SOME OBSERVATIONS ON RENAL FUNCTION IN MENTAL DISORDER.

By B. H. SHAW, M.D.,

Medical Superintendent, Staffordshire Mental Hospital, Stafford.

RENAL dysfunction is so commonly present in cases of mental breakdown that it is of interest to know whether it is especially associated with any definite clinical type or types of mental disorder. In an endeavour to ascertain this, cases have been selected from recent admissions in which the form of disorder from a clinical point of view appeared to be sufficiently marked to warrant placing them in a definite category. Many cases present such a mixture of cycloid, schizoid, confusional or paranoid indications that in an investigation of this nature the selection of sufficiently clear-cut types from a clinical standpoint is not altogether an easy matter. To determine the degree of concentration and polyuria, Rosenberg's modification of the Volhard test has been adopted. It involves little discomfort to the patient and is as follows :—

The patient is confined to bed from 10 a.m. for twenty-four hours. Immediately prior to 10 a.m. his bladder is emptied and he is then only allowed 400 c.c. of fluid until 10 a.m. the following day, and no fruit, vegetables or salads unless their weight is reckoned as fluid. Urine is passed at 2 p.m., 6 p.m. and 10 p.m., and again at 10 a.m. the following morning. Each specimen is kept separately and tested for specific gravity, etc. The total volume of urine passed should not normally exceed 750 c.c., and the specific gravity should reach 1027 (1).

The total amount passed in each case is given in the column headed " Urine", and in the column under " Specific gravity " it is indicated whether this is normal or defective. Under " T.N. per kilo " is stated the total nitrogen per kilogramme of body-weight estimated (in grammes) by the Kjeldahl method, and under " U.N. per cent. " is indicated the percentage of urea nitrogen to total nitrogen. For the presence of albumen the heat and acetic acid test is used, and the albumen is estimated according to the Mayo Clinic grades from 0 to 4. Grade 1 or + stands for faint to definite cloudiness, grade 2 or ++ from definite cloudiness until the finger is obscured when placed behind the tube.

The following results may be regarded as normal as far as the concentration test is concerned, and the nitrogen figures are corresponding averages in this series :

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Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	150	1022	*Nil*		
6 ,,	100	1026	,,	·13	64
10 ,,	70	1030	,,		
10 a.m.	205	1030	,,		
	525				

The total volume of fluid often exceeds the amount ingested; probably, owing to the excretion of extra chloride, more water is lost to maintain the balance.

Summary of Cases Grouped according to Clinical Type of Mental Disorder.

Manic-Depressive.

Case.	Age.	Urine (c.c.).	Specific gravity.	T.N. per kilo.	U.N. per cent.	Albumen.
B. V. T—	26	1,175	Def.	·12	87·3	*Nil*
F. A. B—	25	1,562	,,	·14	72	+
T. I—	55	1,050	Nor.	·16	64·4	*Nil*
J. D—	34	1,000	,,	·19	66·6	++
F. G. B—	20	985	,,	·21	60·8	*Nil*
B. S—	64	1,045	Def.	·17	63·7	,,
A. P—	29	1,235	,,	·16	77	,,

Case T. I— is of interest in that the patient rapidly recovered from the manic state in which he was admitted, when the details of his test were as follows:

Time.	Urine (c.c.).	Specific gravity.	T.N. per kilo.	U.N. per cent.	Albumen.
2 p.m.	315	1017			*Nil*
6 ,,	230	1022	·16	64·4	,,
10 ,,	210	1024			,,
10 a.m.	295	1030			,,
	1,050				

Five weeks later, when he appeared to be quite normal again mentally, the result of the test was:

Time.	Urine (c.c.).	Specific gravity.	T.N. per kilo.	U.N. per cent.	Albumen.
2 p.m.	160	1028			*Nil*
6 ,,	235	1022	·14	64·3	,,
10 ,,	180	1024			,,
10 a.m.	270	1028			,,
	845				

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This is a not unusual occurrence on recovery; even when albumen is present with or without defective concentration some improvement is noted coincident with more rational conduct, and the amount of total nitrogen tends towards normality.

