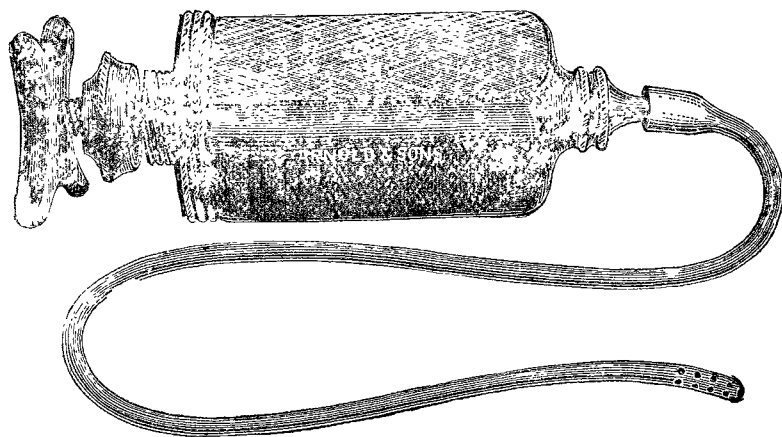


was invaginated in that way and so was acting as an irritant, causing constant diarrhoea. He had got no good from general treatment directed to the upper part of the bowel. When one treated him with sedatives to the sigmoid flexure he began to get well. It will take too long to go thoroughly into the treatment, but you can see the instrument which I have had made for this sort of thing.

I will now describe the other case, which is rather interesting, of a woman who was brought into the hospital with symptoms of gastric ulcer but in addition she was passing a good deal of blood. In appearance this blood was not like the blood which comes from piles or from an ulcer; it was much more generally diffused through the motions and especially when there was a loose motion after taking a saline aperient. On examination we found something different from the other two cases; we found that the mucous membrane was very soft and it felt almost like a bit of plush. We have not used the speculum, but in another case of the same sort which I saw with Mr. Harrison Cripps, in which he operated,



Instrument for introducing ointment into the upper part of the rectum and into the sigmoid flexure. It is a modification of Allingham's ointment introducer, but is much larger and stronger. The piston is provided with a screw cap which fastens on to the body of the instrument. When the cap is free the piston works easily up and down by simple pressure, but when the cap is fixed the piston only works by screwing it round on the cap.

just before operating he dilated the rectum very widely, so that it could be looked into very well. He hooked down a bit of mucous membrane so that one had it under one's eyes and it looked like a bit of red plush; it was thick and velvety and bled on the slightest touch. The treatment which he adopted for it was to take a cautery and to run it down the mucous membrane in lines, so that when the cicatrices contracted a pull would be exerted on the mucous membrane so that it would be tightened up and cease to bleed. That operation did afford relief but it has not cured the patient, although it was done many years ago now. So I have not felt inclined to repeat the operation upon this patient who is in the ward and I have contented myself at present with the use of astringent injections and by means of those, combined sometimes with astringent suppositories, we have obtained a great deal of good and I hope that we shall do more yet. I hope that it will not be necessary to have recourse to operation, nor will it be necessary to have an operation in the case of the man who has been out in South Africa.

THE BRITISH ELECTRO-THERAPEUTIC SOCIETY.—

The annual dinner of this society was held on June 26th at the Café Monico, Dr. H. Lewis Jones, the President, occupying the chair. 46 members and visitors were present. After the usual toasts, the President proposed "The British Electro-Therapeutic Society" and noted on the following points: the steady increase of members since the foundation of the society (January, 1902); the high scientific standard of the papers presented; the most useful discussions that had taken place during the past year or so; and the work of the council and honorary secretaries, more especially in ascertaining the eligibility of the candidates for election. Mr. Chisholm Williams (joint honorary secretary) replied. An excellent musical programme was arranged, Dr. A. E. Haydon being responsible for the violin solos, and songs were sung by Mr. Leslie Buchanan and Mr. Richard Evans.

ON THE FATAL EFFECTS OF CHLOROFORM ON CHILDREN SUFFERING FROM A PECULIAR CONDITION OF FATTY LIVER.

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NINE years ago a paper by the present writer was published in THE LANCET entitled "On Some Fatal After-effects of Chloroform on Children."¹ The present paper deals with the same subject but its title has been altered in order to emphasise and to support the views maintained in the original communication—namely, that chloroform is apt to produce fatal after-results in children who suffer from a peculiar condition of fatty liver. As so many years have elapsed since the first paper was written it may be pardonable to give a brief *résumé* of its contents.

Nine cases were recorded in which death occurred within from 10 hours to six days of operations performed under chloroform. The exact numbers of hours which passed between the operations and the deaths of the patients were 10, 12, 13, 16, 24, 27, 30, 53, and 150 respectively. In Case 10 recovery took place after symptoms of great gravity had lasted for nearly three days. The diseases which necessitated operation were: infantile paralysis (one case), genu valgum (two cases), strumous knee (one case), congenital hydrocele (one case), vesical calculus (one case), psoas abscess (two cases), and iliac abscess (two cases). The operations were therefore of necessity, though not of emergency, in all cases. They were such as are performed daily by surgeons and are not regarded as attended by any particular danger to life. In all cases the children, apart from the disease which rendered operation expedient, were considered to be in good health.

In eight out of ten of the cases the symptoms were of marked cerebral type, resembling those of maniacal delirium in some, whilst in others they suggested meningitis running an unusually acute and rapid course. Except for the absence of jaundice and hæmorrhages many of the cases might have been diagnosed as "acute yellow atrophy of the liver." After recovery from the immediate effects of the chloroform there was usually an interval of a few hours, at the end of which the child would begin to utter piercing cries at short intervals, disturbing the whole building by its shrieks, grinding its teeth, tossing, struggling, and requiring constant attention lest dressings should be torn off or fractured bones displaced. The pupils were often dilated, sometimes unequally, the face being flushed or pale, with a look of wild terror and anxiety. Consciousness was sometimes lost early and never regained; sometimes there were intervals in which the child would be dull and apathetic but would answer rationally when addressed and usually deny being in pain. Vomiting was a marked feature in all but one case. It was copious, frequent, and persistent, and the vomited matter sooner or later almost exactly resembled the dregs of beef-tea. It answered to Gmelin's test and seemed to consist of bile, gastric juice, and succus entericus. In one case it was described as "bloody" and in another as "coffee-ground." Headache seemed to be absent in all cases. The temperature generally fell to 97° or 98° F. immediately after the operation. A temperature of from 95·8° to 96°, indicating profound collapse, was only noted in one case, and this was the only one in which the patient recovered. The temperature commonly underwent several moderate rises and falls and was above normal at the time of death. In one case it rose to 103° four hours after the operation and remained at that level throughout. In two cases it reached the height of 103·2° and 104·6° just before death. In one it rested between 98° and 99°. In the remaining six cases it varied from 99° to

¹ THE LANCET, Jan. 27th (p. 193) and Feb. 3rd (p. 257), 1894.

102°. Pyrexia, therefore, was not a marked feature. The urine was never suppressed, but in two cases (Cases 1 and 8) it was retained and albumin was present after the operation, and in two others (Cases 6 and 7) albumin was present before operation, but no subsequent mention was made of the urine. In the rest the presence or absence of albumin was not noted. The mode of death was, as a rule, by gradual exhaustion. The screaming at length subsided, perhaps lulled by the morphia and other sedatives given, the vomiting became less frequent, unconsciousness led to coma, and the respiration and the pulse gradually failed, the latter being often imperceptible before breathing ceased. In some the vomiting and the restlessness continued almost till the end and death occurred, with suddenness, from heart failure.

