a typical result, the exact changes which occurred depending on the length of time which the animals lived, and the number of bacilli injected. The earliest change which is noted is swelling of the synovial membrane, with the formation of a villous condition of the surface, and the appearance of small caseating patches here and there on the surface, especially at the posterior part, probably where the bacilli had collected in greatest numbers. Soon the joint becomes full, and often distended with caseous material, the synovial membrane being in a condition of tuberculous infiltration, and caseating at the surface. If the animal lives longer the cartilages are attacked and destroyed from the surface, as in man, and the tuberculous material extends into the bone, giving rise to soft caseous deposits, or leading to sclerosis of portions of the bone. In only 1 case did the injections fail, and in that instance an extremely small number of bacilli, and possibly none at all, was injected.

In 3 cases injections were made into the lower epiphysis of the femur, in each instance with positive results. The result of the injection was the development of a caseous tuberculous deposit in the epiphysis, with sclerosis of the bone around. In all the cases the joint had also become affected, and the changes in the synovial membrane and articular cartilages just alluded to were commencing. In 3 cases injections were made into the medulla of the tibia; in 2 of these caseous deposits were formed, 1 has not been examined. In 3 cases injections were made under the periosteum. In 1 of these there was considerable swelling of the periosteum, when the animal died ten days later. In the second the sections did not hit that part of the tibia, but the caseating needle track was seen. In the third there was great thickening of the periosteum with caseous patches in it, and sclerosis of the bone beneath. Similar changes were also seen in one of the cases where the bacilli were injected into the epiphysis of the femur. In 1 case a very dilute material was injected into the femoral artery apparently without effect.

It is thus evident that the result of the injection of pure cultivations of tubercle bacilli into the bones and joints of rabbits is the same as was obtained when phthisical sputum was employed, and corresponds in all respects with the changes in strumous diseases of bones and joints in man. We see similar thickening of the synovial membrane, similar caseation of the new tissue, similar accumulation of cheesy material in the joint, similar destruction of the cartilage, and, when the tuberculous growth has penetrated into the bone, similar formation of soft caseous deposits or thickening of the osseous trabeculae and commencing formation of sequestra.

(To be continued.)

ON THE TREATMENT OF HYDATID DISEASE BY INCISION AND EVACUATION OF THE CYST WITHOUT DRAINAGE.

By C. J. BOND, F.R.C.S.,
Surgeon to the Leicester Infirmary.

THE surgical treatment of hydatid disease has shared in the general advances in surgery, and the incision and drainage of the cyst (supposing aspiration to be undesirable or to have failed) may now be looked upon as the usual and routine treatment.

This will probably remain so in all cases in which suppuration has taken place within the cyst, and so these cases must be excluded from the method of treatment which I am about to describe.

Before, however, dismissing the subject of suppuration in hydatid cysts, it may be well to state that, although the suppuration (apart from the shrinking and calcareous changes which the contents of cysts undergo from the death of the parasite) is probably always due to septic agencies, yet it does not appear that these need always be introduced from outside the body. Thus in a recent case in which a very large cyst between the bladder and rectum was aspirated with a fine sterilised needle, and clear fluid withdrawn, no symptoms occurred for a fortnight, and the cyst appeared to be shrinking; at the end of that time, however, the cyst began to refill, and febrile symptoms occurred, and when opened later, the contents were found to be purulent and offensive.

Here, I think, there is little doubt that the needle was not to blame, but that the suppuration in the dead cyst was due to its proximity to the rectum and the osmosis of intestinal gas, the cyst being only separated from the bowel by the intestinal coats, and the pressure so great as to cause partial obstruction before aspiration.

I wish, however, in the following remarks to bring into prominence a method of treating cysts which are still living and growing, and which contain clear fluid with or without daughter cysts; and this is the method of incision and evacuation of the cyst contents without any subsequent drainage, or with only temporary drainage for a few hours after the operation in certain cases.

