Saccharine, benzoyl sulphonic-imide, Dr. Fahlberg's new sweetening agent made from coal-tar ... : a compilation of the results obtained since its introduction, by the scientific researches of learned men and through the practical experience of experts / by Adolph List, a partner of the firm of Fahlberg, List & Co., saccharine works. English ed.

Contributors

List, Adolph.
Fahlberg, List & Co.

Publication/Creation

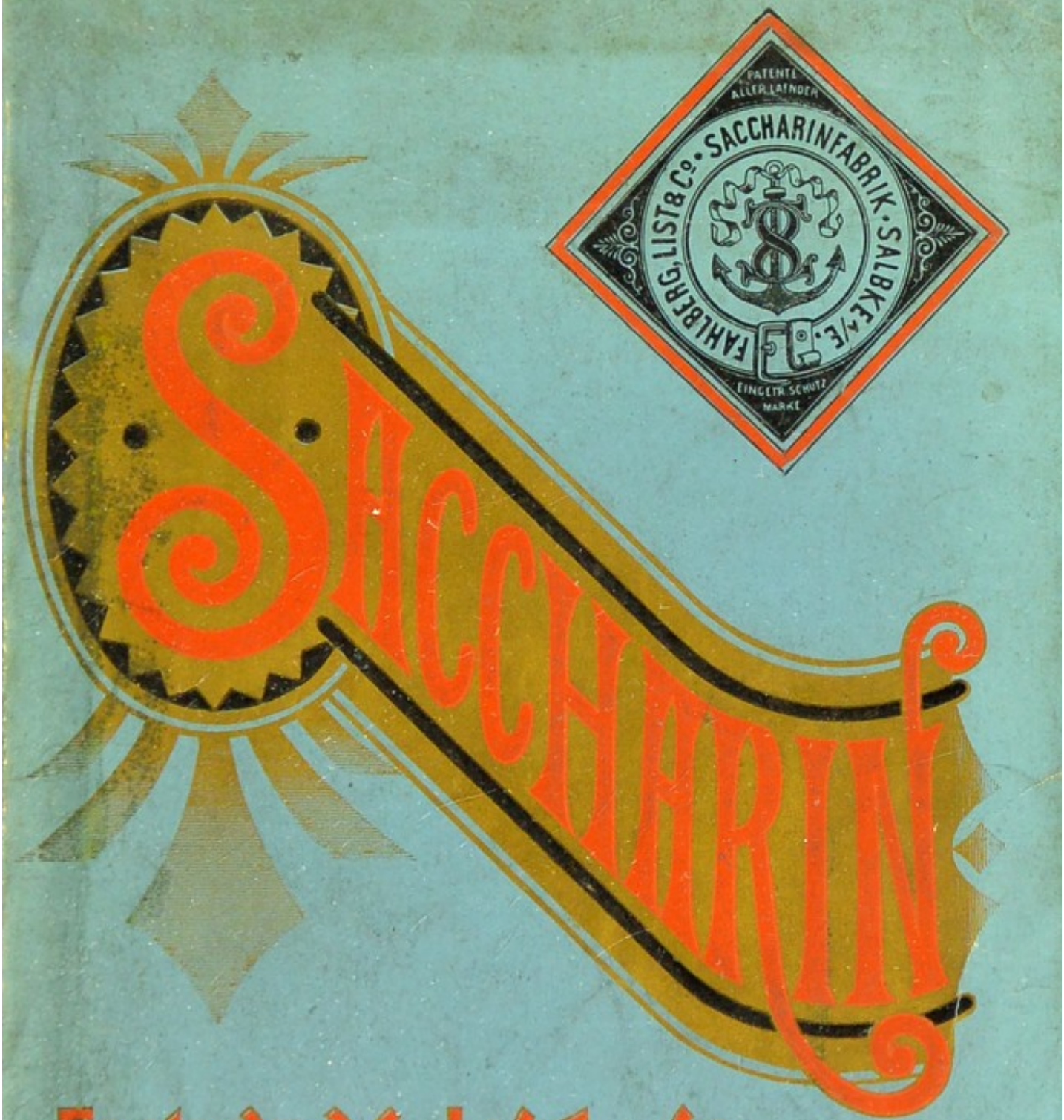
Salbke-Westerhüsen on the Elbe : Fahlberg, List, 1893.