Post-mortem examinations were held in eight out of the ten cases. The organs, with the remarkable exception of the liver (in five cases), gave no conclusive evidence as to the cause of death. In addition to the morbid conditions for which the operations were performed little else was discovered. In one case (vesical calculus) the kidneys were slightly granular, but the child certainly did not die from uræmia. In another (strumous knee) the pelves of both kidneys contained pus, but the kidneys themselves and all other organs appeared to be normal. In a third (iliac abscess) there was slight congestion of the peritoneum but the post-mortem report stated that there was "no apparent cause of death." The heart in four cases showed dilatation of the right side with post-mortem clot and contraction of the left side. In one all the cavities contained post-mortem clot and in another case all the cavities were empty, the right side being relaxed and the left being contracted. The cardiac walls were mostly healthy; in one case they were described as pale and in another there was much fat on the surface; in no case could death be attributed to primary failure of a diseased heart. The lungs were normal in four cases, oedematous and congested in one, congested but otherwise normal in two, and oedematous with some calcareous tubercle in one. The pulmonary condition in no instance accounted for death. The brain in four cases was described as normal, in one there was slight congestion but no evidence of meningitis, and in another there was a good deal of venous congestion on the surface but the brain was otherwise normal. In one case the brain was not examined and in another its condition was not mentioned and was therefore presumably normal. The liver in five out of eight cases was markedly fatty. In three of these the condition was so peculiarly striking that it attracted special attention directly the abdomen was opened. The organ in these cases was of a uniform pale fawn or buff colour, studded internally with pale purple dots which were the intralobular veins. Fatty livers are common enough and everyone is familiar with their purple-brown appearance, streaked and mottled with yellowish streaks and patches, but the pale light fawn colour of the liver in these cases was altogether unusual. During a considerable experience of post-mortem examinations I have never seen the like except in such cases as those now under consideration. The organs broke with brittle fracture, and much oil could be scraped from their surface with a knife. Thin sections stained deeply with osmic acid, the colour being darker in the periphery than towards the centre of the lobules. Under the microscope the peripheral hepatic cells were seen to be distended and globular with fat. Towards the centre the cells were of normal shape but looked granular from the presence of innumerable droplets of oil. The hepatic cells themselves seemed to be otherwise normal. Their nuclei stained deeply with logwood; the connective tissue cells were normal and showed no signs of fatty degeneration. The condition seemed to be one of extreme fatty infiltration rather than of fatty degeneration. Neither macroscopical nor microscopical appearances resembled those of acute yellow atrophy of the liver. But one of these livers, in a child aged four years, weighed only 14½ ounces; another, in a child, aged eight years, weighed 1 pound 3 ounces; and in another child, aged one year and four months, the liver was large, extending one and a half inches below the ribs. In two others it was described as "large, very pale, and extremely fatty on section" in one and as "pale and somewhat greasy" in the other. In the two latter microscopical examinations were not made but their condition was doubtless the same as in the rest. These livers were also very anæmic, the blood expressed from them being pale, watery, and scanty; in some instances it was compared to prune juice. In the remaining three cases in

which the liver is described as healthy, or no mention is made of its condition, it is possible that congestion masked the characteristic pallor. These livers were not examined microscopically.

The conclusions drawn as to the cause of death were: (1) that these deaths, in all but Cases 9 and 10, were due to auto-intoxication; (2) that a fatty condition of the liver, and therefore functional disturbance of that organ, existed before the operations; and (3) that chloroform and operation shock combined aggravated the condition already present (fatty liver) and thus loaded the system with toxic alkaloids which the kidneys (notably in Cases 6 and 7, in which pyelitis and slight interstitial nephritis were found) were unable to eliminate. The symptoms in Cases 9 and 10 were unlike those present in the rest and might have been due to mercurial poisoning, although this was by no means clear. The question of iodoform poisoning arose in one case, but could be dismissed on the grounds that the symptoms did not resemble those of poisoning by that drug and that the amount used was small. The only pre-existing pathological condition which seemed to be directly concerned in the causation of death was that which obtained in the liver in at least five out of eight cases. Before arriving at these conclusions, carbolic acid poisoning and fat embolism as possible causes of death were considered at some length and it was held that neither the symptoms nor the post-mortem findings were in keeping with the theory that either of these agents was solely accountable. The part played by shock resulting from the operations could not be altogether ignored in the causation of death, yet in all cases but one the symptoms of shock were not profound. The amount of collapse was not greater than might be expected after lengthy and severe operations. The patient in whom shock was most pronounced was the only one who recovered.

The views and conclusions set forth above did not meet with acceptance. They were considered theoretical and non-proven, and one of the surgeons in charge of some of the children stated that in his opinion death was due to carbolic acid poisoning or to fat embolism rather than to chloroform.

Now, it was admittedly very difficult to disprove that death was due to carbolic poisoning in eight cases. For carbolic acid was used to purify the skin preparatory to the operations in all of these. In the remaining two cases it was only employed in the form of "strong mixture" with which the parts were scrubbed after the patients had been put under chloroform. Carbolic was used as a dressing in six cases (Cases 1, 3, 4, 5, 6, and 7). In two (Cases 2 and 3) vomiting occurred after carbolic cloths had been applied to the skin preparatory to the operation, and in one of these carboloria was present before, though not after, the operation. Carboloria was also noted after operation in Cases 3 and 4. In Case 8 it was present for one day only after operation. In four cases (Cases 1, 5, 9, and 10) it was absent. Hence in eight cases there was the possibility of carbolic poisoning, whilst in four, symptoms of such poisoning were actually present in the shape of vomiting and carboloria. Yet even in these, the symptoms in general were not fully in accord with the view that carbolic acid alone was to blame. Their course and nature seemed to be in no way modified by the presence or absence of hydroquinone in the urine. Carboloria was absent in Cases 1 and 5, yet the symptoms were the same as in Cases 2, 3, and 4, in which carboloria occurred. Moreover, in all these five cases the peculiar fatty condition of the liver was discovered after death. Ten years ago, when carbolic acid was used with far greater freedom than it is now, carboloria was almost invariable after an operation, but in the great majority of cases it was unattended by other symptoms and in itself was regarded as of little consequence. It is true that sometimes carboloria was accompanied by vomiting, a high temperature, or signs of collapse, but the symptoms were in ordinary cases speedily relieved by changing the dressings. The dressings were changed in Cases 1 and 3 of this series, but without the slightest benefit to the patients. It is difficult to believe that death was due in any of these cases to the effects of carbolic acid alone. At the same time, it is highly probable that persons subject to the condition of fatty liver described may also be specially susceptible to the effects of carbolic acid. The following case seems to illustrate this point and although the patient was an adult it may be interpolated here. I am indebted to Mr. J. Hogarth Pringle of Glasgow for permission to relate it.

CASE 11.—A woman, aged 41 years, was admitted to the Glasgow Royal Infirmary on Oct. 29th, 1897, for treatment of

disease of the left knee-joint. Her previous health had been good except for the condition of the knee, which had given her trouble, off and on, for 27 years. For four years, however, she had had occasional attacks of gall-stone colic. On admission all the organs appeared natural and the urine was free from casts and albumin. The disease of the knee was tuberculous. The limb was put up in wet carbolic cloths (1 in 50) preparatory to operation. After 24 hours the patient began to vomit bile-stained fluid and the urine was greenish, becoming darker on standing. The wet dressings were at once discontinued, but the vomiting persisted for eight days and she was seriously ill, requiring rectal feeding. Champagne only could be retained in the stomach. After subsidence of the vomiting she remained well for nearly three weeks. The urine was still free from albumin and casts. On Nov. 24th the knee was excised under chloroform. No carbolic acid was used. During that night vomiting recommenced and increased in severity. Nothing had any effect in checking it. In the afternoon of the 26th she became drowsy and at night she could not be roused to answer questions. The urine was passed in small quantities and now contained casts. She died comatose on the morning of the 27th, three days after the operation. At the post-mortem examination the operation wound was aseptic. The lungs were healthy. The heart was small but the muscle was healthy. *The liver was markedly fatty.* Both kidneys were fatty, with some interstitial nephritis. Neither the pelvis nor the ureters were dilated. The spleen was normal.

