is only a question of pure respiratory insufficiency in consequence of a yielding thorax. At the autopsy we have often been able to satisfy ourselves of this fact. The ribs are weak and the chest falls widely open when the incision is made on the post-mortem table. In the pleural cavities are then seen the flabby, badly-ventilated, but not inflamed lungs. It is this increase of deaths of rachitic children

FIG. 3.—A girl, 6½ years old, and unable to walk. This child took more than two months to learn the use of her legs.

in consequence of respiratory insufficiency that causes the increase of recorded deaths from "inflammation of the lung," and which makes it probable that the high mortality of little children is really to be ascribed to rickets.

Rickets as a Cause of Crippling.

Rickets as a cause of death is bad enough, but still more perturbing is the high number of cripples with which we have to reckon. First of all, the prodigious number of dwarfs. Observations, now going back a year or more, show that the growth tendency of rachitic dwarfs seems to be slight even after recovery from the condition which gave rise to the dwarfing. No final judgment can yet be passed; nevertheless it already seems probable that complete reparation will not occur. These dwarfs will in the majority of cases remain of lessened citizen value. Similarly with the numerous children in whom severe deformity of the skeleton has occurred. Those also, who in addition are frequently dwarfed, will not become full-valued members of society. On the contrary, it is to be feared that a not inconsiderable proportion of the young people of to-day will later become a charge upon the State.

When an attempt is made to form an exact position of the extent of those affected the ability to walk affords a great criterion. In a town such as Dortmund, in which the inhabitants consist

chiefly of manual workers, and which has a large youthful population, the number of small children amounts to some 10 per cent. of the population, or say 30,000. From the practice of the clinics and consultations, it is estimated that more than 10 per cent. of these children cannot walk. Numbers of them are three, four, or five years old, some even older. Fig. 3 shows a 7 year old child unable to walk.

As to the cause of the prevalence of rickets no doubt can arise. The food-supply, insufficient in amount and faulty in composition, which was all there was to give to children during recent years, the lack not only of fat and milk, but also of fresh vegetables and milk, are without question to be blamed. Most crucial seems to have been the lack of fresh milk. To this conclusion above all points the fact that rickets is far more widespread than before among the children of the well-to-do also. Even in the worst times much could be had for money, but not milk. However much we were inclined earlier to shelter our rachitic patients from excessive ingestion of milk, yet we must now admit that too great a lack causes the disease. Should doubt arise as to the effect of the relative starvation, it must vanish when we see how, under the prolonged influence of these harmful conditions, bony disease occurs in increasing extent among the higher age-groups also.

Treatment has always shown itself of real worth, when the children could be brought to a clean and healthy manner of life with sufficient nourishment. Hospital treatment has, in consequence, shown good results, although existing institutions do not avail by far to accommodate the great number of those requiring it.

A CASE OF SEVERE CEREBRAL TOXÆMIA, FOLLOWING AN INTRAVENOUS INJECTION OF NOVARSENOBILLON.

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With a Note by

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At a time when the treatment of syphilis by arsenical compounds is being conducted on an increasingly vast scale, the details of the following case should be of interest. The type of toxic reaction described is fortunately rare. It occurs almost always some few days after an intravenous injection and, as a rule, ends fatally.

The special points of interest are that the recognised methods of treatment were of no avail, and that immediate improvement, and eventually complete recovery, followed the two measures adopted, which were: (1) continuous inhalation of oxygen; (2) an intravenous injection of urotropine and caffeine.

The patient, a healthy young man, 19 years of age, was sent to Haslar on July 31st, 1919, on account of manifest signs of syphilis, discovered at an examination for draft. Examination in hospital showed a slight degree of general glandular enlargement, a macular syphilide on trunk and limbs, and erosions of anal mucosa. Wassermann positive; urine normal; nothing else abnormal detected. No previous history of fits. On August 2nd 0.45 g. of N.A.B. was given intravenously without reaction. Four days later 0.9 g. was administered, also intravenously. No reaction. On the night

of August 8th (approximately 56 hours after the second injection) the patient vomited. Temperature, 103·8° F. Next morning he vomited again. At 7.30 A.M. on the 9th he was found in a fit, "foaming at the mouth." Details of this attack are not available, as he was not seen in it by a medical officer. He slept most of the day, the temperature rising from 99° in the morning to 103° in the evening.

