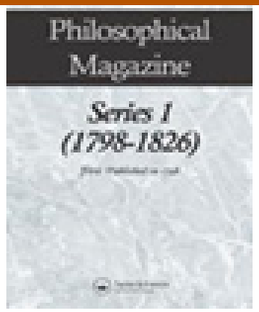

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Cloths thus dyed are of so intense a colour as to appear less bright than scarlets are by the common process; but this deeper reflection of red rays may be obviated by adding to the bath some turmeric or fustic.—[*Bibliothèque Physico-Économique.*]

XXI. *On the Conversion of Animal Matter into new Substances, by the Action of Sulphuric Acid.* By M. H. Braconnot.

Having discovered in previous experiments that woad, barks, straw, hemp, and every other kind of woody fibre, could by the agency of sulphuric acid be changed into gum and sugar, I resolved to extend my researches to animal substances; and as many of these, such as skin, cellular membrane, cartilage, tendon, and tendinous sheath, are entirely dissolved into gelatine by boiling water, I determined first to operate on this substance.

Action of Sulphuric Acid on Gelatine.

Twelve grammes of glue, reduced to powder, were digested with a double weight of concentrated sulphuric acid without artificial heat. In twenty hours the liquid was not more coloured than if mere water had been employed; I then added a decilitre of water, and boiled the whole for five hours, renewing the water from time to time as it wasted. I next diluted it, saturated it with chalk, filtered, and evaporated to a syrupy consistence, and let it stand for about a month. In this period a number of granular crystals had separated, which adhered pretty strongly to the bottom of the vessel, and had a very decided saccharine taste. These crystals were collected by pouring off the supernatant syrup, then washed with weak spirit to dissolve out the adherent syrup, then pressed through a cloth, redissolved in a little water and again crystallised, whereby they became tolerably pure. This sugar might in strictness form a new species of saccharine matter; its properties are the following:

Sugar of Gelatine.

This sugar crystallises much more easily than cane-sugar. If its solution be ever so little concentrated by heat, a crystallised pellicle speedily forms itself, which is quickly renewed when the former is broken down; but when the evaporation is allowed to proceed slowly, we obtain very hard granular crystals, grating under the teeth like sugar-candy, and in the form of flattened prisms or tabular groups. Its taste is nearly as saccharine as grape-sugar; its solubility in water scarcely exceeds that of sugar of milk. This solution mixed with leaven gives no signs of fermentation. Boiling alcohol, even when diluted, has no action

on this sugar. It is less fusible than cane-sugar, and better resists decomposition in a raised temperature. By distillation, it gives a light white sublimate, and an ammoniacal product, which shows the presence of azote. This saccharine matter seems on the first view to have some analogy with sugar of milk; but the latter (as M. Vogel has observed) is changed by sulphuric acid into a sugar very soluble in water and in alcohol; and besides, the sugar of gelatine, when treated by nitric acid, gives no mucous acid, but a new species of acid, which I have named the *nitro-saccharine*, and will be described in the following paragraph.

Of the Nitro-Saccharine Acid.

