(3) The concentration of sugar in the urine varied on a normal diet from 0.1 per cent to 3.8 per cent.

(4) The general health of the patients was good and continued so without treatment. Cases 1 and 2 complained of mild local symptoms presumably due to the glycosuria. Case 4 had no symptoms whatever.

(5) No ketosis was found except in Case 5. It cannot be stated definitely however that this last case was due simply to the pregnancy.

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MUSINGS ON URINARY pH VALUES.
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The kidney has as its function the voidance of waste products, both solid and liquid. The urine thus secreted is an index of the metabolism of the body with or without changes superadded as a result of disease of the urinary tract.

It must be realized that the body is continually striving to keep the composition of its circulating fluids at a constant level. The optimum range of blood reaction is slightly alkaline, being 7.28 to 7.41. Apart from diseased conditions, biochemical variations occur in different parts of the circulation as a result of such physiological functions as digestion and exercise. Urinary analysis is one of the methods of assessing these changes in vital functions.

The kidney is a compact and very complex system of glomeruli and tubules. The part played by the various sections in the secretion of the finished urinary product must remain to a large extent a matter of speculation. Its anatomical structure and position do not lend themselves to direct experiment.

Its functions are: (1) The excretion of fluids; (2) the concentration and excretion of solids and in some cases bacteria. For any one substance in the blood there is a renal threshold; concentration above this level leads to its excretion in the urine. This threshold may vary from the normal as a result of renal or cardiovascular disease. In this article the normal kidney only is being considered.

Urinary reaction is normally tested with litmus paper. This method unfortunately gives no numerical index of acidity or alkalinity for comparison or estimation of the total acid passed per diem, the normal being estimated as equal to between 20 and 40 cubic centimetres of N/10 NaOH per 100 cubic centimetres of urine passed in twenty-four hours.
The testing of the reaction is best done by some colorimetric method such as the B.D.H. capillator. This reaction is dependent on the electrical dissociation of salts and the figure depends on the relative proportion of H and OH ions. Ionization will vary with the electrolyte and its concentration. An appropriate mixture of urine and test dye is compared with a set of standard colours marked with the pH values. The figure 7 is taken as neutrality; figures towards zero indicate acidity; whilst those towards 14 demonstrate alkalinity. It has been stated that the normal urinary range is pH 5-7, McDowall gives 5·5 to 7; from the figures collected I should place 5·5 to 8 as being the symptomless zone. A certain degree of alkalinity would also be in accordance with the normal teaching that the alkaline tide is commoner in the forenoon, and about three hours after meals.

The reaction is usually dependent on the presence of one or other of the phosphates of sodium. On standing ammoniacal decomposition takes place as also in certain cystic conditions. The presence of ammonia will thus alter the reaction, and it is desirable that all specimens should be fresh for testing.

The figures given by me are from my own observations. Certain conclusions are drawn tentatively, but finality is not claimed as there has not been sufficient material. More observations are necessary to elucidate some of the metabolic problems. In some cases chemical analysis would be interesting: for instance as to whether lactic acid appears in the urine after exercise.

Physiological variations are apt to occur. The urine of man and the carnivora is stated to be more acid than that of herbivora. This is based on an increased acid elimination as a result of protein digestion as opposed to a surplus of basic substances in vegetable food. This variation should show itself by the urine being more acid in winter when a relative excess of meat is eaten as opposed to the more vegetarian diet in summer.

Acidity is increased by exercise as a result of which lactic acid appears in the blood (McDowell) [1]. This substance not being a normal constituent of blood must either be oxidized as in the liver, or be excreted by the kidney or sweat. Evidence of either of these methods of excretion should be forthcoming as a result of chemical analysis of the urine or sweat. It may be noted that lactic acid does not ionize freely, whereas its salts would do so more easily; this has its bearing on pH values in the blood or urine.

From my records there does not appear to be any relationship between the reaction and specific gravity, except that where there is a lateritious deposit an increase in the acidity and specific gravity have been noted. In one such case the readings were pH 4·7 and specific gravity 1030. On the other hand pH of 5·1 and 8·2 have been noted with specific gravity of
1010 and 1015 respectively. In febrile conditions a figure of 4·2 can easily be reached.