There can be no doubt that had the operation been performed within the 24 hours after which the carboloria and vomiting occurred, death would not unnaturally have been attributed to carbolic acid poisoning, whereas after-events proved the contrary. It will be noted that in this case also the liver was markedly fatty and that there was no apparent cause of death from disease of other organs. The condition of the kidneys was, no doubt, due to the action of chloroform, which is now known to be capable of producing pronounced renal changes.

Returning now to fat embolism as the alleged cause of death in some of the children, it will be observed that the symptoms in no single case suggested such lesions of the lungs or brain. Had the pulmonary capillaries been so extensively blocked by fat as to cause death, cyanosis, urgent dyspnoea, orthopnoea, asthmatic attacks, with signs of acute pulmonary oedema, could not have failed to appear. But all these signs were absent. Death in all cases was in consequence of gradual or sudden cardiac and respiratory failure. Again, presuming that the cause of death was fat embolism of the cerebral circulation, convulsions, local paralysis, or hemiplegia might surely be expected. But none of these conditions occurred. Had the embolism been of the kidney, suppression of urine, or at least the presence of fat in the urine, would have been discovered. But all these symptoms of fat embolism were absent. With regard to post-mortem evidence, in cases of death due to pulmonary fat embolism one might have expected to find extensive congestion, oedema, and multiple hæmorrhages and infarcts in the lungs. Had the cerebral circulation been blocked, a similar condition, in addition to extensive softening, should have been found in the brain. But post-mortem examination revealed none of these conditions to the naked eye, at all events so obviously as to render the cause of death beyond question. On the other hand, two of the operations (osteotomies) might conceivably have caused fat embolism. Yet the symptoms in these did not differ from those of a patient in whom a few tendons about the ankles were divided, or from those of a case of radical cure of hydrocele and in neither of the latter could the idea of fat embolism be entertained. In all of these a fatty liver was discovered and it seemed more reasonable to connect the liver with the cause of death than a conjectural fat embolism.

Grave doubts may be expressed whether fat embolism is so potent a cause of death as has been supposed. According to Scriba² the quantity of fat which must be introduced into the circulation of an animal in order to cause death must be three times as great as that contained in the marrow of the animal's femur. In man he estimates the maximum fatal quantity as 210 grammes, or about seven ounces. On this calculation it is remotely possible that all the fat contained

in the femur, the tibia, and the fibula in one case escaped into the circulation and so caused death, and that in another the medulla in both femora was sufficient to produce a fatal result. This is possible though not probable. But it is far less probable that scraping of an iliac abscess should cause several ounces of fat to enter the circulation, especially when one considers that the abscess was evacuated at the time of the operation. Finally, it is true that microscopical examination might have shown fat in the pulmonary or cerebral blood-vessels, at all events in some cases. But even if demonstrated it would, in my opinion, have been inconclusive evidence of fat embolism without gross pathological changes indicating the results of capillary obstruction. Mr. W. Watson Cheyne, however, whose opinion and authority command the highest respect, considered the omission of microscopical examination of the lungs and the brain as of great importance.

The writer of a leading article on the subject in THE LANCET³ seemed to adopt the view that carbolic acid or fat embolism was responsible for these deaths and not chloroform, whilst I found that this view was generally accepted by most of the friends with whom I discussed the question, hence I could only look for fresh material and evidence in support of my own contentions with misgivings lest meanwhile my colleagues might be reposing in a false sense of security.

In order to meet criticism the following requirements were needed: (1) that the patient should be an apparently healthy child; (2) that the operation should be a trivial one; (3) that carbolic acid should not have been used either before or during the operation except in the form of "strong mixture"; (4) that the symptoms should be such as I had described; (5) that the characteristic fatty liver should be found after death; and (6) that microscopical examination should be made of the lungs and brain in order to settle the disputed question that fat embolism was the cause of death in such cases. The following case, which my friend and colleague, Mr. F. F. Burghard, kindly allows me to quote, seems to answer most of these requirements. For the notes of the case, which I extract below, I am indebted to Mr. J. A. Drake, house surgeon to the Children's Hospital, Paddington-green.

CASE 12.—A boy, aged three years, was admitted into the hospital under the care of Mr. Burghard for treatment of webbed fingers and toes on April 6th, 1903. The patient was a healthy-looking, well-nourished boy. He was described as having been "dyspeptic" since birth, subject to "bilious attacks" and "night terrors," and "very passionate." He had once had jaundice but no other complaints except urticaria. The day before admission into the hospital he had fallen in the road and grazed his forehead. He was not stunned and was able to walk home, where he arrived crying and "all of a tremble" with blood on his clothes. He was not sick and on the next day he seemed to be as usual except that he would not eat much breakfast and complained of feeling tired when walking. The graze on the forehead was superficial and nothing seemed amiss with the boy on admission. On the 7th, at 3 P.M., Mr. Burghard divided the slight webs between the second and third fingers of both hands. Chloroform was administered by Dr. H. P. Noble and was taken well. The skin was purified on the operating table with turpentine, followed by soap and strong lotion (perchloride of mercury, 1 in 500, and carbolic acid, 1 in 20, in equal parts), washed off with perchloride of mercury (1 in 2000). The wounds were dressed with cyanide gauze soaked in perchloride of mercury (1 in 4000). The operation lasted about 20 minutes. In the evening the child vomited twice slightly but had apparently recovered from the effects of the chloroform. On the next day (the 8th) he seemed quite well but was rather passionate, as he had been before the operation. On the morning of the 9th he was again slightly sick and was noticed to be drowsy and apathetic. In the afternoon of the same day he became distinctly though not deeply jaundiced. In the evening, at about 9 P.M., he suddenly began to scream loudly, the screaming occurring in fits or paroxysms and the boy seeming semi-conscious. He was unable to answer any questions or to locate any painful spot. There was no tenderness over the ears or head or about the abdomen, except possibly in the region of the liver which was distinctly enlarged. Urine was passed involuntarily in the bed. The screams, which were of shrill meningitic type, continued until after 3 A.M., when they ceased after chloral

² De Groub : De l'Embolie Graisseuse; Revue de Chirurgie, Paris, 1895.

³ THE LANCET, Feb. 17th, 1894, p. 419.

