In *cicatricial contraction* of the duodenum a simple gastro-enterostomy is all that is required and occlusion of the pylorus or duodenum is not necessary. Except in very debilitated patients saline infusion will not be required.

In *uncomplicated* cases of duodenal ulcer the operation consists of a posterior gastro-enterostomy combined with occlusion of the pylorus, the effect of such an operation being effectually to prevent any of the gastric contents from ever passing over the ulcer again. The ulcer when once healed is permanently cured. When gastro-enterostomy alone is done the new opening overcomes any dilatation of the stomach, due to spasm of the pylorus, and allows the ulcer to heal; after a time, however, the gastric contents will again pass through the pylorus and the ulcer may recur. The pylorus is occluded by three rows of Lembert sutures placed one over the other; this will be found to completely invaginate the duodenum on itself and to occlude the pylorus.

The *after-treatment* of cases of operation for duodenal ulcer does not vary very much, whatever has been the nature of the case beforehand. In the first place, all patients should be placed in the Fowler position as soon as the immediate shock of the operation has passed off. This is specially important in cases of perforation, since should any leakage occur when the patient was in the recumbent position the fluid would track into one of the subphrenic spaces, forming a highly dangerous subphrenic abscess, whereas if the patient is in the sitting position any fluid will track into the pelvis, where an abscess is comparatively harmless and easily treated.

The next point in treatment is to keep up the normal saturation of the body tissues. A patient requires about three pints of fluid in the 24 hours. If this amount of fluid can be taken by the mouth all is well, but during the first few days after a stomach operation only a small quantity is allowed by the mouth, so the balance must be introduced in other ways. My practice is as follows. For the first 24 hours 10 ounces of saline solution, in which is dissolved half an ounce of glucose, are given by the rectum every four hours. For the first 12 hours teaspoonfuls of hot water are given occasionally; after 12 hours, barley water, albumin water, and raisin tea are given in half-ounce doses every hour; after 24 hours the dose is increased to 1 ounce, after 36 hours to 2 ounces, and after 48 hours to 3 ounces every 2 hours. The amount and number of saline injections are proportionately reduced. Semi-solids are given on the fourth day and chicken or fish on the fifth day. When there is much shock 1-60th grain of strychnine is given hypodermically every 4 hours, and if the patient is in much pain or is restless, a quarter of a grain of morphia with 1-120th grain of atropine is injected on the first night after the operation. It should not, however, be repeated. In uncomplicated cases the patient is kept in bed for a fortnight, and usually leaves the hospital within three weeks.

Results.—In cases of perforated ulcer the result depends almost entirely on the interval which has elapsed between the perforation and the operation; cases operated on within six hours of perforation practically always recover, those within 12 hours recover in most cases, and beyond this time the prognosis is doubtful.

In cases of hæmorrhage the prognosis is always grave, as the condition is desperate, and though operation holds out a good hope of success, the mortality will always be from 10 to 15 per cent.

In operations for cicatricial contraction the results are most successful; the mortality is practically nil, except in debilitated patients. In no class of stomach operation are the results so good, as the patients regain perfect health.

In cases of ulcer without urgent symptoms the mortality is slight and is confined to accidents such as pulmonary embolism, &c.; the permanent results are most satisfactory, in my own cases 85 per cent. are completely cured, and the remainder derived great benefit. In my earlier cases I had some trouble from vicious circle, but these were cured after an entero-anastomosis. I have also had two recurrences after simple gastro-enterostomy; but I have not had any since I have occluded the pylorus in addition to the gastro-enterostomy.

In conclusion, the surgical treatment of duodenal ulcer is urgently demanded in cases of perforation, severe hæmorrhage, and of cicatricial contraction; it is much to be desired in every case of duodenal ulcer whenever the diagnosis is made.

THE RESULTS OF RE-MINERALISATION IN CONDITIONS OF FAULTY METABOLISM, SUCH AS NEURASTHENIA, &c.

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IN THE LANCET of April 18th, 1908, p. 1136, I published a paper entitled "Observations on Blood Pressure, Chlorine Retention and Dechlorination, Hyperacidity, and Variations in the Starch Ration," in which were recorded the results of a series of analyses made to elucidate certain practical problems in metabolism. The present paper is a continuation of that work. The problems dealt with are those concerned with the art of the adaptation of cases with the various factors of environment, and it will be seen that the measurements made for diagnostic purposes or as landmarks on the road to recovery have been necessarily limited to those that can be made by a single individual in a day. I have found it necessary to make continuous observations for long periods of time, as the difficulty in the interpretation of one or two analytical observations is almost insuperable without some sort of measurable, positive knowledge as to the origin of the condition and the course it must take in recovery. A little consideration shows the great difficulty there is in the employment of the numerous devices at one's disposal for the purpose of not only presenting to the patient the necessary chemical elements of the protoplasm in their optimum proportion and quality, but to be able to prescribe the duration of the treatment and to supply favourable factors of environment. The circumstances favouring either retention or the discharge of chlorine afford a comparatively easy method of ascertaining these data; even by the employment of the meagre resources at my disposal the results have been unexpectedly successful.

The observations recorded below have been made mainly with the object of answering the following questions: 1. Is it possible to arrive at a numerical formula indicating the "state of matter" of the somatic protoplasm? 2. Is chlorine retained in the tissues so as to preserve the balance of colloids and crystalloids when there is a deficiency of phosphorus? 3. Which observations can be relied upon as a guide to successful treatment and the limit of its duration? In Case A a group of characteristic measurements were found that showed no indication of variation and instability till a "re-mineralising" mixture was added to the ration. I have been successful in causing the elimination of parenchymatous chlorine, and in altering the tissues so that its tendency to retention is either lost or considerably diminished. The following are the case records on which my thesis rests:—

CASE A.—A man, aged 42 years, who had suffered for some years from constipation and neurasthenia. He had been obliged to relinquish his occupation for over five years. He was not easily fatigued by physical exercise and found no difficulty in walking ten miles. He had noticed that he had sweated with difficulty and in insignificant quantities for some years. The most conspicuous symptoms were mental, even letter-writing presenting an almost insuperable difficulty. The extent of the patient's preoccupation with his infirmities was such that he could talk and think of nothing else. He had a fairly good appetite, he took a very small amount of fluid during the day and had a noticeable distaste for salt, not taking it, for instance, with his eggs. He was emaciated and suffered from Glénard's disease. The blood pressure was between 85 and 90 and the temperature was 96° F. After fitting the patient with a Glénard's belt and keeping the colon empty with oil enemata, the following ration was given and persisted in till the end of the treatment. 1. Proteid; it was particularly insisted on that all proteids should be absolutely fresh; red beef-steak was given at least once a day, mutton, lake trout, and chicken were given occasionally. They were always weighed after cooking for the purpose of tabulating their amounts. 2. Fats; as much fresh butter was given as possible. 3. Starches; biscuits, pulled bread, crusts, and toast, were allowed, while

soft, pulpy starches were forbidden. It is essential in treating these conditions to give the optimum starch ration (in Case A it was from 50 to 75 grammes), avoiding on the one hand the evil effects produced by the absorption of fatty acids from the faulty digestion of an excessive ration in the intestinal canal, and, on the other hand, the disadvantage of an insufficient ration. Fortunately the practice of poltophagic mastication[1] appears to be a most delicate indicator of the optimum ration; it may even be said to give evidence of temporary or permanent general conditions. Thus, in states of extreme fatigue it will be found that the poltophagic mastication of starch may be lost in consequence of the meagre flow of saliva, even though thirst has been satisfied throughout the course of the work causing the fatigue. It is recognised even among starch feeding populations that the power of starch digestion diminishes as the day advances. I remember seeing a remarkably fine specimen of a peasant woman who had been successfully nursing her daughter and granddaughter providing an abundant supply of milk; in addition to this feat she received the respectful admiration of several villages in that she was able to eat a large dish of potatoes in the evening without inconvenience. 4. Salt; the patient was directed to eat as much as he wished, and was informed that as he improved he would eat more salt, and that if he took a larger ration it would not interfere with the elimination of his retained chlorides. Green vegetables, milk, and fruit were omitted from the ration mainly for reasons of expediency, the patient having been under special medical treatment for his stomach condition for some time. In addition to this the colon had passed from the spastic into the atonic state, when it is often advantageous to reduce the bulk of the ration. After a period of six days (No. 1 in the table), during which observations were made enabling me to obtain the data for comparison with the subsequent observations, the following remineralising substances were administered as an additional ration: (1) 0·2 gramme of iodine in organic combination; (2) from 1 to 3 grammes of magnesium oxide and calcium carbonate; and (3) about 1·5 kilogrammes of mixed vegetables (cabbage, onions, carrots, leeks, sage, celery, &c.) which were finely divided, crushed, boiled for three or four minutes, and kept in a Norwegian stove for ten hours, the resultant mixture being strained and concentrated to about a wineglassful.