It has been stated by some that the present habit of giving oranges freely has a deleterious effect on the acid-base balance, and calcium metabolism in such processes as the healing of fractures. So far as my observations are concerned this is not borne out. I have not noticed any increase in urinary pH value and X-ray photos have shown satisfactory deposition of calcium in bones.

Frequency of micturition and scalding are noticed with a pH of 5 or upwards, the highest figures occurring in elderly patients being 3·3 and 3·8. A pH of 5 may be asymptomatic. The irritation in some cases may be due more to the presence of crystals than to acid.

In children nocturnal frequency and scalding have been met with a pH of 8·7, no deposit being present.

Two children in the post-influenzal state passed, just before food, specimens which had a lateritious deposit and pH 5.

As examples of the alkaline tide in the normal state the following may be taken: child, aged 5, pH 7·2, slight deposit of phosphates on boiling; adult night specimen pH 8·2.

In rheumatism there tends to be an increased excretion of acid during the attacks. This does not seem to have any relation to diet; from the dietary aspect in some cases a more alkaline urine might be expected. Readings of pH 5 are common in rheumatic attacks and I have met 4·7 or more in acute lumbago. With the high acidity of the latter there is almost always a lateritious deposit.

This acidity raises the question of metabolic disturbance in rheumatism and rheumatic gout. Diet in certain cases has a definite effect. For instance one patient complained of the pain being worse after taking stewed rhubarb, the liquor of which had a pH of 1.

Under certain conditions, such as acute rheumatism, the sweat is unduly acid, an index of increased acid formation.

In lumbago there is fibrositis of the affected muscle. This would interfere with the circulation and metabolites be retained longer than normal. This retention itself would tend to produce fibrosis from irritation. It has been shown recently that the injection of lactic acid into muscle produces pain, and it may legitimately be inferred that some of the pain in fibrositis and in stiffness after exercise is due to a local retention of lactic acid.

In a case of diabetes without acidosis, pH readings in twenty-four hour specimens were 5·7, 6·7, 6·0, 5·6, 6·2, 6·3.

In a child aged 10, where there was a tentative diagnosis of cyclical vomiting, the urinary pH was 7·8, a reading which was taken to negative the diagnosis. A week later when the symptoms had disappeared the acidity had risen to 5·1.

During the febrile period in a child the acidity was 5.
A child, aged 5, in bed on a milk diet and suffering from intestinal tuberculosis, had a pH of 8.2 and phosphatic deposit.

Excessive acidity is stated to occur in some cases of eczema.

The therapeutic rendering of the urine acid is now largely used in the treatment of B. coli in urine. In the older treatment with hexamine this was attained by the exhibition of sodium acid phosphate. The amount given was governed more by rule of thumb than the exact estimation of urinary acidity.

The more modern treatment by mandelic acid requires control of the acid at a level of 5 or more.

It has been shown (Stohl and Janney, 1917) [2] that B. coli will not grow when the pH is between 4.7 and 5.

Nitro-hydrochloric acid has also been used for rendering the urine acid (Chance and Maloney, 1935) [3]. It is in this regard interesting to note that the use of 1 per cent lactic acid (which has a pH 1 approx.) is of considerable value as an irrigating fluid in cases of appendix abscess (Lloyd-Williams, 1915) [4]. The inhibition is probably due to the high pH value. A similar action has been observed in chronic enteritis as a result of the administration of lactic acid bacilli and of the acid itself (Lloyd-Williams, 1923) [5].

REFERENCES.

Travel.

FROM ROME TO KARACHI BY AIR.

BY COLONEL K. COMYN.

(Continued from page 61).

A perfect landing was made in the crowded harbour of Alexandria and the 587 miles from Athens completed. The stay at Alexandria lasted rather more than one hour. The passengers were taken to the sailing club for this period while the flying boat was refuelled, engines looked over and crew changed. At 12.30 we took the air again and after circling over the harbour turned east for Aboukir Bay and thence to Palestine, across the Eastern Mediterranean. The sea is left at Haifa and we strike inland past Mount Carmel. There is nothing very striking or unusual in the appearance of the country here from the air and an uneventful lap is