Details of two further cases in this category are as follows:

Case of F. A. B—, marked heredity, high standard of intelligence:

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	615	1011	+	·14	72
6 ,,	237	1018	+		
10 ,,	250	1018	*Nil*		
10 a.m.	460	1015	+		
	1,562				

Case of B. V. T—, heredity, hallucinated, obsessional, good intelligence:

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	430	1016	*Nil*	·12	87·3
6 ,,	215	1022	,,		
10 ,,	165	1026	,,		
10 a.m.	365	1026	,,		
	1,175				

Melancholia.

Case.	Age.	Urine (c.c.).	Specific gravity.	T.N. per kilo.	U.N. per cent.	Albumen.
C. H—	65	1,000	Def.	·13	71·4	+
T. H—	42	895	,,	·17	66·3	*Nil*
J. C—	41	1,280	,,	·16	64·3	++
H. F—	32	1,130	,,	·11	71·6	+
D. A—	55	1,010	,,	·20	69·5	*Nil*
C. F—	47	862	,,	·09	80	,,
F. B—	64	1,125	,,	·16	77·6	+
W. B—	58	1,030	,,	·15	66·6	+
H. T—	28	1,240	,,	·17	73·6	*Nil*

Details of Cases.

Case of D. A—, depressed, agitated, apprehensive, cut throat a year ago:

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	280	1015		·20	69·5
6 ,,	250	1021	*Nil*		
10 ,,	75	1023			
10 a.m.	405	1024			
	1,010				

The large quantity of night urine is probably significant in association with defective concentration and high total nitrogen.

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Case of J. C—, depressed and introspective with delusions of wireless in body :

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	270	1014	++	·16	64·3
6 ,,	260	1016	++		
10 ,,	290	1017	++		
10 a.m.	460	1019	++		
	1,280				

Case of H. F—: Very depressed at the time of the test, but later the patient developed definite schizoid indications and his history showed that he had always been below the average of intelligence; his maternal aunt was a mental defective and other relations were decidedly subnormal. Details of his case when he was in a very depressed state :

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	460	1012	*Nil*	·11	71·6
6 ,,	305	1026	,,		
10 ,,	180	1020	,,		
10 a.m.	185	1022	+		
	1,130				

One month later he became confused and developed marked schizoid signs, when the result of the test was as follows :

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	240	1022	*Nil*	·09	69
6 ,,	35	1030	,,		
10 ,,	45	1030	,,		
10 a.m.	205	1030	,,		
	525				

Thus coincident with the mental alteration was a marked change in the concentration power of the kidneys, but the total nitrogen, which was initially low, became less.

Case of C. F—: Complicated by the fact that he suffered from valvular heart disease, and the mental disorder followed on severe influenza.

It will be noted that in every case in which the mental disorder could be definitely classified as melancholia the concentration was defective.

Case of H. T—: Rather low-grade mentally, depressed and introspective :

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	395	1014	*Nil*	·17	73·6
6 ,,	450	1013	,,		
10 ,,	70	1018	,,		
10 a.m.	325	1024	,,		
	1,240				

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A fortnight later, no mental change being observed, this patient was tested again and was given two doses of pituitrin hypodermically during the 24 hours, with the following result :

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	350	1014	*Nil*	·15	63
6 ,,	220	1018	,,		
10 ,,	40	1026	,,		
10 a.m.	225	1026	,,		
	835				

Showing a reduction of 405 c.c. in quantity of urine passed and improvement in specific gravity.

Dementia Præcox.