Persistent URL

https://wellcomecollection.org/works/djt9tyef

License and attribution

Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
https://wellcomecollection.org



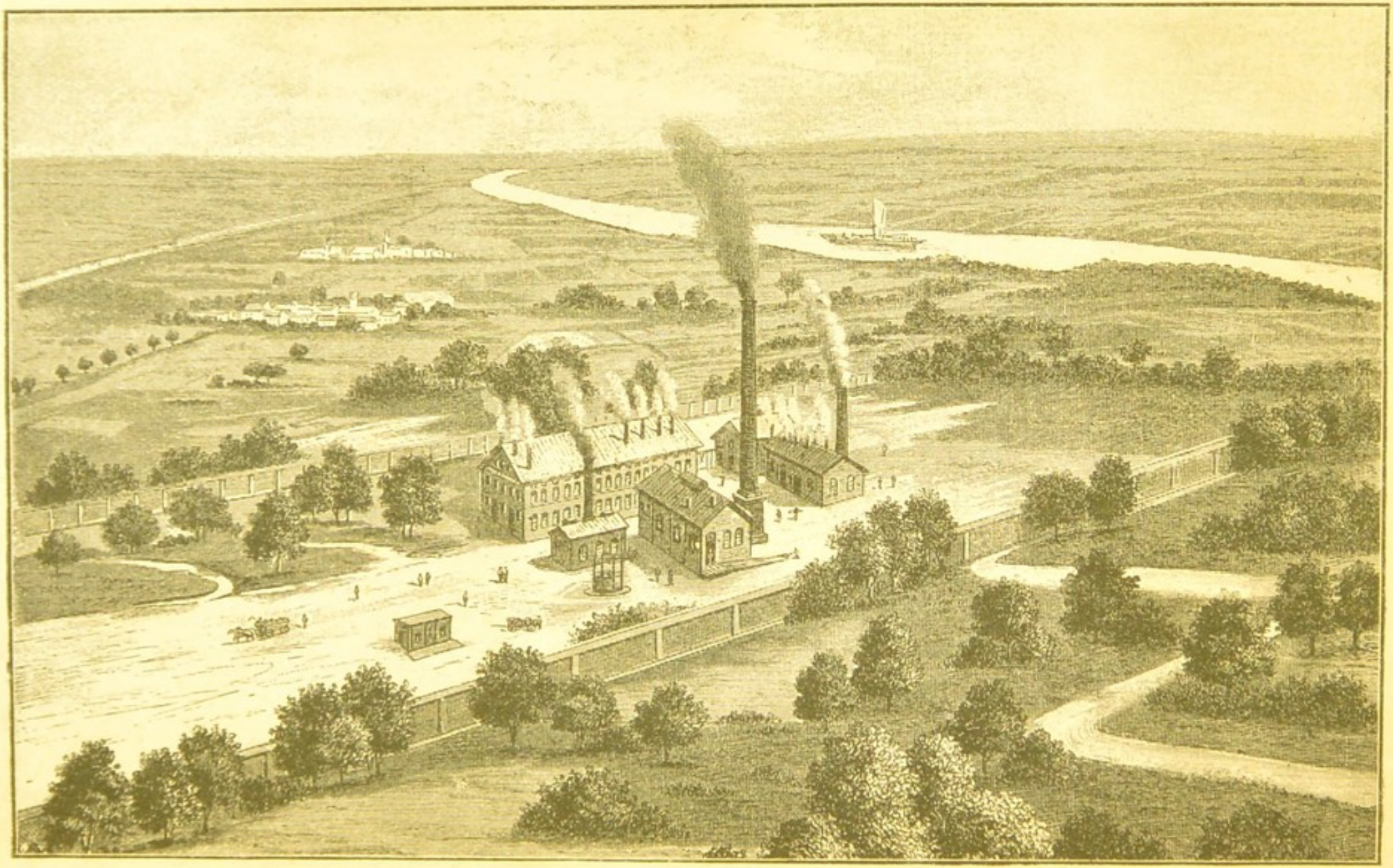
FAHLBERG, LIST & CO.