Further events were as follows: August 10th, 9.10 A.M., severe epileptiform seizure (second), preceded by cyanosis and contortions of the face and contractions of the left arm. Patient bit his tongue in the fit. 9.20: Typical post-epileptic state. Pulse 80. Temperature 99°. 10.10: Macular (arsenical) rash on left forearm. 11.45: Patient conscious, but dull and lethargic; answered questions after a long interval. Rash generalised and very irritable; patient scratching skin, especially of perineum. 12.50 P.M.: Another fit (third); duration of convulsions, two minutes. 1.20: Semi-conscious; incontinence of urine; face cyanosed; restless; signs of cerebral irritation. 1.23: Another fit (fourth). Duration, 1 minute. 1.30: Temp. 100·6°; left arm twitching; patient unconscious. 2: Semi-conscious. 3: Apparently conscious; would not answer questions, open mouth, or swallow; pulse 76, volume full. 4.15: Another fit (fifth), lasting one minute; incontinence of urine; temperature 100·6°. 6: Temperature 102°, pulse 92. 9: Signs of cerebral irritation. August 11th, 4 A.M.: Another fit (sixth); right side of body more convulsed than left. 4.30: Generalised muscular twitchings. 5.10: Restless and irritable. 9: Incontinence of urine and fæces; pulse 84; temperature 102·4°; unconscious; less irritable. 9.35: Violent fit (seventh); deep cyanosis; pulse very feeble, but soon improved. 10: Unconscious; pulse 80.

Treatment Adopted.

The following recognised methods of treatment had been tried without any signs of improvement: Adrenalin in 15-minim doses, calomel gr. i. hourly, chloral and bromide (by the mouth and rectum), venesection, and lumbar puncture (18 c.cm. of fluid withdrawn). Shortly after the seventh fit, at the suggestion of Surgeon-Lieutenant-Commander Dudley, continuous oxygen was administered, and an intravenous injection of urotropine 1·5 g. and caffeine 0·2 g. in 15 c.cm. of sterile distilled water. The course of events thereafter was as follows:—

12.30 P.M.: Sudden extreme cyanosis while patient was lying placid and unconscious; pulse 60; cyanosis soon passed off, without any fit developing. (N.B.—Each fit was preceded by cyanosis and distortion of the face. In the seventh fit the patient became black, and this, in association with a temporarily imperceptible pulse, gave rise to the fear that a fatal issue was imminent.)

From this moment onward improvement was steady and rapid.

3 P.M.: Colour normal; signs of returning consciousness. 5: Patient opened his eyes and stated that he was "all right." During the night he slept quietly. Incontinence of urine at 1 A.M. on August 12th. At 9 A.M. his condition was normal, and but for incontinence of fæces on the night of the 13th, and relative amnesia for 14 days, his recovery was uneventful.

Examinations of the Blood, Urine, and Cerebro-spinal fluid.

Blood (August 10th).—Red cells, 6,650,000 per c.mm.; white cells, 19,200 per c.mm.; hæmoglobin, 80 per cent.; colour index, 0·6. No alteration in shape, size, or staining of red cells; two myelocytes seen. Differential leucocyte count: 68·3 per cent. polymorphonuclear cells; 26·7 per cent. small mononuclear cells; 5 per cent. large mononuclear cells.

Arneth count: 1. 2. 3. 4. 5.
66 25 8 1 0
91 9

Normal (40). Normal (60).

Arneth count indicates a very marked toxæmia.