If nitric acid be poured on sugar of gelatine while still coloured, it does not appear to dissolve in the cold, but becomes very white, and the acid appears to take up the colouring matter: if this mixture be then heated, a solution takes place, but without the evolution of red nitrous vapour, and the effervescence that occurs when other animal and vegetable matters are heated with this acid. This nitrous solution being now evaporated (slowly towards the end), gives a residue which congeals on cooling into a single crystalline mass. This, when pressed between paper and re-dissolved, yields the *nitro-saccharine acid* in purity. The quantity of this acid is much more than that of the saccharine acid from which it is obtained. It is very soluble, and crystallises with the greatest ease in beautiful, colourless, transparent, flattened prisms, slightly striated like Glauber's salt. Its acid and somewhat saccharine taste resembles that of the acid of tartar. When heated by itself, it puffs up considerably, melts indistinctly, and gives out a pungent vapour. It produces no change on earthy or metallic solutions. With potash, it forms a super-acid and a neutral salt, both of which crystallise in fine needles, and have a cooling nitrous taste leaving an after-flavour of sugar. When thrown on hot coals they detonate like saltpetre. The nitro-saccharine acid dissolves carbonate of lime with strong effervescence, and the liquor, gently evaporated, entirely passes into fine needled prismatic crystals, which do not deliquesce in the open air, are little soluble in concentrated alcohol, melt on hot coals, and then detonate. This acid forms with oxide of copper a crystallisable salt unchangeable in the air: with magnesia, a deliquescent, uncrystallisable salt, which puffs up excessively when heated, melts, and leaves a brown spongy residue resembling a vegetation. With oxide of lead it gives a permanent gummy mass that will not crystallise: with iron and zinc it produces metallic salts, evolving hydrogen during solution.

These

These are the properties of some of the salts of this acid, which appears to be a compound of sugar and gelatine with nitric acid, and it is remarkable that this kind of sugar has its elements so intimately combined, as to resist the disorganising power of nitric acid, which decomposes with evolution of nitrous gas the other vegetable compounds.

Examination of the Syrup separated from Sugar of Gelatine.

This syrup, decidedly saccharine in its taste, still retained a quantity of the sugar above described, but mixed with a matter slightly azotic, and in part separable by tannin under the form of a reddish precipitate. The syrup, diluted with water, mixed with leaven, and kept a long time in a warm place, assumed neither the spirituous nor the putrid fermentation. When strongly heated it puffed up, and burned without the fetid smell that distinguishes animal matter, and left a coal of very easy incineration. Indeed the gelatine had lost much of its animal character, and approached more to the vegetable substances slightly animalised: as no azotic gas was given out during the action of sulphuric acid on gelatine, I had reason to suppose that ammonia was formed, and accordingly this alkali was evolved on rubbing the syrup with potash.

This syrup is but little acted on by alcohol; but when the spirit is diluted and boiling, it dissolves a portion of the syrup, and on cooling deposits a sediment consisting of sugar, and a peculiar white matter which will be presently examined. The spirituous solution gave by evaporation a syrup with a decided odour of honey, and some tendency to crystallise.

The greater part of the syrup, which was the portion insoluble in weak alcohol, still retained a saccharine taste mingled with that of animal jelly. I could not succeed in precipitating all the animal matter by tannin.

Action of Sulphuric Acid on Muscular Fibre.

Some lean beef pulled into small pieces was soaked in a large quantity of water, which was frequently renewed to separate all the soluble matter, and then strongly and in small portions pressed between folds of cloth. Thirty grammes of the beef fibre, thus prepared, were mixed with as much sulphuric acid, in which they softened and dissolved without changing the colour of the acid, or disengagement of sulphurous acid. The solution was then heated to promote the solution of some remaining particles, and cooled to allow of the separation of a layer of fat which rose to the surface, though the precaution had been taken to choose a very lean piece of meat. The solution was then diluted with about a decilitre of water, and boiled for nine hours, renewing the

the water from time to time; then saturated with chalk and evaporated, and it yielded an extract not sensibly saccharine, but which had such a decided taste of osmazome, that it appeared to me fit to be used in preparing soup. This extract rubbed with potash disengaged ammonia. In the fire it swelled and burnt, leaving a coal easy to incinerate. The solution of the extract did not putrefy in a gentle and long continued heat. Some of the extract was boiled at several intervals with alcohol of 34° (Baumé), the different portions of spirit were mixed together, and deposited, on cooling, about a gramme of a peculiar white matter, which for the present I shall term *leucine*.

Of Leucine.