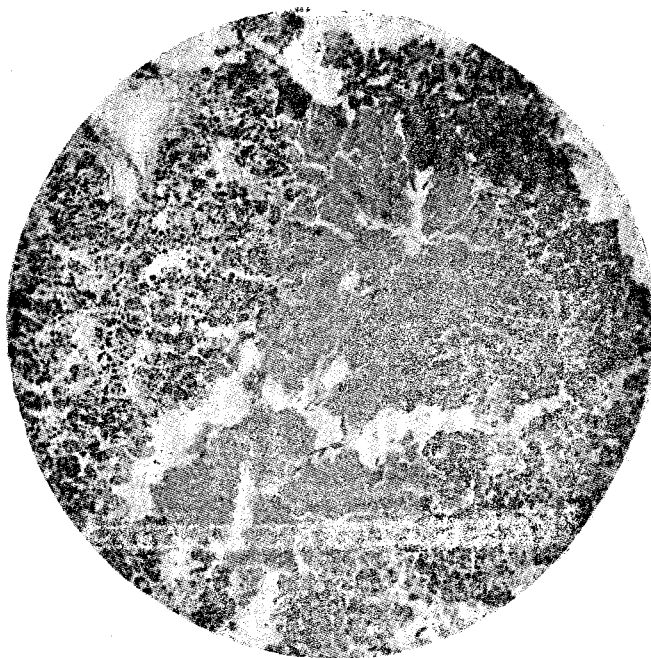
and bromide (six grains of each) had been given in two doses and also half a drachm of bromidia. On the 10th he cried out occasionally but the shrill screaming did not recur. He lay in a practically unconscious condition. The pupils were equal and reacted very slightly to light; they were moderately dilated, the conjunctival reflex being very much diminished. The knee-jerks were present but difficult to elicit; the plantar reflexes were sluggish and extensor in type. The respirations were 16 per minute and somewhat deep and irregular, the pulse being 116 and regular and of fair volume. He was constantly sick during the morning, the vomit being brown in colour and resembling "beef-tea," though he had taken none. The jaundice was about the same as on the previous day and the liver could be felt two fingers' breadth below the ribs. The fæces, after calomel and an enema had been given, were of normal colour. Urine was passed unconsciously; it was alkaline and contained no albumin or sugar or bile. Stellar phosphatic crystals were present and some doubtful tyrosin needles, but no leucin could be found. The urine contained no free fat. Towards night the unconsciousness increased to coma. The conjunctival reflexes vanished and there was slight lateral nystagmus, especially in the left eye, with a tendency in both eyes to turn upwards. The respirations were loud and rather quick at times, then becoming noiseless, but not of typical Cheyne Stokes character. The pulse was 120 and still regular. The knee-jerks were absent. The boy moaned occasionally and being unable to swallow was fed by the nasal tube. At 2.45 A.M. on the 11th he died somewhat suddenly, 84 hours after the operation. The temperature throughout remained between 97° and normal.

The post-mortem examination was made 12 hours after death. The body was well nourished but deeply jaundiced. The operation wounds were quite healthy. As regards the heart, the valves and walls looked normal. The right auricle and ventricle were moderately distended by dark post-mortem clots. The lungs were full of air and somewhat congested in parts. Here and there dark petechiæ were found on the pleural surfaces and also in the interior. They varied in size from that of a pin's head to that of a pea. Otherwise the lungs appeared to be normal in all respects. The bronchial glands were not diseased. The liver weighed 1 pound 12 ounces. It was of a pale fawn colour exactly resembling the colour of the liver as described in other similar cases. It was smooth and of soft consistency. The cut surface was of the same fawn colour and showed innumerable dark purple specks (the intralobular veins). The blood expressed was thin and watery and resembled prune juice. The gall-bladder was not distended and contained about one and a half drachms of dark green fluid bile. The main ducts were not obstructed and the duodenum seemed healthy. The kidneys, the suprarenal capsules, the spleen, and the intestines showed no abnormalities. The mesenteric glands were pale, soft, and a little enlarged, but not tuberculous. The convolutions of the brain were pale and slightly flatter than normal. The meninges seemed perfectly healthy. The ventricles contained a normal amount of fluid. The entire brain was firm in substance and showed no sign of softening anywhere. On section it was of normal appearance. The liver and portions of the brain and lungs were reserved for further examination, and I am indebted to Mr. J. W. Thomson Walker, pathologist to the hospital, for the following report on their condition.

The liver was preserved in formalin. The anterior edge was thick and rounded, and the whole organ was probably increased in size. The capsule was smooth and glistening, and the underlying tissue was pale. On section the surface showed a very striking pinkish fawn colour, no bile staining or hæmorrhage being present. The lobules were normal in size and were well defined by a ring of yellow which occupied two-thirds of each lobule, and their central zone was marked by a brownish red point. There was no increase of the fibrous tissue of the liver capsule or of the portal canals. The veins were normal to the naked eye. Portions of the liver were prepared and stained with osmic acid, safranin, and hæmalum and eosine. In the osmic acid preparations chloroform was used as a clearing agent, and for the removal of the paraffin in which the tissue was imbedded. In the other portions no attempt was made to preserve the fatty contents of the cells, which were consequently dissolved out, and they served as excellent contrast sections with those stained with osmic acid.

Microscopical examination.—With a low power ($\times 60$) the osmic acid preparations showed a ring of fatty cells occupying the outer zone of each lobule. Inside this the intermediate zone showed a few minute points of black in the liver cells, while in the central zone none were visible. In the sections stained with safranin and eosine and hæmalum the liver cells of the central zone were filled with fine granules which gave them a dull opaque appearance. A nucleus was dimly visible in a few but in most was completely obscured. Passing outwards towards the periphery of the lobule the nuclei of the liver cells became more evident and in the outer zone where the fat had been dissolved out of the sections the nuclei were well stained and centrally placed. The

central vein of the lobule was normal and there was no increase in the fibrous tissue of the portal canals. The vein, artery, and bile-ducts of the portal canals were normal. Surrounding the bile-ducts of each system there was an increased number of nuclei which in some was very well marked. There seemed to be some increase in the number of the small bile-ducts at the periphery of the portal systems and here and there between the lobules. Under a high power ($\times 450$) the liver cells of the central zone had a very fine granular appearance which in most of the cells completely obscured the nucleus. Minute brownish and black globules were also apparent in the protoplasm of these cells in the sections stained with osmic acid. In the outer part of the lobule the liver cells contained droplets of fat of varying size. In some cells there were but few droplets, while in others the whole cell was filled with them. In none of the cells had the fat formed a single large globule. In the outer zone of the preparations in which the fat had been dissolved out and hæmalum and eosine or safranin used as a stain the liver cells were well defined. The nucleus was centrally placed, well stained, and of a natural contour, and the protoplasm was reduced to a network the varying-sized meshes of which had contained the fat globules. The nuclei of the capillaries between the cell columns of the lobule were well stained and prominent. The slight increase in the number of fine bile capillaries at the periphery of the lobules was confirmed under this power and the increase in the nuclei around the bile-duct of the portal systems was found to be due to an infiltration of small round cells. The condition present in this liver is that of cloudy swelling and fatty degeneration. (See illustration.)



Liver from Case 12, showing distribution of fat globules in peripheral zone of lobules. $\times 50$.

Lung.—The portion of the lung examined showed a number of small hæmorrhages to the naked eye. Under the microscope the hæmorrhages were grouped around the smallest bronchioles. The air vesicles in the affected areas contained proliferated and desquamated epithelium and numerous blood corpuscles, the latter giving the impression of simple hæmorrhages macroscopically. The capillary blood-vessels in these areas were distended with blood but nowhere showed any sign of fat embolus nor was there any fatty change recognisable in their walls. There were proliferation of the epithelium of the small bronchioles and well-marked congestion of the vessels and infiltration of the connective tissue around the larger bronchioles. The condition was one of capillary bronchitis. [It should be noted that the condition of the lung above described only affected small scattered areas. The lungs as a whole were healthy.—Note by L. G.]

Brain.—No pathological changes were found in the nerve cells, nerve fibres, or neuroglia of the portion of brain examined and the blood-vessels were normal.

This case seems to meet all the requirements laid down. The child was apparently healthy, the operation was trivial, and the possibility of carbolic acid poisoning could be excluded. After recovery from the immediate effect of chloroform there was the usual delay in the onset of symptoms. For more than 36 hours nothing occurred to excite alarm. Then after a period of drowsiness and apathy there was the occurrence of wild and piercing shrieks continued for the greater part of the night followed by the stage of unconsciousness, vomiting of the characteristic beef-tea-like matter, and ending in coma and death. Jaundice was a peculiar feature of this case. It occurred in none of the others and is a symptom of great interest and importance to which further reference will be made. The pale and fatty liver precisely resembled that which had been described in other cases. The microscopical appearances in this and in the earlier cases were practically the same, except that in the latter cloudy swelling of the hepatic cells was not apparent. Finally, fat embolism was not present in either brain or lungs.

