An Investigation
into
the Medicinal Property
of
the Water-Cress
which enjoys a popular reputation
as a remedy against Rheumatism,
Gout and Rheiny

Preliminary Remarks.

In August 1895, Mr. W. S., aged 69,
consulted me for a painful
affection of his right knee. He
came from a gouty stock, and
had had several attacks which
had been called gout. His
urine was scanty, very acid,
and deposited urates copiously.
On examination, it showed no
dsigns of albumen (Heller's test).
The knee was not markedly
deswollen, but was rather tender.
No other joints were affected.
I declare that this Thesis is entirely my own composition.
Edinburgh 30th April 1898
H. Aylmer Dunat M.B.
The patient was advised to diet himself strictly, to avoid altogether meats, soups, fish, eggs, tea, coffee, cocoa, and wines or spirits, and to take but a small allowance of bread or butter. To eat plentifully vegetables, fruit and toast. To drink milk in abundance. Also to take as much exercise as the condition of his knee would allow. Medically, he was ordered fifteen grains of baker's of soda four times a day. By this treatment it was hoped to diminish the protein metabolism of the patient to a minimum, and so, to relieve to a certain extent, the strain upon the circulation and upon the kidney, giving the latter an opportunity to eliminate the arrears of effete material which had accumulated in the system. Secondly, to hasten that elimination by means of the baker's of soda.
and the alkaline elements of
the vegetable dietary. This treatment
as was to be expected, was eminently
successful, the patient being seen
a few days later, in his usual
health, walking about the town
and attending to his affairs.

About three weeks after this
illness, Mr. N.R.S. still more or less
observing the same diet, noticed
that whenever he ate copiously
of watercress, he felt much better,
his urine diminishing in acidity,
or even becoming alkaline.
In proof of this he showed me
slips of litmus paper which he
had used to test the urine before
and after a meal of watercress
and bread and butter. There was no
doubt that his contention was
correct. Of course, we know that
vegetable diets in general
tend to produce alkalinity of
the urine, and the patient was
eating copiously of vegetable food.
and hardly of any animal matter. Still the changes in the reaction of the urine were so marked in connection with the eating of watercress, that I was impressed.

For, if we had in such a common and easily cultivated plant as the watercress, an agent by which we could alkalinate the urine, and perhaps the blood, we would possess an alternative to turn to when we wished to help the elimination of uric acid, and when, as sometimes happens, bicarbonate of soda upsets the stomach, or produces an intolerable amount of giddiness or buzzing in the ears.

In connection with the likelihood of the watercress being a possible remedy against gout or rheumatism, such like diseases of cold and damp climate, I remembered the reasoning which Dr. MacLagan tells us in his book on Rheumatism.
led him to seek in the willow, for a remedy against that disease. He says that remedies often to be provided by nature in close proximity with the diseases which they have the power to combat. He instances the bruichon tree as an indigenous plant of South America where the malarial poison is so prevalent.

This theory, perhaps in a broader sense, more poetical than scientific, has lately been brought very forcibly to our notice by the work of Prof. Fraser in Edinburgh, of J. Salmolet in the French colonies of Indo-China, that dill in France. For, a closer proximity of a poison and its antidote could not be imagined than that of the secretions of two glands of the same animal, or again, of the secretion of a gland and of the serum of the same creature.
As the willow flourishes on the banks of slow flowing rivers, and in marshes, so does the watercress thrive wherever it can find shallow water on a mud bottom, provided the temperature of the water itself be not too low and the water itself not stagnant.

Besides, the common watercress enjoys a worldwide popular reputation as a medicinal agent. And unanimity of a nation, much more of a race in matters of diet, is generally based on experience of ages, that is it, even though only a remnant, still something of truth which it may repay us to seek for.

The Romans et al. used the watercress as a medicinal agent. In England it is credited with anti-pneumatie, anti-gouty & anti-scrobutic properties. In France it is used as an anti-scrobutic, & as a stimulant.
to appetite and digestion in cases of general debility, and in cases of commencing Phthisis, also as a diuretic in vesical catarrhs. In Germany it is employed similarly and even in South America, in the Andes, Bertero found the watercress used in the same way.

In France the street cry of itinerant watercress vendors used to be: “La Sante du Corps” — the health of the body.
Botany and Chemistry

My first care was to seek for literature on the subject. This is De l'nn's Bibliotheca Therapeutica. It mentions but one work, that of Dr. Chatin, Professor of Botany at the School of Pharmacy in Paris. This is a small work dealing principally with the Botany, the cultivation, and the Chemistry of the watercress. Lastly, the author enumerates its supposed medicinal properties.

The watercress belongs to the Nat. Ord. of the Cruciferæ, and to the genus Nasturtium. It is known in France under the name of Nasturtium Officinale. The name Cress is derived from the Latin Crescere, to grow, and alludes to the rapid growth of the plant. This name, however,

has been applied to a variety of plants which have no generic resemblance to the nasturtium officinale, except that they all have in common the same sharp pungent taste. Such are the Garden Cress (Eupidiun sativum), the Bitter Cress (Cardamine amara), the Mauritius Cress (Eupiante album), the Field Cress (Cardamine pratensis) the Ribwort (Cochlearia corona) & many others.

The cultivation of the Water Cress was first carried out systematically in Germany, in the neighbourhood of Erfurt and Dresden. M. Gardon an officer of Napoleon's armies, who had seen the German “Cresseris” during the wars, established similar cultivations in the neighbourhood of Paris in 1811, to supply the markets of that city where all classes eat largely of the vegetable.
The chemical composition of different specimens of the walnuts depends on several conditions:

I. The absence or presence of cultivation, and if present, the quantity of manure used. The richer the soil in Nitrogenous matter + Sulphur, the more the plant will contain of the oil which gives the well known pungent flavour.

II. The season at which the plant is gathered. That gathered in summer being hardly richer in extractive matter than that procured in the winter, although the growth of the plant is not so active, the loss of water by desiccation is not so great.

III. The stage of the life history of the plant. The flowering plants yield about 30% more of the extract from the compressed nut juice than the younger plants, taking about 25% more of the oil.
IV. The exposure of the growing plant to the sun has also a marked influence on the amount of the oil.

V. The nature of the water in which the cress has been grown. Cress grown in hard water will contain about 0.016 per cent of iodine, 0.016 of the commercial article, but if the water be rich in iodine, as much as 0.03 gm may be found in the same quantity of the leaf and stalk.

So with Iron. Ordinary cress contains 0.1 to 0.2 per cent of that metal in the ash, whereas cress grown in ferruginous spring water shows as much iron as 2½ or 3 per cent of the ash. (1) Further it has been observed that richness in iodine bears a proportion to richness in iron. (2)

The preparation of Nastr. offici.

