agent by Sturrock (1939). Although pethidine does not fulfil all his criteria it is suggested that it approaches the ideal more nearly than any other obstetric analgesic drug in current use.

Brief recommendations for the use of pethidine in labour are given.

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REFERENCES

- Andrews, H. L. (1942a). *J. Pharmacol.*, **75**, 338.
 — (1942b). *Ibid.*, **76**, 89.
 Batterman, R. C. (1943). *Arch. intern. Med.*, **71**, 345.
 — and Himmelsbach, C. K. (1943). *J. Amer. med. Ass.*, **122**, 222.
 — and Mulholland, J. H. (1943). *Arch. Surg.*, **46**, 404.
 Benthin, W. (1940). *Dtsch. med. Wschr.*, **66**, 760.
 — (1942). *Med. Klinik*, **38**, 342.
 Branwood, A. W. (1943). *Edinb. med. J.*, **50**, 177.
 Christie, R. V. (1943). *Lancet*, **1**, 294.
 Cripps, J. A. R., Hall, B., and Haultain, W. F. T. (1944). *British Medical Journal*, **2**, 498.
 Dietrich, H. (1939). *Dtsch. med. Wschr.*, **65**, 969.
 Duguid, A. M. E., and Heathcote, R. St. A. (1940). *Quart. J. Pharm. Pharmacol.*, **13**, 318.
 Eisleb, O., and Schaumann, O. (1939). *Dtsch. med. Wschr.*, **65**, 967.
 FitzGerald, G., and McArdle, B. (1943). *Lancet*, **1**, 296.
 Fuchs, H. (1941). *Med. Welt*, **15**, 371.
 Gallen, B., and Prescott, F. (1944). *British Medical Journal*, **1**, 176.
 Gilbert, G., and Dixon, A. B. (1943). *Amer. J. Obstet. Gynec.*, **45**, 320.
 Gruber, C. M., Hart, E. R., and Gruber, C. M., jun. (1941). *J. Pharmacol.*, **73**, 319.
 Hardy, J. D., Wolff, H. G., and Goodell, H. (1940). *J. clin. Invest.*, **19**, 649.
 Hecht, H., Noth, P. H., and Yonkman, F. F. (1943). *J. Amer. med. Ass.*, **121**, 1307.
 Himmelsbach, C. K. (1942). *J. Pharmacol.*, **75**, 64.
 Hori, C. G., and Gold, S. (1944). *Canad. med. Ass. J.*, **51**, 509.
 Lull, C. B., and Hingson, R. A. (1945). *Control of Pain in Child-birth*, 2nd ed., William Heinemann Medical Books, London.
 Mackenzie, E. K. (1943). *Lancet*, **1**, 446.
 Noth, P. J., Hecht, H. H., and Yonkman, F. F. (1944). *Ann. intern. Med.*, **21**, 17.
 Roby, C., and Schumann, W. R. (1943). *Amer. J. Obstet. Gynec.*, **45**, 318.
 Rothschild, F. (1941). *Helv. med. Acta* (Supp. 7), **8**, 83.
 Rovenstein, E. A., and Batterman, R. C. (1943). *Anesthesiology*, **4**, 126.
 Schumann, W. R. (1944). *Amer. J. Obstet. Gynec.*, **47**, 93.
 Sonnek, W. (1941). *Dtsch. med. Wschr.*, **67**, 868.
 Sostmann, H. E. (1940). *Med. Welt*, **14**, 325.
 Spitzer, W. (1944). *British Medical Journal*, **1**, 179.
 Steinberg, M. (1945). *Amer. J. Obstet. Gynec.*, **50**, 542.
 Sturrock J. (1939). *J. Obstet. Gynaec. Brit. Emp.*, **46**, 428.
 Venters, Margaret (1944). *British Medical Journal*, **1**, 339.
 Yonkman, F. F., Noth, P. H., and Hecht, H. H. (1944). *Ann. intern. Med.*, **21**, 7.