The next case, although incomplete so far as the post-mortem examination is concerned and therefore hitherto unpublished, is obviously one of the series.

CASE 13.—A well-nourished and healthy-looking little child, aged one year and ten months, was admitted to the Children's Hospital, Paddington-green, under the care of Mr. Burghard on Feb. 24th, 1898, for treatment of nœvus on the left shoulder. Part of the nœvus had been removed by Mr. Burghard in June of the preceding year but it had since grown again, though not very rapidly, in the neighbourhood of the operation scar, and now extended in front to the middle of the clavicle and backward as far as the acromion. The child's general health had always been good. On admission the temperature was 100·8° F. but she was very bright and amused herself by running about in the ward during the morning. She slept between 1.45 and 3.45 P.M., then awoke and was very sick, bringing up large quantities of currants and other undigested food. The temperature was normal in the evening and she slept well during the night. She was again slightly sick after breakfast but seemed otherwise well. At 10 A.M. on the 25th Mr. Burghard excised the remaining portions of the nœvus, the child being under chloroform. The operation lasted 20 minutes. There was very little hæmorrhage. The wound was dressed with cyanide gauze. Carbolic acid was only used in the form of "strong mixture" to purify the skin at the commencement of the operation. The child recovered normally from the immediate effects of the chloroform and showed no signs of shock. At 4.30 P.M. she was slightly sick after taking milk and barley-water, but the sickness did not recur during the evening. The temperature at 9 P.M. was 102°. She slept well through the night. At 5 A.M. on the 26th she awoke, was restless and appeared to feel sick but did not vomit. She slept again till 7.15 A.M. and then became very restless, somewhat cyanosed, and brought up a little dark-coloured fluid. She was then quite conscious. The pulse became feeble and rose from 136 to 160. The respirations were sighing in character. She was very thirsty. Brandy and strychnine were given. The wound was dressed at 9.30 A.M. and looked healthy. There was no hæmorrhage. At 11 A.M. she vomited more dark-coloured matter. At noon she became unconscious though still very restless and thirsty. At 2 P.M. there were slight general convulsions. A saline injection was given as a last resource, but the child died half an hour later, 28 hours after the operation. The pulse at the last was 160 and the temperature at the time of death was 106°.

At the post-mortem examination the operation wound was found to be healthy in all respects. There was no clotting in the veins. The lungs were slightly cedematous. All the other organs seemed healthy with the exception of the liver which was of a pale fawn colour and softer in consistence than normal. The blood in it was fluid, thin, and of a pale prune colour. The liver weighed 13 ounces. Microscopical examination of the organ showed a slight increase of fibrous tissue along the portal canals in places, but the hepatic tissues appeared healthy. Unfortunately, it was preserved in alcohol which prevented demonstration of fat present by the osmic acid process. But Dr. R. Tanner Hewlett, who was kind enough to examine sections, reported that they were "undoubtedly markedly fatty in places." As in other cases, the accumulation of fat was in the periphery rather than in the centre of the lobules.

The symptoms in this case were not of the pronounced cerebral type noticed in most of the others. Screaming and delirium did not occur, but extreme restlessness and vomiting of beef-tea-like matter were present as in others, soon followed by unconsciousness.

I have to thank Dr. H. Lambert Lack for notes of the last case to which I shall refer. In the absence of a post-mortem examination it is even more difficult to explain than the rest, but nevertheless it seems worth recording.

CASE 14.—A girl, aged about three years, was admitted to the Throat Hospital, Golden-square, for treatment of a small post-pharyngeal abscess. Dr. Lack opened the abscess from behind the sterno-mastoid without difficulty. Chloroform was administered by Dr. James Atkinson and was taken well. The operation lasted from 10 to 15 minutes. On the next morning (24 hours later) the child seemed fairly well but was often sick, and the temperature was 102° F. At 8 P.M. the same night, 33 hours after the operation, the child had a "cold fit," in which there was slight shivering and the extremities became blue. The temperature rose to 107° and death occurred half an hour later. Carbolic acid had been used at the operation and in the dressings, but there was

no carboluria. Unfortunately, the friends would not allow a post-mortem examination.

The symptoms in this case resembled those of the last-mentioned case in the hyperpyrexia and slight convulsions which occurred. Hyperpyrexia was only noted in these and it is therefore probable that hyperpyrexia occasioned the convulsions. In this case, again, cerebral symptoms in the shape of screaming were absent. Indeed, the stage of excitement, although so prominent in the majority of cases, was not invariably present in all.

It will, I think, be admitted that this new series of four cases, including that of the woman in Case 11, throws light on the original ten recorded in the earlier paper.

The additional cases seem to prove the following: 1. That neither carbolic acid poisoning nor fat embolism will account for these mysterious fatalities. 2. That the severity of the operations has little if anything to do with the cause of death. 3. That the only pathological condition commonly found after death is a peculiarly intense fatty degeneration or fatty infiltration of the liver. This condition was found in five of the first series and in three of the second series of cases. It was not noted in three of the first series, but in these a microscopical examination was not made. Of the remaining three one recovered and in two permission for a post-mortem examination was refused. 4. The only other circumstance common to all the cases was that chloroform had been administered some hours or days before death. We are therefore driven to seek an explanation in the morbid state of the liver which was demonstrated in eight out of 14 cases and can therefore not be regarded as a pure coincidence and also to inquire again what part (if any) was taken by chloroform in producing it.

It is necessary, in the first place, to be more explicit as to the precise nature of the fatty changes found in the liver. Is the condition one of fatty degeneration or merely of fatty infiltration? In the earlier paper I decided in favour of fatty infiltration on the ground that the accumulation of fat was far more marked in the periphery than in the central parts of the lobules and also because the hepatic cells seemed healthy and their nuclei were well defined and stained. Moreover, although the cells towards the central portion of the lobules looked granular from the presence of innumerable droplets of oil, towards the periphery the cells were distended by fat globules of much larger size. The question of degeneration *versus* fatty infiltration is indeed difficult to decide. Mr. Thomson Walker has kindly sent me the following comment on the subject in the light of the case examined by him (Case 12).

It is admitted by the best authorities that the differentiation by the microscope between fatty degeneration and fatty infiltration of the liver cells is by no means always possible. The presence of numerous small globules of fat in the liver cells affords the basis for the classical description of fatty degeneration in contra-distinction to the single large fat globule of fat infiltration. The two conditions are frequently described as occurring together, and, further, when occurring apart, their characteristic appearances may be transposed. It therefore may be said that while the well-known characteristics suffice to distinguish the two conditions in the majority of instances yet there are cases in which too much confidence must not be reposed in the grouping of the fat globules within the liver cells. Other factors must, therefore, have their influence in differentiating between these two conditions. The distribution of the fatty change is not unimportant. Fatty degeneration, resulting as it does from some general toxic process, is usually pretty evenly distributed throughout the entire lobule; fatty infiltration, on the other hand, is often confined to the outer zone. This, however, is only a matter of degree; the cells of the whole lobule from periphery to central vein may be occupied by fat globules absorbed from without, while, on the other hand, the outer part of the lobule may be in a condition of fatty degeneration while the more central part shows an earlier stage of the same process in cloudy swelling of the cells. The presence of a centrally-placed, healthy-looking nucleus is an apparent contradiction to the term "degeneration," but in the earlier stages of fatty degeneration it obtains. The division and breaking down of the nucleus and of the whole cell structure are phenomena of the later stages and of the more severe forms of fatty degeneration and need not be looked for as a point on which to base a microscopic diagnosis. In the case under consideration the number of globules in each cell points to a degeneration, while the limitation to the outer zone is rather against this. At the same time, as has been noted, the more central area of the lobule is in a condition of cloudy swelling and the combination and sequence of cloudy swelling and fatty degeneration are well recognised. The slight increase of, or apparent increase of, bile-ducts and the round-cell infiltration around the bile-ducts are not a marked feature of the condition and may be disregarded.