TABLE I.—*Case A. Ration Scale and Consequent Observations.*

Observation numbers corresponding to those in Table II.	Ration. Proteid (grms.)	Starch (grms.)	Fat (grms.)	NaCl (grms.)	Eggs.	Temperature. Mouth (° Fah.) M. and E.*	Rectum (° Fah.) M. and E.	Body weight (Kilos.) N. and M.†	Blood pressure (Mm. Hg) M. and E.	Exercise (miles).	Weight lost per hour at night (grms.)	Liquid ingested approximately (c.c.)
3‡	—	—	—	—	—	97·2 97·2	98·7 98·9	54·5 53·75	—	—	41	775
4	265	73	151	1·7	3	97 9 97·9	99·1 98·9	55·0 54·5	108 108	2½	29	725
5	256	72	191	1·7	3	97·7 98·7	98·7 99·1	56 0 55·25	114 116	3½	31	775
6	328	70	204	1·7	3	98·1 98·3	99·1 99·1	57·0 56·5	113 115	2½	35	825
7	283	65	205	1·7	3	98·3 98·3	99·3 99·1	57·5 57·0	114 118	4	31	775
8	155	45	158	1·7	3	98·7 98·7	99·7 99·7	58·0 57·75	118 116	3½	35	775
9	171	40	123	1·7	2	98·5 98·5	99·5 99·3	56·75 56·25	110 115	3½	37	775
10	243	59	181	1·7	3	98·5 98·3	99·1 99·1	58·5 58·0	110 115	5	27	875
11	195	47	175	1·7	3	98·5 98·3	99·1 98·9	59·0 58 5	112 118	4	35	825
12	206	55	193	1·7	3	98·3 98·1	99·1 99·1	59·5 58·75	110 114	5½	35	825
13	206	57	178	1·7	3	98·3 98·1	99·1 99·1	60 0 59·75	110 115	6	33	825
14	183	57	171	1·7	3	98·3 97·9	99·1 98·9	60·75 60·25	111 114	7	23	875
15	226	53	180	1·3	3	98·1 98·1	99·1 98·9	61·75 61·0	108 116	4	39	925
16	216	60	186	1·3	3	98·3 98·3	99·1 99·1	62·5 61·75	114 118	9	43	975
17	201	52	214	1·3	2	98·3 98·1	99·1 99·1	62·5 62·25	110 115	4½	39	825
18	200	62	170	1·3	2	98·1 97·9	98·9 98·7	61·5 61·0	115 120	6	33	925

* M. and E. = Morning and Evening.
† N. and M. = Night and Morning.
‡ With regard to Nos. 1 and 2 no observations were made.

The ration of iodine is especially useful in conditions where the specific gravity of the urine is low and where there is an abnormal amount of NH_3.

The main indications that I have followed in the administration of calcium are a blood pressure under 100 or a large loss of calcium in the urine. Magnesium, which Loeb[2] has described as having dynamical properties similar to those of calcium, is probably useful for the purpose of facilitating the solution of calcium oxalate[3] and to supply its deficiency in the tissues, whence it may have been slowly abstracted by oxaluria. There appears to be some evidence that magnesium plays an important part in metabolism; on this point Gaube du Gers[4] writes: "In that condition of retarded nutrition with its protean symptoms called neurasthenia a state of demineralisation is present—that is to say, relative mineral starvation. This deficiency in the mineral elements of the soil is not due to feebleness of the tissues, but owing to demineralisation healthy metabolism is impossible." According to this author and Deschamps,[5] who has made practical use of this principle in the treatment of neurasthenia, the element that is conspicuously deficient is magnesium, which they state is an important constituent of the nervous tissues, especially the grey matter. They state also that magnesium diminishes in the urine during intellectual efforts and increases afterwards. The vegetable salts were given mainly for their potassium, which Bunge[6] found to expel chlorine from the tissues. It is interesting to recall that vegetable salts are an indispensable ingredient of the ration of the starch feeding populations both in the South of Europe and in many parts of Asia. Fresh fruit juices, especially grapes, or vegetables boiled in milk and strained, are useful alternatives. Such mixtures are most useful in nervous, irritable conditions with insomnia.

In order to record the variations resulting from the treatment a number of observations were made twice daily, each result recorded in the tables being an average of six observations. Among the factors of the tables will be found the loss of weight per hour at night. This is obtained by weighing the patient at night and in the morning, then dividing the difference between the two by the number of hours after subtracting the weight of the urine, the resulting number will show variations between 10 and 100 grammes an hour. I found in my own case when I was losing from 75 to 100 grammes an hour, the ingestion of a gramme of calcium carbonate at night would be followed by a considerable decrease in the weight lost which was accompanied by a diminution in the appetite for breakfast. This observation was frequently repeated; it raises an interesting point as to the cause of the excess carbon ration found in conditions where fat is being stored, as in the early stages of toxæmia preceding hibernation. If it is due to a "holding up" or precipitation of the calcium ions by combination with organic acids which Loeb[7] showed to occur in his observations, it would link up this phenomenon with the immediate and striking effects of phosphoric acid on heart failure and palpitation[8] (which are also favourably affected by calcium chloride) and fatigue sensations that are so frequently found

[1] Higgins: Is Man Poltophagic or Psomophagic? THE LANCET, May 20th, 1905, p. 1334. The soft palate in man and the poltophagic animals is an organ for the digestion of starch in the mouth. Prolonged conscious mastication, with the rejection of fibrous material (except in those cases that have atonic colons, when used with care) does harm by causing coprostasis from atrophy of the muscular coat of the bowel from disuse when continued for too long a period of time.

[2] Loeb: The Dynamics of Living Matter, pp. 79–80.
[3] Von Noorden: Metabolism and Practical Medicine, vol. iii., p. 1047.
[4] Gaube du Gers: Cours de Minéralogie Biologique, p. 209, Paris, 1897.
[5] Deschamps: Les Maladies d'Energie, p. 162 et seq., Alcan, Paris, 1908.
[6] Bunge: Physiological and Pathological Chemistry, p. 120.
[7] Loeb: Op. cit., pp. 79 and 80.
[8] Higgins: Op. cit., p. 1141.

TABLE II.—*Case A. Record of Urinary Analyses, each number being an Average of Six Observations.*