On August 12th, the leucocytes numbered 10,300 per c.mm. Differential count: 58·5 per cent. polymorphonuclear cells; 31·0 per cent. small mononuclear cells; 3·0 per cent. large mononuclear cells; 4·0 per cent. eosinophiles; 0·5 per cent. basophiles.

Arneth count: 1. 2. 3. 4. 5.
29 36 27 8 0
65 35

The whole count suggests that the toxæmia is less acute.

August 14th: Leucocytes, 6300 per c.mm.; no important changes in differential count.

Arneth count: 1. 2. 3. 4. 5.
26 39 29 6 0
65 35

Urine (August 11th).—Acid, specific gravity 1015; trace of albumin; no sugar; urea 2 per cent.; large deposit of uric acid and amorphous urates. (It has already been noted that the urine, prior to treatment, contained no abnormality.)

Cerebro-spinal fluid.—18 c.cm. of clear colourless fluid. A mere trace of blood settled on standing. Normal amount of reducing substance and globulin. Cells: 5 lymphocytes and 110 erythrocytes per c.mm. Wassermann: Negative (using 0·8, 0·2, 0·05, and 0·012 c.cm. of fluid).

Remarks.

The amnesia at first was complete as far as the illness was concerned; the patient could remember nothing. He recalled being at his dépôt, but he could not recollect being sent to hospital, nor any incident which occurred in hospital prior to the onset of the toxic symptoms. He had a vague idea that he had seen me somewhere before, but he could not recall the circumstances. He was greatly mystified as to why he was in hospital and how and when he arrived there. On August 26th (14 days later) he told me that he had suddenly remembered all the details of his case up to the day of the second injection of N.A.B.

The chart records graphically the features of the case in relation to the treatment. The improvement which followed the continuous administration of oxygen, and the injection of urotropine and

caffeine directly into the blood-stream, is a striking fact. That it was due to one or other of these measures, or to both, seems a not unreasonable assumption. The prompt treatment of future cases of this type by these two measures may throw further light on the matter. The administration of oxygen was not stopped until 9 A.M. on August 12th, when the patient had been conscious for eight hours.

After History.

The patient returned from convalescent leave on Oct. 5th, 1919. He looked extremely well. His memory was normal.

Wassermann (Oct. 10th), weak positive.

Urine (Oct. 8th).—Cloud of albumin; the deposit contained a few crystals of calcium oxalate; no cells. Oct. 12th: Nil, abnormal.

Blood (Oct. 7th).—Leucocytes, 7200 per c.mm.; polymorphs, 36·8 per cent.; small mononuclears, 59·2 per cent.; large mononuclears, 3·2 per cent.; eosinophiles, 0·4 per cent.; basophiles, 0·4 per cent. (The excess of small mononuclear cells may have been associated with latent syphilis.)

Arneth count: 1, 2, 3, 4, 5.
 19 29 31 18 3
 48 52

He was discharged to duty on Oct. 14th, 1919.

Note by Surgeon Lieutenant-Commander DUDLEY.

These cases of delayed 914 poisoning are probably accompanied by anoxæmia—i.e., insufficient supply of oxygen to the tissues. In the case just described the attacks of cyanosis are the chief evidence of this anoxæmia, which may well be of the type that Haldane¹ describes as due to the alteration of the dissociation curve of oxyhæmoglobin, whereby oxygen diffuses less easily into the plasma. The highly acid urine with a very heavy deposit of uric acid crystals suggests the possibility of a breakdown in the mechanism controlling the hydrogen-ion content of the blood, which in turn prevents the respiration centre from performing its function normally. The lack of dyspnoea, the loss of consciousness, and the amnesia resemble carbon monoxide poisoning, which is a definite anoxæmic condition. It was these observations, together with a favourable experience of the use of oxygen in influenzal broncho-pneumonia, also an anoxæmia, which suggested that oxygen might be of use in this case. The urotropine was given, as H. Michel² had reported successful results with it in acute mania and delirious influenzal broncho-pneumonias, supporting his clinical experience by animal experiments. Intravenous urotropine produces a profound diuresis, and H. Michel thinks toxins are eliminated this way via the kidneys. Should this man's recovery be in any way due to the therapeutic agents employed, it may reasonably be supposed that the oxygen held in check the anoxæmia, while the urotropine stimulated the kidneys to remove some poisonous product resulting from the arsenical injection. As far as the experience of one case goes, it would seem that of the two agents employed the oxygen was the more useful. The Arneth count in this case is interesting as showing how a chemical poison acts the same way as a microbial one on the nucleus of the neutrophile leucocyte. Another arsenic compound, AsH₃, acts exactly the same way.³ A comparison of the Arneth counts on August 10th and 12th is strong evidence that a large quantity of deleterious substance must have been got rid of by the organism between those dates. While admitting the danger of drawing conclusions from a single case, considering the fatality and anxiety these severe toxic reactions cause, the use of oxygen in these reactions is worth a further trial.