On the whole, therefore, bearing in mind the limitations of microscopic diagnosis above pointed out, I believe the condition present in this case (Case 12) is one of fatty degeneration and this conviction is somewhat strengthened by the clinical history of the case.

The microscopic appearances in the case examined by Dr. Walker do not differ essentially from those found by myself in other cases except for the presence of cloudy swelling and of slight increase of bile-ducts in the former, and it will be

remembered that this was the only one in which jaundice occurred, which fully accounts for the difference. I am, therefore, now inclined to agree with Mr. Walker that the condition in all cases was one of fatty degeneration rather than of fatty infiltration. He agrees with me that my preparations of the liver in earlier cases show changes of a similar type to those which he describes and that none of them is an example of acute yellow atrophy.

We must now consider the cause of fatty degeneration of the liver in these cases. Was it directly produced by the action of chloroform or was it pre-existent at the time of operation under chloroform?

As mentioned in my earlier paper, the pathological effects of long-continued administration of chloroform have been investigated by Ungar and Strassmann, Thiem and Fischer,⁴ and also by Ostertag of Berlin.⁵ The results of chloroforming several animals for an hour or so during a period of many days were thus summed up by Ostertag:—1. Fatty degeneration of organs, especially fatty infiltration of the liver, and fatty metamorphosis of the cardiac and skeletal muscles, kidneys, and stomach. 2. These fatty changes were considered to be due to the action of chloroform upon the blood (destruction of red corpuscles) and upon the tissue cells. 3. Some individuals were found to show a greater susceptibility to chloroform than others and to succumb at an earlier period to its effects. 4. The fatal effect was due to cardiac failure or paralysis, occasionally accompanied by slight anatomical lesions of the myocardium, and also to gradual carbonisation of the blood. Ungar and Strassmann described similar fatty changes, without, however, appreciable alteration in the blood. These researches appear to prove that the results of long-continued administration of chloroform are to produce fatty changes in the body generally and in the liver in particular. More recently these experiments on animals have been repeated and the results confirmed by Heintz,⁶ by Bandler,⁷ and by Ferdinand Schenk⁸ who examined the livers of animals at the beginning of chloroform narcosis and some days or weeks subsequently and found that the fat which appeared in the organs a few hours after inhalation sometimes did not disappear for days or even weeks. Ether gave rise to similar changes but to a less extent.

Analogous results of chloroform upon human beings.—Casper⁹ said: "It can no longer be doubted that there is such a thing as chronic poisoning by chloroform—that is, that the drug when it does kill does not always kill instantaneously, but that hours, days, or even weeks may elapse during which the person anæsthetised remains continuously under the influence of the poison, to which at length he succumbs." He quoted cases from Berend¹⁰ in which death followed the use of the anæsthetic during the ensuing night or within 15 or 48 hours, and mentions one of his own in which a woman never completely recovered her senses lost during the inhalation and died 11 days subsequently. The significance of some of these cases is perhaps doubtful, but one related by Berend is worth mentioning. This was that of a drunken painter whose left shoulder was excised by Langenbeck. The operation lasted three-quarters of an hour. Complete consciousness, motion, and sensation returned. In the evening vomiting suddenly occurred and recurred during the night after swallowing fluids. At 8 A.M. on the next day the pulse suddenly ceased and the movements of the heart could scarcely be felt, but the respiration was free and regular although the patient complained of oppression. An attempted venesection gave vent to a little watery ink-coloured blood. He died 17 hours after the operation. The chief post-mortem appearances were black watery blood with air-bubbles in the cardiac veins, in the branches of the pulmonary artery, and even in the larger veins of the extremities. The lungs were distended and anæmic. The heart was not distended, but both sides contained fluid blood with dark feebly coagulating clots. *The liver was fatty* and the kidneys were pale and firm. The brain was peculiarly pale and here and there quite anæmic. Casper regarded a dark fluid condition of the blood as always present in the bodies of those who had died from chloroform, but he

admitted that it was not confined to those who had so perished. In some of my cases a somewhat similar condition of the blood was noted, but it was not invariable.

The following are more recent instances of fatalities attributed to prolonged administration of chloroform. Schenk¹¹ records the cases of two women who died on the third day after difficult gynaecological operations with symptoms of heart failure and severe affection of the kidneys. Post-mortem examination showed fatty degeneration of the heart, the liver, and the kidneys. Death was attributed to the long period (from one and a half to two and a half hours) during which the patients were under chloroform. He deprecated the practice of repeating inhalations of chloroform at short intervals. In his valuable paper Schenk enumerates many instances of similar fatalities after operations under chloroform recorded by other observers. Thus Fränkel and Bastanielli each reported three cases; Roth, Eisendraht, Ambrosius, Marthen, Thiem and Fischer, and Bandler, one each; whilst Heintz contributed no fewer than eight to the series. In all of these, symptoms occurred more or less resembling those which I had already described in children and in all of them fatty changes were found either in the liver, heart, or kidneys, or in all these organs. In some instances the changes in the liver were described as those of acute yellow atrophy, in others as of fatty degeneration or fatty infiltration. More recently still, Cohn¹² has published the case of a woman, aged 21 years, whose uterine appendages were removed under chloroform. The inhalation lasted one hour and 175 grammes of chloroform were expended. After two days jaundice and albuminuria with numerous casts appeared. There was neither fever nor increase of pulse rate. Death took place on the fifth day. The necropsy showed extensive necrosis of the uriniferous tubules and degenerative changes in the liver cells which Cohn attributed to the prolonged action of chloroform. Finally, just as the present paper was on the point of completion, Ballin¹³ reported a case in which an operation for acute appendicitis on a man, aged 20 years, was followed on the fourth night by typical symptoms of acute yellow atrophy of the liver. The patient recovered eventually after treatment by venesection and intravenous saline transfusion. Ballin has collected nine other cases of post-operative acute yellow atrophy, mostly from the above-named authors mentioned in Schenk's paper. All ten cases have in common that one or two days after an operation a slight icterus developed which was followed by vomiting, violent delirium, coma, and death in all but one. In seven cases chloroform was used and in one Billroth's mixture; in the remaining two records the anæsthetic is not mentioned. Except in one case all the operations were upon the abdomen. In all cases the operations were severe and lengthy, requiring a large amount of the anæsthetic. All the patients above mentioned were adults. Abundant evidence is therefore at hand, since the appearance of my earlier paper in 1894, that the danger to which attention was then drawn of chloroform narcosis in children was by no means over-rated. The symptoms and pathological findings in children which were then described are, on the whole, similar to those which have been subsequently observed in adults. There is, however, an important difference between the views of other observers and my own as to the exact part played by chloroform in causing these untimely deaths. All authorities seem united in ascribing the pathological changes met with after death to the action of chloroform alone; whereas I formerly held, and still believe, that chloroform only takes the rôle of "the last straw" in the matter, for the following reasons.

Although experiments on animals show that general fatty degeneration is the result of prolonged narcosis by chloroform repeated for many days, it is extremely difficult to believe that changes so profound as to cause death can be produced by inhalation of chloroform lasting only an hour or so. Schenk's experiments only prove that fatty livers can be produced by chloroform, not that the production of such fatty livers is fatal in healthy subjects. Were it otherwise, such fatalities as have been described would be of everyday occurrence. Moreover, although in all of my first series of cases in which a fatty liver was found the period of inhalation lasted certainly not less than an hour, this was not so in the second series. For instance, in

⁴ Deutsche Medicinische Zeitung, 1889, p. 1111.

⁵ Pathologisches Institut, Virchow's Archiv, vol. cxviii., p. 2.

⁶ Rotterdam, Inaug. Diss., 1896.

