patient on April 4th, inclined to the view that tuberculous meningitis might be a probable explanation of the symptoms, though he had in mind the possibility of lethargic encephalitis. In the light of the subsequent history of the case he fully concurred with the ultimate diagnosis. The prognosis in the early stages of the disease was considered to be hopeless by a number of medical men who saw the patient.

As almost every feature which previous observers have regarded as of grave import was present in this case, the patient's complete recovery must be deemed remarkable. The sudden and severe onset indicated an unfavourable prognosis, as H. F. Smith found a mortality rate of 60 per cent. in cases with sudden onset. The severity of the general symptoms was also of unfavourable omen, as, from a study of the official records of the Ministry of Health, Parsons concluded that cases with marked general symptoms were more fatal than those in which the local symptoms were more prominent. Hall states that sudden death is not uncommon in cases, such as the foregoing, where bulbar symptoms were a prominent feature. Edwin Bramwell has emphasized the gravity of the prognosis in cases where previously deepening lethargy was accompanied by such symptoms as a rising temperature, profuse sweating, and incontinence; sweating, however, was not noticed in the case here recorded. Most observers agree that a severe attack is not necessarily followed by residua, and up to the present none have manifested themselves in this case. In view of the frequency with which cases are recorded as illustrative of the beneficial action of some particular remedial measure, it is significant to observe that a case of the gravest type may recover without any special treatment.

I am indebted to Dr. J. Wilkins, medical superintendent of the Eastern Hospital, for permission to publish this note, and to Dr. G. W. Ronaldson for directing my attention to the literature of lethargic encephalitis.

THE EXPERIMENTAL PRODUCTION OF STONE IN THE BLADDER.*

BY

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THE EXPERIMENT.

EARLY in 1926 young rats to the number of 120—66 females and 54 males—aged between 60 and 90 days, were fed on a diet consisting of tinned Scotch oatmeal 636 grams, linseed meal 240 grams, tinned cornflour 300 grams, sodium chloride 12 grams, calcium phosphate 12 grams, and distilled water 450 c.cm. The ingredients were mixed together and made into cakes by baking in a slow oven. The animals were given as much of this diet as they cared to eat. Distilled water was provided for drinking purposes. One half of them (33 females and 27 males) were given iodine in the drinking water, in the proportion of 0.1 mg. to the litre; the other half were given no iodine in the drinking water. The presence or absence of iodine in the water made no difference to the results in so far as stone in the bladder was concerned.

During the course of the experiment it was observed that the diet was very faulty: the young rats failed to grow normally, cannibalism was frequent, and the animals suffered from a variety of diseases, of which one was urolithiasis, another a severe anaemia resembling "pernicious anaemia" in the human subject. When the experiment had been in progress for one month 16 rats were killed by chloroform and subjected to *post-mortem* examination; similarly, 16 were killed and examined at fortnightly intervals up to the end of the eighth week. Stone in the bladder was not found in any of them. The experiment was then carried to the death of the remaining 72 animals,

the last rat dying on the 157th day. Complete *post-mortem* examination was made in each case immediately after death. The present note deals with those animals found at *post-mortem* examination to have been suffering from stone in the bladder.

The chemical composition of the diet is given in the following table.

Table showing the Composition of the Diet used in the Experiment.

Constituent.	Percentage	
	Expressed on Original Sample.	Expressed on Moisture-free Sample.
Moisture	20.50	—
Mineral matter	5.73	7.20
Ether extractives	10.45	13.14
Crude protein	9.705	12.26
Crude fibre	1.06	1.32
Carbohydrates	52.555	66.08
Total	100.00	100.00
Albuminoids... ..	9.36	11.77
Insoluble mineral matter	0.37	0.465
Soluble mineral matter	5.36	6.735
Total	5.73	7.20
Soluble silica	0.0363	0.0455
Phosphoric acid (P ₂ O ₅)	1.451	1.82
Iron oxide (Fe ₂ O ₃)	0.046	0.058
Alumina (Al ₂ O ₃)	0.366	0.462
Mangano-manganic oxide (Mn ₂ O ₃)	0.0014	0.00176
Lime (CaO)	1.08	1.38
Magnesia (MgO)	1.05	1.32
Potash (K ₂ O)	0.21	0.264
Sulphuric acid (SO ₃)	0.19	0.23
Chlorine	0.396	0.49
Soda and undetermined (by difference)	0.533	0.664
Total	5.36	6.735

The table shows that the protein content of the diet was relatively low; the absence from it of protein of animal origin (milk) was a serious fault. The oatmeal contributed approximately 5.67 per cent. of the total protein, the linseed meal 5.21 per cent., and the cornflour 1.37 per cent. A further fault was deficiency of vitamin A. The sole source of this factor was the oatmeal and the linseed, the amount provided by the cornflour being negligible. All seeds are deficient in vitamin A to a greater or lesser extent; in comparison with others, oats is relatively poor in vitamin A, linseed relatively rich in it. The experimental diet, therefore, though not devoid of vitamin A, did not contain a sufficiency of this factor; the failure of the animals to grow normally and their susceptibility to various infections were due in part to this cause. The diet was not deficient in vitamin B, nor did it appear to be deficient in vitamin E, but it was, no doubt, deficient in vitamin D, although the animals presented no clinical signs of rickets. A further fault in the experimental diet was its richness in phosphates, and in lime, magnesia, and chloride; it contained approximately twice as much phosphorus (P₂O₅), three times as much calcium (CaO), and six times as much magnesium (MgO) as is present in the average well balanced human dietary. To these faults there was possibly added a toxic action of the diet itself on the urinary tract.