Saccharin-Works

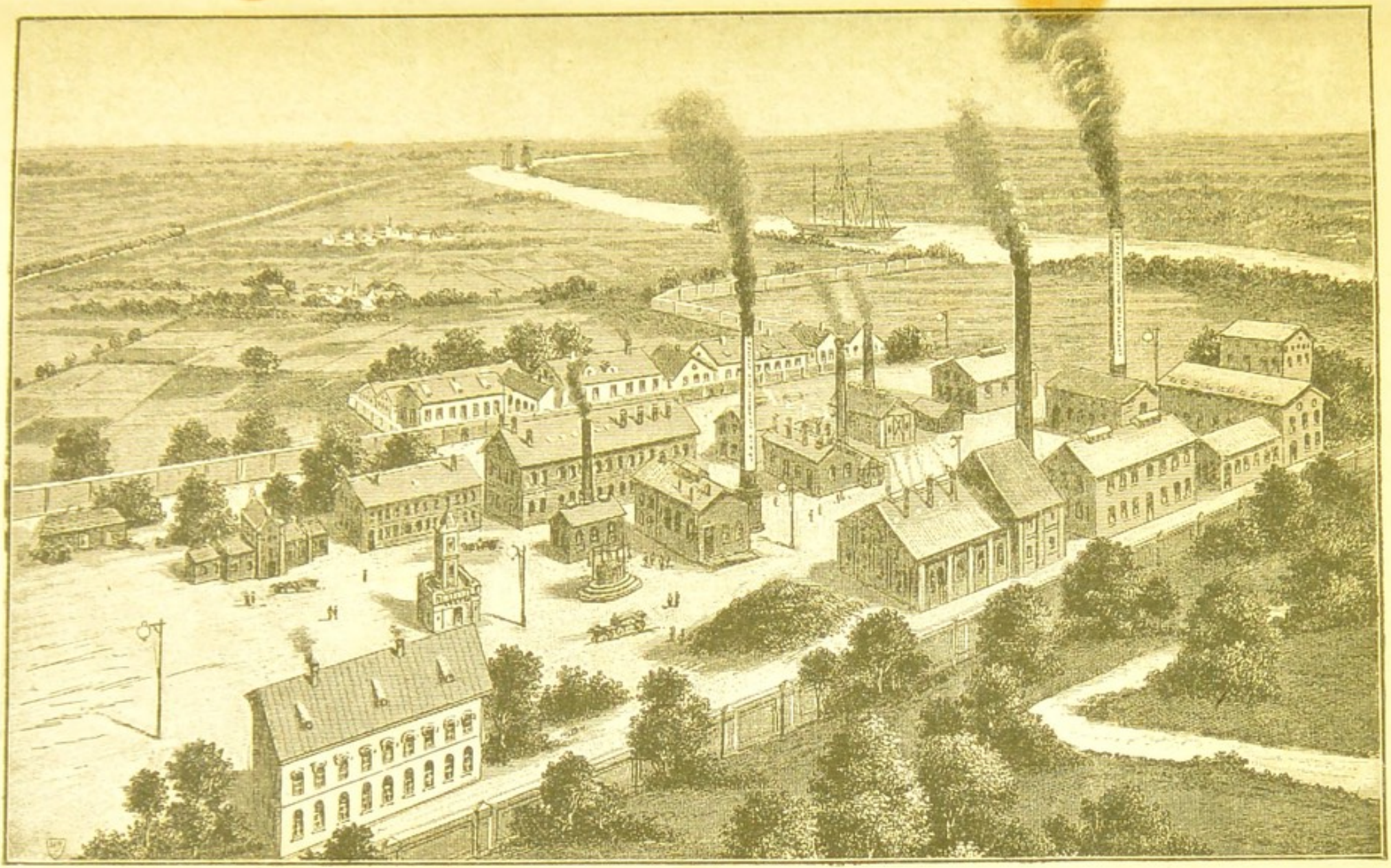
SALBKE-WESTERHÜSEN O. ELBE

Germany

English edition.