Number.	Dates.	Volume, D. and N.*	Total volume.	Specific gravity.	Solids, D. and N.	Total solids.	Chlorides, D. and N.	Total chlorides.	Urea, D. and N.	Total urea.	Ammonia, D. and N.	Total ammonia.	Uric acid, D. and N.	Total uric acid.	P_2O_5, D. and N.	Total P_2O_5.	Earthy phosphates, D. and N.	Total earthy phosphates.	Magnesium phosphate, D. and N.	Total magnesium phosphate.	Calcium phosphate, D. and N.	Total calcium phosphate.	Calcium ppt. by NH_3.	Calcium in NH_3 filtrate, D. and N.	Total calcium in NH_3 filtrate.	Acidity in grms. oxalic acid, D. and N.	Total acidity in grms. of oxalic acid.
1	July 28th August 2nd	230 241	471	1026 1026	13·7 14·3	28·1	2·46 2·33	4·79	7·08 7·08	14·1	— —	—	·255 ·275	·530	0·87 0·79	1·66	·336 ·322	·658	·098 ·112	·210	·138 ·244	·382	·454	·22 ·205	·425	1·66 1·54	3·2
2	,, 3rd ,, 8th	332 501	833	1024 1020	17·8 20 7	38·5	4·52 4·71	9·23	7·29 9·13	16·4	·258 ·263	·521	·269 ·259	·528	0·59 0·67	1·26	·258 ·354	·612	·146 ·242	·388	·154 ·125	·279	·437	·171 ·157	·328	1·16 1·59	2·75
3	,, 9th ,, 14th	296 480	776	1027 1022	18·0 21·9	39·9	3 54 4·35	7·89	7·96 11·1	19·0	·247 ·268	·515	·231 ·371	·601	1·00 1·06	2·06	·41 ·583	·993	·252 ·308	·560	·158 ·258	·416	·411	·172 ·224	·396	1·2 0·88	2·08
4	,, 15th ,, 20th	396 531	927	1027 1023	21·3 29·9	51·2	3·97 5·3	9·27	8·2 12·47	20·6	·258 ·392	·650	·247 ·403	·650	0·74 0·96	1·7	·434 ·568	1 002	·218 ·396	·614	·18 ·186	·366	·551	·108 267	·375	0·92 1·13	1·92
5	,, 21st ,, 26th	303 403	706	1031 1028	22·8 25·8	48 6	3·57 3·41	6·98	9·2 13·3	22·5	·19 ·247	·437	·298 ·316	·614	1·09 1·07	2·16	·507 ·632	1·139	·234 ·387	·621	·134 ·170	·304	·34	·116 ·168	·284	1·33 1·59	2·92
6	,, 27th Sept. 1st	488 458	946	1028 1023	25·8 27·6	53·4	4·71 4·08	8·79	12·5 10 9	23·4	— —	—	·398 ·372	·770	1·1 1·02	2·12	·737 ·51	1·247	·313 ·34	·653	·247 ·25	·497	·452	·14 ·086	·226	1·23 1·45	2·68
7	,, 2nd ,, 7th	530 393	923	1028 1025	27·8 21·3	49·1	4·86 4·33	9·19	11·4 10·26	21 6	·2 ·214	·414	·356 ·309	·665	1·22 1 0	2·22	·596 ·539	1·135	·42 ·32	·74	·267 ·203	·47	·27	·087 ·089	·176	1·37 1·37	2·74
8	,, 8th ,, 13th	353 325	678	1028 1025	22·6 18·0	40·6	3·31 3·22	6·53	11·16 10·1	21·2	— —	—	·303 ·271	·574	1·21 0·92	2·13	·283 ·271	·554	·142 ·131	·273	·141 ·136	·277	—	·097 ·081	·178	1·17 1·4	2·57
9	,, 14th ,, 23rd	323 318	641	1029 1027	19·8 18·7	38·5	2·61 3 00	5·61	10 3 10 3	20 6	— —	—	·26 ·255	·515	1·34 1·13	2·47	·266 ·258	·524	·078 ·084	·161	·169 ·174	·343	—	·073 ·03	·103	1·76 1·47	3·23
10	,, 24th ,, 29th	333 398	731	1030 1024	22 9 21·3	44·2	3·43 3·19	6·62	9·9 11·3	21·2	— —	—	·336 ·291	·627	1·46 1·23	2·69	·261 ·373	·534	·103 ·165	·268	·158 ·195	·353	—	·106 ·093	·199	2·08 2·11	4·19
11	,, 30th Oct. 5th	328 341	669	1030 1025	27·4 23·9	51·3	4·16 3 05	7·21	11·8 10 8	22·6	— —	—	·277 ·367	·644	1·64 1·51	3·15	·26 ·314	·574	·169 ·174	·343	·178 ·119	·297	—	·175 ·124	·299	—	—
12	,, 6th ,, 11th	353 346	699	1030 1024	24·9 16·8	41·7	4·02 2·82	6·84	10·7 10·4	21·1	— —	—	·352 ·295	·647	1·32 1·08	2·4	·344 ·405	·749	·205 ·209	·414	·195 ·201	·396	—	·155 ·142	·297	2·62 2·0	4·62
13	,, 12th ,, 17th	345 341	686	1029 1025	22·5 18·0	40·5	4·27 2·64	6 91	9·6 9·2	18·8	— —	—	·298 ·273	·571	1·34 1·24	2·58	·332 ·358	·67	·222 ·232	·454	·109 ·107	·216	—	—	—	1·68 1·66	3·34
14	,, 18th ,, 23rd	391 403	794	1029 1023	24 9 19·4	44·3	4·64 2·85	7·49	11·2 9·1	20·3	— —	—	·34 ·312	·652	1·53 1·09	2·62	·415 ·407	·822	·203 ·195	·398	·179 ·214	·393	—	—	—	1·63 1·84	3·47
15	,, 24th ,, 29th	396 363	759	1028 1025	26·1 17·6	43·7	5·0 3·06	8·06	9·6 8·3	17·9	— —	—	—	—	1·06 0·9	1·96	·409 ·409	·818	·148 ·283	·431	·293 ·173	·466	—	—	—	1·29 0·7	2·99
16	,, 30th Nov. 4th	430 380	810	1030 1028	29·2 25·5	54·7	6·49 4·2	10·69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	,, 5th ,, 10th	370 340	710	1030 1027	26·3 20 6	46·9	6·49 3·92	10·41	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	,, 11th ,, 16th	343 284	627	1030 1025	23·3 16·2	39·5	6·35 2·11	8·46	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* D. and N. = Day and Night.

in the more acute phases of these conditions. It may be stated generally that it is better to keep this measurement under 50 grammes during treatment; it seems to show a higher degree of protoplasmic activity. As there is a tendency to lose the breakfast appetite for starches when this measurement is low, I have asked myself whether under these circumstances there is not an increased formation of glycogen from fat with fixation of oxygen. Bouchard[9] has recorded an actual increase in weight from this cause in the human subject and animals during a short period of time. Albumin, though frequently looked for in the urine, was not present in this case. With the exception of those occasions when there was either a small precipitate of calcium or an absence of precipitate in the filtrate after precipitation with ammonia, there was a copious precipitate with Fehling that took from 10 to 20 minutes to show itself, and though there was no fermentation with yeast Professor Zanoni of Milan found pentose with a trace of glucose.

It will be seen that two separate analyses have been made for the 12 hours preceding and following bed-time. The object of this is to compare the variations of the elimination of the urinary solids in the working and resting hours. The normal $\frac{\text{day}}{\text{night}}$ quotient, as it has been called, is between 2 and 3 for all the urinary solids. Very little work has been done on this subject. Leathes[10] showed that even in the case of uric acid (which is always found to have the lowest $\frac{\text{day}}{\text{night}}$ quotient of the urinary solids) there is a diminution of 50 per cent. in rate of excretion during the resting hours. Mr. Castellain analysed his own urine and that of a neurasthenic patient with whom he was travelling for some weeks. He very kindly showed me the figures; in his own case the average quotient for solids, urea and chlorides, was about 3; in that of the patient from 0·8 to 1·2. I have used the phrase decreased velocity of the metabolic traffic in order to express the condition showing a low $\frac{\text{day}}{\text{night}}$ quotient so as to be able to emphasise the fact that there is no evidence to convict one organ, or group of organs, more than another, but rather there is every indication of a general condition affecting all the tissues equally.

The results of the treatment analytically were as follows—Chlorides: the salt ration was controlled by using dried salt kept in a glass-stoppered bottle, which was weighed at intervals. Before the mixture of minerals was added to the ration the average output for six days was 4·79 grammes, which was calculated as the amount of the full ration—viz., the average added ration, together with the unestimated chlorides contained in the food. The output rose to 8·44 grammes the day after the re-mineralising mixture was taken. Observations were made from July 28th to Nov. 16th, the total dechlorination being estimated at 396 grammes. On Oct. 31st 15·09 grammes were eliminated, and on Nov. 8th 16 grammes, the patient was ingesting 1·5 grammes of added sodium chloride. These observations were made 89 and 97 days respectively after commencing treatment. During this time the output of the ordinary constituents was increased as follows: Urea, from 2·2 to 8·4 grammes in excess of the amount eliminated during the first period of six days, phosphoric acid up to 1·49 grammes, magnesium phosphate 0·443 gramme, and uric acid 0·307 gramme.

The increased velocity of the metabolic traffic as shown by the variations of the $\frac{\text{day}}{\text{night}}$ quotient was modified as follows: as regards the volume, it will be noted that as the specific gravity of the night urine was always lower than that of the day the quotient was not higher than 1·2; solids, 1·4; chlorides from 0·7 to 3·0; for the urea from 0·7 to 1·4; phosphoric acid being from 0·7 to 1·4.

With regard to the relationship of one constituent with another, it was found that $\frac{\text{uric acid}}{\text{phosphoric acid}}$ varied from 4·2 to 2·2 (normal 2·2); $\frac{\text{urea}}{\text{chlorides}}$ commenced at 1·2 and reached 4·4; it remained normal from period No. 10 to No. 15 (normal 2·9); $\frac{\text{urea}}{\text{phosphoric acid}}$ started at 3·5 and reached 14·5 (No. 5); from No. 6 to 15 it varied between 8 and 10 (normal 10); $\frac{\text{chlorides}}{\text{phosphoric acid}}$ varied from 2·2 to 7·5 (normal 4). As will be seen by the records, there was an improvement in all directions; the patient sweated with exercise though the weather was colder. It is to be regretted that illness made it impossible for me to continue the observations till the dechlorination was complete.

CASE B.—This is my own case, and is in continuation of the notes in THE LANCET.[11] The record can be divided into three divisions: (1) observations made during the periods Nos. 1 to 10 (during this division 2·0 grammes of calcium carbonate and magnesium chloride were taken morning and evening); (2) a time of unusually hard work during which the magnesium and calcium were discontinued (this is included in Nos. 11 and 14 in the records); and (3) from Nos. 15 to 20 there was exceptionally hard work, a similar quantity of vegetable salts as those administered in Case A were taken, with 0·2 gramme of iodine in organic combination.