THE SCHICK REACTION

FOR THE DETERMINATION OF SUSCEPTIBILITY TO DIPHTHERIA.

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THE object of this paper is to show the results of an investigation made on the subject of the Schick test¹ with a view primarily to the forming of some opinion as to its reliability, its difficulties, and its suitability for application in general and hospital practice, together with the advantages that might be expected to arise therefrom.

The test is performed by injecting a very small dose of diphtheria toxin into the skin, and noting after a certain lapse of time whether there is a reaction produced or not. If there is a reaction the test is said to be positive, and this result indicates that the subject lacks natural antitoxin immunity, and is therefore more likely to be susceptible to diphtheria. This reaction is due to the irritating effect of the toxin on the skin cells. When the patient has circulating in his blood natural diphtheria antitoxin the injected toxin is neutralised, so that no local reaction is produced. The test is then said to be negative, and the subject to be immune to diphtheria.

The toxin injected is a ripened one which has been recently carefully standardised and its minimal lethal dose (hereafter indicated as M.L.D.) accurately determined. The M.L.D. is the smallest amount of toxin that will produce death in a 250-gramme guinea-pig within four days. Such a toxin is taken, and suitable dilutions made until we have a diluted toxin containing one-tenth of an M.L.D. in 1 c.cm. The amount actually injected in the test is 0·2 c.cm. of this diluted toxin, which therefore contains one-fiftieth of an M.L.D.

Technique and Interpretation of the Schick Reaction.

This injection must be intracutaneous and of accurate dosage, and is best made by means of a fine needle fitted on to a hypodermic syringe graduated in tenths of a cubic centimetre. If the injection is made subcutaneously it is quite useless. A satisfactory injection should leave a round, white wheal the size of a large split pea, sharply defined, with the pores showing up well. The most convenient site for the injection is the flexor aspect of the forearm just below the fold of the elbow. The skin surface should be cleaned with a little alcohol or ether previous to the injection and the needle introduced very obliquely, the lumen superficial and when in position showing slightly through the upper layers of the skin. The operation is a painless one; 0·2 c.cm. having been injected the needle is withdrawn. The arm is then inspected after varying periods and a note of the readings made.

A typical positive reaction begins to show distinctly in from 24 to 48 hours and reaches its height about the third day. It is a sharply circumscribed area of redness with definite, though slight, infiltration, circular or somewhat oval in shape, and varying from half to one inch in diameter. This persists for about a week and on fading leaves a brownish, pigmented area which shows traces of desquamation. This pigmented area persists for a month or longer. A negative reaction is shown by the absence of redness and infiltration; after 24 to 48 hours there is nothing to be seen except perhaps a point of redness marking the needle track.

The reaction previously described was, as stated, a typical positive one. To distinguish such from a negative presents little difficulty, but in actual practice two sources of difficulty arise. The first is that in quite a

¹ Brit. Med. Jour., July 19th, 1919.

² La Presse Médicale, March 10th, 1919.

³ Journal Industrial Hygiene, September, 1919.