and the unpalatability of the substance will also militate against its general acceptance in practical dietetics.

REFERENCES.

- ¹ Knoop: *Beiträge z. Chem. Physiol. u. Path.*, 1904, vi, 150.
- ² Dakin, H. D.: *Journ. Biol. Chem.*, 1907, iii, 57. *Ibid.*, 1908, iv, 77, 91, 221, 227, 419.
- ³ Höckendorf: Quoted by Dakin.
- ⁴ Embden, G., and Kalberlak: *Beiträge z. Chem. Physiol. u. Path.*, 1906, viii, 121. Embden, Salernoni, and Schmidt: *Ibid.*, 1905, viii, 129. Embden and Marx: *Ibid.*, 1908, xi, 318.
- ⁵ Ringer and Jonas: *Journ. Biol. Chem.*, 1913, xiv, 43.
- ⁶ Kahn: *Proc. Soc. Exper. Bact. and Med.*, 1923, xxi, 31.
- ⁷ Idem, *ibid.*, 1921-22, xix, 265-266.
- ⁸ Kahn: *Amer. Journ. Med. Sci.*, 1923, clxvi, 824.
- ⁹ Joslin, C. P.: *Treatment of Diabetes Mellitus*, 1923, 463-465.
- ¹⁰ Desgrez, Bierry, et Rathes: *Compt. rend. de l'Acad. des Sci.*, 1924, 178, 1771-1775.
- ¹¹ Sevringhaus, E.: *Scientific Proc. Soc. Biol. Chem.*, xviii, xix. *Journ. Biol. Chem.*, lix, 1924.
- ¹² Allen, F. M.: *Amer. Journ. Med. Sci.*, 1924, clxvii, 557.
- ¹³ Cowie and Hoag: *Journ. Amer. Med. Assoc.*, 1921, lxxvii, 493.
- ¹⁴ Pybus and Lyon: *BRITISH MEDICAL JOURNAL*, August 23rd, 1924, p. 328.

THE PERMEABILITY OF MENINGES TO URANIN AS A METHOD IN THE DIAGNOSIS OF MENINGITIS.

(Preliminary Communication.)

BY

OTTO JERVELL, M.D.

(From the Christiania (Oslo) Municipal Hospital,
Medical Section VIII.)

A METHOD whereby it is possible to decide simply by lumbar puncture whether meningitis is present or not may possibly be of interest. The normal meninges and plexus choroides have the power of preventing a number of substances that are foreign to the organism from passing into the spinal fluid; diseased meninges have lost this power. Especially in meningitis this permeability of the meninges to chemical substances is greatly increased, and it is thus natural to investigate whether the determination of the latter can be of assistance in diagnostic difficulties. The substance must be easily found in the spinal fluid and be non-poisonous. Such a substance is uranin (sodium fluorescein), a red colouring matter very readily soluble in water; a weak solution gives an intensely light-greenish fluorescence which strongly recalls the fluorescence seen in a positive Schlesinger reaction. The fluorescence does not disappear until the solution is weakened to 1 in 10,000,000. Weaker solutions have a dirty greenish colour, without fluorescence.

A series of investigations carried out by Kafka,¹ Schönfeld,² Jörgensen,³ and others have established that uranin, in doses of 6 to 8 grams by the mouth, passes into the spinal fluid in about 30 per cent. of healthy individuals, but in small quantities only. In dementia paralytica, and also in syphilitic persons, uranin was found more frequently in the spinal fluid, especially if it was altered. These authors do not appear to have made any determination of the permeability of the meninges in meningitis.