Chlorides.—Two balances were made, the first at the end of two days and another similar to that in my first paper (alluded to above) at the end of ten days. In the case of the two-day balances during time included in the first division there was a total retention of only 31 grammes, in the second 5·9, and in the third 19 grammes. The amounts eliminated and recorded in the chloride balance table were made every ten days. The small totals on the side of elimination can be accounted for by retention during periods of unusual exertion. Thus the increased eliminations during Nos. 13 and 14 can be accounted for by three exhausting journeys to England in three weeks with bad cases. Again, Nos. 16, 17, and 19 were subsequent to unusual fatigue. Widal and Javal[12] have described a floating balance of from 1 to 3 pounds of water, which many normal subjects lose with a small dechlorination. Ambard[13] found in his own case that there was a loss of 15 grammes of chlorides with 1500 grammes of water before he attained chloride equilibrium. When these facts are taken into consideration, together with the inevitable small errors, it is practically certain that there was no considerable retention of chlorides similar to that recorded in the observations of my first paper. The object of leaving off the earthy salts and replacing them with the vegetable salts was to see whether the original condition could be reproduced. The preponderance of magnesium over calcium phosphate was maintained till the end of October, so that magnesium must have been stored in the tissues and slowly given up. Metabolic states associated with a wastage of earthy salts have been frequently described; it has even been held that a preponderance of earthy over the alkaline phosphates characterises certain hysterical and neurasthenic states. At the beginning of November I had a very severe "nervous" breakdown that rendered it necessary for me to remain in bed for four months and from which I have not yet recovered. The prominent changes in the analyses before the illness were: (1) the specific gravity was lower at night during the unfavourable periods; (2) there was a marked increase in the urea though the proteid ration was not increased; (3) there was an increase in the ration and output of chlorides of from 14 to 20 grammes; (4) an increase in the urinary acidity from an equivalent of from 4·2 to 6·9 grammes of oxalic acid; (5) a fall during the third period in earthy phosphates; and (6) a fall in magnesium phosphate from 0·704 gramme in the first period to 0·474 in the third. There was a fall in blood pressure from 100 to 75 millimetres of mercury about 14 days before the breakdown. During October I noted on many occasions that after working continuously from 5 to 6 in the morning till 12 o'clock I felt unusually fatigued; on taking a gramme of calcium carbonate the sensation of fatigue disappeared in a short time, and about 300 cubic centimetres of

[9] Bouchard: Traité de Pathologie Générale, tome iii., 1st Part, p. 972.

[10] Leathes: Discussion on the Physiology of the Purin Bodies, Brit. Med. Jour., April 22nd, 1908, p. 495.

[11] Higgins: Loc. cit.

[12] Widal and Javal: La Cure de Dechloruration, p. 27.

[13] Ambard et Beaujard: Hypertention Arterielle et Retention Chlorurée, Société de Biologie, 20 Fev., 1904, p. 317. Labbé and Morchoisne (Le Metabolisme de l'Eau et des Chlorures, Revue de Médecine, April, 1905, p. 250) obtained confirmatory results, and concluded that the abrupt variations in weight recorded in normal persons are due to retentions and discharges of water and chlorides.

TABLE III.—*Case B. Chloride Balance.*

Nos. for reference to periods.	Dates 1908 and 1909.	Total chlorides eliminated.	Chloride of sodium added to food.	Estimated error.*	Retention of chlorides.	Dechlorination lost.	Concentration-volume chlorides. Day.	Concentration-volume chlorides. Night.	Balance.
			Period 1.						
1	Dec. 30th Jan. 8th	159	110	33	—	16·0	70	76	—
2	,, 9th ,, 18th	135·9	100	33	—	2·9	78	104	—
3	,, 19th ,, 30th	144·6	92	33	—	19·6	68	89	—
4	Feb. 9th ,, 18th	142·5	90	33	—	19·5	76	109	133·1 grms. eliminated.
5	,, 23rd March 3rd	159 4	105	33	—	21·4	86	100	—
6	,, 4th ,, 20th	164·1	128	33	—	3·1	76	99	—
7	,, 21st ,, 30th	164·6	122	33	—	9·6	85	109	—
8	April 2nd ,, 11th	154	120	33	—	1 00	80	88	—
9	,, 17th ,, 26th	158	107	33	—	18·00	70	81	—
10	,, 27th May 6th	135	90	33	—	12·0	65	85	—
			Period 2.						
11	,, 19th ,, 25th	125	100	23·1	—	1·9	63	71	—
12	,, 29th June 4th	127·9	79	23·1	—	24·7	60	81	61·2 grms. eliminated.
13	,, 11th ,, 20th	163·9	111	33	—	19·9	70	74	—
14	,, 21st ,, 29th	152·1	112	25·4	—	14·7	64	70	—
			Period 3.						
15	Aug. 1st ,, 10th	162·6	128	33	—	1·6	61	70	—
16	,, 11th ,, 20th	179·1	125	33	—	18·1	65	72	—
17	,, 24th ,, 30th	204·6	145	33	—	26·6	65	78	86·3 grms. eliminated.
18	,, 31st Sept. 9th	191 9	160	33	1·1	—	73	87	—
19	,, 10th ,, 18th	180	113·3	30·7	—	36 0	72	72	—
20	Oct. 13th ,, 21st	204	147·3	30·7	—	4·0	69	68	—

* See first paper (THE LANCET, April 18th, 1908) = Chlorides in food that were not estimated.

clear urine were excreted shortly afterwards. During the process of recovery my blood pressure has risen from 75 to 170 millimetres of mercury [14]; on omitting calcium the blood pressure has fallen to 115 millimetres of mercury. My weight rose from 10·5 to 16 stones in three months.

CASE C.—These analyses were made on two consecutive days in a case of a youth, aged 16 years, who was incapacitated in consequence of a low fatigue point. He had suffered for some five years from frequent attacks of asthma, influenza, and bronchitis; his blood pressure had fallen from 165 to 90 millimetres of mercury during the preceding year. This case was one of those obstinate cases of "nerves," constipation, &c., with a tendency to obesity.

The two cases that follow are examples of the effect of remineralisation in cases with a tendency to atony:—

CASE D.—A man, aged 59 years. Weight, 73 kilogrammes; height, 1·7 metres. He had suffered from neurasthenia, migraine, constipation, &c., for more than 25 years. During the previous year his blood pressure fell from 155 to 100 millimetres of mercury. The patient looked and felt extremely ill; he was pallid, restless, and irritable. The temperature was 96° F. and the blood pressure was 80. A complete examination of the blood was made by Dr. Spitta, who pronounced it to be normal. An interesting feature of this case was the association of headache and increased neurasthenic discomfort on the days when there was an increase in the urinary solids. The ration was approximately the same during the time the analyses were made.

This patient spent the winter in North Africa, carefully avoiding fatigue, exposure to cold, and constipation. I prescribed phosphoric acid (maximum dose of 100 minims daily) to be taken before exercise and to relieve fatigue sensations, two grammes of calcium carbonate and magnesium oxide, iodine, and eggs. In April there was a remarkable change in his condition, the blood pressure was 100 and his temperature normal; the improvement has been maintained for 18 months.

CASE E.—A woman, aged 59 years, who had been more or less under medical treatment for neurasthenia, constipation, nervous dyspepsia, &c., for about 30 years. There was an extreme state of weakness from inanition, the pulse was feeble, and the blood pressure was 105. She had felt herself obliged to reduce her ration to inconceivably low limits; she stated that she had existed for some time on a few zwieback and one or two cups of tea. She explained her dilemma by the statement that "she was unable to eat because of the intense discomfort; at the same time, she fully realised that if she did not eat she must die." A ration was given of about 200 grammes of red beefsteak, about a gramme of magnesium oxide and calcium carbonate, with iodine and vegetable salts. Eggs and milk caused great discomfort; the former were given in small quantities till toleration was established. Complete rest was prescribed for three weeks; after this the patient gradually increased her exercise till she recovered a remarkable degree of health and activity. In this case, on one or two occasions, she had nothing but the vegetable salts for two or three days at a time; the partial starvation seemed to improve her condition and increase her appetite for days afterwards. The analyses were made during a period of over three months.

CASE F.—A man, aged 57 years. Weight, 76 kilogrammes. The patient had had a rest-cure for neurasthenia in the previous October, and subsequently he went to Egypt and the Riviera. In the month of April following he felt worse than before undertaking the rest-cure. With a similar treatment as that of Case D this patient recovered sufficiently to be able to resume his work. Oxybutyric and diacetic acids were present in the urine as well as a trace of glucose.

CASE G.—The patient, aged 24 years, was the daughter of an American physician. There was a history of ill-defined illnesses, neurasthenia, and nervous dyspepsia for six years. She had been in the clinics of stomach specialists in the United States, Germany, and Switzerland.

CASE H.—This patient had recently had a rest-cure in London for neurasthenia. The patient was in a highly irritable and nervous state while the analyses were made.

The Condition of the Colon.

The following cases (A to G) correspond with those described above.

CASE A.—The abdominal wall was soft and bulged below the umbilicus. The colon was full from the cæcum to the sigmoid flexure; massage only induced a temporary contraction of the transverse fibres; there was no spasm. It was not till after injecting seven ounces of olive oil for three nights that the colon could be emptied by massage. After fitting this case with a Glénard's belt, it was found that the muscles recovered their tone in two or three weeks without exercises. No difficulty was found in keeping the colon empty with oil enemata.

CASE B.—During the second week in June, 1908, a considerable collection of intestinal sand caused constipation; it was removed in three or four days with oil enemata. The sand consisted of two parts of calcium and one of magnesium salts. During August and September recurring bouts of obstinate constipation were experienced, with membranous colitis and spasm of the transverse and descending colons. After the fatigue of a journey to England painful contractions of the colon were constantly present, and there was no action without oil enemata. The effect of the oil was remarkably complete and rapid; for instance, if an oil enema was given at 8 A.M., and some charcoal after breakfast at 8.30, the bowels would be open three or four times, and the charcoal would appear in the fæces before 12 A.M. After inspissated ox-gall was administered by the mouth oil

[14] Dr. J. N. F. Fergusson of Malvern, who made the observation for me, had some doubts as to the accuracy of the instrument used.

