she had been more pertinacious, and had not allowed long intervals to pass without treatment, she might have avoided this distressing complication. In any case, her life has been very definitely prolonged, and she has been relieved for a long time from the initial pain.

CASE X.—Mrs. R., aged 68, noticed a lump in her left breast the size of a pigeon egg in December, 1913. In February, 1914, she was sent to me by Dr. Bates, both he and the patient having definitely decided against operation on the ground of her age and general frailness. There was a hard indurated patch about 4 cm. in diameter and much puckering of the skin, which was adherent to the growth. In October, 1914, the tumour had become very indefinite, fairly soft, and almost blended with breast tissue. Three small pea-like glands were felt in the axilla, which have since disappeared, and though the primary growth is still there, and still requires treatment, it appears to be well in hand, and her health and weight are well maintained.

Sarcomata.

CASE XI.—Mrs. H., aged 50, sent by Mr. Deanesly in September, 1913. A year before a small lump in the wrist was removed. A recurrence in wrist and axilla followed, which Mr. Deanesly removed. I gave her x rays, but on July 14th she had some recurrence in the wrist, above the area usually irradiated. This was removed by Mr. Deanesly, and she still received occasional irradiation, and now the question arises whether it would be justifiable to stop it.

CASE XII. Sarcoma of Concha and Parotid Region.—Mr. K., aged 19; growth removed by Mr. Deanesly and the patient sent on at once to me. I irradiated him for two months, after which he ceased coming, but I understand he is still clear.

CASE XIII. Sarcoma of Cheek and Upper Jaw.—Miss K., aged 30, sent to me by Dr. McAlister Brown on October 12th, 1914. A year previously had a "gumboil" on the cheek, which gradually got bigger, and then penetrated the cheek and was seen on the outside. She saw Mr. Cholmeley, who pronounced it inoperable. There was a fungating mass protruding through the left cheek, just below the zygoma; it measured 3 cm. horizontally, and the anterior portion bulged outward very prominently. There was also a large fungating mass occupying the posterior part of the fornix of the left cheek. There was intense pain and much fetid discharge. I gave heavy x-ray doses, at first through 1 mm. and later through 2 mm. aluminium on the outside, and also through a funnel into the mouth without filter at first and later through 1 mm. aluminium. The pain rapidly disappeared, the discharge ceased, the growth in the cheek completely disappeared, and the cheek healed, the internal growth receded until all that was left was an ulcer between the alveolar margin of the upper jaw behind the site of the last molar tooth and the adjacent surface of the cheek. All went well until December 28th, when there was some pain on swallowing, possibly due to reaction from the internal applications. In January last she developed a distressing spasm of the left external pterygoid, pushing the jaw over to the right side, and the only relief she could gain was by putting her denture in place, when the movement to some extent stopped. She found relief from chloretone. Mr. Cholmeley saw her again, but he still thought the growth inoperable, and her general condition is such as to make further treatment inadvisable.

CASE XIV. Sarcoma of Jaw and Tongue.—H. P., male, aged 43. Growth removed by Mr. Deanesly. Recurrence took place, and on October 14th the stump of the tongue was covered with a fetid grey slough. There were large masses of glands beneath the chin, partly breaking down. X rays by cross fire within and without. February 24th, submental glands completely disappeared. Triangular stump of tongue, 2.5 by 4 by 5 cm., in a fairly healthy condition.

CASE XV. Sarcoma of Jaw.—E. P., female, aged 49. Growth removed by Mr. Deanesly in June, 1914. Shortly after growth appeared on site of scar. On September 21st the growth was cauterized and removed down to the digastric muscle, leaving a large wound opening into the mouth. She was then referred to me for x-ray treatment. By January 21st the wound had healed, but a pea-sized nodule appeared beneath the angle of the jaw. On February 25th other nodules felt, and dose increased in quantity and frequency.

CASE XVI. Epithelioma of Dorsum of Hand.—G. W. M., aged about 55. The growth was 5 cm. across, with affected glands in supracondylar and axillary regions. I sent him to Mr. Deanesly, who removed the tumours, and the patient returned to me for the rays (July 29th, 1914). Now a small recurrence has appeared in the supracondylar scar, but he is otherwise quite clear. A similar case has also been treated from about the same time without any recurrence.

It would be very useful to have a symposium of methods for treating malignant disease at the Electro-Therapeutic Section of the Royal Society of Medicine, similar to that with regard to opaque meals, with a view of endeavouring to co-ordinate our methods and establishing a standard practice.

My present practice has been to use heavy tungsten target tubes of the well-known American patterns. Until recently I used German and London tubes of the same heavy calibre, but it is a great advantage to have a tube that is high to begin with, that requires the regulator to

be used every time, and that can be worked hard from the beginning without having to wait till the tube is seasoned before any serious work can be done. But in the future the Coolidge tube will doubtless play an important part in therapy.

The diseased area is generally placed at a distance of 15 cm. from the target, and a filter of 2 mm. aluminium used with or without an additional fabric filter, which is often the patient's clothes. The pastille is always covered with the same filter, and 1 pastille or 10 X Kienbock given. The tube is generally at 8 Benoist and worked at 2 m.a. If the area is large it is divided into two or more, each of which receives this dose. If it can be approached by cross fire this is always done, and glass funnels are used for the mouth or vagina. I use one of the standard tube boxes and holders, but instead of having a straight lever attaching the box to the arm, I use one bent at a right angle, so that the long axis of the tube instead of being vertical is horizontal, as in the vertical position the cathode stem is always coming into contact with some part of the patient's body; with the axis horizontal this is avoided. I nearly always treat the patient while sitting, and have a special chair, made like the laryngological chair with back rest, but having clamps for the back rest at each side as well as in the middle of the chair. In this way the head can be made to bend over in a restful position on to one of the lateral rests, so that the tube box can fit into the widened hollow of the neck.