Uranin given in larger doses enters the spinal fluid where the meninges are not infected, and the patient's skin becomes intensely yellow. After several experiments we decided upon 2 grams of uranin for an adult, or about 0.03 per kilogram of body weight. One or two hours after such a dose the patient turns yellow, but the coloration is not stronger than in icterus, and the yellow colour of the skin and mucous membrane disappears comparatively quickly, as a rule after five to six hours. Uranin has no poisonous effects, and according to C. Jörgensen's investigations does not irritate the meninges. It can be administered by the mouth or by intramuscular injection in a 20 per cent. solution, but not subcutaneously, as a strong solution produces a sensitive infiltrate. After half an hour to an hour the blood serum gives a greenish fluorescence, which in the great majority of cases does not disappear until the serum is weakened to 1 in 64. The concentration of uranin in the blood is strongest two to three hours after it has been given, and it is at that time, therefore, that the lumbar puncture should be performed. We employ the following technique:

The patient is given 2 grams of uranin by the mouth (preferably in wafers) or by intramuscular injection (20 per cent. solution) if he is not quite conscious. Three hours later lumbar puncture is undertaken in the usual manner. In order to ascertain whether

the spinal fluid is fluorescent or not, the test tube must be held against a dark background. In meningitis the fluid gives off a distinct greenish fluorescence. No importance should be attached to a doubtful fluorescence. The presence of blood may confuse the reaction, since the blood contains great quantities of uranin. Investigations made at this section prove, however, that at least 1/3 c.cm. of blood must be mixed with 10 c.cm. of spinal fluid in order that the latter shall become fluorescent.

We have employed this simple method with 74 patients, 18 of whom were suffering from various forms of meningitis. The spinal fluid (from, in all, 22 lumbar punctures) taken from patients suffering from meningitis was in all cases fluorescent, in some quite strongly, like a markedly positive Schlesinger reaction. It is true that the fluorescence was weak in three instances, but nevertheless distinct. The method used in these cases, however, differed somewhat from the technique usually employed, the lumbar puncture being performed within one hour after the patient had received the uranin. In addition, the dose of uranin given to two of the patients was too small (1 gram). The spinal fluid in 38 of 56 non-meningitic cases was as clear as water. In 8 cases the fluid was of a dirty green colour without fluorescence; this shows that minimum quantities of uranin had entered the spinal fluid. In 10 cases the spinal fluid was faintly fluorescent, but in 7 of these there was an admixture of blood, which, as mentioned above, makes the results uncertain. Three of the non-meningitic cases, on the other hand, exhibited a faintly fluorescent spinal fluid three hours after 2 grams of uranin. The fluorescence disappeared, however, in a dilution of 1 in 2, whilst the spinal fluid from patients with meningitis showed fluorescence in a dilution of 1 in 8 and up to 1 in 30. (For this determination we employed small test tubes 11 mm. in width, and observed the fluorescence in a dark box, where the light at a distance of 15 cm. enters through a 20 dioptric biconvex lens.)

Conclusions.

Uranin in doses of 0.03 gram per kilo of body weight does not enter the cerebro-spinal fluid, or does so only in small quantities if the meninges are not infected. In meningitis the colouring matter enters the fluid in easily demonstrable quantities. If, therefore, by lumbar puncture three hours after uranin has been given in the doses stated, the spinal fluid shows a distinct greenish fluorescence, we can with great probability diagnose meningitis without making other investigations of the spinal fluid. If the spinal fluid shows no fluorescence, meningitis can with certainty be excluded.

It is not possible to decide what form of meningitis, if any, is present. The passing of the colouring matter into the spinal fluid merely indicates the greater or lesser permeability of the meninges. In meningitis comitans, circumscripta, etc., the uranin does not enter the fluid, or does so in relatively small quantities, even when pleocytosis is present. Opinions differ as to whether it is correct to designate these conditions meningitis, but this is doubtless chiefly a dispute about words.

REFERENCES.