⁷ Mittheilungen aus dem Grenzgebiet der Medicin und Chirurgie, 1896.

⁸ Zur Tödlichen Nachwirkung des Chloroforms, Zeitschrift für Heilkunde, 1898, p. 93.

⁹ Forensic Medicine, vol. ii., p. 293, New Sydenham Society, 1862.

¹⁰ Cases of Death from Chloroform, Hanover, 1850.

¹¹ Op. cit.

¹² Deutsche Zeitschrift für Chirurgie, June, 1902.

¹³ Annals of Surgery, March, 1903.

Case 12 the duration of the operation (division of webbed fingers) was only from 15 to 20 minutes, yet this case is perhaps the most typical of the whole series both in the nature of the symptoms and in the condition of the liver discovered after death. In Case 13, again, the period of inhalation was only 20 minutes and here, also, the fatty liver was found. Again, the amount of chloroform used in these cases probably did not exceed one or two drachms, all of which would not have been inhaled. In one case lasting fifteen minutes half a drachm was the amount of chloroform evaporated in a Junker's inhaler. It is almost incredible that such small amounts of chloroform, inhaled for so short periods as those mentioned, should be capable of producing extreme fatty metamorphosis in healthy organs. Therefore, one can only conclude that this fatty metamorphosis pre-existed the operation and that chloroform in some manner aggravated the fatty condition already present and made it fatal.

In the original paper two theories were suggested in explanation of the *modus operandi* of chloroform in these cases.

Fat embolism theory.—Presuming the liver to be previously fatty owing to diminished oxidising powers in the blood arising from an unknown cause, it was possible that chloroform, by still further decreasing oxidation, might increase the fatty metamorphosis already present. In such circumstances more fat might be poured into the circulation than could be oxidised. The result might be fatty embolism of both lungs and brain. This theory was, however, discarded because, as already mentioned, the symptoms in no case suggested fat embolism of either lungs or brain, whilst the post-mortem examination in Case 12 conclusively negatives the existence of fat embolism as the cause of death in one and, therefore, I think, in all the other cases.

Toxæmic theory.—Although the liver in no case answered to the classical description of acute yellow atrophy, yet the nervous or cerebral character of the symptoms, the peculiar vomiting of beef-tea-like matter, so prominent in most though not in all of the cases, strongly resembled the type met in acute yellow atrophy or after poisoning by phosphorus and other drugs having a similar action. It is true that jaundice and hæmorrhages were absent except in Case 12. But here jaundice was well marked and hæmorrhages were found in the lungs after death. So the case may be regarded as the coping stone of the rest, for it leaves no room for doubt that the liver is really at fault in these events and that its fatty condition is truly pathological and not merely a physiological and innocuous coincidence.

The cause of the cerebral symptoms in acute yellow atrophy of the liver has long been a matter of dispute. Frerichs thought they depended on the presence of leucin and tyrosin in the blood, Virchow regarded them as simply uræmic and Rokitsanski thought that they were of nervous origin, but not any of these views are tenable. Sir Lauder Brunton¹⁴ has insisted on the analogy between the symptoms of acute yellow atrophy and those of poisoning by phosphorus, lupinotoxin, and toluyldiamine, and has argued with much force that in acute yellow atrophy death is due to poisons which have a similar action to those mentioned, but are formed within the bodies of the patients themselves by microbes, the nature of which is unknown.¹⁵ Sir Lauder Brunton,¹⁶ has, moreover, brought forward abundant evidence that an important function of the liver is to deal with poisons entering the portal circulation from the intestinal tract and to prevent them from passing into the general circulation. If they did so they would speedily prove fatal unless eliminated by the kidneys. But normally they are either destroyed in the liver or re-excreted in the bile, or should they enter the general circulation they escape by the kidneys. In order to prove fatal such poisons, whether introduced from without or generated within the body, must either be in such excess as to destroy the hepatic structure and functions—e.g., as in acute atrophy or phosphorus poisoning—or else the liver and kidneys must be functionally inadequate to deal with them, though only present in such quantities as are normally easily disposed of by healthy organs.

Applying such information to the cases under consideration it seems probable that: 1. The liver being previously

to the operations in an advanced state of fattiness was probably on the verge of functional inadequacy with regard to elimination of toxins entering the portal circulation, though still able to hold its own in ordinary circumstances. 2. Chloroform by decreasing oxidation already deficient aggravated the condition of fattiness already present and so lowered the hepatic functions that ptomaines or toxins escaped into the general circulation. 3. Chloroform, moreover, by its specific action on the kidneys, prevented the elimination of such poisons by the urine and was thus again immediately concerned in the cause of death. These were the conclusions arrived at in the earlier paper and I am at a loss to suggest any other explanation of the facts. The writer of the leading article in THE LANCET to which reference has already been made threw doubt on the contention that chloroform is the direct cause of death in the subjects of the form of fatty liver described on the ground that the most marked cases of lardaceous and fatty disease are daily operated upon under chloroform without the occurrence of such symptoms as I had observed. He also mentioned that animals which were poisoned by the use of phosphorus and then chloroformed in the Hyderabad experiments did not show any unusual reaction towards the anæsthetic. I must again insist that in children the form of fatty liver to which attention has been drawn is altogether peculiar to these cases of fatality following operations under chloroform. I am familiar with most kinds of fatty liver but have never seen the pale fawn- or buff-coloured variety except in such cases as these. The distinction is that the fatty change affects the entire organ uniformly and is not confined to portions of it. And this may account for the sequence of events. The nearest approach to its appearance is in acute yellow atrophy, but, as already mentioned, the liver in these cases is not atrophied. With regard to the Hyderabad experiments on animals it is possible, as THE LANCET stated, that parallel symptoms might have arisen had the animals been kept alive longer. But the conditions would not, I think, be the same and it would be difficult to decide how far chloroform and how far phosphorus were responsible for events which might then have occurred.

Prophylaxis and treatment.—There is nothing new in the suggestion that operations may be dangerous to the subjects of fatty liver. Verneuil¹⁷ and Symonds of Oxford¹⁸ described cases of unexpected death after operations and noted the existence of fatty livers post mortem. They advised against operations in such cases but they did not attribute the fatal results to chloroform. Their warnings, as well as my own, have hitherto been disregarded, doubtless because they were thought to refer to ordinary cases of fatty liver. But it is probable that Verneuil and Symonds had in mind the peculiarly intense form of fatty liver which I have described. The practical value of the caution would be greater were it easier to recognise with certainty the existence of these markedly fatty livers during life. One may suspect the condition but cannot prove it, for *per se* it seems never fatal. The train of fatal symptoms is not met except in those who die after operations under chloroform or in definite instances of acute yellow atrophy, which these are not. There are no infallible physical signs to guide us. But it is possible that the history of symptoms in the patient might give rise to suspicion of the existence of a morbidly fatty liver. A history of repeated so-called "bilious attacks," which on inquiry or observation are usually diagnosed as "acute gastric catarrh," is suggestive of the presence of fatty liver. Such attacks are characterised by violent and incessant vomiting, fever, delirium and night terrors, diarrhoea or constipation, epigastric pain and tenderness, and sometimes slight jaundice. The tongue is thickly coated; there may be aphthous ulcers on its surface and a copious flow of clear glairy mucus in the mouth. There is also the sweet and characteristic odour of acetone in the breath. These symptoms suggest some acute form of ptomaine poisoning and may be indications of a fatty and incompetent liver. They seldom last more than a few days and recovery is invariable. They are usually attributed to chill or to indiscretions in diet, but often such explanations are not forthcoming. A history of the kind is not given in any but one of the children (Case 12) and here it is only vaguely indicated in such terms as "always dyspeptic since birth," "subject to bilious attacks," and "once had jaundice." Perhaps a history of similar symptoms in other patients

¹⁴ Acute Atrophy of the Liver. Brunton and Tunnicliffe, St. Bartholomew's Hospital Reports, vol. xxxii., 1896.