The first case, to which I have already referred, is that of a healthy young man, a butcher—seen with Mr. Serres, of Os-gathorpe, and Dr. Hatchett—in whom there was a large cyst, situated between the bladder and rectum, beneath the peritoneum; this had grown upwards, filling the pelvis, blocking the rectum and urethra, and reaching up to the level of the umbilicus, and resembled a full-term pregnancy; the bladder was dragged up with it, and its fundus, though empty and compressed, reached to within 2 inches of the umbilicus. This caused a difficulty during the operation, for, on making a median incision, the empty bladder uncovered by peritoneum was the first thing met with. The incision was prolonged upwards and the peritoneum opened above the bladder, and thus the cyst was reached. On opening the latter—which, it will be remembered, was aspirated three weeks previously—I found the elastic cyst proper had separated from the outer cyst wall, and lay curled up loose in the cavity, together with much pus and a quantity of smaller daughter cysts; the elastic membrane and contents were removed entirely and the cavity sponged out, and to this fact I attribute the rapid closing of such a very large cavity; a large drainage tube was placed within the cavity. The more important feature in the case, however, follows. On exploring the general peritoneal cavity, I found in a reflection of the peritoneum in the right iliac fossa a small cyst, the size of a Tangerine orange. As I could not drain it, I incised the cyst and removed the elastic membrane and clear fluid, this being a growing cyst, I also scraped away some of the inflammatory adventitious cyst wall, immediately outside the elastic cyst proper; but this was, I think, unnecessary, and might lead to hæmorrhage. The remains of the cyst were then returned into the peritoneal cavity; no bad effects followed, and at a subsequent operation on the same patient—to which I shall refer—no trace of the cyst could be found. After dealing with this cyst, I discovered another much larger one in the epigastric region; but, considering the already large wound and serious character of the operation, it was decided to leave it for subsequent treatment. The patient recovered well, and at the end of three weeks the large cavity was a mere sinus, which soon healed.

He reappeared five months later, looking well, having gained a stone in weight, and without any symptoms of pressure on the bladder or rectum. On examination, however, I found that the cyst in the epigastrium had grown, and was now the size of a foetal head, and there was another cyst or cysts at the lower part and to the left of the abdominal cavity.

A week later I opened the abdomen by a median incision passing through the umbilicus. I then discovered three cysts, the larger one referred to above, which lay beneath the transverse colon and omentum, and two others the size of cricket balls, one in the left renal region apparently in connection with the left mesocolon, and one quite movable at the lower part of the cavity, situated entirely in the omentum. The upper cyst was first dealt with, the omentum being gently teased away and the surface of the cyst bared; it was then tapped with a fine trocar and cannula, and most of the clear fluid drawn off without aspiration. I then drew the less tense cyst towards the abdominal wound with artery forceps, and incised it freely. On doing this I found that the white elastic cyst proper had shrunk somewhat away from the walls or ectocyst, and lay, together with daughter cysts, in the cavity; it was easily withdrawn with ring forceps, and came out quite clean, although, from its brittleness, in several pieces. I then wiped the cavity out dry with a sponge, and allowed the cyst to fall back into the abdominal cavity. I then dealt with the

other cyst on the left side of the abdomen in the same way, but the third or omental cyst was removed entirely after tapping, by ligaturing off the portion of omentum in which it grew. I then found, on trying to draw out and fix the openings in the cysts directly to the skin, that a good deal of dragging on the abdominal contents occurred, so I simply closed the abdominal incision in the usual way, allowing two or three of the silk sutures to pass also through the cut edges of the cyst walls; between these two drainage tubes were inserted, one into the lower and one into the upper cyst; but, as there was very little discharge, these were removed in sixteen hours, and the abdominal incision allowed to close throughout. Union occurred at once, with the exception of a small spot at the umbilicus, which continued to discharge. The temperature remained normal throughout, and in a month's time he was out of doors. Unfortunately, at this date, owing to some strain or chill or other cause, an attack of abdominal pain and violent vomiting occurred, which was followed by some discharge of pus from the incision, and Dr. Serres removed several pieces of the laminated lining of the upper cyst. This ceased in a week's time, and the patient soon became again convalescent.

It will thus be seen that the healing of the wound and recovery were not interrupted, and I attribute the throwing off of some pieces of the cyst wall to some attempts made in the case of the upper cyst, or that first operated on, to detach some of the inflammatory outer cyst lining in addition to the elastic cyst proper, which alone should be removed; and further, from this result also it seems desirable that the emptied cyst, after suturing the incision in it, should be completely returned into the abdomen, as was done at the first operation, and not anchored to the site of the incision in the abdominal wall.

Judging from the experience of this case, it may, I think, be concluded that certain abdominal hydatid cysts, in which there is difficulty in bringing the cyst wall up to the surface of the body, can be well treated by incision and replacement of the cyst, provided that due care be taken to thoroughly evacuate the cavity of all its fluid and elastic solid contents, and to suture the inverted edges of the incision afterwards. The hæmorrhage and other accidents which have been described as following on detachment of the cyst wall must have been due to the teasing away, not the elastic membrane, but the outer wall or ectocyst itself. The addition of a few catgut sutures in the inverted edges of the opening is to prevent the subsequent entrance of a coil of intestine. Any serum secreted by the cyst wall would, I feel sure, be rapidly absorbed.