- ¹ Kafka: Untersuchungen zur Frage der Entstehung, Zirkulation und Funktion der Cerebrospinalflüssigkeit. *Zeit. f. d. ges. Neurolog. u. Psych.*, 13, 192, 1912, and 15, 482, 1913.
- ² W. Schönfeld: Versuche am Lebenden über den Übergang von Farbstoffe aus dem Blut. *Arch. f. Dermatol. u. Syph.*, 132, 152, 1921.
- ³ C. Jörgensen: Uraninets Udskillelse i Spinalvaedskken, Neurologisk Selskaps forhandling, 1920-21, p. 25, *Hospitalstidende*, 1921.

A WEAK POINT IN STERILIZING METHODS.*

BY

KENNETH BLACK, F.R.C.S.ENG.,

PROFESSOR OF SURGERY, KING EDWARD VII COLLEGE OF MEDICINE,
SINGAPORE.

ONE of the problems of the operating theatre is to ascertain the temperature reached in the centre of a packet, tin, or drum of dressings in a sterilizer. It is very different from that of the steam around the outer side of the packet or tin, but the latter alone is registered by a thermometer projecting into the sterilizer and capable of being read from the outside, or, more commonly, by means of a pressure gauge. I made tests with a specially prepared thermometer, similar to a clinical thermometer

* Read at a meeting of the Malaya Branch of the British Medical Association.

but registering far higher temperatures. I placed it inside a tin of dressings, which I then "sterilized" in a high-pressure sterilizer of the largest and most up-to-date pattern. When the temperature of the steam in the inner jacket of the sterilizer was 240° F. that in the middle of the tin of dressings was only about 160° F. After screwing down the safety valve of the sterilizer and "sterilizing" for more than an hour after the maximum pressure had been registered by the gauge, the special thermometer in the centre of the tin registered 220° to 230° F. I tested many other sterilizers, and found that all those of low pressure, such as are used ordinarily in nursing homes and small hospitals, were practically useless, whilst even those of high pressure were mostly inefficient unless "sterilization" was continued for a far longer period and at a higher pressure than that suggested in the maker's printed instructions. On one occasion a theatre sister, doubting the accuracy of my suggestion that her high-pressure sterilizer was not efficient, took the trouble to place a raw egg in the middle of each packet of dressings, but, after completing the "sterilizing" process, discovered that the eggs were still raw. Afterwards she "sterilized" several times at a temperature and pressure regarded as dangerously high, previously having placed my special high-registering thermometer in the inside of the drums of dressings. She discovered that my thermometer even then rarely registered a temperature exceeding 200° F.

It is possible, of course, to argue that if no mischief has been proved to have resulted from the ordinary methods of "sterilization" it matters little whether or not a very high temperature has been obtained in the middle of the tin of dressings. It would be equally possible, however, to argue that, if no mischief has resulted from the use of dressings that have not been "sterilized" at all, "sterilization" is a superfluous precaution. I scarcely believe, nevertheless, that failures to detect and record mischievous results are likely to convince competent surgeons that "sterilization" by sterilizers is useless. Probably they will continue to believe that, when "cooking" our dressings, towels, overalls, etc., we ought to aim at obtaining in the inside of each drum or packet a temperature at least equal to that of the boiling point of water (212° F.).

I have for many years past endeavoured to solve the problem of ascertaining easily and economically the temperature inside a tin of dressings undergoing "sterilization." There is no difficulty, of course, in ascertaining this temperature by means of the special thermometer already mentioned. Such a thermometer, however, is unsuitable for ordinary use, being costly, easily broken, and inconvenient. I have tried, therefore, to find an economical and convenient substitute.

On discovering that a famous surgeon had been experimenting with tiny tubes of phthalic acid, I obtained a number of these from the Paris firm that made them. I placed a tube within each of several tins of dressings, which I then proceeded to "sterilize." The powder in each tube was supposed to change colour from white to red as soon as a certain very high temperature (I think 300° F., but am not quite sure) had been reached. I found, however, by experiments, that the powder always changed colour from white to red during "sterilization" of a tin, no matter what temperature was indicated as having been reached. I found also that the powder changed colour to red when I left a tube in my waistcoat pocket for a week, or even when I held it in a warm hand for a time. Clearly, therefore, these tubes of phthalic acid do not suffice for our present purposes.