With which the present experiment

(1) A. Bhatin loc. cit. p. 107, 109
(2) A. Chab. loc. cit. p. 107.
was made, was gathered in the colony of Natal, where I am in practice and where I first worked at this subject. The plant used was not cultivated, it was gathered in the month of January which is about the height of our summer. The stream in which the plant grew was fully exposed to the sun. The plant was commencing to flower. The water of the stream was not analysed, but it was observed that it deposited no iron near its source, and that it was clear, sparkling, and sweet.

The main constituent of bress is water. Out of 100 parts by weight of the green plant, can be expressed as a rule, 70 parts of juice leaving 30 parts of residue or marc. Of the Natal Specimen, it yielded, with an ordinary hand press, about 3\text{\textfrac{1}{8}} of juice, leaving a quantity of marc the size of a small hen's egg
The note of the weight of this has been unfortunately misplaced. In the marc remain the bulk of the iron and of the phosphates of the plant which are mostly insoluble, whereas in the juice we find the greater part of the sulphur and azotized oils, of the iodine and of the bitter principles of the plant. Ales, of course, of the soluble salts.

To conduct this experiment, the juice was the preparation selected because it was the one which most nearly approached the natural product most likely to be used in popular practice. And a tincture would have contained such a proportion of alcohol in the large doses likely to be necessary, that the result on the metabolism would have been observed. And any preparation requiring the application of heat such as an infusion, a decoction, or an extract would cause the ba
of the essential oil wholly or in part. Therefore, in the further consideration of the Chemical aspects of the plant it will not be necessary to discuss the insoluble Constituents which are retained in the marc.

Of the soluble elements found in the juice, perhaps the most important is the essential oil. So it will be noticed that all the plants which possess, or are supposed to possess, antiseptic and tonic properties, contain an oil akin or similar to the essential oil of the Watercress. Such are some Capparidaceae, amongst which is the Watercress (Jardou Xasturtium).

To understand the composition of the oil of Xasturtium officinale it is best to commence with a study of one with a chemical similarity to it, viz: Parlie oil which is the Sulphide of Allyl and whose Composition

J. Druickly, The Vegetable Kingdom, Lond. 1846. p. 367 & 368.
is expressed by the formula $C_3H_7S$.

If we replace one of the radicals, Propenyl ($C_3H_5$) by one of Cyanogen, we obtain the essential oil of Mustard $C_3H_5S-CN$, which is the Sulphoxyanate of Acetyl and is formed from the Iodoacetate of Potash by the ferment contained in the seed. (2) Then again, the oil found in the Cruciferae generally, and which is found largely in the Common Scurvy grass (Cochlearia officinalis) is the volatile oil of Mustard in which one atom of the Propenyl radicle, $C_3H_5$, has been replaced by one atom of the Butyl radicle $C_4H_9$. The oil contained in the Nasturtium Officinale is similar to the last named.

(4) Thus forming Sulphoxyanate of Butyl $C_4H_9S-CN$. 
but is less strong according to Husemann. C. Chatin, however, says that watercress contains the essential oils both of Allium sativum and of Cruciferae, therefore holding more sulphur in its composition. Jodine occurs in very appreciable quantities in watercress. It was discovered there by the Chemist Müller (quoted by Ridsley in his "Vegetable Riptoni" p. 353). The older writers ascribe great importance to this constituent element of their watercress, working, as they did, at a time when Jodine was credited with almost miraculous properties against, not only Syphilis, but also against leprosy and Tuberculosis. Especially so, at that time, Jodine was given in very small doses. Now that we

<table>
<thead>
<tr>
<th>Article</th>
<th>Quantity</th>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4</th>
</tr>
</thead>
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<tr>
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<td>100.00</td>
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<td>21.16</td>
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<td>1.83</td>
<td>1.83</td>
<td>1.83</td>
</tr>
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</table>

The table lists the quantities of the different articles.
The amount of the ash is shown as follows:

<table>
<thead>
<tr>
<th>Soluble Salts</th>
<th>IRIS</th>
<th>Flower</th>
</tr>
</thead>
<tbody>
<tr>
<td>56.3</td>
<td>59.07</td>
<td></td>
</tr>
</tbody>
</table>

It takes 2.50 parts by weight of the expressed juice to produce one part by weight of the ash, and the flowering plant is 50% rich in ash than the green plant.

The Natal sample of juice by experiment was kindly analyzed for me by W. Irwin Macadam Esq. to whom I am happy to acknowledge my indebtedness. Mr. Macadam reports as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids</td>
<td>24.091</td>
</tr>
<tr>
<td>Organic solids</td>
<td>14.994</td>
</tr>
<tr>
<td>Inorganic solids</td>
<td>9.047</td>
</tr>
<tr>
<td>Phosphate anhydroxide</td>
<td>0.429</td>
</tr>
<tr>
<td>Organic acid = Tartaric acid</td>
<td>0.825</td>
</tr>
<tr>
<td>Potassium oxide</td>
<td>3.827</td>
</tr>
<tr>
<td>Sodium oxide</td>
<td>1.635</td>
</tr>
<tr>
<td>Calcium oxide</td>
<td>0.353</td>
</tr>
<tr>
<td>Magnesium oxide</td>
<td>0.709</td>
</tr>
</tbody>
</table>
Probable Physiological Action

A study of the chemical composition of the plant shows that it might act in one of two ways:

I. The Potash & Soda salts would have the action usually ascribed to Alkalis on the metabolism of the body, & on the excretion of already existing stores of Uric Acid in the body.

II. The sulphocyanobutyl and iodide of Allyl might have some influence in stimulating the hepatic cells in their function of completing the products of Nitrogenous Metabolism, or might form with Uric Acid, or with some producer of Uric Acid, some more soluble compound which would therefore be more easily excreted in the urine.

Taking the first alternative

I. Action through Alkaline Salts.

Practically all vegetables tend to act in this way on account of the salts
of the vegetable acids which they contain. These, in the blood, are converted into the carbonates of the corresponding base. They are supposed to increase the alkalinity of the blood, and are therefore supposed to make that fluid a more suitable medium for the dissolution of the uric acid which is being formed in the system, which has been previously deposited in the tissues. This is the generally accepted version of the action of alkalies in promoting the excretion of uric acid.