Case.	Age.	Urine (c.c.).	Specific gravity.	T.N. per kilo.	U.N. per cent.	Albumen.
F. G—	27	465	Nor.	·12	70·6	*Nil*
G. P—	34	665	,,	·15	70	,,
T. E. J—	17	640	,,	·09	67	+
T. H. C—	35	985	Def.	·16	60	*Nil*
B. R—	19	310	Nor.	·14	63	+
W. V. B—	31	525	,,	·11	66·6	*Nil*
G. R. P—	17	750	Def.	·13	71·4	+
H. G—	33	580	Nor.	·10	69	*Nil*
T. J. J—	19	1,045	Def.	·18	66	,,

Case of G. R. P—: Early schizoid indications; highest school standard; condition said to have been brought on by overstudy. Mother below average mentally, sister emotional and highly strung. Duration two weeks.

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	155	1022	*Nil*	·13	71·4
6 ,,	185	1020	+		
10 ,,	305	1013	*Nil*		
10 a.m.	105	1024	,,		
	750				

The boy improved mentally, and 11 weeks after above test he was practically normal, when the test repetition showed as follows :

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	175	1024	*Nil*	·15	64
6 ,,	85	1034	,,		
10 ,,	90	1032	,,		
10 a.m.	190	1032	,,		
	540				

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The case of T. H. C— was one of long duration, and in the case of T. J. J— the mental breakdown appeared to be a direct sequela of severe influenza.

Case of T. J. J—. Male, highest standard at school, condition said to have followed severe influenza, primarily confusional, later schizoid, temperature subnormal:

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	320	1018	*Nil*		
6 ,,	230	1024	,,	·18	66·1
10 ,,	180	1024	,,		
10 a.m.	315	1026	,,		
	1,045				

A month after the above test, no change occurring in the mental state, the test was repeated, and during it he had two hypodermic injections of pituitrin. Result:

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	230	1018	*Nil*		
6 ,,	95	1022	,,	·10	66
10 ,,	145	1023	,,		
10 a.m.	235	1027	,,		
	705				

Showing, presumably as a result of pituitrin injection, a reduction of polyuria by 340 c.c. and normal concentration. Later this case, when apparently quite recovered mentally, gave the following results to the test:

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	425	1214	*Nil*		
6 ,,	200	1017	,,	·18	64·8
10 ,,	250	1024	,,		
10 a.m.	420	1028	,,		
	1,295				

Paranoia.

Case.	Age.	Urine (c.c.).	Specific gravity.	T.N. per kilo.	U.N. per cent.	Albumen.
T. L—	36	485	Nor.	·13	69	+
W. L—	51	1,175	Def.	·15	73	+
C. J. T—	63	1,155	,,	·17	82	++
G. A. R—	42	734	Nor.	·13	84	+
W. D. B—	48	600	,,	·13	71	*Nil*
T. W—	56	460	,,	·10	83	+
J. W—	59	880	,,	·16	68	++

Case of W. L—: Male; was invalided for "trench nephritis" in 1917—six months in military hospital; occupation later, blacksmith. Gradually

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developed ideas of suspicion about his wife—entirely unfounded, reasons quite inadequate; assaulted various people in consequence. At times urine does not contain albumen.

Details of test:

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	330	1016	*Nil*	·15	73
6 ,,	230	1021	+		
10 ,,	230	1020	*Nil*		
10 a.m.	385	1024	,,		
	1,175				

A somewhat similar state in another patient (W. W—), resulting from an attack of scarlet fever twelve years ago, with delusions of an exalted nature, became quite normal as to renal function after eight months' stay in hospital, and at the same time he lost his delusions. This change, of a remarkable nature, appeared to be consequent on his taking to a very active life out of doors—spade-work, etc.—and in such a case the inhibition of water diuresis by exercise must be associated with increased pituitary secretion.

Platt quotes cases of definite nephrosis showing immediate improvement, amounting in some cases to complete cure after an attack of some intercurrent affection, such as pneumonia, and in the days when erysipelas was rife in our wards, after such an attack it was not at all uncommon to find at times a rapid and remarkable improvement in the mental disorder.

Hysteria.