Leucine when dry is white and pulverulent, but still retains a little animal matter, precipitable by adding tannin with precaution to the solution. After some hours standing, I filtered the liquor, which passed colourless. I then evaporated it till a pellicle formed on the surface; under which, after twenty-four hours standing, one could distinguish small mamillated crystals somewhat crisp in the mouth, and of a dead white, lining the bottom of the dish. If, on the other hand, the solution of leucine in tepid water be left to spontaneous evaporation, there form on the surface a multitude of small detached, flattened, circular crystals, exactly resembling button-moulds, with an inverted edge on their circumference, and a depression in their centre. Leucine has an agreeable taste of gravy or broth. It is lighter than water, swimming on its surface. When heated in a small glass retort it melts, but at a much higher temperature than boiling water gives out a smell of boiled meat, and partly sublimes in small granular opake-white crystals: the remainder, which is liquid, contains empyreumatic oil, and renders blue the reddened colour of litmus.

The solution of this sublimate in water is not troubled by subacetite of lead, nor any other of the usual metallic tests, except nitrate of mercury, which entirely separates it from its solvent, in the form of a white flocculent precipitate, the supernatant liquid assuming a rose-colour.

Leucine dissolves readily in nitric acid. If this solution be heated to expel the greater part of the acid, a very slight effervescence is perceptible, but no production of red nitrous vapour; and the remaining solution, after gentle evaporation, congeals into a crystalline mass, which, after pressure between filtering paper and re-solution in water, crystallises into thin, divergent, colourless needles. This forms a peculiar acid, analogous to the nitro-saccharine above described.

This *nitro-leucic acid* forms peculiar salts with the several bases.

bases. With lime it produces a permanent salt crystallised in rounded groups. With magnesia the salt formed appears as small granular crystals, which do not deliquesce in the air, in which respect it differs from the nitro-saccharate of magnesia.

Examination of the alcoholic Liquid from which the Leucine had precipitated.

The solution still retained a quantity of leucine. On evaporation it left a thick granulated residue, out of which cold alcohol dissolved a reddish extractive matter, leaving the leucine untouched. This extract is slightly deliquescent, and has rather a bitterish taste of burnt roast meat. It was not changed by sulphuric acid; its solution in water was hardly troubled by sub-acetite of lead and infusion of galls, and not altered by sulphate of iron.

Of the Substance insoluble in Alcohol.

The extractive matter resulting from the muscular fibre treated with sulphuric acid was only partially soluble in alcohol, as before described; the portion insoluble in this re-agent was the most abundant. I dissolved it a second time in water, to separate the sulphate of lime with which it was mixed, and obtained by evaporation a yellowish-brown extractive matter, slightly deliquescent, and having a taste of broth, probably owing to the leucine which it still retained. In the fire it swelled and burnt like matter moderately animalised, and left a coal easy to incinerate. The solution of this extract in water gave a reddish precipitate with infusion of galls, which was loose and flocculent, like that which arises from matter little animalised. Persulphate of iron gave a copious reddish flocculent precipitate; nitrate of silver, a grey precipitate; nitrate of mercury, a white coagulum. As the sub-acetite of lead gives also a copious white precipitate with this extract, and does not disturb the solution of leucine, I hoped to be able by this means to separate the two; and in consequence added this re-agent, and obtained the white precipitate, and from the filtered liquor I first separated the lead which it retained by carbonate of ammonia, and evaporated the syrupy residue; but I procured very little leucine by this process.

Action of Sulphuric Acid on Wool.

Fifteen grammes of white woollen cloth, cut into small shreds, were moistened with sixty grammes of sulphuric acid, lowered with a quarter of its weight of water. A little sulphurous acid gas was given out, and the wool became reddish, but without perceptibly softening; the mixture was then exposed to a water-boiling heat, on a sand bath, and with shaking it was changed to an uniform mucilage. The digestion was continued till a complete

complete solution was effected, and the whole became a red liquid, and ceased to give out sulphurous acid: it then deposited a sediment, which on further examination was easily burnt to ashes, and proved to be sulphate of lime, with a fat bituminous matter, an animal substance, and a very little silex.