AN OUTBREAK OF STAPHYLOCOCCAL FOOD-POISONING

BY

J. G. ODDY, M.B., Ch.B.

AND

H. W. CLEGG, M.D., D.P.H.

*From the Department of Bacteriology and Preventive Medicine,
University of Manchester*

Since 1930 many outbreaks of food-poisoning have been described in which the evidence has pointed to a staphylococcus as the responsible organism. Commonly, milk and milk products have been the vehicle, but other foods, such as prepared meats, have less often been the medium in which the toxic substance was disseminated. The actual time and place when contamination of the food occurred have been difficult to define, and conclusions have been made on circumstantial evidence. Early last year Williams *et al.* (1946) described three outbreaks of staphylococcal food-poisoning due to ice-cream, in two of which, by typing the isolated staphylococci with bacteriophage, they were able to trace the source of contamination to an assistant in the cookhouse where the ice-cream was prepared.

The present article describes an outbreak of staphylococcal food-poisoning due to consumption of pressed pickled beef in which the source of infection was demonstrated by means of bacteriophage typing.

The Outbreak

On Sept. 27, 1946, 167 miners at several collieries were taken ill three hours after eating sandwiches containing pressed pickled beef. The outbreak was explosive, and clinically the onset was sudden, with dizziness, nausea, vomiting, diarrhoea, and pain in the abdomen. All the patients were much better in 24 hours and were normal in about three days. Fifteen men were sent to hospital with severe prostration, but were not detained longer than 24 hours.

This outbreak had been preceded by two smaller ones, on Aug. 16 and 30, involving 16 and 22 men respectively, pressed beef sandwiches being the suspected food. On the first occasion the cause was not established. On the second occasion a staphylococcus was isolated from the pressed pickled beef but not from the vomit. All the meat came from one cooking centre, but in the second outbreak this was not obvious, because the sandwiches had on this occasion been made up elsewhere. Immediately the third outbreak occurred steps were taken to investigate the matter in detail.

The Food.—At the centre from which the pressed beef was distributed the meat was cooked, pickled, and pressed by one butcher, who placed it, when ready for cutting, in a large refrigerator of the domestic type, operating at a temperature just above freezing point. The quality of the food and the conditions during preparation were quite satisfactory. The pressed beef was made into sandwiches on the day of distribution to the collieries. One pressed beef sandwich was wrapped in grease-proof paper along with another containing either roast beef or corned beef. The whole packet was known as a "B" pack, and had stamped on it a date after which the pack should not be eaten (this prevented the sale of stale sandwiches). These "B" packs arrived at the various collieries between 9 a.m. and 1 p.m. on the day of distribution, and were issued to the afternoon shifts at 2 p.m., to the night shifts at 10 p.m., and to the day shifts at 6 o'clock the following morning.

The scientists on the whaling factory ship *Balaena*, in the Antarctic, have been investigating for the Department of Scientific and Industrial Research methods of ensuring that whale meat is in the freshest possible condition when frozen. There are certain general principles of slaughtering of animals for meat and the handling of carcasses which can be followed only with difficulty in whaling. One of the most important of these is rapid cooling of the carcass immediately after death. Owing to the bulk of the whale's carcass and the thickness of the blubber cooling takes place very slowly, and the meat is therefore likely to go bad rapidly. As the time between death and butchering on the deck of the factory ship may vary considerably, some method of cooling the carcass as soon as possible after death had to be found. An experiment was recently carried out to test a method of doing this. The carcass of a whale when caught is normally inflated with air to prevent its sinking. This causes the whale to roll over on to its back and float belly uppermost. In the experiment portions of the skin and blubber were removed as soon as possible after death to admit cold sea water, which at that time was at a temperature of 30° F. (−1° C.). It was necessary to insert a special temperature-recording unit deep into the body before this to register the temperature immediately after death and any subsequent change. The leader of the scientific team, Dr. R. A. M. Case, therefore entered the water as the whale surfaced after its final dive. Clad in a frog-man diving suit he swam under the belly of the whale and shot his recording thermometer into it. It was found that when the blubber was stripped from the belly the internal temperature of the whale fell rapidly.

