the arrangements made for dosage at the London Hospital, and to my clinical assistants, Dr. T. Smith and Barclay, for their valuable supervision and assistance.

[The paper was illustrated by lantern slides showing the clinical features of the cases, the parasites, and the results of treatment, and by specimens of cultures.]

THE ELECTRICAL RESISTANCE OF THE BLOOD AND URINE AS A TEST OF THE FUNCTIONAL EFFICIENCY OF THE KIDNEY.

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In a communication made to the Royal Society of Edinburgh on December 21st, 1891, the author gave an account of the experiments he had made to ascertain and compare the electrical resistances of various kinds of urine both in states of health and of disease.

The fluids were held in a U-shaped electrolysis tube containing two disc-shaped platinum electrodes arranged so as just to rest upon the surfaces of the fluid, 21 c.cm. of which were used for each experiment. The measurements were made by Kohlrausch's method, and at a temperature of 65° F.

As a result of the observations, which extended also to artificial urines, it was found that the specific resistance of a normal urine amounts to about 45 ohms, and that the resistance is a measure of the salts, chlorides, phosphates, sulphates, etc., present in the urine; the greater the concentration the less the resistance and vice versa. In disease the resistance was found to be increased chiefly in acute croupous pneumonia (due to the diminution in the chlorides), in diabetes mellitus, acute and chronic Bright's disease, and in pernicious anaemia. As it is believed that the glomeruli are mainly responsible for the presence of salts in the urine, a high electrical resistance, other things being equal, would indicate an impairment of the function of the glomeruli.

Within the last ten years the author has made many attempts to measure the electrical resistance of the blood; various methods (dilution with distilled water, measurement of a column of blood in a capillary tube, etc.) have been employed and subsequently rejected. The principal difficulty is due to the fact that only very small quantities of blood can generally be obtained at one time. The best results were obtained by placing 5 c.mm. of freshly-drawn blood between two cup-shaped electrodes 3 mm. in diameter, coated with spongy platinum, and fixed at 0.75 mm. apart. The length of the cylinder of blood between the electrodes is of less importance than its diameter, because the cross-sectional area varies with the square of its diameter, and the resistance of a conductor varies directly as its length and inversely as its cross-sectional area. By employing electrodes of fixed diameter and at the same distance apart, and the same quantity of blood for each observation, and by making the measurement at once before such changes as coagulation or evaporation could occur, fairly consistent results were obtained. The average specific resistance of normal blood measured in this way is 93.5 ohms, but it may fall to 85 or rise exceptionally to 130. The resistance depends again upon the salt concentration of the blood.

A striking change is to be observed in pernicious anaemia, the resistance in this disease being usually about one-half (50 ohms) that of normal blood. The deduction is that the blood in this disease contains an abnormal amount of salts due either to destructive metabolism or to renal inefficiency, or to both. Light is thrown on this question by examining the resistance of the urine; this will be found to be abnormally high. Hence we have the striking fact that while the urine contains too few salts, the blood contains an abnormal amount. This, then, is a clear case of renal inefficiency.

In view of this fact (impairment of the glomerular function of the kidney) the pathology and treatment of pernicious anaemia require reconsideration. These results, obtained some years ago, and the introduction of cryoscopy, have led me to compare this method of deter-

mining the renal efficiency with that of cryoscopy, and to originate a ratio which I will call "The Haemo-renal Salt Index," namely:

The Electrical resistance of the blood.
The Electrical resistance of the urine.

In health this would be equal to two or three whole numbers, for example:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{93.5}{45} = 2.08.$$

If this number increases it indicates that the blood contains fewer salts and the urine more, and that the functional activity of the kidney is increasing; if, however, the haemo-renal salt index diminishes it indicates that the functional activity of the kidney is diminishing. Thus in a bad case of pernicious anaemia the haemo renal salt index is less than one, it is a fraction, but with an improvement of the patient it will at once increase, and with his recovery it will return to normal.

The following are some illustrations:

1.—A. B.: Healthy:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{119}{38.25} = 3.1 = \text{haemo-renal salt index.}$$

2.—M.: Advanced pernicious anaemia, a patient of Dr. G. Gibson, examined July, 1906:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{40.8}{68} = 0.6.$$

3. A. D.: Pernicious anaemia with many relapses, a patient of Dr. A. James, examined February, 1902:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{51}{115} = 0.44 = \text{index.}$$

4. A. B.: Secondary anaemia, patient of Dr. Gibson, examined July, 1906:

$$\frac{\text{R. of blood}}{\text{R. of urine}} = \frac{85}{56.1} = 1.5 = \text{index.}$$

5. A. T.: Chronic rheumatism, patient of Dr. Gibson. Index 3.3.

6. W.: Chronic interstitial Bright, patient of Dr. Gibson. Index 2.1.

7. H.: Recovery from pernicious anaemia; R.B.C. nearly 5 million. Patient of Dr. Gibson. Index 1.7.

This method is more sensitive, more rapid, and more accurate than cryoscopy, but it does not measure exactly the same thing. Cryoscopy measures the total molecular concentration, and is independent of the kind of molecule, provided they are not dissociated (salts, acids, and bases are exceptions).

Electrical resistance depends only upon the salts, acids, and bases, and of these sodium chloride is by far the most important; it is practically unaffected by the presence of albumen, sugar, and other non-electrolytes.

Urea has a small effect only. The combination of cryoscopy with the determination of the haemo-renal salt index would give us more precise information as to renal capacity than the use of either method alone; the one method should not be regarded as a substitute for the other, but rather as complementary to it, but of the two the electrical method is so much more convenient and rapid that it is likely to come into extended use in the future.

THE name of Dr. John T. Collier has been placed on the Commission of the Peace for the City of Lincoln.

THE foundation-stone of the first sanatorium to be erected by the National Association for the Establishment and Maintenance of Sanatoriums for Workers suffering from tuberculosis was laid at Benenden in Kent on July 14th. The grounds extend to 250 acres, and the buildings, when complete, will accommodate 200 patients. They will be chiefly of steelwork, with fireproof "frazzi" filling. Of the funds which have been collected, about £1,000 have come from the working classes, the maintenance of the beds being secured by subscriptions from Friendly Societies and trade unions. The patients will be distributed in ten bed pavilions, the maintenance of each being secured by subscriptions before its erection. The Chairman (Mr. C. H. Garland), in his speech, stated that there were at present not more than 3,000 beds for open-air treatment in England altogether, and that considerably less than one-third of them were available to the industrial classes.