¹⁵ Acute yellow atrophy has been attributed to action of specific germs (Klebs, Tomkins), that of streptococci (Nepveu), that of staphylococci (Bondillier), and to the bacillus coli (Minz), Ballin, op. cit.

¹⁶ Disorders of Digestion. 1886, p. 17, 1901, p. 364.

¹⁷ Gazette des Hôpitaux, March 3rd, 1881.

¹⁸ Medical Times and Gazette, vol. ii., 1860, p. 351.

might have been elicited on inquiry.¹⁹ In future it seems advisable that such inquiries should be made and if affirmed the operations should be deferred except in cases of urgency. It is significant that several of the children who died had vomited with more or less frequency and severity during the 12 or 24 hours preceding operation. These occurrences should contra-indicate operation and the practice of admitting a child on one day to hospital and operating on the next should be discontinued. Although most of these children were described as "healthy looking" it may be that their standard of health would only pass muster in the surgical wards. Children suffering from the complaints for which these were treated are usually regarded as delicate at home and therefore, as subcutaneous fat covers a multitude of sins, in order to increase it they are plied with abundance of carbohydrates and cod-liver oil until their livers may store more fat than they can use.²⁰ Should the condition of *foie gras* be suspected a course of diet calculated to reduce it might be prescribed before operations are undertaken.

Allusion has already been made to the curious susceptibility which some showed to the action of carbolic acid when applied to the skin. In default of a more scientific test the drug might be used in this manner as a rough gauge of an equal susceptibility to the action of chloroform, carbolic acid being comparatively free from danger.

Lastly, the possibility of foreseeing whether chloroform may be dangerous in a given case by means of indications afforded by the urine must be considered.

In 1893 Sir Lauder Brunton²¹ quoted Poehl of St. Petersburg as saying that in Russia "they are now able by analysing the urine beforehand to tell whether chloroform will be dangerous in any case or not." "If the quantity of alkaloidal substances which they can precipitate from it is great, the administration of the anæsthetic will almost certainly be risky, whereas if the alkaloidal substances are scanty the anæsthetic can be administered with perfect safety." Sir Lauder Brunton added: "Why death should occur in persons after a second or third administration has hitherto been a mystery, but it can now be readily understood on the supposition that from indigestion, imperfect action of the liver, or some other cause the alkaloids were more abundant at the time of the fatal administration than they were on the previous occasions."²² It is obvious that these remarks of Sir Lauder Brunton have special application to the cases which are the subject of this paper. Whether the promise held out has been in any way fulfilled in Russia or the suggestion acted upon here I do not know. I believe that there are practical difficulties in carrying out systematic investigations of the sort. Large quantities of urine have to be examined in order to discover appreciable amounts of alkaloids or bacilli, whilst the quantity of alkaloids sufficient to prove fatal may be infinitesimally small and we cannot even be sure that the poison which presumably causes death is in existence until after the operation under chloroform has been performed. Yet this seems to be the only precautionary line which promises any success.

Before quitting the subject the practice of administering phloridzin before operations, which, I believe, has been suggested in order to test the adequacy of the kidneys, requires notice. Phloridzin by its action on the kidneys produces glycosuria, hence if after its administration sugar appears in the urine the kidneys are held to be sound.²³ The test may be of value so far as the kidneys are concerned, but, according to Romfeld,²⁴ phloridzin, like phosphorus, has the effect of causing storage of fat in the liver. If this be so the practice alluded to might be dangerous in cases where fatty liver already exists.

Diagnosis.—The diagnosis is not difficult if the peculiar character of the cerebral symptoms is borne in mind. The screaming and delirium so often noted should not be mistaken for the ordinary crying and fractiousness of a child in pain or "when feeling ill."²⁵ Jaundice would seem, of course, to be a valuable indication of danger, but it was only present in one of my cases. It occurred, however, in all

the cases collected by Ballin. Yet in itself, apart from other symptoms, jaundice is not particularly alarming. It is mentioned in most text-books on anæsthetics as an occasional and insignificant sequel to operations under chloroform, no fatal instances being recorded. One case has been reported in which recovery took place after two attacks of jaundice supervening on operations under chloroform.

Treatment.—The mortality in my own cases shows the futility of the treatment adopted, which chiefly consisted in the free administration of alcohol combined with morphia, opium, and other anodynes and sedatives. Such treatment may be not only useless but positively harmful by preventing elimination of poisons. But citrate of caffeine and carbonate of ammonium and strychnia may be used as stimulants. The symptoms are those of acute yellow atrophy and Ballin collected cases which show that in adults this disease is actually present. Although I have not been able to demonstrate atrophy of the liver in children it cannot be doubted that the condition of fatty degeneration present is closely akin to it. Treatment, therefore, should be on similar lines. Active purgation, venesection, and saline transfusion are the only modes of treatment which afford any hope of success and should be promptly adopted. It is useless to wait until the child is comatose before having recourse to them.

In conclusion, it may be mentioned that in Schenck's experiments ether was also found to produce fatty changes in the livers of animals, though to a far less extent than chloroform. Hence when a fatty liver is suspected ether should be the anæsthetic used.

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THE EDUCATION OF PHYSICALLY DEFECTIVE CHILDREN UNDER THE LONDON SCHOOL BOARD.¹

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THE following paper deals with the provision of education for children physically incapable of attending the ordinary elementary schools. I propose to approach the subject chiefly from the medical aspect, to give a somewhat detailed analysis of the various groups of cases now collected in special classes in London, to describe shortly the methods and arrangements adopted in these classes, and to discuss briefly the question how far any special provision for physically defective children is necessary or desirable. Before discussing the classes themselves a short account of the history of the movement may not be out of place.

Since 1892 centres have existed throughout London where classes are held for the instruction of mentally deficient children. In these classes there were also a certain number of cripple or delicate children who were unfit to attend ordinary schools. In 1900 the attention of the School Board was directed to the establishment of special classes for physically defective children only and as one of the medical officers of the Board I was instructed to examine and to report upon all the cripple children not attending school who had come under the cognisance of the officials of the Board. These children were collected together as far as possible for medical examination at different centres, but a large number had to be visited in their homes. Over 600 cases in all were examined and reported upon. As regards the diseases from which these children suffered, tuberculous affections of the joints headed the list, comprising 48 per cent. of the whole. Spinal caries and hip disease accounted for by far the greater part of these, being 22 and 20 per cent. respectively, leaving 6 per cent. for other joints. Most of these were chronic cases with a history of some years' duration. A large proportion had never been to school, some had attended school for a time and had left owing to difficulty with the stairs, a fall, or some other cause. Next in order of frequency were cases of paralysis—viz., 29 per cent. More than half of these (16 per cent.) were cases of infantile paralysis. In many of the cases the paralysis (usually not of the infantile variety) was associated with hydrocephalus, epilepsy, or imbecility. Rickets furnished a fair number—

¹⁹ This was so in two of the cases mentioned by Ballin, op. cit.

²⁰ In adults a corresponding fatty liver may be induced by alcohol, as suggested by Ballin (op. cit.).

²¹ THE LANCET, Oct. 7th, 1893, p. 861.

²² Schenck, on the other hand, attributed these fatalities to repeating inhalations of chloroform before the fatty changes produced in the liver have had time to pass off.

²³ Dr. H. D. Rolleston informs me that Klemperer found that in seven out of ten cases of granular kidney phloridzin did not give rise to glycosuria.

²⁴ THE LANCET, July 17th, 1897, p. 169.

²⁵ THE LANCET, Feb. 24th, 1894, p. 370.

¹ A paper read at the International Congress of Medicine at Madrid in April, 1903.