They were eaten about five hours after the miners received them. On the occasion of the outbreak under discussion 1,661 "B" packs were sold among 10,098 miners. The afternoon and night shifts, totalling 1,713 persons, to whom 189 "B" packs were sold, apparently did not suffer any ill effects. All the 167 victims were members of the day shifts, numbering 8,385 men, to whom 1,472 "B" packs were sold. It was not possible to ascertain how many "B" packs each man consumed. Storage conditions varied from colliery to colliery, some having refrigeration, but others having to keep the packs at room temperature—at that time about 74° F. (23.3° C.).

Bacteriology

Staphylococcus pyogenes aureus was isolated from the vomit of three individual patients by plating, via Robertson's meat medium, and also, by direct plating on blood agar, from a vessel into which several miners had vomited. It was also isolated from some "B" packs remaining at one of the collieries, as well as from "B" packs belonging to the suspected batch that had not been distributed; and was recovered from the outer surface of a block of uncut pressed beef in a refrigerator at the cooking centre. We failed to isolate it from the brine in which the pressed beef was prepared, from the bench on which the sandwiches were cut, and from the bread-slicing machine. Petri dishes of nutrient agar exposed in the centre did not grow a *Staph. pyogenes*.

Kelly and Dack (1936) have shown that staphylococci will grow in meat with a content of 10% sodium chloride, which prohibited the increase of spore-forming and non-spore-forming rods; this is in accord with our experience, for after 18 hours' incubation the blood-agar plates, after direct plating and plating via Robertson's meat medium, gave a preponderant growth of staphylococci, although a spreading organism finally outgrew the cocci on the plates after three to four days.

A search for carriers was made among the staff at the cooking centre. Swabs were taken from the nose, throat, and any lesions in exposed parts of the body likely to be a source of contamination to the food. In all, 58

TABLE I.—*Staph. pyogenes aureus* Found in Swabs from Personnel

No. of Persons	No. of Swabs	No. of Positive Swabs	Site of Positive Swabs		
			Nose	Throat	Hands
28	58	10	6	2	2

TABLE II.—Distribution of Positive Swabs

No. of Positive Swabs	Total No. of People	Nose Only	Throat Only	Nose and Hand	Throat and Hand
10	8	5	1	1	1

swabs were examined from 28 persons, and the results are shown in Table I. The 10 positive swabs came from eight people, and the distribution is shown in Table II.

All the coagulase-positive staphylococci from whatever source were of *aureus* type, fermented mannite, liquefied gelatin, and were haemolytic on horse-blood-agar plates. They were all submitted to the central laboratory of the Public Health Laboratory Service for bacteriophage typing. Staphylococci belonging to the same bacteriophage type (47/47C) were shown to have been present in the vomit (individual and pooled), "B" packs, pressed beef, and the nose and on the hand of the butcher who prepared the pressed beef. Neither *Staph. pyogenes* nor organisms of the *Salmonella* and dysentery groups were isolated from faecal samples submitted from seven patients.

Discussion

An explosive outbreak of gastro-enteritis involving 167 persons two to four hours after they had eaten pressed pickled beef sandwiches suggested the probability of toxic origin. Two independent lines of inquiry led to the source of the trouble. One investigation, by the local and county medical officers of health and their staff, by elimination, led through the common denominator of the pressed beef as a vehicle to the butcher who was the sole person handling the beef in all three outbreaks. In the second outbreak, although the sandwiches had been prepared at another centre, the beef was processed by this butcher. The other line of inquiry, consisting of the chemical and bacteriological analysis of the food and material involved in pickling the beef, showed that inorganic substances capable of toxic effects were absent or were present in normal quantities—for example, nitrites, arsenic, zinc, antimony, lead, mercury, copper, and tin—while *Staph. pyogenes aureus* was isolated from an uncut block of pressed beef and the sandwiches. It had also been isolated from the vomit of individual cases and a communal bucket, as well as from eight of the workers in the food-preparing centre. This evidence was reinforced by bacteriophage typing.