View of the Saccharin-Works Salbke-Westerhusen o/Elbe in 1886.



View of the Saccharin-Works Salbke-Westerhusen o/Elbe in 1893.

SACCHARINE

Benzoyl Sulphonic-imide

Dr. FAHLBERG's New Sweetening Agent made from Coal-tar.

---

500 times sweeter than the best sugar.

An Eminent Preservative.

A Perfectly Harmless Spice.

A Compilation

of the Results obtained since its Introduction, by the Scientific Researches of Learned Men and through the practical experience of Experts, by Dr. Adolph List, a Partner of the firm of

FAHLBERG, LIST & Co

Saccharine Works

Salbke-Westerhüsen on the Elbe.

Saxony — Germany.

English Edition

1893.

Index.

PREFACE.

In the year 1881 some American newspapers published a brief notice to the effect, that Dr. Constantine Fahlberg, Chemical Fellow of the Johns Hopkins University, Baltimore, had succeeded in preparing from coal-tar sources a body characterised by an enormous and hitherto unheard of sweetening power. The news was received, on the whole, with incredulity, and when it passed over into European journals savants of celebrity and renown thought fit to ridicule the matter. People jested about stones being converted into bread, about a new sort of sugar sweeter than the ordinary article by 300 times and furnishing besides an alcohol, whose intoxicating effect was 300 times more powerful than common spirit; a minute quantity of this alcohol, they said, sufficed to inebriate the imbibers. There was, in short, no end of joking on the subject.

Not long after, however, certain indications of there being some truth in the matter became evident, and when at last the sweetening or rather sweet substance was exhibited and subjected to practical tests, when physiologists had studied the effect of this new and remarkable substance on the animal organism, and when finally letters patent were applied for in all civilized countries with a view to manufacturing this

saccharine on the large scale, then at length the scoffers grew silent — but no, it is wrong to say that, for they went from one extreme to the other, as is generally the case. What had been undervalued at first, was then over-estimated and prejudiced just the other way! The power of »cutting up« all trade and industry was now attributed to the new body, the ruin of the sugar-cane industry was foretold and that of the beet-root too, the present flourishing sugar industry would go to wreck and ruin, it was said. A violent opposition to the new discovery arose and all conceivable means were adopted to prevent its general introduction.

Such was the change of opinion in respect to the new body, now known throughout the world, though to most people by name alone. It has been in the market for seven years now, and in spite of the vehement opposition it has met with, in spite of all clever devices to raise suspicion against it, and notwithstanding the hampering measures of the authorities, it has come into general use, is greatly valued, indeed considered indispensable in numerous industries, and is ranked among the most useful and necessary products of the world of drugs and chemicals.

This little work published in German, English, French and Spanish and treating of the new body, its qualities, operation and effect; its composition and manufacture, its history, use and market, is intended to be laid before the American public and all visitors to the International Exposition at Chicago in 1893, with a view to make this chemical product more generally known, and to give all interested in the subject an opportunity of testing its value and useful qualities. It is hoped, in a word, that by this means, it will eventually prove as serviceable to American as it has to European industries.

Considering the immense importance of this new sweetening agent to all, its eminent utility, both for

science and in daily life, for the kitchen and the household, we determined on making this work as complete as possible. We find it now far more voluminous than we expected it to be and than we deemed advisable. We have nevertheless resolved on presenting it to the public as it is and not in an abridged edition containing merely the most important facts, for we wish it to be of use and service to everybody and trust that all who get a copy of the little volume will find in it something to excite their interest. In order to facilitate research we have added a carefully arranged Table of contents.

SACCHARINE.

Trade name. Scientific name.
Composition. Formula. Origin. Manufacture.
The trade article.