TABLE IV.—*Case B. Urinary Analysis.*

Number.	Dates.	Volume, D. and N.*	Total volume.	Specific gravity.	Solids, D. and N.	Total solids.	Chlorides, D. and N.	Total chlorides.	Urea, D. and N.	Total urea.	Ammonia, D. and N.	Total ammonia.	Uric acid, D. and N.	Total uric acid.	P_2O_5, D. and N.	Total P_2O_5.	Earthy phosphates, D. and N.	Total earthy phosphates.	Magnesium phosphate. D. and N.	Total magnesium phosphate.	Calcium phosphate, D. and N.	Total calcium phosphate.	Calcium ppt. by NH_3.	Calcium NH_3 filtrate, D. and N.	Total calcium in NH_3 filtrate.	Acidity in grms. of oxalic acid, D. and N.	Total acidity.
1	Sept. 10th Oct. 9th	592 501	1093	1025 1026	33·8 28·7	62·5	7·63 5·06	12·69	11·9 10·9	22·8	—	—	·409 ·301	·710	1·66 1·67	3·33	·328 ·402	·73	·21 ·162	·362	·118 ·24	·358	—	—	—	2·02 2·0	4·02
2	Nov. 4th ,, 13th	704 355	1059	1025 1025	40·4 31·6	72·0	11·7 7·52	19·22	12·3 10·3	22·6	—	—	·383 ·363	·746	1·78 1·4	3·18	·426 ·397	·823	·209 ·131	·34	·217 ·266	·483	—	—	—	1·87 1·72	3·69
3	,, 14th ,, 19th	562 482	1044	1026 1026	42·4 29·7	72·1	12·3 7·1	19·4	12·8 9·4	22·2	—	—	·557 ·366	·923	2·0 1·5	3·5	·526 ·304	·83	·236 ·153	·389	·29 ·151	·441	—	—	—	2·19 1·4	3·59
4	,, 29th Dec. 8th	707 570	1277	1027 1027	44·2 33·5	77·7	12·47 7·03	19·5	15·1 12·7	27·8	—	—	·527 ·396	·923	1·88 1·62	3·5	·458 ·366	·824	·271 ·195	·466	·187 ·171	·358	—	—	—	2·26 1·85	4·11
5	,, 9th ,, 18th	752 507	1259	1027 1028	45·1 31·1	76·2	12·16 6·39	18·55	15·5 11·2	26 7	—	—	·567 ·349	·916	1 98 1·72	3·7	·544 ·417	·961	·33 ·21	·54	·214 ·207	·421	—	—	—	2·25 1·91	4·16
6	,, 19th ,, 29th	784 494	1278	1026 1027	46·9 27·3	74·2	12·2 5·6	17·8	12·6 8·7	21·3	·682 ·461	1·143	·602 ·337	·939	1·74 1·25	2·99	·556 ·382	·938	·383 ·21	·593	·173 ·172	·345	—	—	—	1·54 1·49	3·03
7	,, 30th Jan. 8th	716 466	1182	1028 1029	44·6 30·4	75·0	10·15 5·75	15·9	12·2 8·9	21·1	·756 ·544	1·2	·52 ·324	·844	2·04 1·59	3·63	·63 ·489	1·119	·418 ·318	·736	·212 ·171	·383	—	—	—	2·15 1·9	4·05
8	,, 9th ,, 18th	755 469	1224	1028 1027	46·2 27·1	73·3	9·35 4·24	13·59	12·9 8·8	21·7	·736 ·496	1·232	·641 ·328	·969	1·96 1·41	3·37	·554 ·358	·912	·372 ·192	·564	·182 ·166	·348	—	—	—	1·71 1·53	3·24
9	,, 19th ,, 30th	711 392	1103	1029 1029	47·2 24·8	72·0	10·22 4·24	14·46	13·2 8·2	21·4	·72 ·353	1·073	·537 ·32	·857	2·17 1·29	3·46	·551 ·406	·957	·356 ·236	·592	·195 ·16	·355	—	—	—	2·06 1·55	3·61
10	Feb. 9th ,, 18th	776 495	1271	1026 1025	46·1 24·1	68·8	8·73 4·5	13·23	11·9 8·3	20·2	·667 ·543	1·21	·584 ·419	·903	1·89 1·31	3·2	·498 ·415	·913	·402 ·34	·742	·096 ·078	·174	—	—	—	1·7 1·41	3·11
11	,, 23rd March 3rd	989 514	1503	1023 1025	46·3 28·1	74·4	10·7 5·24	15·94	14·0 8·1	22·1	·755 ·427	1·182	·497 ·294	·791	2·16 1·38	3·54	·61 ·412	1·022	·448 ·319	·767	·162 ·093	·255	—	—	—	1·61 1·25	2·86
12	,, 11th ,, 20th	902 555	1457	1026 1025	47·3 28·0	75·3	10·86 5·55	16·41	13·4 8·9	22·3	·717 ·412	1·129	·586 ·385	·971	2·04 1·24	3·28	·504 ·371	·875	·363 ·282	·645	·141 ·039	·23	—	—	—	1·66 1·45	3·11
13	,, 21st ,, 30th	886 631	1517	1023 1024	44·9 33·1	78·0	10·54 5·92	16·46	13·2 10·6	23·8	·793 ·559	1·352	·555 ·373	·928	2·05 1·34	3·39	·579 ·542	1·121	·435 ·35	·785	·131 ·094	·215	·254 ·115	·237 ·135	·372	1·63 1·45	3·08
14	April 2nd ,, 11th	817 499	1316	1025 1026	44·1 29·1	73·2	9·91 5·49	15·4	12·6 9·1	21·7	·66 ·435	1·095	·505 ·342	·847	2·08 1·45	3·53	·566 ·473	1·039	·437 ·353	·79	·131 ·138	·269	·128 ·091	·228 ·127	·355	2·04 2·01	4·05
15	,, 17th ,, 26th	771 461	1232	1026 1028	45·0 29·3	74·3	10·67 5·16	15·83	12·4 8·6	21·0	·743 ·462	1·205	·361 ·303	·664	1·77 1·35	3·12	·523 ·398	·921	·382 ·25	·632	·15 ·147	·297	·142 ·1	·212 ·136	·348	2·51 2·49	5·00
16	,, 27th May 6th	652 406	1058	1030 1031	44·1 28·5	72·6	8·72 4·87	13·59	12·8 8·6	21·4	·52 ·29	·81	·627 ·364	·991	1·88 1·48	3·36	·57 ·45	1·02	·339 ·228	·567	·231 ·222	·453	·183 ·142	·217 ·091	·308	2·71 2·35	5·05
17	,, 19th ,, 25th	690 500	1190	1027 1029	44·3 31·4	75·7	10·8 7·02	17·82	12·4 9·8	22·2	·734 ·581	1·315	·632 ·41	1·042	1·67 1·47	3·14	·531 ·473	1·004	·4 ·295	·695	·139 ·16	·199	·168 ·101	·27 ·193	·463	2·34 2·2	4·54
18	,, 29th June 4th	720 514	1234	1027 1024	43·9 28·2	72·1	11·8 6·49	18·29	11·4 10·2	21·6	·669 ·461	1·13	·571 ·365	·934	1·79 1·49	3 28	·588 ·455	1·043	·39 ·304	·694	·167 ·181	·328	·24 ·113	·235 ·177	·412	2·5 2·31	4·81
19	,, 11th ,, 20th	783 506	1289	1024 1024	38·5 27·3	65·8	10·5 5·89	16·39	14·1 10·9	25·0	·734 ·52	1·254	·531 ·296	·827	1·79 1·6	3·39	·571 ·424	·995	·42 ·301	·721	·175 ·121	·296	·207 ·153	·193 ·125	·318	2·95 2·59	5·54
20	,, 21st ,, 29th	800 610	1410	1025 1021	43·7 32 0	75·7	10·15 7·6	17·75	14·7 12·8	27·5	·798 ·76	1·558	·546 ·395	·941	1·78 1·69	3·47	·605 ·464	1·079	·392 ·318	·71	·209 ·147	·356	·252 ·171	·418 ·426	·844	2·55 2·4	4·95
21	August 1st ,, 10th	565 578	1143	1029 1030	35·9 32·2	68·1	8·88 7·38	16·26	10·9 10·1	21·0	—	—	·494 ·422	·916	1·42 1·5	2·92	·415 ·345	·76	·21 ·17	·38	·219 ·181	·4	·219 ·21	·21 ·187	·397	2·61 2·33	4·94
22	,, 11th ,, 20th	651 545	1196	1030 1028	45·8 34·0	79·8	9·62 8·29	17·91	16·4 13·9	30·3	·344 ·238	·582	·538 ·392	·93	1·77 1·15	2·93	·465 ·378	·843	·282 ·239	·521	·182 ·148	·33	·187 ·203	·22 ·122	·342	2·33 1·88	4·21
23	,, 21st ,, 30th	778 750	1528	1028 1023	50·1 37·4	87·5	11·47 8·99	20·46	15·8 13·9	29·7	·317 ·272	·589	·548 ·382	·93	2·04 1·57	3·61	·487 ·421	·908	·356 ·282	·638	·18 ·179	·359	·134 ·152	·257 ·224	·481	2·5 1·63	4·13
24	,, 31st Sept. 9th	748 667	1415	1025 1020	40·6 29·4	70·0	11·13 8·05	19·18	16·2 14·6	30·8	·214 ·28	·494	·544 ·421	·965	1·71 1·37	3·08	·39 ·328	718	·209 ·180	·389	·18 ·148	·328	·126 ·123	·185 ·201	·385	2·33 1·81	4·14
25	,, 10th ,, 18th	847 589	1436	1027 1027	50·7 34·9	85·6	11·74 8·15	19·89	19·5 18·1	37·6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2·64 1·53	4·17
26	Oct. 11th ,, 21st	717 608	1325	1027 1025	37·6 33·3	70·9	10·33 8·89	19·22	15·0 14·0	29·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3·09 2·89	6·08

* D. and N. = Day and Night.