I should emphasize the great value of the use of x rays as a prophylactic after operations for primary, and especially after recurrent, growths. In cases of recurrence, the question before the surgeon's mind should always be: Shall I hand over to the radiologist at once, or operate and then hand over? In many cases of recurrence x rays without operation would be better, for to disturb the lymph channels is always a dangerous proceeding except in primary operation, in which case one can get apparently quite clear of the infected area.

The ideal practice would be to radiate the open wound with a good stiff dose of rays, in which case they would get direct access to any danger cells that might lurk on or near the cut surfaces. It is a question whether it would not be well worth the extra trouble and the risk of disturbing the aseptis of the wound and of the prolongation of the anaesthetic. Better have a coccus or two in the wound than a cancer cell or two!

But in any case systematic prophylactic after-treatment would give much better results after operation, and if an operation were done for recurrence it should be done with the cautery and not the knife, and the cold cautery of diathermy seems to be the best of all. Also, if x rays are to be given in recurrences, they should be used at once. Delay in radiation in such cases is as dangerous as delay in operation in primary cases. Wherever there is recurrence there is much greater danger of subsequent recurrences than in the primary operation, and it appears to me to be the duty of any surgeon who has any faith in radiation to have his recurrent cases radiated at once, even if he demurs to the same treatment after primary operations.

The general position is that on the whole we have *not* quite succeeded in curing the majority of our likely cases, but, in spite of disappointments, the possibility of attainment becomes nearer, and some day, if we persevere, we may turn the corner, make some change in instrumentation or technique, and the goal may come in sight.

MALIGNANT OEDEMA.

BY

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THE following conclusions are based upon a recent series of 11 cases treated in No. 2 Canadian Stationary Hospital, Le Touquet, France. Apart from actual mechanical damage to the tissues, there is perhaps no other disease in the present war which presents such dramatic awfulness as malignant oedema (septic gangrene). Its onset is so rapid and its result so disastrous that, if the surgeon wishes to save his patient, he has no time to lose from the moment his diagnosis is, not apparent, but suspected.

In other wars the mortality of malignant oedema has reached as high as 90 per cent., and yet I believe, if the treatment is instituted early enough, the mortality should be *nil*.

Symptoms.

The disease, we find, most frequently originates in a large bullet or shell wound, usually deep in the channel of exit. Its onset is insidious but rapid, and not especially painful. The wound is black, instead of red, and at first appears to be filled with decomposing blood clot, from which on, or sometimes without, pressure bubbles of gas issue. In a few hours the wound may present one of two phases—it either becomes dry and black, having an appearance of being seared with the actual cautery, or in other cases it presents a dark greyish slough not unlike diphtheritic membrane. The surrounding skin for several inches is often dark in colour, a smooth spreading pseudo-ecchymosis about the colour of iodine stain. It does not present the mottled appearance of true ecchymosis. The limits of the colour usually mark the extent of the disease. At the end of twenty-four hours the limb commences to swell, owing to gas in the tissues, and in a few hours becomes markedly oedematous. On pressure one can sometimes, but not always, elicit gas crepitus. The limb gradually becomes enormously enlarged and the skin is drawn taut, presenting a shiny appearance. There is one characteristic symptom prominent above all others, and unmistakable when once encountered: a vile pungent odour of remarkable penetrating power, capable of permeating a large hospital ward. It can only be compared to the odour of dead blood in a large cavity when scented at close range, but intensified a hundred-fold.

At the end of forty-eight hours, if the patient lives so long, the face assumes a sickly greenish pallor, and the expression becomes anxious. There is no change in the mentality. Patients remain rational to the last. The pulse presents the usual features of grave toxæmia. The temperature ranged in the cases under my observation from 100° to 105° F., and the pulse and respirations were in direct ratio to the temperature. It is quite likely the high temperature is due to complicating staphylococcal organisms, for in the most severe case of all, which, by the way, recovered, the maximum never exceeded 101° F. The pulse ranged from 104 to 128, unusually high in this series.

Treatment.

The necessity for the following treatment being carried out in detail is illustrated by the fact that we lost our first case—a skin wound only of the upper arm—because we treated it superficially. Two cases were moribund on entry, and died in a few hours. One case had a badly shattered limb, and was saved by amputation. The other seven cases recovered. It is necessary to make immediate and deep incisions down to the bone, under chloroform, by means of a 6 in. blade amputation knife. These incisions were, in the cases at Le Touquet, 4 to 6 in. in length. They were afterwards kept wide open with fenestrated rubber tubes, 1 in. in diameter, passed on transversely through the muscle to a counter incision. Not less than three, and in one case six, large openings, were made. The wounds were irrigated with solutions of hydrogen peroxide of the ordinary strength, followed by a mixture of the same solution with an equal quantity of carbolic acid 1 in 100. The wounds were also lightly packed with gauze. Dressings and irrigation were repeated every three hours. A high cradle was placed over the wounded part so as to admit plenty of air. After a few hours (as soon as checking of bleeding would permit) the gauze drainage was removed and only a thin layer of gauze left to cover the wound. It is quite possible that had these wounds been exposed for hours to direct sunlight we should have had a more rapid result.

The wounds have a great tendency to close in a few hours, and this, unless prevented by the surgeon, will bring about the anaërobic conditions we are trying to avoid. A pair of forceps and the moving about of the rubber tubes will prevent this accident. Night and day special nurses were employed, and since the adoption of this system of treatment (in the last seven cases) we have had no deaths. Recovery took five to seven days.