Trade name. The name, we assigned to our sweetening substance and under which we brought it into the market, and by which it is now universally known, is — **Saccharine** — derived from the latin word saccharum = sugar (Greek: σακχαρ, Sanscrit: çaccara) and means therefore the quintessence of sugar or properly speaking its most prominent quality: sweetness. This name was given to the body after its having been ascertained that, when mixed in suitable proportion with starch-sugar, it proved to be a product similar to cane or beet-root sugar both in taste and in respect to its physiological effect or its value as a nutriment. This fact was ascertained so far back as the year 1879 but did not attain publicity at the time for the very simple reason of its not being of any great interest. Exhaustive experiments had first to be made, methods of manufacturing saccharine invented, apparatus constructed and the expense of production vastly reduced, before manufacturing on a large scale could be thought of, and the foundation stone thus laid for a new and promising chemical industry.

Special mention is made of this for the purpose of claiming priority for the name — Saccharine — for our sweetening substance. The mistaken idea prevails that saccharine was named thus from the date of its being placed in the market; then again Péligot-Scheibler selected the same name for a body produced by the effect of lime on a boiling solution of starch-sugar and having a bitter taste.

Scientific name. The scientific name for saccharine is anhydrous benzoyl ortho-sulphonic imide or benzoic sulfinide. Saccharine is therefore, as shown by its scientific name, not a carbohydrate, such as sugar is, but a derivate of benzoic acid.

Composition. In its composition saccharine contains the following elements: carbon. oxygen, hydrogen, nitrogen and sulphur, which are combined as indicated in the formula

$$C_6H_4 \begin{matrix} CO \\ SO_2 \end{matrix} > NH.$$

Origin. Saccharine is derived from coal-tar, the elementary body or product of manufacture being toluene (toluol), a hydrocarbon which is obtained together with benzene or benzol, various other oils, and bituminous residua, in the fractional distillation of coal-tar oil. Toluene is a volatile, colourless fluid of 0,86 specific gravity and of formula C_7H_8, is very mobile and transparent, smells slightly of benzene, boils at 110° C., is insoluble in water and alcohol, but dissolves easily in ether. As there are far larger quantities of coal-tar than can ever be used in the manufacture of saccharine, there will always be an ample supply of toluene to meet all demands.

The manufacture of Saccharine. It may be of interest to give a short description now of the various phases and processes toluene passes through and is subjected to, before it finally appears in the shape of saccharine.

1) When toluene is heated with common sulphuric acid (not above 100° C.) toluene sulphonic acid is formed:

$$\underset{\text{Toluene}}{C_6H_5CH_3} + 2H_2SO_4 = \underset{\text{Toluene sulphonic acid}}{C_6H_4 \begin{matrix} CH_3 \\ SO_2OH \end{matrix}} + H_2SO_4 + H_2O$$

2) The sulphonic acid thus obtained consists of three isomeric toluene monosulphonic acids, the ortho, para and meta acids. The sulphonates are neutralized with lime and converted into the corresponding calcium salts:

$$2\left(C_6H_4 \begin{matrix} CH_3 \\ SO_2OH \end{matrix}\right) + H_2SO_4 + 2CaCO_3$$

$$= \underset{\text{Lime salts of toluene sulphonic acids}}{\left(C_6H_4 \begin{matrix} CH_3 \\ SO_2O \end{matrix}\right)_2 Ca} + CaSO_4 + 2CO_2 + 2H_2O$$

3) The calcium salts are converted by carbonate of sodium into sodium salts:

$$\left(C_6H_4 \begin{matrix} CH_3 \\ SO_2O \end{matrix}\right)_2 Ca + Na_2CO_3 = 2\underset{\text{Sodium salt of the toluene sulphonic acid}}{C_6H_4 \begin{matrix} CH_3 \\ SO_2ONa \end{matrix}} + CaCO_3$$

4) The sodium salts in solution are evaporated to dryness, ground and dried.

5) The dried sodium salts are converted into sulpho-chlorides by mixing them intimately with phosphoric trichloride and

by exposing them to a current of chlorine with thorough stirring:

$$C_6H_4 \begin{matrix} CH_3 \\ SO_2ONa \end{matrix} + PCl_3 + 2Cl$$

$$= C_6H_4 \begin{matrix} CH_3 \\ SO_2Cl \end{matrix} + POCl_3 + NaCl$$

toluene sulpho-chloride

6) The sulpho-chlorides are then separated by crystallisation. The ortho-toluene sulpho-chloride, which alone furnishes saccharine, remains liquid and is separated by centrifugal machines from the remaining crystallised sulpho-chlorides.