TABLE V.—*Urinary Analyses of Cases C, D, E, F, G, and H.*

Case.	Volume, D. and N*.	Total volume.	Specific gravity, D. and N.	Solids, D. and N.	Total solids.	Chlorides, D. and N.	Total chlorides.	Urea, D. and N.	Total urea.	Ammonia, D. and N.	Total ammonia.	Uric acid, D. and N.	Total uric acid.	P_2O_5, D. and N.	Total P_2O_5.	Earthy phosphates, D. and N.	Total earthy phosphates.	Magnesium phosphate, D. and N.	Total magnesium phosphate.	Calcium phosphate, D. and N.	Total calcium phosphate.	Calcium ppt. by NH_3.	Calcium in NH_3 filtrate, D. and N.	Total calcium in filtrate.	Acidity in grms. of oxalic acid, D and N.	Total acidity.
C.	270 250	520	1028 1029	18·7 17·5	36·2	4·42 3·34	7·76	5·9 5·6	11·5	·238 ·27	·508	·36 ·373	·733	1·98 1·27	3·25	·229 ·218	·447	·148 ·05	·198	·081 ·148	·229	·267	·303 ·14	·443	1·43 2·5	3·93
	430 230	660	1028 1029	28·9 16·6	45·5	8·84 4·5	13·34	8·1 4·7	12·8	·479 ·234	·713	·495 ·332	·827	1·16 0 97	2·13	·225 ·126	·351	·168 ·057	·225	·057 ·169	·226	·223	·2 ·115	·315	1·2 1·24	2·44
D.	650 530	1180	1018 1020	24·1 22·0	46·1	3·9 3·18	7·08	3·4 2·3	5·7	—	—	·313 ·249	·562	1·23 1·06	2·29	·371 ·325	·696	·065 ·16	·225	·306 ·265	·571	—	—	—	1·04 1·27	2·31
	680 710	1390	1020 1017	28·2 24·8	53·0	8·43 2·69	11·12	13·2 10·6	23·8	—	—	·371 ·327	·698	1·76 1·27	3·03	·306 ·39	·696	·085 ·071	·156	·221 ·319	·54	—	—	—	2·17 1·27	3·44
	500 650	1150	1027 1016	30·7 21·4	52·1	4·2 3·12	7·32	10·2 10·9	21·1	—	—	·431 ·276	·707	1·4 1·13	2·57	·525 ·292	·817	·2 ·097	·297	·325 ·195	·52	—	—	—	2·3 1·82	4·12
	740 1180	1920	1020 1010	32·6 23·6	56·2	6·21 4·95	11·16	15·5 20·3	35·8	—	—	·432 ·236	·668	2·11 2·11	4·22	·407 ·472	·879	·092 ·177	·269	·314 ·295	·609	—	—	—	2·3 1·06	3·36
	920 630	1550	1015 1025	28·3 19·4	47·7	4·78 4·53	9·31	21·2 13·6	34·8	—	—	·394 ·328	·722	1·3 1·07	2·37	·368 ·283	·651	·092 ·063	·155	·276 ·22	·496	—	—	—	1·74 1·13	2·87
	1150 700	1850	1015 1020	35·3 29·0	64·3	4·6 5·74	10·34	6·2 14·9	21·1	—	—	·485 ·332	·817	2·07 1 13	3·2	·46 ·49	·95	·115 ·07	·185	·345 ·42	·765	—	—	—	1·72 1·26	2·98
	1040 830	1870	1015 1014	32·0 23·8	55·8	13·1 3·81	16·91	11·5 15·8	27·3	—	—	·422 ·256	·678	3·95 1·49	5·44	·624 ·332	·956	·156 ·124	·28	·468 ·208	·676	—	—		1·87 1·32	3·19
E.	350 200	550	1022 1027	16·4 12·3	28·7	4·62 3·04	7·66	6·43 5·06	11·49	·166 ·17	·336	·272 ·142	·414	·49 ·93	1·42	·116 ·082	·198	·024 ·115	·039	·092 ·067	·159	·217	—	·136	0·84 0·28	1·12
	310 200	510	1020 1028	12·8 12·9	25·7	3·75 1·24	4·99	9·8 5·12	14·9	—	—	·14 ·191	·331	·4 ·89	1·29	·1 ·22	·32	·03 ·06	·09	·07 ·16	·23	—	·306 ·057	·363	1·3 0 93	2·23
	360 500	860	1020 1015	14·9 15·4	30·3	3·24 3·9	7·14	7·4 8·5	15·9	—	—	·205 ·303	·508	0·63 0·87	1·5	·126 ·325	·451	·188 ·224	·412	— ·101	—	·192	042 238	·28	— ·05	0·5
	700 630	1330	1017 1014	24·5 18·8	43·3	7·7 5·16	12·86	11·9 10·7	22·6	—	—	·295 ·281	·576	0·98 0·79	1·77	·413 ·324	·737	·136 ·157	·293	·277 ·167	·444	—	—	—	1·58 0·71	2·29
	560 580	1140	1015 1017	17·2 20·3	37·5	4·76 5·8	10·56	9·46 9·55	19·0	—	—	·242 ·251	·493	0·56 0 53	1·09	·313 ·327	·64	·201 ·153	·354	·112 ·194	·306	—	·219 ·17	·389	1·2 0·26	1·46
	730 630	1360	1023 1020	36·2 26·2	62·4	7·4 6·42	13·82	10·7 12·6	23·3	·868 ·578	1·446	·519 ·607	1·126	1·6 1·28	2·88	·401 ·299	·7	·189 ·198	·387	·212 ·102	·314	·576	·153 ·089	·242	3·35 2·89	6·24
F.	770 650	1420	1020 1018	31·0 24·1	55·1	6·31 5·46	11·77	10·8 8·7	19·5	·44 ·142	·582	·324 ·338	·662	1·25 0·97	2·22	·431 ·352	·783	·25 ·149	·399	·181 ·203	·384	·203	·052 ·145	·197	2·1 2·1	4·11
G.	420 410	830	1024 1020	22·0 17·0	39·0	4·7 4·18	8·88	8·4 7·3	15·7	·612 ·569	1·181	·143 ·196	·339	1·92 1·22	3·14	·235 ·188	·423	·134 ·102	·236	·101 ·086	·187	·087	·341 ·235	·596	1·81 1·64	3·45
H.	500 480	980	1026 1026	29·3 28·1	57·4	7·4 6·72	14·12	12·0 10·3	22·3	1·224 1·09	2·314	·358 ·474	·832	1·3 1·16	2·46	·42 ·316	·736	·227 ·189	·416	·193 ·127	·32	·52	·053 ·113	·166	2·04 1·34	3·38
	670 480	1150	1024 1025	35·3 27·2	62·5	7·1 6·72	13·82	14·3 13·2	27·5	·82 ·531	1·351	·58 ·372	·952	1·63 1·15	2·78	·536 ·504	1 04	·234 ·252	·486	·302 ·152	·454	·578	·131 ·094	·225	2·01 3 07	5·08

* D. and N. = Day and Night.

was retained all night in a normal manner without causing diarrhœa. No mucus had been found in the fæces from November till March when ox-gall was administered; in the course of a week a quantity of grape-skin membranes and mucus were discharged. The mucus, &c., was measured daily by washing the fæces through a sieve; a progressive diminution was found in the course of from six to eight weeks with a great improvement in health.

Roger[15] demonstrated that bile exercises a solvent action on the colic mucus which has the effect of preventing the adhesion of coagulated mucus that occurs in membranous colitis. He was able to produce adherent and coagulated mucus in animals by irritating the bowel and diverting the current of bile. Hence the alleged successful treatment of membranous colitis by administering ox-gall by rectal injection and by the mouth. The former device may cause considerable pain and irritation; it is said, however, to be more efficacious than the latter.

CASE E.—The conspicuous feature of this case was the extreme degree of atony both of the abdominal muscles and the colon. The bowels had not been opened without aperients for 25 years. By using a quilted shot-bag so as to cause an even distribution of weight over the abdomen while the patient was awake and afterwards providing her with a Glénard's belt I was astonished to find that the abdominal muscles recovered their tone and finally that the colon contracted when it was massaged. No difficulty was found in obtaining a daily action of the bowels with small oil enemata administered at night.