The same bacteriophage type was found in the pressed beef block, the pressed beef sandwiches, the various vomits, and on the person of only one worker in the food-preparing centre—the butcher who was responsible for pickling and cooking the meat and who handled it from the raw state to the finished pressed block ready for slicing. He was harbouring the organism in his throat and in a trivial cut on the palmar surface of his right hand, and it seems most likely that from this second source the contamination of the pressed beef occurred. The cut could easily have been overlooked, and was causing the butcher no discomfort, although the swab revealed a heavy growth of the offending staphylococcus. It was the sort of minor lesion that would have been treated lightly by anyone. The general hygiene of the centre was excellent—floors and benches were clean and the workers wore clean caps and overalls.

It is of great interest that all the cases occurred among the day shifts. The sandwiches were made during the earlier part of the day of distribution, and by the time they were eaten by the afternoon shifts were about eight hours old, by the night shifts 17 hours old, and by the day shifts about 25 hours old. No complaints occurred among the afternoon and night shifts, and it therefore seems that, under conditions prevailing in the sandwiches, it took the organism between 17 and 25 hours to produce enough toxin to cause sickness. Experimental confirmation of this is difficult because the only satisfactory indication of the presence of enterotoxin is the reaction of a human volunteer. The kitten test as described by Dolman and his collaborators (1936) has not been found completely reliable by Fulton (1943). However, under almost identical conditions of temperature and material (five hours' incubation at 37° C., followed by 16 hours' refrigeration and a further six hours' incubation of a pressed pickled beef sandwich) Kelly and Dack (1936), using human volunteers, showed that no ill effects were observed on eating the sandwiches after the first 5 hours' incubation, but that the typical symptoms of staphylococcus enterotoxin poisoning followed the ingestion of the sandwiches at the end of 26 hours. Incidentally they noted that under identical conditions one volunteer showed no ill effects, while another was severely ill. It would appear also that the organisms are capable of producing the enterotoxin under a wide temperature range, because at the collieries storage conditions varied from 35° to 74° F. (1.7° to 23.3° C.), and yet cases occurred

at each of them and no correlation between the storage temperature and the number of cases could be made out.

The butcher who was the source of the staphylococcus causing the outbreak had local treatment for the lesion in his hand, which soon healed. He also had a course of sulphathiazole, and swabs from his nose, throat, and hand are now negative.

This experience has shown the value and importance in such outbreaks of close liaison between all interested parties and the necessity for thorough and prompt investigation by a bacteriologist with up-to-date services at his disposal.

Summary

An outbreak of toxic food-poisoning following the consumption of pressed pickled beef sandwiches is described. The evidence showed *Staph. pyogenes aureus* (phage type 47/47C) to be the cause. Personnel handling food should pay scrupulous attention to personal hygiene and especially to lesions, however slight.

Close liaison between all interested parties was an important factor in finding the cause.

Our thanks are due to Drs. Hall, Brothwood, and Carroll and the staff of the Lancashire County Council Public Health Department, especially Mr. Eckersley and Mr. Ward, for providing many of the circumstantial details. We also wish to thank Prof. H. B. Maitland for his criticism and advice.

Drs. Allison and Williams, of the P.H.L.S. Central Laboratory at Colindale, kindly phage-typed the staphylococci for us, and Mr. C. H. Walker, analyst to the Lancashire County Council, performed the chemical analyses.

REFERENCES

- Dolman, C. E., Wilson, R. J., and Cockcroft, W. H. (1936). *Canad. publ. Hlth. J.*, 27, 489.
Fulton, F. (1943). *Brit. J. exp. Path.*, 24, 65.
Kelly, F. C., and Dack, G. M. (1936). *Amer. J. publ. Hlth.*, 26, 1077.
Williams, G. C., Swift, S., Vollum, R. L., and Wilson, G. S. (1946). *Bull. E.P.H.L. Serv.*, 5, 17.

d-TUBOCURARINE IN CAESAREAN SECTION

BY

T. CECIL GRAY, M.B., Ch.B., D.A.

Anaesthesia for caesarean section is a subject full of controversy, but the advent of *d*-tubocurarine seems to offer a solution to some of its problems. It assures an easy induction and eliminates any necessity for harmful doses of toxic anaesthetic agents. This report on a series of 30 such operations in which this drug has been used is published in the hope that it will encourage others, who may have greater opportunities in this field of anaesthesia, to explore its possibilities. It is hoped that the constancy in results may convince despite the paucity in numbers.