Case of *major hysteria:* M. O. S—, female, æt. 26. On admission she had very strong acetonuria. Concentration test:

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	155	1020	+	·13	66·4
6 ,,	160	1022	*Nil*		
10 ,,	70	1028	+		
10 a.m.	135	1030	+		
	520				

It is possible that the albumen had some relation to the very strong acetonuria present on admission; the fact of there being no polyuria is of interest.

In other cases with a hysterical basis this absence of polyuria has been observed.

Acetonuria is frequently met with in routine urine examinations irrespective of cases which are directly referable to inanition, and recent work done in relation to this is summarized by Bergland and Medes in referring to the enormous oxidative capacity of the kidneys, by concluding that ketone bodies are formed in the liver and are oxidized in the muscles and kidneys.

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Anxiety Neurosis.

Case.	Age.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
A. T—	37	850	Nor.	+	·14	66
D. H. B—	24	1,010	,,	*Nil*	·14	74
E. L—	42	890	Def.	+	·15	67·4
A. R. H—	30	815	Nor.	*Nil*	·15	60·5
A. J. B—	40	810	Def.	,,	·209	69

Details of A. T— : Male, married, miner, six children ; home conditions unsatisfactory. Principal trouble, headache and depression ; introspective, hard-working, " tired of fighting ".

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	160	1012	*Nil*	·14	66
6 ,,	250	1022	,,		
10 ,,	160	1026	,,		
10 a.m.	280	1028	+		
	850				

Details of E. L— : Male, introspective and morbid, complaining of peculiar abdominal sensations, also in side and shoulder.

Time.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
2 p.m.	315	1016	*Nil*	·15	67·4
6 ,,	210	1020	+		
10 ,,	115	1022	*Nil*		
10 a.m.	250	1022	,,		
	890				

It will be noted that cases of anxiety neurosis approximate towards other affective disorders and show a high total nitrogen.

Exhaustion (Confusional) Psychosis.

Case.	Age.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
A. C. B—	55	500	Nor.	*Nil*	·127	59
G. T—	53	560	,,	,,	·11	63·3

These cases improved rapidly and made very good recoveries. The tests were made on admission when in a confused mental state. The normal amount of urine and low total nitrogen and percentage of urea nitrogen in these cases is of interest in comparison with the figures obtaining in anxiety neurosis.

Encephalitis Lethargica.

Case.	Age.	Urine (c.c.).	Specific gravity.	Albumen.	T.N. per kilo.	U.N. per cent.
J. P—	49	760	Nor.	*Nil*	·09	66
F. G. F—	22	555	,,	,,	·13	64·3
H. G. C—	25	1,035	,,	,,	·13	67
A. W—	24	460	,,	+	·14	66·4

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These were all undoubted post-encephalitic cases and the results are of considerable interest.

Discussion.

Of 250 admissions to this hospital in 1935, albuminuria was present in varying degrees in 183, that is, 73·6%. Of 109 male admissions 61 showed albuminuria; of these 29·5% belonged to Grade 2 and 70·5% to Grade 1, while of 141 female admissions, the corresponding figures were respectively 30·9% and 69%.

The significance of slight degrees of albuminuria is a matter of considerable controversy. Thus Elwyn (2) states "that in all types of albuminuria there is either a deficiency of oxygen supply or injury by a toxin, and that in either case glomerular and capsular epithelium are damaged." Ashburn reports, of 2,269 cadets 7% were positive for albumen, and Parmenter says that over a period of four years 5 to 7% of Harvard freshmen showed albuminuria. Of this 5 to 7%, subsequent examination showed that two-thirds of the cases which had albuminuria on the first examination had negative reports, while only 6·7% had what seemed to be definite evidence of kidney damage; 12% were noted as having persistent albuminuria, 13% occasional, and 68·3% transient. These figures are out of all proportion to those obtaining here; thus of the past 492 admissions albuminuria was present in 59·5% as compared with the above-mentioned 5 to 7% found in apparently normal persons.