Afterwards I gave a trial to various kinds of wax. Finally, I made a series of experiments with fusible metals, and was encouraged, eventually, to devise the pyrometer here described. It is placed in the inside of a tin, drum, or packet of dressings, etc., and remains there during the process of "sterilization." It consists of a round piece of cardboard, to which are attached six small squares of fusible metal, each having a different fusing point. Convenient fusing points have been found to be 190°, 200°, 212°, 220°, 230°, and 240° F. Each square is marked with its own fusing point, and the cardboard is similarly marked in the proper places. When the temperature of 190° F.

is reached the first square fuses; when that of 200° F. is reached the second square fuses, and so on. Consequently, by glancing at the pyrometer when the dressings are unpacked after "sterilization," the surgeon can see how many squares have fused, and consequently what minimum temperature has been reached in the inside of the packet or tin. When a square fuses its surface becomes rough and its outline blurred, whereas an unfused square remains bright and its edges sharp. As the pyrometer can only be used once cheapness is essential. A pyrometer consisting of only one thin square of fusible metal melting at exactly 212° F. would suffice, and its cost would be insignificant.

Messrs. Matthey and Johnson of Hatton Garden make these metals to melt at any temperature desired. They all contain bismuth, and this renders the metal somewhat brittle to roll into sheets, but it can be cast fairly easily into thin plates or melted into tiny square castings. The accuracy of the actual melting points is easily checked.

It has rather surprised me that none of the surgical instrument makers, apparently, has ever seriously endeavoured to provide surgeons with a check or reliable test of the machines they supply, which are believed and claimed to sterilize the contents of the largest drums, even when tightly packed. I noted that the standard type of dressing drum, with holes that close and open, possesses no advantage over an ordinary plain metal box with a hinged lid, which is closed over a layer of cotton-wool. The superheated steam appears to penetrate into the latter, even when closed, just as readily as into the former, and the latter has the advantage that it more nearly approaches the ideal organism-proof receptacle than the former, with its numerous loopholes for the possible entrance of bacteria.

A DIATHERMY SNARE FOR REMOVAL OF POST-NASAL GROWTHS.

BY

E. BROUGHTON BARNES, F.R.C.S. Ed.,
NORTHAMPTON.

The diathermy snare here illustrated was devised by me and I have used it on an angio-fibroma of the nasopharynx with success.

The snare consists of a vulcanite body, with metal liner with solid end, into which the diathermy cable screws. In the liner of the body of the snare is a hollow metal slide. The wire, which is of hard drawn silver, is passed through the stem of the snare into this slide, and a vulcanite-headed screw works through a slot in the body into the slide and grips the wire in it. The diagram, in which the snare looks rather frail than it actually is, shows the mechanism clearly. The instrument was made for me by Messrs. Watson (Kingsway), and the arrangement of the instrument is their design.

The case in which I used it was that of a boy of 13 with an angio-fibroma springing from the basi-sphenoid by a pedicle half an inch broad and a quarter of an inch thick. The tumour was about 1½ in. long by 1 by ¾ in., and showed below the soft palate. The wire was passed through the mouth over the pedicle and forced against the basi-sphenoid with the finger-nail; it was then tightened and the current was switched on at a fairly high amperage. The wire came home and the tumour fell off in about three seconds. There was no stain of blood. At no time after the operation did the child have any pain at all. Five weeks later I saw the boy and was unable to detect any sign of growth. Apart from the simplicity of the procedure and freedom from haemorrhage with the diathermy snare, it seems probable that there will be less liability to recurrence after the use of the diathermy snare than if the tumour had been removed by ordinary surgical procedures.

The only precaution is to see that the child's nasopharynx is low, as the tumour falls free and might be aspirated into the glottis.

Microscopic examination showed that the tumour in this case was very vascular.