Further, I see no reason why we should not deal with cysts of the liver and other organs in the same way, provided, of course, that suppuration had not occurred, and that sufficient length of incision into the cyst ($1\frac{1}{2}$ to 2 inches or more) could be made to allow of complete exacuation. The elastic lining shrinks on first withdrawing the fluid, and can be removed by gentle traction with the aid of ordinary ring or pile forceps. The advantages of a method which completes the treatment at one operation, and without any subsequent open drainage wound with its attendant risks, are obvious. The operation is, in fact, a supplementing and finishing of the method of aspiration which only withdraws the fluid portion, by the withdrawal of the solid portion also of the cyst contents, and is, I believe, the safer method of the two. I have myself seen alarming symptoms appear in a patient in whom I had just aspirated a large hepatic hydatid cyst.

It is also highly important, even in suppurating cysts in which drainage is necessary, to remove the solid contents at the time of incision. With regard to the individual case mentioned, multiple cysts, either sub- or intraperitoneal, are not so very frequent; the recto-vesical space seems, however, to be a somewhat favourite locality, and from the experience of this and other cases of cysts in this position, and in such close proximity to the bowel, the risk of suppuration after simple aspiration appears to be a real one. In this case, also, all four methods of treatment were exemplified, namely: (1) aspiration; (2) incision and evacuation; (3) incision, evacuation, and drainage; (4) extirpation.

It is, perhaps, needless to add in conclusion that strict asepsis must be observed—not necessarily, however, the introduction of irritating lotions.

ON CERTAIN CONDITIONS THAT MODIFY THE VIRULENCE OF THE BACILLUS OF TUBERCLE.¹

By ARTHUR RANSOME, M.D., F.R.S.

Physician to the Manchester Hospital for Consumption and Diseases of the Throat.

It is acknowledged by most pathologists that tuberculous sputum, dried up and broken into dust, is the most common vehicle by which the bacillus of tubercle is conveyed into the body. But its power for evil is obviously modified by a multitude of conditions, some of them inherent in the animal body exposed to infection, others due to external influences. Judging from the facts relating to the distribution of tuberculous disease, its incidence in certain localities, and especially its prevalence in badly drained, badly ventilated, and imperfectly lighted dwellings, it has been surmised that the three chief external conditions that mitigate the virulence of the bacillus are (1) a dry soil, (2) abundance of fresh air, and (3) light.

But hitherto few, if any, direct experiments have been made to determine the extent to which these several influences possess mitigating powers. It is true that Dr. Candler, in his work on the *Prevention of Consumption*, affirms that light is the chief agent in destroying the bacillary virus; and Professor Koch, in his address to the International Congress at Berlin last year, lends the weight of his great authority to the same opinion; but in neither case is any proof given of the truth of this view.

It was in order to test the influence of light, air, and dry soils upon the virulence of the bacillus of tubercle that the following series of experiments were devised. It was decided to expose tuberculous sputum:

(a) In a locality (Bowdon) where the soil was dry and sandy—about 100 feet in thickness—and where very few cases of phthisis were known to have originated. It was to be placed in full daylight or sunlight and exposed to abundant streams of fresh country air.

(b) A portion of the same sputum would be exposed under similar conditions in the same place, with the one exception that it would be put into a darkened chamber.

(c) A third portion would be taken to a small four-roomed tenement in Manchester, on a clay soil, without cellarage and badly ventilated, but it would be placed on the window-ledge with as much light as could there be obtained.

(d) A portion would be placed in the same cottage, but in a dark corner of a sleeping room in which it was known that three deaths from phthisis had occurred within the space of six or seven years.

(e) Finally, a portion would be exposed to used air coming from a ward in a consumption hospital in Bowdon, in darkness.

Two collections of sputum were obtained:

(A) From a woman dying of phthisis, collected on April 25th. This specimen contained comparatively few bacilli.

(B) Also from a woman in the third stage of phthisis. This sputum contained abundance of bacilli.

Sputum (A) was not considered to be very suitable for the purpose owing to the sparseness of bacilli, but it was decided to use it by way of control experiment. Owing to an accident the portions exposed under conditions (c) and (d) were lost. These collections of sputum were divided into portions and placed in watch glasses marked A 1, A 2, A 3; B 1 to B 10. Some of these watch glasses were exposed without further arrangement, but others, where there might be a possibility of infection, were enclosed in cages, so arranged that air could reach them through a thin layer of cotton-wool, one kind of cage being constructed of two squares of glass, supported at their edges by cork, and surrounded by cotton-wool, the other of small flasks, the bottoms of which had been cut off, and the lower edge resting in a small circular tray fitted with wool, the mouths of the flasks being also loosely stuffed with the wool.

These watch glasses were then exposed for five weeks under the conditions already noted, commencing on April 29th, 1890, with the exception of B 9 and 10, which were started on May 2nd. Most of the specimens were withdrawn on

¹ Read before the Royal Society.