When albuminuria is found on admission it is customary in this hospital to examine a specimen once weekly for six weeks, and very considerable variation is frequently noted. Thus Grade 1 may alter to Grade 2 or vice-versa, while several specimens may give negative results and later become positive. Consequently the absence of albumen in a given specimen is of doubtful value as far as renal function is concerned, whereas repetition shows that the concentration test is extremely reliable and constant. It is worthy of note also that synchronizing with mental recovery there is usually a corresponding approach to normality as far as water concentration is concerned.

Apart from albuminuria, defective concentration was present in 34% of all cases examined here up to the present, and that there is a pathological lesion of hormonal and/or of local origin causing this is undoubted. It is an interesting fact that dropsy is seldom met with in psychiatric cases, and whatever the renal lesion is, the fact that it entails polyuria may have a bearing on this absence of anasarca.

As this inquiry is mainly of a clinical nature, I do not propose to discuss in extenso the pathology of this defective renal function and polyuria in so many cases of mental breakdown, but would point out the marked decrease in the volume of urine noted in the cases of J. T— and T. J. J— as a result of the injection of pituitrin during the period of the test, also that the diuresis in diabetes insipidus is due to decreased reabsorption. The fact that thyroid

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and adrenal cortex extracts oppose the antidiuretic action of pituitrin must be borne in mind, and the direct effect of hyperactivity of these glands cannot be excluded in considering the ætiological factors involved. Presumably there is a selective activity of the epithelium of the different portions of the renal tubule, and the constriction of the descending limb of the loop of Henlë is of significance as tending to retard the flow from the glomerulus.

In considering what part is played by the glomerulus in this disturbance of function, the nervous innervation of the glomerular arteries and capillaries is of first importance. While the kidney is well supplied with vaso-constrictors *via* the splanchnics, there are few vaso-dilators; thus, while section of the vagus and stimulation of its peripheral end produces no effect on the volume of urine, section of the splanchnic increases and stimulation of its peripheral end decreases it. According to most observers this is of a temporary nature, and on section of the splanchnics the resulting dilation of the glomerular vessels, after a period of intermittency, soon passes off and the volume of urine reverts to normal.

It is possible, therefore, that while sympathetic exhaustion may have a bearing on the production of polyuria, its effect would be of comparatively brief duration. In this connection, too, taking clearance of sugar and creatinine as an index of glomerular activity, it has been shown by a number of observers that the antidiuretic action of pituitrin is not produced by direct effect on the glomerulus, since no change is observed in the glomerular filtrate as a result of its action.

Platt summarizes the Cushny theory as follows: "The glomerular filtrate during its passage through the tubules undergoes marked changes, and the modern theory as advanced by Cushny holds that these changes in composition are due to a process of differential absorption in the tubules, the epithelium secreting a fluid of practically constant composition resembling Ringer-Locke's solution back into the blood-stream. This hypothesis, in essentials at least, is now generally accepted. It should be noticed that in the reabsorption of this solution back into the blood-stream, a considerable amount of work is done by the renal epithelium against the osmotic resistance of the fluid in the tubule; the process is therefore one of vital activity requiring oxygen for its performance, and it is an interesting fact which strongly supports the reabsorption theory that under conditions of diuresis, when large amounts of dilute urine are secreted, actually less oxygen may be consumed by the kidney."

When one considers that there are approximately 1,000,000 excretory units in the human kidney, each consisting of glomerulus, convoluted tubules and loop of Henlë, that the total glomerular surface is about 1·5 sq. m., with a filtration capacity amounting to as much as 150 c.c. per minute, it is obvious that a limited lesion of the glomerular and tubular system will not be of much import as far as the total output after reabsorption is concerned, and consequently if the pathological lesion is of purely local origin, depending on chill or infection, the number of renal units not functioning properly is very much

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less than if the lesion is due to quite extrinsic causes, such as hormonal deficiency or excess, inasmuch as the proper function of every unit is dependent on a normal supply of hormone as far as its vitality is concerned. It is further to be noted that, just as inanition or deficient glomerular flow will lead to more or less permanent epithelial defect if of long duration, so prolonged deprivation of hormonal innervation may lead to a permanent loss of cellular function of a widespread nature, of which defective renal concentration may be an index.