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RESULTS OF THE EXPERIMENT.

Of the 72 animals fed on this diet for longer than fifty-six days, 21 were found at *post-mortem* examination to have stone in the bladder—17 females and 4 males; a case incidence of 29 per cent. The incidence of the disease varied in the two sexes, being 40 per cent. in females and 13 per cent. in males. In two other cases in females an intense cystitis, but no stone, was present; in one of these there was some earthy incrustation around the neck of the bladder. Haemorrhage from the bladder was occasionally observed during life. In males protrusion of the penis was a constant symptom in those suffering from stone.

In 18 cases in which stone was found, a greater or lesser degree of cystitis was present; in these the bladder was

FIG. 1.—Kidneys, with ureters, from two cases of experimentally produced stone in the bladder in rats. The middle kidney (with ureter) is from a healthy control animal.

usually greatly distended and congested. In 3 cases there was no cystitis, showing that the deposition of the phosphatic calculi was not secondary to inflammation of the bladder. In 8 cases the left ureter was much dilated with associated pyonephrosis or hydronephrosis (the fluid was not examined for pyogenic organisms). The photograph (Fig. 1) shows the ureters in two affected animals and that of a control animal for comparison. Earthy deposits, but no formed stones, were present in the kidney in 4 cases. The stones in the bladder were either single or multiple, as many as five being found in one bladder (see Fig. 2); they were of a dirty white colour and their surfaces were rough and jagged. Occasionally formed stones were not found, or if

FIG. 2.—Experimental production of stone in the bladder in rats. The diet was the same as that described in the text, except that whole wheat flour was substituted for the oatmeal. Each ureter also held a small stone; there were five in the neck of the bladder.

found were so minute as to be more properly called "gravel." Earthy incrustations around the neck of the bladder were sometimes present. The stone, stones, or gravel varied in weight in individual cases from 17 mg. to 27 mg. in males, and from 8 to 42.6 mg. in females. The largest single stone weighed 35 mg.; a stone of proportionate size in man would have weighed about one pound. Chemical examination showed the calculi to consist mainly of earthy phosphates (calcium and magnesium) along with traces of calcium oxalate. Stone was found only in animals which died between the 84th and the 157th day of experiment; the diet did not appear to cause the disease until after fifty-six days of its use.

During the 157 days this experiment lasted 340 *post-mortem* examinations were made in rats which had been fed in various other ways. In none of these was stone in the bladder present. The stock diet in use in my laboratory does not give rise to calculus in rats; it consists of whole wheat chapatties, milk, butter, sprouted pulses, green vegetables, raw tubers, fresh meat in small quantities once a week, and water. Nor do synthetic diets deficient in vitamin B, but complete in other respects, cause stone in the bladder in rats; nor diets whose sole fault is deficiency of suitable protein or of suitable salts; nor synthetic diets whose sole source of vitamin A is 8 per cent. of pure Lucca oil. It seems, therefore, that the diet used in the present experiment was productive of calculus because of the peculiar combination of its faults—deficiency of vitamin A, absence of animal protein, richness in earthy phosphates, with possibly a toxic action of the ill-balanced diet itself on the urinary tract. This tentative interpretation of the results observed is to be considered in connexion with the recently reported observation of Fujimaki (1926) that stone in the bladder and kidney can be produced in rats by feeding them for long periods on synthetic diets deficient in vitamin A. The experimental production of stone in the bladder by means of an ill-balanced diet composed of foods in common use by man would appear to confirm and to extend the observation of Fujimaki, although it raises other considerations which require further investigation for their elucidation.

CONCLUSIONS.

1. Stone in the bladder has been produced in rats by means of an ill-balanced diet composed of foods commonly used by man. The stones were of the phosphatic variety.
2. The main faults of this diet were: (a) absence of protein of animal origin; (b) deficiency of vitamin A; and (c) excess of earthy phosphates. To these faults there may possibly have been added a toxic action of the diet itself on the urinary tract.

REFERENCE.

Fujimaki (1926): *Japan Medical World*, February 15th, vi, 2.

ACTINOMYCOSIS IN THE BRAIN OF A CHILD.

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ACTINOMYCOSIS is sufficiently rare to warrant a record of the following case in a child, aged 11, in which the brain was affected.

Actinomycosis, first reported by Bollinger in bovines in 1877,¹ and in man by Israel in 1878,² and by Porfick in 1879, is rather rare, and this appears to be the only instance of its occurrence in the brain of a child. Records of English cases appear to be limited to that described very fully by Delépine in 1889³; the patient was a decorator, 65 years of age.

Moersch in 1922⁴ reported from the Mayo Clinic seven cases affecting the brain, all of which were secondary infections, the youngest being aged 20 and the oldest 41.

In the United States Sanford and Voelker collected (1925) 670 cases.⁵ Among 574 in which the ages are known, there were 14 under 10, and 89 between 10 and 20. Of 588 cases where the location was known, there were only 9 in which the brain was affected; of these the youngest was 24 years of age, and the oldest 63.

A boy, born on January 15th, 1915, was admitted to the Booth Hall Infirmary for Children, Manchester, on September 27th, 1926. The history was that he had been quite well until March, 1926. He then complained of pain in the right side, and had twitching of the right arm and leg, of which he also lost the use. Later on he complained of headache and vomiting, and was admitted to the medical side of the Manchester Royal Infirmary, being transferred to the surgical side on July 26th, 1926, as a case of left cerebral tumour with increased intracranial tension. He then had left-sided headache, and the right arm showed flaccid paralysis. Vomiting, unaccompanied by nausea, was present. Sensation was unimpaired, but there was bilateral optic neuritis.