CASE G.—There were enteroptosis, slight gastroptosis, a contracted transverse and descending colon, constipation, and a fæcal tumour of the size of a large orange in the splenic angle of the colon which had been notified by a physician during the previous year. Appropriate treatment combined with wearing a belt resulted in an extraordinary improvement in this case. Her mother wrote that her condition had been thought to be hopeless. I append notes here of some interesting cases.

CASE 1.—A man, aged 26 years, who had been treated for some six or seven years for neurasthenia, constipation, &c. The patient was emaciated, with bent shoulders and a sallow, unhealthy complexion. Crepitation and obscure resistance were found over the splenic angle of the colon. The descending colon was contracted to the size of a lead pencil. A Glénard's belt removed the stooping and increased the strength of the abdominal muscles. I saw this patient later, after clearing out a quantity of retained fæces with oil enemata; there was a sharp attack of localised peritonitis over the splenic angle of the colon. Two days later there was a hardness felt under the inner third of Poupart's ligament. On the following day there was a marked improvement that was associated with a disappearance of the swelling under Poupart's ligament. There was a history of a serious illness while the patient was at school caused by a lumbar abscess presenting in the groin. I feel convinced that there was an old sinus connected with the colon in this case.

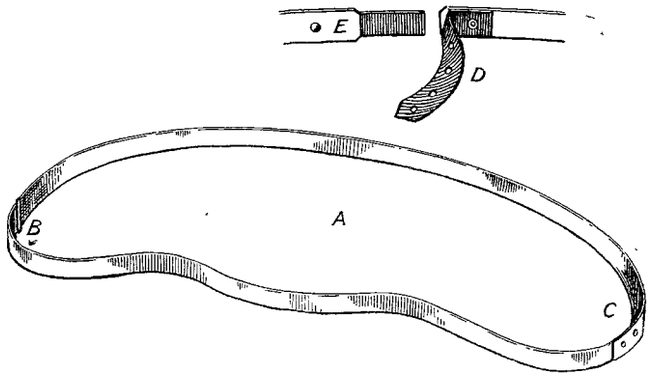
CASE 2.—A woman, aged 33 years, with a history of neurasthenia, a low fatigue point, headaches, and frequent illnesses for some ten years. The bowels acted irregularly. There was a spasm of the descending colon with an extreme condition of gastroptosis, the stomach falling below the umbilicus; it could be easily replaced by firm pressure over the pubes. Glénard's belt was ineffective in this case; the patient devised a rigid iron support worn over a low corset that was perfectly satisfactory (see Fig. 1). There was a great improvement in health, the chest expanded 3 or 4 inches, and the characteristic stooping was removed. One of the advantages of the rigid support was that it did not exercise any pressure over the hips.

CASE 3.—A man, aged 36 years, had been vaguely ill with neurasthenia, &c., for more than ten years; he had had a bad breakdown two years previously and had not had a natural opening of the bowels for four or five years. He was in the habit of taking cascara every four days. There was contraction of the transverse and descending colons, the cæcum and ascending colon being empty. It was clear, after using oil enemata and charcoal, that fæces collected in the splenic angle of the colon.

[15] An account of this work with records of cases is found in Pathogénie et Traitement de la Colite Muco-membraneuse by Nepper-Maloine, Paris, 1906.

CASE 4.—A woman, aged 35 years, had complained of vague disorders, tiredness, headaches, indigestion, &c., for some years, for which she had not been able to obtain relief. The bowels were said to be regular. On giving charcoal the fæces were found to be black for five days, though nothing but the usual contraction could be felt; oil enemata cleared

FIG. 1.



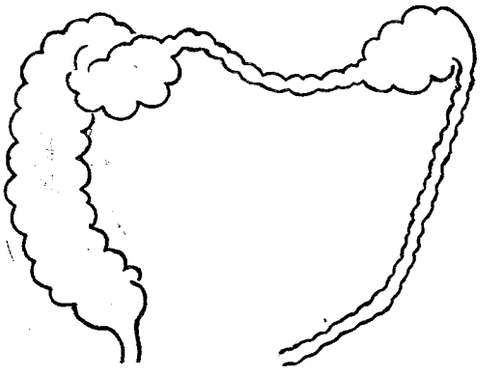
Rigid steel band worn over a low corset or belt for gastroptosis. A, Convexity to be varied with the needs of the individual. B, Hinge. C, Fastening, that is shown above. E, Tongue of metal which fits into a groove behind D, a strap. (Made by Montague, Bond-street, London, W.)

out a quantity of fæces, and in the course of a week it was found that the charcoal passed through normally in 24 hours.

Glénard first described these conditions[16] (see Fig. 2). If his experience of 25 years could be summed up in a few words it would be that if these patients are properly fed, provided with a belt, and purged, they will recover.

Under normal conditions the space between the abdominal wall and the lumbar curve is insignificant; the elastic muscles, aided by the great omentum, amply suffice to maintain the viscera well above the ledge provided by the lumbar

FIG. 2.



Chronic spasm of the colon (after Glénard). Showing the contracted transverse and descending colons and the splenic pouch referred to in the text.

curve. So soon, however, as the muscles weaken there is traction on the diaphragm which can only be relieved by flexion of the trunk. Riva-Rocci has shown that even slight irritation of the diaphragm alone is sufficient to cause the most uncomfortable neurasthenic sensations. The relief of these sensations by flexion increases the visceroptosis by depriving the viscera of the support of the lumbar curve, thus throwing still more weight on the abdominal muscles. A most striking demonstration of the unsuspected force exercised by the weight of the viscera can be obtained by standing behind a patient and attempting to replace them by pressure with both hands immediately above the pubes. This experiment suffices to make one realise the absolute necessity for mechanical support.

The belt secures (1) pressure over the pubes which maintains the viscera above the lumbar curve, relieves the strain on the back muscles and the mechanical interference with respiration, both resulting from moving the centre of gravity forwards in stooping to relieve the traction on the diaphragm; (2) the low blood pressure from splanchnic stasis is relieved

[16] An admirable account of these conditions is to be found in the works of Monteuis—"Les Deséquilibres du Ventre et Abdominales Méconnues," Baillière et Fils, Paris.

by its pressure; (3) the muscles recover their tone when relieved from the overwhelming weight of the viscera; and (4) the traction on the hepatic and splenic attachments of the colon is relieved. This traction often causes most persistent pain and inconvenience.

It is important to bear in mind the value of saline purgatives in these cases; Glénard states that he has seen nothing but good effects by their use "for indefinite periods." Provided that one or two satisfactory evacuations are obtained in the morning there can be no question that salines are of the greatest value in these conditions. The effects produced cannot be accounted for by their purgative action alone; in my own case there was a most striking and decided improvement in the sensations of fatigue, &c.

I have no hesitation in attributing these conditions to the effects of the cumulative action of the toxins produced by cold, fatigue, and auto-intoxication. The conspicuous analytical features are: (1) diminished velocity of the traffic of the urinary ingredients shown by the $\frac{\text{day}}{\text{night}}$ quotient; (2) urea and other constituents are insufficient, that is to say, they do not correspond to the ration; (3) there may be evidence of chlorine storage; and (4) there are variations, (*a*) in the proportions of Mg and Ca phosphates, and (*b*) the earthy and alkaline phosphates. The underlying idea is that the attacks of the toxins on the protoplasm are permanently expressed *inter alia* by intracellular deficiencies in phosphorus and the earthy salts. The faulty function of this deficient protoplasm is most evident in the low fatigue point and a tendency to produce fatty acids. If it is true that a low loss of weight per hour at night indicates a formation of glycogen from fat, and further that this result can be determined by administering calcium, this measurement will form a valuable indicator of a type of cellular activity or of a "state of matter." Obesity from this point of view would be the result of a diminished power of transforming fat into glycogen during the resting hours associated with an excessive carbon ration. This excessive ration with fat storage occurs in hybernating animals in the autumn, while toxæmia from cold is increasing. If one of the differences between the end of a day's work and the beginning is that more glycogen is available for muscular work after the resting hours, there would be a plausible explanation of the dietetic habits of the populations that are accustomed to do several hours' work with a very small breakfast. Whatever explanation is adopted, the fact remains that cases such as I have described are undoubtedly better when their starch ration is limited to the amount they can poltophagise. Treatment consists in the presentation of the deficient protoplasmic elements as a daily ration while the patient is placed under as perfect conditions as possible. It is essential to realise that it is necessary for the patient to have a balance of energy available for repair at the end of the day. Mental or physical work carried up to, or worst still beyond, the fatigue point, exposure to cold, the ingestion of insufficient or unsuitable food, a sufficient degree of intestinal auto-intoxication, would either of them suffice to postpone recovery indefinitely, at the same time perpetuating or aggravating their analytical peculiarities.

When it is remembered what striking effects are produced on the type of cellular activity by the modification of the concentration of saline solutions one asks oneself whether spontaneous dechlorinations such as I have described in my first paper would not suffice to produce the nuclear anarchy of malignant disease when local conditions are favourable.

Cases such as I have described must be very common—they all occurred in the course of a year in a small general practice.