But Bing in his "Lectures on Phaenology," says that as the decomposition and oxidation of albumen, fat, & other organic substances are promoted by, or even depend on, the media being alkaline, so, he believes to imply, the continued medicinal action of alkalies, as in the constant use of mineral waters, will tend to increase the metabolism of the body. This has

(i) loc. cit. Vol II. p. 20.
been confirmed by a series of experiments on men, with Carbonate and Citrate of Sodium by Haddeman (quoted by Bing). In that case, after the exhibition of alkaline salts, we would expect, in the products of the final metabolism of protein matter, to find signs of that increased metabolism. The experiment which I conducted to which I am about to describe does not bear this out. Nor does it bear out the theory that alkaline salts wash out of the body the pent up stores of uric acid therein contained. In this position, I do not stand alone. Von Noorden says: "Of experiments free of fallacy, on the influence of alkalies on the excretion of uric acid, few exist" (1).

of uric acid daily, and when he added an alkaline vegetable salt to his drink, the amount immediately increased to 1.478 grammes, then gradually sank to the normal 1.1891 grammes. (1) Haig, in this country, has laid great stress on the influence of the alkaline salts on the excretion of uric acid. (2) He has made many experiments on himself and many observations on patients, all of which, he claims, show that these remedies act simply as solvents to uric acid, (3) and that they do not increase the nitrogenous metabolism of the body, simply increasing the alkalinity of the blood, thence favouring the output of the previous stores of uric acid, and that this action therefore would be most marked when the blood is

(1) O. Leder. Einfluss der Kohlen-Nahrungs auf die N. Ausscheidung des Menschen. Centralblatt f. m. Wt. 1888
(2) A. Haig. Uric acid as a factor in Pusulation of Ghee. 4th Ed. London 1897. p. 34. (3) A. Haig. l.c. p. 34
in a condition of minimum alkalinity. But Dr. Haig does not tell us that he has, in his cases, actually tested the alkalinity of the blood, and in a recent number of the British Medical Journal, Dr. Luff publishes his observations of the alkalinity of the blood in a case of subacute gout. The conclusions arrived at as a result of his work are:

@) the alkalinity of the blood of gout is not necessarily diminished during an attack. (b) no constant relationship exists between the alkalinity of the blood and the acidity of the urine during an attack of gout. It will be interesting to watch if Dr. Luff will make further observations on this subject, or if other workers will confirm his results to which

A P. Luff. The alkalinity of the blood in Gout. British Medical Journal. Apr. 23rd. 1898
are not in accordance with usually accepted theories. In France it is held by Bouchard (Maladies par paludissement du la Fuite du 13. 272. Quoted by Deulafosy) that the excess of these acids (oxalic and lactic) in the blood is one of the conditions which favors the precipitation of uric acid, either as uric acid or as urate "into the tissue."

Hermann found that the abundant use of vegetable salts was without influence on the excretion of uric acid. Salkowski (3) showed a result in direct contradiction to all the preceding.

For he actually got a diminution of uric acid excretion during the use of alkalies. During the preliminary period, he passed 0.8218 grammes of uric acid per diem. Then he took Acetate of Soda until he produced alkalinity of the urine, during which period he excreted 0.6923 grammes per diem. Then in an after period, he rebounded to his former excretion of 0.8229 grammes a day.

Von Jaksch made a series of observations with the Falkowski Ludwig method in a case of Diabetes and found the quantity of uric acid excreted per diem to be 0.94 to 1.4814 gpm, and that this excretion was not diminished by the administration of alkalies. What is unfair to draw conclusions from a case in which there is

[citation]

such an important disturbing element as a "disease of stuffchange" (1).

These experiments all have one important fallacy. To judge of the efficacy of a drug as an eliminator of such a complex product of metabolism as uric acid, it is evident that we should place the body changes of the subject experimented on under the keenest possible supervision. Any possible outside influence on the tissue changes should be, immediately before, and during the experiment, reduced to a minimum. For one thing, the

(1) It is interesting to note that both in France and Germany, words have been coined which describe that class of diseases depending on disturbance of metabolism. In France, they are called "Maladies dystrophiques," in Germany "Stoffwechselkrankheiten." The first might, with advantage, be naturalized in English as "dystrophic diseases," the phrase being explicit, or simpler than the corresponding Tegmenti polyvalente.

In America, Piller speaks of "Dystrophies."
the "reign of theInterior should be fixed. In this, it is evident that Barker's experiment failed, for he speaks of his "usual diet." Heig, who tells us that he is practically a vegetarian is still wider of the mark, for he introduces at each meal into his economy, a varying quantity of vegetable acid salts—we very substance which he is experimentally investigating significant and also a varying amount of protein substances, which, although vegetable, still have an effect on the excretion of nitrogen in its various combinations.

It is a significant fact that both investigators who obtained positive results especially state that they were not on a fixed diet. Hermann & Salkowski say nothing about the fixing of their diets. Therefore a critical study of what is already definitely known on the influence of alkalis on urea excretion could hardly help one in foreseeing the probable effect
of Nectarium on that function. All the more, that the experiments quoted were conducted with such large doses of the drugs chosen, or the plant contains such a small proportion of alkalies that we could hardly ascribe any marked effect of the Cress on metabolism, to its alkaline constituents.

Turning to the Second Alternative

II. Action through the oil contained in the Water Cress. This might, in the system, form with some of the Nitrogenous products of Metabolism, substances which are more soluble than uric acid, and which would therefore be more easily thrown out. Or the, this oil might have a direct effect by stimulating Metabolism, or increase the output of uric acid. Or again, it might inhibit Metabolism, to decrease the formation of push
Uri acid, and allow of part of these of the body to be eliminated.
A study of the effect of Salicylic acid would help us to understand this possible action of the essential oil of the watercress. Possibly this parallel is far fetched, for we have in another essential oil, the oil of wintergreen, obtained from the Gaultheria procumbens, which is Methyl-Salicylic Ether, an agent which, as might however be expected from its composition, produces symptoms similar to those caused by Salicylic acid and which is used by some in the treatment of rheumatism. The action of Salicylic acid on the excretion of Nitrogenous matter by the urine is two-fold:

2. W. Oster Principles and Practice of Medicine. Edin. Lond. 1897 p. 299
First it unites with glycocoll, probably in the liver, to form salicyluric acid in water according to the formula:

\[ C_7 H_6 O_3 + C_2 H_3 (N H_2) O_2 = C_9 H_7 NO_4 + H_2 O \]

This salicyluric acid is more soluble than uric acid, hence passes out more easily.

Secondly, large doses of salicylic acid (5 grammes) given daily to healthy human subjects decrease the total N. in the urine from 19.3 to 17.4 grammes per day. (E. Salome quoted by Bing)\(^1\). But at the same time, and this is unifying, the amount of uric acid excreted is markedly increased. In the case of two diabetic patients observed by P. Führbrüner, (also quoted by Bing)\(^1\), the administration of 5-10 grammes of salicylate of soda per day decreased the average daily excretion of urea from 45.3 to 32.8 grammes, and yet the uric acid was increased.

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\(^1\) L. Bing. loc. cit. vol II. p. 270.
to five times its normal amount. Bing goes on to say that "as yet it is not determined whether this arises from its formation in larger quantity or from the more rapid excretion of the acid already present in the body, or from its oxidation into urea being diminished."