Technique

The best results were obtained with the following technique and dosages. As premedication, 1/100 gr. (0.65 mg.) of atropine is given one hour before operation. When the surgeon is scrubbed up and ready, the induction is carried out on the table with an injection of 15 mg. of *d*-tubocurarine ("tubarine";—Burroughs Wellcome and Co.) followed by 0.3 g. of "kemithal" (cyclohexenyl-allylthiobarbiturate) in 5% solution. Anaesthesia is maintained with cyclopropane, using the closed circuit. The loss of consciousness which results from the initial injection is, however, only transient, and it is necessary that the face-piece of the anaesthetic apparatus be applied without delay. Respiration is "aided" (Gray and Halton, 1946) from the beginning, for it is of paramount importance that the small

amount of depression that may result from this dose of *d*-tubocurarine must not be allowed to result in any suboxygenation.

The operation is started as soon as the patient fails to respond to painful stimuli. An early indication as to when this plane has been reached may be afforded by the reaction of the patient to the application of the towel clips. Up to the time of delivery of the child the anaesthesia must be kept as light as possible. It has been found useful to turn the absorption canister out of the circuit for a few minutes before the uterus is incised. In such a short time this has probably little effect upon the mother, but may build up a carbon dioxide tension in the foetal blood which may well contribute to the early commencement of respiration by the baby. After delivery the anaesthesia is deepened as required, but it is not necessary to carry it lower than deep first plane. A pharyngeal airway is not usually inserted. In fact it is inadvisable, as this procedure may well precipitate vomiting. Endotracheal tubes and a laryngoscope are always to hand, but have been found necessary only on the one occasion described later.

Results

There has been a certain dependability about the results of this technique which has been encouraging. There is no anxiety with regard to depression of the infant. With the exception of two understandable cases these babies have all cried most lustily as soon as the head was delivered. They have been quite unusually lively and have shown no evidence of curarization. One of the exceptions was an infant who was rather sleepy but cried after five minutes. In this case thiopentone, 0.15 g., was used for induction instead of the usual "kemithal." The other was a premature baby of 32 weeks weighing 3 lb. 2 oz. (1.42 kg.), and the mother was eclamptic, having had several fits before delivery. This baby took six minutes to expand its lungs.

An increased contractility of the uterine muscle has been observed. The placenta always separates very easily and the uterus contracts down firmly. The injection of "pituirine" (pituitary lobe extract) which had always been routine was continued in the early cases before this feature was appreciated. It was seen to be unnecessary and has been abandoned. Five patients who it was felt might be predisposed to post-partum haemorrhage received 0.5 ml. of pituitrin. The usual indication for this was a justifiable apprehension on the part of the surgeon rather than any unsatisfactory condition of the uterus. Nineteen patients who had no uterine stimulant showed excellent contraction throughout, and not infrequently clots have been observed extruding through the cervix at the end of operation.

As a result of the extremely light anaesthesia the patient wakes up as the dressings are applied, and she often has been told the all-important news before she leaves the theatre. On occasion there have been slight residual signs of curarization at the end of an unusually quick operation, but only twice has it been necessary to inject adequate doses of "prostigmin" and atropine. This has always resulted in complete recovery.

Post-operative vomiting or retching is rare, and is only minimal when it does occur. One of the patients under review developed a chest complication, but it was of doubtful nature and had completely cleared up within 48 hours. There was no evidence of any undue retention of urine; nor have any eye symptoms as reported by Langton Hewer (1946) been seen. There has been no case of ileus.

Discussion

The ideal anaesthesia for this operation should be safe and, if possible, pleasant. It must provide good working