7) The ortho-toluene sulpho-chloride is converted into ortho-toluene sulpho-amide by conducting gaseous ammonia over it:

$$C_6H_4 \begin{matrix} CH_3 \\ SO_2Cl \end{matrix} + (NH_4)_2CO_3$$

Ortho-toluene sulpho-chloride

$$= C_6H_4 \begin{matrix} CH_3 \\ SO_2NH_2 \end{matrix} + NH_2Cl + H_2O + CO_2$$

Ortho-toluic amide

and freed from ammonium chloride by washing.

8) The ortho-toluic-sulpho-amide is then converted by oxidation with potassium permanganate solution into the potassium salt of saccharine:

$$CH \begin{matrix} CH \\ SO_2NH_2 \end{matrix} + 2KMnO_4 = C_6H_4 \begin{matrix} CO \\ SO_2 \end{matrix} > NK$$

Potassium saccharine

$$+ KOH + 2MnO_2 + 2H_2O$$

and the latter is then separated from the eliminated manganese dioxide.

9) Precipitation is then effected by adding mineral acids, and benzoyl ortho-sulphonic imide or benzoic sulfinide = saccharine, is separated:

$$C_6H_4 \begin{matrix} CO \\ SO_2 \end{matrix} > NNa + HCl = NaCl + H_2O + C_6H_4 \begin{matrix} CO \\ SO_2 \end{matrix} > NH$$

Saccharine

It will suffice to have explained the process of manufacturing saccharine in this brief manner. The method is the object of numerous patents acquired in all civilised countries, and its carrying out, occupies continually a large staff of analytical chemists, who work in a laboratory connected with the manufactory, and provided with all the most modern improvements, so that no stone shall remain unturned for the perfection of the process, as well as for ascertaining the most profitable way of dealing with the by-products.

The Trade Article Saccharine. Saccharine, as made in works, is a white amorphous powder, which seen through a microscope is found however to consist of minute crystals. In cold water it is slightly soluble, rather more soluble in warm, but in boiling water it is quite soluble, and the solution possesses an intensely sweet taste.

Saccharine is made solely by the owners of the patents in their saccharine manufactory built by them especially for the purpose, at Salbke-Westerhüsen on the Elbe (Prov. Saxony, Germany), the following specialities being produced for sale.

I. **Pure Saccharine.** So-called »pure saccharine«, which has been exclusively the trade article hitherto, is 300 times sweeter than sugar. It is not a single substance but a mixture of 2 kinds of benzoyl sulphonic imide — about 60 percent of the anhydride of the ortho with about 40 percent of the para and meta anhydrides, of which latter it contains a small quantity only. The ortho combination alone possesses the sweetening quality and confers a sweetening power surpassing that of sugar by 300 times.

As the separation of the ortho compound from the others, presented, in wholesale manufacture, many technical difficulties and could not be carried out until recently, this so-called pure saccharine was in reality, till then, the purest and best factory-made trade article obtainable.

II. **Refined Saccharine.** After many long and exhaustive experiments a method of manufacturing has at length been discovered, by means of which it is possible to separate the ortho compound from the others, and to produce on a large scale benzoyl sulphonic imide which is offered now for sale under the name of »refined saccharine« and is 500 times sweeter than sugar. In treating of the qualities and use of saccharine the two above-mentioned articles will be discussed separately, and it will be further demonstrated which of them deserves the preference in each special case.

III. **Easily soluble Saccharine.**

IV. **Easily soluble refined Saccharine.** In aqueous solutions saccharine contains an atom of hydrogen capable of being replaced by alkalis, and with suitable bases forms salts, which are almost as sweet as the pure product, the anhydride; they dissolve nevertheless easily in all fluids, and furnish neutral solutions. Both from the pure and from the refined saccharine a sodium salt is, therefore, produced, which is known in the trade under the names: »easily soluble saccharine« and »easily soluble refined saccharine«. These products contain 90 percent respectively of pure and refined saccharine and are therefore respectively about 275 and 450 times as sweet as sugar.