The third explanation can hardly be accepted, for it is not natural to suppose that the stopping that of the oxidation of the Nitrogen, and the forming therewith a compound of less solubility than the natural Nitrogenous final product of metabolism, could give the relief expeneces after the administration of salicylic acid in rheumatic affections. The two first explanations seem to meet the needs of the case. If salicylic acid unites with glucurone, a precursor of uric acid, to form salicyluric acid, a more soluble compound than uric acid, then that effect...
Matter will be passed out more freely, and the store of uric acid will be rapidly diminished, hence the relief of rheumatic pain after the administration of salicylic acid. How much of the uric acid excreted is derived from the old stores of the body must remain doubtful. All the more that a consideration of the modus operandi of salicylic acid accounts to my mind for part at least of the increase. For Bieiz has shown (1) that sodium salicylate is converted by carbonic acid, at a high tension, into a powerful antizymotic agent which is probably salicylic acid. But salicylic acid besides its anti-depilary action, is a paralysing agent to protoplasm generally. It is easy to understand how it may even cause the death of protoplasm whose vitality has been diminished. These

(1) L. Bieiz. loc. cit. p. 265
conditions hold good in the case under consideration. For then
would be, around the parts af-
feated by the deposition of the
birefring, an increase of leucocytes,
either engaged in phagocytosis,
or at all events of lowered vitality:
the salicylic acid might easily
cause the death of some of these,
and the nuclei derived from
these dead leucocytes would
account for, at any rate, part
of the increase of uric acid in
the urine. This theory would
lie in accordance with the
opinion of Horbaczewski who
finds the nucleiin the source
of uric acid. The nuclei contain
or is Nuclein acid, which splits
up into Phosphoric acid + uric
acid + nuclein bases. If the
theory just put forth above be correct,

(i) C. A. Schäfer. Text-book of Physiology.
E. & London 1898. Vol. II. p. 879
we would expect to find in the urine, during the administration of salicylate, an increase of phosphates as well as an increase of uric acid. This point, so far as known, has not yet been worked out.

It was thought that if water-cress had any antirheumatic properties, this could only be due, as already explained, to an action of its essential oil akin to that of salicylic acid.

At all events, the first point to investigate was whether the plant did really possess the qualities popularly ascribed to it.

The literature on the subject of the water-cress, & on that of the action of alkalis, & of green vegetable generally, benigneantly and contra-dietory, it was felt that one crucial experiment would be more satisfactory than more literary research, or than a number of
trials on cases of rheumatic
sprit of scurvy. The experiment
would decide whether these trials
had been made.
The difficulties were immense.
The choice of a plan of experiment
was a serious matter, and the
invasion which it made on
my personal comfort & assump
tion was no trifle.
The Experiment.

I experimented on myself to as certain that all details would be faithfully carried out. For reasons already explained the expressed juice was the preparation selected. This juice was prepared in the same way as theucci of the British Pharma copeia. It is a brownish, slightly turbid liquid with an odour reminding one at the same time of that of watercress & that of artichoke. It has a not unpleasing taste when taken in small quantities, but is rather bitter when a large amount is swallowed, especially when undiluted.

Its subjective effects can be dismissed with a few words. It produces a sensation of warmth in the stomach, as
doubt due to the contained oil. It seemed to markedly increase the appetite, causing even the dry biscuits and meat pail of the diet to be enjoyed.

The subject, who generally enjoyed good health, was, at the time of the experiment, as well as could be expected. Although he comes from a gouty stock, he has never suffered from gout, or from any manifestation of the "Uric acid diathesis" he lives principally in the open air, on a fairly plain diet. Therefore it is not likely that the experiment could be observed by the elimination of any stale of uric acid pent up in the system.

The diet chosen was similar to one used in a series of experiments by D. H. Stohl, John Stockman [incomplete].

About 6 lbs of lean turkey steaks were cut into small bits, thoroughly mixed, then passed through a mincing machine. In that way was insured a thoroughly uniform meat supply. This was kept on ice, and the day's ration was accurately weighed out at noon daily. Butter and the other articles of the diet were also daily drawn from the one store purchased at the commencement of the experiment, and carefully weighed. Milk was procured daily from a dairy, & measured with equal precision. And so was the water for the tea. In that way the amount of fluid taken remained the same, and it would become apparent whether the drug could increase the liquids of the urine as well as the solids, or one without the other. On the 5th and 6th days however, whilst the drug was being
taken, it was found necessary, on account of its pungent taste, to dilute it with water (quantity noted). This, on the authority of Dr. Hooden, would have no effect on the excretion of uric acid.® Booking was required for only two of the articles of diet: the porridge & the rice. Thereby chance of error were diminished, and as it happened nothing went wrong. As salt was necessary for the oatmeal porridge, a saturated tol. was made, 1 of this one dessert spoonful was measured out daily. The daily amount of food taken was:

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat (taken in two meals)</td>
<td>120 gram</td>
</tr>
<tr>
<td>Biscuit</td>
<td>300 g</td>
</tr>
<tr>
<td>Butter</td>
<td>60 g</td>
</tr>
<tr>
<td>Oatmeal</td>
<td>60 g</td>
</tr>
<tr>
<td>Rice</td>
<td>40 g</td>
</tr>
<tr>
<td>Sugar</td>
<td>50 g</td>
</tr>
<tr>
<td>Milk</td>
<td>1000 cc</td>
</tr>
<tr>
<td>Clarat (taken at dinner)</td>
<td>250 cc</td>
</tr>
<tr>
<td>Tea, 4 tablels in two large cups of water</td>
<td></td>
</tr>
</tbody>
</table>

® B.V. Hooden, loc cit p. 55.
This diet was sufficient as regards solids, as shown by the weight not varying except as could be accounted for otherwise. But not enough water had been allowed, as seen by the diminution of the urinany water. And yet thirst was not suffered from.

The same amount of exercise was taken daily. This consisted in walking to the laboratory and back twice every day, and a walk of one hour and fifteen minutes in the afternoon before dinner. It was considered best to make exercise practically a constant, although it has been repeatedly shown that muscular work does not sensibly increase metabolism of protein, since Heck & Wolfleram contradicted the previously accepted opinions of Liebig.

As far as could be gauged also, the same amount of mental work was done daily.
The scheme of the experiment was to fix the diet, and to live so that the metabolism should keep at a certain level, and when that was attained, to take the drug for a couple of days. Then to allow the metabolism to return to its former level. Finally during one day to take large doses of alkalis to ascertain whether any increase in the excretion of uric acid was produced by salts of Soda and Potash.

The experiment which was commenced on the 15th. April lasted 10 days.

The first day can be left out of account as the urinary excretion would necessarily be influenced by the ordinary food of the day before. From the 16th. to the 19th. April, the diet was followed by the urinary excretion observed.