The breakdown in my own case was clearly the result of overwork and anxiety during and after the re-mineralising process. I should like to be able to prove that it was mainly due to interference with the $\frac{\text{CaMg}}{\text{NaK}}$ balance first by having an increased ration of Ca and Mg for six months and afterwards the large ration of vegetable salts for the four months immediately preceding the illness. The policy of concentrating treatment and attention on the mental symptoms in these cases produces a condition of either futile exasperation or despair—states of mind which are equally prejudicial to recovery. I am convinced that it is essential that these patients should be made to understand that they are not suffering from "nerves" but from a serious condition of vicious metabolism that demands their intelligent coöperation for a long period of time, and that unless this is done they will not recover. I have seen cases where relations, friends and medical attendants appear to combine to produce conditions that render recovery absolutely impossible.

The question whether or not the absence of sufficient exogenous uric acid in the urine shows that it is being retained in the body has some light thrown on it in these conditions. In Case A, when there was an intake of 200 grammes of cooked meat (No. 1), there were only 14 grammes of urea and 0·53 gramme of uric acid, whereas in No. 14, with 180 grammes, there were respectively 18 and 0·65 gramme.

In Case B a striking association is noticed in the increased velocity of the traffic of uric acid and increased proportion of magnesium over calcium phosphate in the urine. I had the advantage of a consultation in Vienna with Professor von Noorden about a case that presented analytical peculiarities similar to my own. Uric acid retention was diagnosed and treated in the usual way. This patient had come over at the end of January from Cape Colony—that is to say, from midsummer to midwinter. During the time that the analyses were being made he was taking long fatiguing walks of over three hours in bitterly cold weather. I am unable to say whether this proceeding favours uric acid retention, but there can be no question that in such a case it diminishes the velocity of the traffic of the urinary solids.

To recapitulate, the first step in the diagnosis of these cases is to find whether or not there is coprostasis by using charcoal tablets (six morning and evening), whether there is mucous colitis present by means of ox-gall for at least a week, carefully examining the colon and fæces, and, finally, supplying a belt when necessary. The next step is to give a weighed ration and make analyses for at least four days. To repeat the analyses for a similar period with the same ration combined with the re-mineralising process.

The most important application of these principles is in the correction of metabolic errors at their inception. I well remember when consulting Dr. Haig some 12 years ago that, in addition to my "gouty" symptoms, I had noticed that I was passing more urine during the night than in the day time. I was unfortunate enough to treat this condition for some years by means of phosphorus starvation and excessive exercise. Harmful as I am convinced that Haig's diet wrongly applied may be, it is, comparatively speaking, harmless when it is compared to the careless application of the principle of Chittenden's economical nutrition. Two points require explanation and attention in Chittenden's experiments: first, that the nitrogen ration varied between 0·09 gramme per kilogramme in his own case and 0·17 gramme per kilogramme in the case of W. L. Anderson. The second point is the enormous percentage of catastrophes that resulted from his experiments: (1) physically unfit at the end of 20 days of economical nutrition; (2) cardiac irritability in 47 days; (3) acute tuberculosis in 26 days; and (4) acute melancholia in 106 days. I know that physiologists tell us that they have nothing to do with pathological conditions, yet the fact that these conditions arose in a body of men who are above the average when compared with a similar number in the civil population necessitates further explanation before these principles are proposed for extensive application. The art of adaptation necessarily deals with all the factors of environment; the ration therefore requires to be adjusted skilfully and scientifically not only to climate and work, but to the "state of matter" of the individual.

It is undeniable that diets such as those of Haig and Chittenden have their uses under suitable circumstances, but unless these conditions are defined they are often used for unsuitable cases. Prolonged personal experience has convinced me that it is possible to inflict irreparable damage to the tissues by persisting in the use of either unsuitable or inadequate dietaries. Above all, it is necessary to remember that their evil effects may take years to declare themselves, without providing any recognisable subjective indications during the process.

Bio-technics, or the art of adjusting individuals with their environment, consists in those modifications of the ration, of work, rest, climate, &c., necessary to attain and maintain the optimum chemical and physical equilibrium. There would appear to be a danger of forgetting that this art, which has

been practised empirically with varying success since the time of Hippocrates, even exists. The recent revolution, however, in our conceptions of the dynamics of living matter, combined with the numerical records of the physical changes associated with the successful practice of our art, cannot fail to provide us with the impetus necessary to attain scientific control of life through the harmonious adjustment of living tissues to their environment.

Pallanza, Italy.

THE INFANTILE TYPES OF THE TEMPORAL BONE AND THEIR SURGICAL IMPORTANCE.

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The Infantile Types.

I APPLY the term "infantile" to those bones which retain throughout life the characteristics of the outer antral wall and mastoid mass as seen in infancy. (Fig. 1.) On making a lateral vertical section through the antrum and mastoid mass in infancy it will be seen that the outer wall of the antrum is composed of two layers—a thin outer layer of compact bone, and an inner layer of fine cells. These cells are formed before birth; therefore I call them the "fœtal cells" to distinguish them from any which may form in later life, and from which they can be differentiated always by their fineness and inward direction. The mastoid mass is, as a rule, *diploëtic*, but it may be formed of *dense* bone. If the mass is diploëtic, a thin layer of compact bone, which can be easily demonstrated by scraping away the diploë, separates it from the antral cavity. There are, therefore, two types in infancy: (1) one in which the mastoid mass is diploëtic; and (2) one in which the mastoid mass is dense. Each type may persist all through life, but of course on an exaggerated scale.

FIG. 1.

Right temporal bone of an infant.

1. *The diploëtic form in the adult.*—In this type the thin outer compact layer of the outer antral wall has increased in thickness from the periosteal side and is of extreme density; the inner layer of "fœtal cells" is still seen; the mastoid mass is entirely diploëtic, and the separating layer between the diploë and the cavity of the antrum is much increased in thickness. (Fig. 2.) Whenever the mastoid process is entirely diploëtic the outer aural wall is always formed of dense bone. This type is seen in about 20 per cent. of all bones, and it can be seen at all ages; it is as common in females as in males, and I think it is always symmetrical, but on this point I wish to make further investigations.

2. *The dense form in the adult.*—In this type the dense mastoid mass persists all through life, but the condition of the outer antral wall remains the same as in the diploëtic type, the outer layer being very much increased in thickness and of extreme density, while the inner layer of "fœtal cells" is still seen. (Fig. 3.) This form is only seen in about 1 or 2 per cent. of all bones.

Both types are remarkable in the absence or scarcity of cells in other parts of the bone than the mastoid region. There is no external sign to show when these types are present, and the statement made by Kanasugi in his book "Contributions to the Topographical Surgical Anatomy of the Mastoid Region" that "in general small short processes are diploëtic and large ones pneumatic" cannot be relied on. The outer antral wall is often of great thickness as well as density in these infantile types. The greatest depth of the antrum from the surface is seen in them: it may measure three-quarters of an inch (19 mm.). A forward lateral sinus is usual and is found much more frequently and to a much greater extent than in the cellular types. The sinus often comes well forward below the level of the antrum and may reach the posterior meatal wall, or it may even dip in between the cavity of the antrum and the surface. The antrum may be large or small; if large, the posterior wall may be of extreme thinness and translucency, and may have the cerebellum or lateral sinus, or both, lying against it. In some specimens the posterior antral wall is pushed in by the cerebellum, thus narrowing the antral cavity from before backwards.

As in all types the antrum may be highly placed, or the middle fossa may dip down either between the antral cavity and the surface, or external to the superior semicircular canal, causing a low flat antrum. In one bone the descending part of the facial nerve curves inwards before emerging at the stylo-mastoid foramen.

I wish to say that a dense outer antral wall does not always mean that cells are not present in the mastoid. For the outer antral wall may retain this infantile form and a few cells may be present along the squamo-mastoid suture, thus closely resembling the pure infantile type; or cells may be well formed in the upper part of the mastoid or throughout the process; or a narrow track may pass through the upper mastoid to large cells in the lower or projecting part of the process. A rare condition is for a dense outer antral wall to be associated with a narrow tortuous tract of cells with very dense walls running through the mastoid. I may also say that if cells, apart from the "fœtal cell," are present in the outer antral wall they are also present to a greater or less degree in the mastoid.

Surgical Importance.

The surgical importance is the same in both forms and may be considered under two heads: (1) Influence in cases of suppuration in the antrum; and (2) influence on operations for suppuration in the antrum and its sequelæ.

1. *Influence on suppuration.*—It is obvious that an acute suppuration in the antrum may exist without any signs behind the ear, as it is impossible for pus to penetrate the outer antral wall or reach the mastoid process, and that there is a great liability for further serious extension, especially to the posterior fossa if the posterior antral wall is very thin.

If intracranial or labyrinthine infection does not occur in acute suppuration there is a great chance of the suppuration becoming chronic; the lining membrane of the antrum undergoes destruction and degeneration, or some local destruction of part of the bony walls or ossicles takes place and causes a chronic discharge from the middle ear tract.

The importance of the "fœtal cells" lining the outer antral wall in connexion with suppuration has never received sufficient attention, due probably to the fact that they are removed during operation without being examined carefully. They must certainly cause deficient drainage and be liable to caries; partial destruction of them can be seen in some bones in which chronic suppuration has occurred.

There is no doubt that the infantile types are found most