Normally the urea nitrogen should amount to between 60 and 85% of total nitrogen, depending on diet; it is decreased according to Morse (3) in acidosis, all cases of urinary retention such as the latter stages of nephritis, hepatic disorders, and in psychic states such as melancholia. Exercise lessens it. It is increased in fever, diabetes and polyuria in general, in exophthalmic goitre, and in many cases of cancer. In general it is increased in heightened metabolism and lessened in lowered metabolism. It is variable in acute nephritis, chronic nephritis, hysteria and excessive exercise.

All these patients, the results of whose renal concentration tests, etc., are given, took their food normally.

The following are the average figures for 10 apparently normal urines with normal concentration: Total nitrogen ·126 per kilo of body-weight; urea nitrogen per cent. of T.N. 66·1. Of a series with defective concentration only, the corresponding averages were: T.N. per kilo ·158, percentage of U.N. 70·7. Of those with albumen and normal concentration T.N. per kilo was ·14, and U.N. per cent. 73. In the majority of cases in which the percentage of urea nitrogen to total nitrogen was over 80, the mental and physical condition was distinctly improved. It is therefore possible that a low percentage of urea nitrogen bears some relation to decreased metabolism, and associated with this subnormal temperatures are almost constant.

The following table of cases in the series in which there existed a definite hereditary history of insanity is of interest:

Name.	Age.	T.N. per kilo.	U.N. per cent.	Albumen.	Urine (c.c.).	Concentration.	Insane heredity.	Mental disorder.
F. B—	25	·14	72	+	1562	Def.	Maternal grandmother, mother and uncle	Cycloid.
A. P—	29	·16	77	*Nil*	1235	Nor.	Father, brothers and sisters	,,
S. D—	46	·16	66·6	,,	555	,,	Father recovered thirty years ago	,,
J. W. W—	59	·13	68	++	880	,,	Father, sister and nephew	Paranoid D.P.
M. M—	15	·17	60	++	660	,,	Sister	Cycloid.
G. P—	34	·15	70	*Nil*	665	,,	,,	Schizoid.
T. E. J—	17	·09	67	+	640	,,	Maternal aunt	,, and M.D.
B. T—	26	·12	87·3	*Nil*	1175	Def.	Father, sister epileptic	Cycloid.
G. A. R—	42	·13	84·5	+	734	Nor.	Father (suicide)	Paranoid.
S. S—	29	·16	60	*Nil*	802	,,	Sister	Schizoid.
C. E. D—	48	·169	69	+	740	,,	Brother and father M.D.	Paranoid.
O. A. H—	40	·14	73	+	915	,,	Father	Cycloid.
H. F—	32	·11	71·6	+	1130	Def.	Maternal aunt M.D.	Schizoid.

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The high percentage of albuminuria is noteworthy, as is also the fact that excessive polyuria appears to be in direct ratio to degree of heredity.

While it is not unusual to find some improvement in renal function coincident with mental recovery, this is by no means always evident, and is a point of considerable importance. An example is the case of T. J. J—, above mentioned. Another instance is that of a manic-depressive case, a highly intelligent young man with marked heredity, who during his manic phase had a polyuria amounting to 1562 c.c., albumen +, defective concentration, T.N. per kilo ·14, and U.N. per cent. 62·7. When he had apparently recovered mentally the only departure from the above figures was a slightly lessened polyuria to 1265 c.c. Relapse is probable in such a case, and it is possible that the concentration test may be an indication of a state of somatic instability very probably associated with defective cellular oxidation.

References.—(1) Platt, R., *Nephritis and Allied Diseases.*—(2) Bergland and Medes, *The Kidney in Health and Disease.*—(3) Morse, W., *Applied Biochemistry.*

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