On the 20th. and 21st. of April, in addition to the diet 435 c.c. of the Queen's Mustard 1600 c.c. of water were
administered on the two days. On the 22nd no drug was taken, but in addition to the diet a quantity of water equal in volume to the bulk of the liquid fluid of the day before were swallowed.
On the 23rd April, 6 grammes of Bicarbonate of Potash, 6 grammes of Bicarbonate of Soda were taken in the same quantity as the day before.
On the 24th April, the 10th day of the experiment, the subject returned to the same diet as the first five days of the experiment.
It is convenient to give names to these different periods: we shall call the first period 16, 17, 18, 19 April the Intermediate period.
2nd  "  20th-21st. " the water then period
3rd  "  22nd " the Intermediate "
4th  "  23rd-24th. " the Alkaline."

The 24th April is bracketed with the 23rd because the effect of the alkali was still apparent on the 24th.
The subject, a moderate smoker, did not use any tobacco during the experiment, because it is held that tobacco "clears the blood of uric acid," and it is manifestly impossible to regulate the amount of the products of the combustion of tobacco which will be absorbed.

The effect of this diet on the body weight was watched almost daily. The Saturday-Sunday and Sunday days did not allow the weight to be recorded from the same machine on those days. The weights are therefore not mentioned on the 19th, 18th, and 24th of April.

The whole urine of the 24 hours was collected and mixed and measured. Before taking the quantity required for each estimation, the urine was stirred in the containing vessel.

Each estimation was done in duplicate, and whenever the...
the two results did not seem to be sufficiently approximate, a third observation was made.

The methods employed were for Acidity.

Reaction to blue and touluidine. Also, a decinormal solution of sodic hydrate was dropped into a measured quantity of urine (10 cc.) until 1 drop of phenol phthalain, used as an indicator, showed that the fluid had become alkaline. It is evident that this method is open to the objection that addition of the standard alkali neutralizes the acid phosphatic of urine until a point is reached when the action of the alkaline phosphates originally present in the urine, plus the action of the newly-formed alkaline phosphates, balance the action of the acid phosphates on the indicator. Then the addition of one drop
more of the standard alkaline solution turns the colour of the indicator. But that does not mean that all the acid phosphat in the urine have been neutralised by the alkali added. Therefore the degree of acidity, as measured by this process can never be a correct one. However the method is one, the practical value of which, if we understand its weak point, is undoubted. And furthermore, it is employed in most observations on the urine.

for Phosphate.

The total amount of phosphoric acid was found by treating a measured specimen of the urine (50 cc.) with acid solution of acetate of soda (5 cc.), heated almost to boiling point. On the first day of the alkaline period when the urine was markedly alkaline to litmus, an excess
of acetic acid was added. The hot fluid was titrated with a standard solution of nitrate of uranium, until a drop of the hot mixture would turn from a solution of ferrovanadate of potassium dropped on a porcelain slab.

for Chlorides.
The usual titration with standard solution of nitrate of silver in the presence of chromate of potash of 10 c.c. of urine, until the orange colour becomes evident.

This process was preferred to the process by ignition because the estimation of chlorides was not an important feature of the experiment, and because the silver process is certainly more convenient.

for Total Nitrogen.
The well known Kjeldahl’s method by which a measured specimen of urine (5 c.c.)
is oxidised by 25 cc. of sulphuric acid in the presence of a head of mercury at a high temperature and then distilling over free ammonia by liberating it with an excess of NaHCO₃ and K₂S into an excess of a decinormal solution of sulphuric acid, which afterwards titrated for the free acid left.

for Uric Acid.

The method of J. Hopkins, which depends on the fact that a saturated solution of chloride of ammonium is a medium in which urates cannot remain in solution. From this medium they can be filtered & subsequently decomposed by hydrochloric acid into uric acid & chlorides. A second process of filtration & washing frees the uric acid from the accompanying chlorides, the acid having been made soluble by the addition of a small
Quantity of Carbonate of Soda is titrated with a standard solution of Permanganate of Potash in the presence of the heat obtained by the mixture of sulphuric acid with water. The quantity of urine used for this analysis was always 100 cc.

The actual work is shown in the accompanying table. It is interesting to examine the different columns at first singly and then, as occasion demands in their relationship one to the other.

The weight during the first day of the experiment, $\frac{3}{4}$ lbs were lost. This was probably due to the insufficient amount of water allowed in the diet sheet. It is interesting to note that in the paper by Dunlop, Paton,
<table>
<thead>
<tr>
<th>DATE</th>
<th>BODY WEIGHT</th>
<th>DRUGS</th>
<th>QUANTITY</th>
<th>%</th>
<th>ACIDITY</th>
<th>PHOSPHATES</th>
<th>CHLORIDES</th>
<th>NITROGEN</th>
<th>URIC ACID</th>
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<td>5</td>
<td>11.2434 lb</td>
<td>none</td>
<td>17754.1</td>
<td>+</td>
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<td>4.014</td>
<td>1.705</td>
<td>2.983</td>
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<tr>
<td>6</td>
<td>11.18.2 lb</td>
<td>none</td>
<td>1235 - 1021</td>
<td>+</td>
<td>0.815</td>
<td>3.892</td>
<td>2.04</td>
<td>2.522</td>
<td>0.96</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>d0</td>
<td>1042 1021</td>
<td>+</td>
<td>0.852</td>
<td>3.676</td>
<td>2.53</td>
<td>3.137</td>
<td>0.857</td>
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<tr>
<td>8</td>
<td>-</td>
<td>d0</td>
<td>870 1076</td>
<td>+</td>
<td>0.466</td>
<td>4.056</td>
<td>3.14</td>
<td>2.739</td>
<td>0.943</td>
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<tr>
<td>9</td>
<td>11.18 2 lb</td>
<td>d0</td>
<td>900 1025</td>
<td>+</td>
<td>0.846</td>
<td>4.08</td>
<td>3.26</td>
<td>2.934</td>
<td>1.12</td>
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<tr>
<td>20</td>
<td>11st 20th</td>
<td>165 cc HCl</td>
<td>1280 1021</td>
<td>+</td>
<td>0.302</td>
<td>3.865</td>
<td>2.156</td>
<td>2.75</td>
<td>0.855</td>
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<tr>
<td>21</td>
<td>11st 2 1/2</td>
<td>water in 5 doses in the 24 hr</td>
<td>1500 1017</td>
<td>+</td>
<td>0.265</td>
<td>3.969</td>
<td>1.69</td>
<td>2.541</td>
<td>0.69</td>
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<tr>
<td>22</td>
<td>11st 2 1/4</td>
<td>570 cc of water in 5 doses</td>
<td>1375 1017</td>
<td>+</td>
<td>0.257</td>
<td>3.492</td>
<td>1.728</td>
<td>2.376</td>
<td>0.676</td>
</tr>
<tr>
<td>23</td>
<td>11st 2 1/2</td>
<td>water in 5 doses</td>
<td>1425 1020</td>
<td>+</td>
<td>0.897</td>
<td>1.382</td>
<td>1.696</td>
<td>2.417</td>
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<tr>
<td>4</td>
<td>-</td>
<td>d0</td>
<td>1300 1018</td>
<td>+</td>
<td>1.985</td>
<td>2.578</td>
<td>1.752</td>
<td>2.277</td>
<td>0.708</td>
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</tbody>
</table>
Stockman and Macadam already quoted, that we found in experiment A, that the amount of water was too small, and that there was a loss of weight in the first twelve hours, the weight after that remaining constant until diminished by severe exercise. In the present experiment, there was also from the insufficiency of water in the diet. Then the weight remained constant until the increase in fluid taken during the 2nd period, increased it by half a pound, at which it remained during the third period, falling again during the fourth or alkali period probably on account of the influence of the soda or alkali salts on the metabolism. It will be remembered in connection with this point that Dr. TANNER experienced a very serious loss in body weight
During his famous fast, when he attempted to do without water as well as without food, becoming seriously ill and recovering comparatively healthy, as well as weight when he drank water again. This chart will show the relation of body weight with water ingested per day.
Total Quantity and Specific Gravity of the Urine.