The acid solution, diluted with water, was boiled for nine hours, then was saturated with chalk, and evaporated to the consistence of an extract, which was yellowish, and had a taste like the extractive matter of broth, giving the same appearances when burnt, and yielding ammonia by trituration with potash.

This extract was treated with weak boiling alcohol, in successive portions, which dissolved out of it a small quantity of leucine, and a substance a little animalised. As to the portion insoluble in this weak spirit, which was the most considerable, it had the same taste of broth, and all the other properties which were found in the analogous substance produced from fibrine.

Wishing to know in what state the wool existed immediately after its conversion into mucilage, I moistened eight grammes of it with sixteen grammes of sulphuric acid, diluted with four grammes of water; and after some minutes digestion in a boiling-water heat, and subsequent shaking, there resulted a thick red mucilage, which totally dissolved in water, except a little whitish matter, which was only a portion of the wool, but little changed. The acid liquid was saturated with chalk, and gave by evaporation a substance having exactly the appearance of common glue, but with little cohesion, not deliquescent, and easily reducible to powder. Its taste was disagreeable. In the fire it puffed up and burnt with a smell like scorched wool, but less fetid, but without giving out any sulphurous acid: the coal burnt to ashes as easily as vegetable coal. This substance gave out ammonia when rubbed with potash. Infusion of galls poured into the solution of this substance decomposes it entirely: the precipitate is white, flocculent, and does not collect into an elastic cohesive mass like that which forms in the solution of gelatine. Acetite of lead hardly troubles it; but on adding nitric acid there forms a small insoluble deposit of sulphate of lead. Nitrate of mercury and sub-acetite of lead produce copious white precipitates. Persulphate of iron acts on this as it does on solution of gelatine, it coagulates it entirely into an orange-red mass. Boiling alcohol hardly touches it.

It appears, therefore, that the principal facts contained in this Memoir are the following:

1. That animal substances may be changed by the action of sulphuric acid into substances containing a much less proportion of azote.

2. That this change is brought about by a subtraction of hydrogen

drogen and azote, in the proportions necessary to form ammonia; and probably by an absorption of oxygen from the sulphuric acid.

3. That gelatine may be converted in this way into a species of sugar, *sui generis*, which does not appear to exist any where naturally.

4. That this sugar combines intimately with nitric acid, without sensibly decomposing it, even with the assistance of heat, and there results a peculiar crystallised acid, to which I have given the name of *nitro-saccharine*.

5. That wool, and especially fibrine, when treated with sulphuric acid, yields a peculiar white matter, which I have denominated *leucine*.

6. That this matter, heated with nitric acid, does not sensibly decompose it, and produces a crystallisable *nitro-leucic* acid.

7. Lastly, That other uncrystallisable and sapid substances, analogous to certain vegetable principles, are also produced by the action of sulphuric acid on the most insoluble of the animal principles.

XXII. *On the Culture of Turnips. By* George Webb Hall, *Esq.**

Having executed the instructions of the Board of Agriculture, "to condense the whole of the information contained in the several Reports and Communications to the Board on the Culture of Turnips," into one general view, that the practice of all the counties in England and Scotland, on this most interesting and important branch of agriculture, might be laid fairly before the public in a compressed form, for the benefit of those to whom all the County Reports and Communications might not be accessible; I am tempted to step a little beyond the line of my instructions, in offering to the consideration of the Honourable Board a few observations of my own on the culture of this invaluable root; for which the laborious investigation I have now given the subject, added to my own experience, may render me not altogether unqualified.

If, on the completion of this work, I were to be asked by the Honourable Board, Upon a review of the practice of the whole island, which county do you consider to approach nearest to maturity in the culture of turnips? I should answer, without hesitation, The county of Middlesex stands unquestionably pre-eminent to every other in the kingdom in the manner of cultivating turnips; inasmuch as the system there pursued is calculated to produce the best crops at the least expense, and at the

* From the Communications of the Board of Agriculture.