The day was counted from twelve midnight to twelve midnight, so that the urine passed on rising was collected with the urine for that day as also the urine passed at 12 midnight before going to bed. The last meal was taken at 7.30 pm. This arrangement seemed fair and convenient. The usual precautions were taken not to lose any water.

All the urine of the 24 hours was poured into one vessel, and the sp. gr. was taken immediately. Before removing measured portions for analysis, the whole was always stirred.

On the first day, the quantity passed and the sp. gr. were about as usual with the subject's normal condition. On the following day, the 1st of the Preliminary Period, it became evident that the allowance of water in the food was insufficient.
But with the fall in urinary liquid to 235 cc., there was no correspondence in the S. g. p. which remained the same. To account for this anomaly, we notice a slight decrease of 0.2 grammes in acidity, are of 3.4 grammes of chlorides, and one of 3.8 grammes of total N. On the other hand, the lactic acid has increased by 0.4 grammes, the phosphoric acid by 0.6 grammes.

On the following two days, the urinary secretion falls to a certain level and practically keeps to it, and there is a corresponding rise in the S. g. p., which also keeps at a level. The variations in the solids are also slight except in the case of the chlorides which have for some unaccountable reason increased by 2.2 grammes. During the 2nd or weekness period the urinary water increases by 380 cc. to 406 cc. on the days of this period, and the S. g. p. corresponds rigly.
lowered from 1025 to 1021 at this to 1027. The increase in the weight of the urine is more than accounted for by the extra quantity of fluid taken during that period. But as the tissue had been starved of water to a certain extent, a part of the extra fluid absorbed would naturally go to supply that want. Since we may conclude that the drug has a slight diuretic effect. This is all the more apparent if we compare the mean excretion of the preliminary period, 1012 C.E., with that of the waterless period, 1390 C.E. But it must be observed that this is truly an increase of water, the mean E.P. gr. having diminished from 1023 to 1019.

In the intermediate period, the urinary water falls by 125 C.E. also the same quantity of extra fluid is taken, thereby supporting the opinion that waterless does
Tend to increase urinary water. The urinary solids however do not change, the sp. gr. remaining the same, and yet all the urinary constituents which have been estimated are slightly decreased. Probably, however, some of the other urinary constituents which were not estimated had increased.

The alkalies administered on the first day of the T. C. or alkali period slightly increased the urinary water, but with this difference from the watercress period, that the solids were all increased slightly except the Chlorides and the Acids, the specific gravity having again risen to 1.020. The effect of the drugs administered on the quantity and the sp. gr. of the urine is shown in the following chart:

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<th>3% gr Quant</th>
<th>Cpp 15</th>
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<th>21</th>
<th>22</th>
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</tbody>
</table>

**DRUGS**

- Cere
- Cere
- Alk.
Acidity

The urine on each day of the experiment turned blue litmus paper red, except on the first day of the 10 to 15 or alkali period when it turned red litmus paper blue. This was the only day on which there was a variation of any consequence in the acidity. During the preliminary Period, the highest total acidity was 4.089g, the lowest 3.676 gms, the mean being therefore 3.926 gms. During the II° or watercress period the mean was 3.917. In other words, the watercress had no effect on the acidity of the urine. This is interesting as not agreeing with the usual actions of vegetables, which mostly all decrease markedly the acidity of the urine. This result however is explained by the small amount of alkaline salts in the juice as shown by Mr. Macadam's analysis.
In the intermediate period, the acidity fell somewhat, but on the first day of the alkali period it diminished greatly, the percentage being .097, and the total quantity 1.382, the urine being turbid giving great trouble in the filtering process necessary for the estimation of uric acid. The effect of the alkali had not completely passed off on the last day of the experiment, the total being still about 1 gramme below the smallest amount passed on any day of the experiment. The importance of the acidity of urine does not consist in the acidity itself, as in the influence which that has, or is supposed to have, on the excretion of the other solid constituents of the urine. Principally the excretion of uric acid. Starig holds that the more acid the urine, the less uric acid will
be found in it. And although many investigators have published results which contradict those of Haig, yet that observer still insists that his conclusions are correct. He says that “high urea acid is dependent upon two factors — (1) the low acidity of the urine corresponding to a high alkalinity of the blood, and, moreover, that fluid a good solvent of urea acid, & (2) the presence somewhere in the body of a quantity of urea acid available for solution when the condition of the blood becomes favourable to that solution.” It has already been mentioned that Dr. Luff has contradicted that law of Haig's by direct observation of the alkalinity of the blood in a case of subacute gout. The experiments of several German

(1) A. Haig loc. cit. p. 16.
Scientists on the effect of alkalies on the excretion of uric acid have been quoted. Again Herrnstein and Groe have shown that a mixed diet of flesh, fish, food and vegetables with wine occasionally, produced extending over a period of sixteen days produced a total acidity of the urine equal to 4.5 grains per day with an excretion of 14 grains of uric acid a day. During a second period of 8 days during which the subject was kept on a beef and diet, and none of these articles of food were taken, except on the middle day of the experiment, the total acidity was 36 grains per day, of the uric acid 9.6 grains. That is to say the excretion of uric acid varied with the total acidity of the urine.
In a second experiment by Herrick and Grove, in which the diet was fairly fixed, the authors similarly concluded that "the excretion of uric acid does not vary inversely with the daily acidity of the urine." The first two periods of the present experiment do not throw much light on this vexed question because the quantities we have to deal with are so small, that it is not fair to draw conclusions from them. For instance the difference between the average daily excretion of acids between during the first and second periods is 9 milligrams and the difference between the excretions of uric acid for the same periods is 319 milligrams — a difference out of all proportion to the difference of total acidity. But the intermediate alkaline periods are of more interest.

The total acidity of the first period has fallen by 5 accigrammes lower than that of the previous day, and the uric acid has also fallen with it by 7 centigrammes.

And in the last or alkaline period, although the total acidity has fallen to a point never reached before during this experiment, the uric acid is increased only by 294 milligrammes from the previous day's excretion, it is lower than other days when the acidity was nearly three times as much. In the last day again, whilst the acidity is nearly twice as great as the day before, the excretion of uric acid remains the same or almost the same. The curve of acidity and the relation of acidity to uric acid is shown in the chart on the following page.
These varied irregularly in the first a Preliminary Period, some days increasing, and decreasing on others. But from the first day of the Water-Cress Period they slowly but steadily diminished to the end of the experiment with only an insignificant break on the first day of the Alkali Period. It is difficult to explain this steady diminution. It can hardly be due to the Water-Cress, because it continues after the administration of the drug has ceased. And it cannot depend on the alkali because it had begun before that drug had been exhibited. Anyhow it appears from the experiment that neither bastardphosphoric acid nor the Carbonate of the Alkalis, has any influence on the presence of phosphates.
in the urine.
But the Phosphates of the urine, like the total acidity are of
interest both especially on account of their relation to other solid
constituents of the urine, principally
the Urine acid. A connection with
total acidity might at first
seemed to be thought possible, because
acidity of the urine depends
mainly on the presence in it
of Acid Phosphates. But then,
the estimation of Phosphates in
a given specimen of urine
includes all phosphate,
basic as well as acid, and
hence acidity cannot bear no
constant proportion to
phosphates in the urine.
The relation of urine acid to
Phosphates in the urine, on the
other hand, has a reason in
the common source of both
compounds. As already men-
tioned, Uric acid and the
allophenic bases, and phosphoric acid. The urine is derived from the nucleic acid metabolised in the body. This source of the uric acid in the urine has been advanced by Horbaçewski. It follows that uric acid, or, at any rate, that part of it which is derived from the metabolism of nucleic acid, will bear a constant proportion to the phosphoric acid coming from the same source. That is admitting, of course, that nucleic acid has always in it the same proportion of phosphorus, a matter of some doubt if we compare the following formulae:

\[
\begin{align*}
C_{29}H_{49}N_9P_3O_{22} & \quad (\text{Miescher}) \\
C_{30}H_{32}N_9P_3O_7 & \quad (\text{Kossel}) \\
C_{40}H_{54}N_{14}(P_2O_5)_2 & \quad (\text{Schmiedeberg})
\end{align*}
\]

In these formulae the proportion of \( P \)&\( N \) is 31:42 in the first formula, & 31:49 in the 2nd.
A very slight variation which accounts for the small alteration, in the urine, of the ratio between phosphoric and uric acid, if we calculate this ratio from the figures in the large table, we find:

- 16th April: 4199 : 2.522 :: 1 : 6.0
- 17th: 4583 : 3.137 :: 1 : 6.8
- 18th: 4263 : 2.739 :: 1 : 6.4
- 19th: 4554 : 2.934 :: 1 : 6.4
- 20th: 4813 : 2.975 :: 1 : 5.7
- 21st: 4614 : 2.971 :: 1 : 5.7
- 22nd: 3835 : 2.376 :: 1 : 6.1
- 23rd: 4132 : 2.417 :: 1 : 5.8
- 24th: 4114 : 2.277 :: 1 : 5.3

That is,

uric acid : phosphoric :: 1 : a peculiar verb.

unless some disturbing element is brought to bear on the former in the way of clearing up of all zones deposited in the tissues, salicylate of soda on account of its forming salicylurie acid with uric acid
might destroy that proportion. But if Horbaczewski's contention be correct, it would only do so apparently. For the proportion of Phosphoric acid to Uric acid, the result of metabolin 

is only that of solution, would not be altered as the destruction of creatin 

would mean increase of Phosphoric acid as well as increase of Uric acid. But it is impossible to separate in the urine the Uric acid due to 

metabolism from that due to 

simple solution.

The Excretion of the Phosphates as well as their relation to the output of Uric acid is shown graphically in the chart 

which follows:
<table>
<thead>
<tr>
<th>PHOSPH</th>
<th>URIC</th>
<th>15</th>
<th>16</th>
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<td>2.2</td>
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</table>

**DRUGS** | **CRESS** | **ALK.**
The Chlorides.

These were examined in the course of the experiment, but they are not of much interest to us as they almost seem to bear on the other sides of the urine.

One point however is worthy of notice — although the amount of Chlorides in the urine depends mainly on the amount taken in the food, and that the diet was fixed as much as it is possible to be, yet there were variations, sometimes marked, in the amount passed. For instance, on the 16th Apr. 12.2 gr. were passed, on the 17th 8.8 gr., on the 18th 8.2 gr., & on the 19th 10.08 gr.

Total Nitrogen

The total daily output of Nitrogen in the first period behaved like the Phosphates. It varied irregularly, but within narrow limits, putting aside the first day which might still have been influenced by the Nitrogenous diet of ordinary life the days before.

During the second period, however, it began to rise, but afterwards steadily fell until the end of the experiment. It looks as if this fell may be due to the drugs taken, especially in the case of the alkali period when the change is more marked, although that is in contradiction to the views of Bing quoted before on p. 22 of this essay.

The mean daily total excretion of Nitrogen for the four periods of this experiment are as follows:
I. Preliminary period 13.39
II. Watercress 12.46
III. Intermediate 11.08
IV. Alkaline 11.39

If we bracket the 3rd or intermediate period with the watercress period as being influenced by it, we find the figures as under:

I (Vide.) 13.39
II + III. (Post int.) 11.77
IV. (alk) 11.39

From which we may conclude that both watercress and alkalis have a slight effect in checking nitrogenous waste in the body, but only that Nitrogenous waste which is the outcome of the catabolism of albuminous matter which does not contain Phosphorus. For it has already been pointed out, neither the watercress nor the alkali has any effect on the excretion of Phosphates.

The distinction of the Catabolism
of protoids from that of nucleoproteids is furthermore evident when we compare the excretion of total nitrogen with that of uric acid. Haig explicitly states that uric acid is always formed in health in a certain proportion to urea. This proportion he lays down as 1:33 or 1:35, and he quotes Yvon and Belhiez who found it to be 1:30 to 1:40 and Leicester who puts it down to 1:33 (1). Haig also states that a low proportion of uric acid to urea (e.g. 1:45), indicates that there is no uric acid in the blood, or very little of it, and that a high output of uric acid in the urine with a low output of urea, indicates a large quantity of uric acid in the blood, which will cause headaches, high tension pulse t. t. t. It is not so much, according to him, the absolute quantity

(1) A. Haig, loc. cit. p. 13 (2) loc. cit. p. 67
of uric acid passed. Even when high, which causes the symptoms enumerated, as the substitution of the proportion:

\[
\text{uric acid} = \frac{1}{3.5} \text{ urea}
\]

by another which might be expressed:

\[
\text{uric acid} = \frac{1}{15} \text{ to } 25 \text{ urea}
\]

These statements of Haig are not accepted by Physiologists. Hopkins says that the uric to uric acid ratio has no value, and he quotes Palkowski who says with much reason, that variations in individual persons are so great, that before affirming that any given proportion is pathological we must know the normal behaviour of the particular organisation in question. (2)

An examination of the results

(1) A. Haig. loc. cit. p. 193
(2) A. Schaper loc. cit. p. 573 & p. 575
in the large table will show that Kârî's veins are not borne out by this experiment. It is a fact that 86% of the total Nitrogen excreted in the urine is expelled as Urea, hence we may easily convert the total Nitrogens into the corresponding amounts of Urea and compare those with the Uriceacid. This is shown in the following table:

<table>
<thead>
<tr>
<th>Date</th>
<th>Uric acid (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16th</td>
<td>1.325</td>
</tr>
<tr>
<td>17th</td>
<td>1.299</td>
</tr>
<tr>
<td>18th</td>
<td>1.26</td>
</tr>
<tr>
<td>19th</td>
<td>1.236</td>
</tr>
<tr>
<td>20th</td>
<td>1.234</td>
</tr>
<tr>
<td>21st</td>
<td>1.215</td>
</tr>
<tr>
<td>22nd</td>
<td>1.248</td>
</tr>
<tr>
<td>23rd</td>
<td>1.242</td>
</tr>
<tr>
<td>24th</td>
<td>1.223</td>
</tr>
</tbody>
</table>

That is, except on the first two days of the first period, the
the uric acid ratio was always
markedly smaller than the
one which Dr. Haiglays down
as physiological, that on several
occasions it was, according
to his expressed views, distinctly
pathological, and yet the
subject did not suffer from
through these ten days, from
the slightest headache or other
physical inconvenience, although
he was working many hours
a day in the laboratory, and
reading the whole evening at
home, doing in fact an amount
of study, and being confined
in rooms more than he had
been accustomed to for years.

The same conclusion has been
arrived at by Herrumpham
and Sive who say "uric acid
may be passed to the amount
of 1/24 of urea without bad effects."
The excretions of uric acid of total Nitrogen are shown side by side in the following chart:
Uric acid

The averages of the four periods were:

I. Preliminary: 43.94 g. uric acid
II. Watercress: 47.13...
III. Intermediate: 38.35...
IV. Alkali: 41.23...

or, bracketing the 2nd and 3rd periods:

I. 43.94
II. 42.74
III. 41.23

These are very slight differences, but they serve to show that neither castorium officinale, nor the alkaline carbonates, have any influence in increasing the output of uric acid. A very disappointing result to attain! At first it seemed as if the watercress would increase the amount of the uric acid, but the slight increase noticeable on the first day of the second period was...
not only not kept up on the 2nd day, but it actually diminished although the dose of the drug was increased by 103 c.c. Therefore the slight increase of the 20th April cannot be put down to the action of the watercress which is thus proved, as far as this experiment goes, not to possess its reputed anti-rheumatic and antisyphilitic virtues.

The influence of the alkaline Carbonate on the excretion of Uric acid was therefore no longer necessary as a check to show whether any plus excretion was not due to amylaretho-...stained in this excess Fastinchi. Still it was felt that it would be interesting to see which of the contra-dietary accounts of the effects of these drugs was to prove correct.

Under the influence of the large dose of the mixed Carbonate of Potash and soda, the urine became alkaline to test dilut.
and the acidity diminished enormously, and yet the excretion of
the urea acid, although it recovered
from the fall of the intermediate
period, never rose to the amount
attained on any previous day.
This experiment is therefore in
accord with the investigations
of Hermann already quoted.

The relative aspects of the excre-
tion of urea acid with that of
the other solid constituents have
been dealt with under the proper
heads of each of these con-
stituents, and need not be
repeated here.

But enough has not been said
as to the relation of the urea acid to
urinary water. Here again, the
present experiment contradicts
those of Harg, who holds that
during the excretion of the amount of
urea acid in the urine very
 inversely with the amount of
urinary water.
For we found that in the first
period, the urinary water decreased steadily and rapidly, and the uric acid varied irregularly. And in the water cress period, the water decreased rapidly, and the uric acid decreased.

Further comparing the averages of the different periods, we find:

I. In the Preliminary Period,
   mean quantity of water, 1011 cc.
   uric acid, 438.49 gr.

II. In the water cress period,
    mean quantity of water, 1390 cc.
    uric acid, 471.3 gr.

III. In the Intermediate Period
    mean quantity of water, 1375 cc.
    uric acid, 383.85 gr.

IV. In the alkali period
    mean quantity of water, 1362 cc.
    uric acid, 412.3 gr.

This is plainly shown if we have recourse to the usual graphic method.
<table>
<thead>
<tr>
<th>Urine</th>
<th>Uric Acid</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>Ave.</th>
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**Drugs:**

**Cress**

**Alk.**
Conclusions.

This experiment was undertaken to test the grounds for the reputation of the Common Water-Cress as a remedial agent against Rheumatism, Gout, &c.
Therefore its action on some of the products of metabolism was observed—principally lactic acid.
The methods employed were the most approved, and were performed with due care.
Every precaution was taken in the details so that no source of error might creep in.
These observations claim to show:
I. That Nasturtium officinale has a slight effect in alleviating urinary water.
II. That it does not have any influence on the acidity of the urine.
III. That it does not affect the excretion of phosphates;
in the urine.

IV. That it may have a very slight
effect in decreasing Nitrogenous waste.
V. That it does not increase
the excretion of Urine acid, the
effect on that constituent of Urine
being so slight, that it may be
disregarded altogether.

Hence we conclude that the
Common Watercress cannot be
of much use as a remedy against
Rheumatism & Gout.
And that if it helps in Scurvy,
it must be simply as any other
green vegetable.
This experiment also throws
doubt on the supposed action
of alkalies in increasing Nitrogenous
metabolism.
It also shows that alkalies
don't increase the excretion
of Urine acid in the urine.

P.T.O.
Table showing Averages in each Period of the Experiment.

<table>
<thead>
<tr>
<th>PERIODS</th>
<th>WEIGHT QUANT.</th>
<th>SP. GR.</th>
<th>ACIDS</th>
<th>PHOSPHATES</th>
<th>CHLORIDES</th>
<th>TOTAL NITROGEN URIC ACID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>% TOTAL</td>
<td>% TOTAL</td>
<td>% TOTAL</td>
<td>% TOTAL</td>
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<tr>
<td>I</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>PRELIMINARY</td>
<td>1151 2/40</td>
<td>1011.7</td>
<td>1023.2</td>
<td>3.98</td>
<td>3.926</td>
<td>2.74</td>
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<td>II</td>
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<td>1019</td>
<td>2.836</td>
<td>3.917</td>
<td>1.945</td>
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N. Ayhner Suman
MB