Both kinds of easily soluble saccharine, the common and the refined, are offered for sale in two different forms — in the shape of powder and in the granular form. Chemically speaking they are perfectly similar, and so too are they in sweetening power, taste, physiological character, and price. They differ only in appearance and structural condition; one kind is a fine powder, the other granular, this latter kind being solely made for the direct use of saccharine as a sweetening substance in households; the waste arising from the use of a fine powder is thus avoided and the measuring off of the substance into suitable quantities greatly facilitated.

V. **Saccharine in Tablets.** Saccharine tablets offered for sale, are made by means of small presses and are intended for direct use. They consist of a mixture of bicarbonate of soda and refined saccharine in the proportion of 3 to 1, which is compressed into a handy shape and definite dose by means of powerful pressure.

The tablets have a thickness of 6 mm. and weigh 0,07 grm. each, contain, therefore, 0,0175 grm. of refined saccharine and are equal to 12 grms. of sugar. In the same way as sugar is used daily in the shape of cubes in households, so it is intended that these cakes shall facilitate the direct use of saccharine for the same purposes and save the trouble of weighing it off in small quantities.

The Qualities of Saccharine.

Taste and sweetness. Solubility. Body. Acidity. Melting-point. Crystallisation. Antiseptic qualities.

Taste and sweetness. As already stated, saccharine possesses an intense sweetness perceptible to tongue and palate alone but not to be estimated by apparatus of any kind. The taste and the sweetness of saccharine are consequently the most important of its qualities to be discussed. In all the shapes and forms, in which, as already mentioned, saccharine is offered for sale, the taste is very similar to that of commercial sugar and is devoid of any after-taste. It is purely sweet, but of such intensity is this sweetness that saccharine like many other spices — **never must be used in its pure solid condition nor in a large quantity, but only in the right proportion to sugar, and therefore much diluted.** — Dr. Adolph Hofmann, a renowned scientist, professor of hygiene at the University of Leipsic, writing on the taste of saccharine, says very pertinently:

»Whenever saccharine in the dry state is applied to the tongue it calls forth such an intense perception of taste that the sweetness is overpowered by the irritation of the nerves, analogously to very bright light and very loud sounds, which do not produce respectively more colours or greater perception of tone, but nervous irritations of a most unpleasant nature.«

Our nerves of taste are therefore not so organised as to allow us to judge every degree of sweetness independently of its strength so as to make the taste of it perceptible at all times. If we partake of saccharine in its pure solid condition we perceive a strongly metallic, acidulous taste, which is accompanied by a sharp grating feeling in the throat, *i. e.* a sure sign of irritation of the mucous membrane. As saccharine is difficult of solution and as there is but little fluid for that purpose in the mouth, the solution of the solid or rather, dry saccharine proceeds very slowly, and in consequence we retain the unpleasant taste just described for some length of time.

Saccharine must, therefore, always be diluted, if we wish to judge of its agreeable taste and form a right opinion of it. In various detailed treatises on saccharine this point has been

mentioned in particular; Stutzer (Saccharine. Examination of its chemical physiological action) says for instance:

»Even when largely diluted, for instance 1 : 10 000, saccharine still tastes intensely sweet and possesses an agreeable flavour.«

Mosso and Aducco say:

»The characteristic quality of saccharine is its extraordinarily sweet taste, which is still perceptible in a neutralised solution of 1 grm. to 70 000 grms. of distilled water. The sweet taste of common commercial sugar can only be made perceptible in an equal measure when the proportions are as follows: 1 grm. of sugar to 250 grms. of water.« Saccharine is therefore t according to these writers, 280 times sweeter than sugar.

Dr. Jessen determined the sweetness of sugar both in comparison with Indian cane-sugar and with the marketable beet-root sugar and discovered pure saccharine to be 360 times sweeter than cane-sugar and 300 times sweeter than beet-root sugar, easily soluble saccharine to be 304 times sweeter than cane-sugar and 253 times sweeter than beet-root sugar.

When saccharine was first introduced, complaints were made, however, about its taste whenever saccharized beverages, that is to say saccharine in a diluted state, were in question. The after-taste left by these beverages was said to be disgusting and smacked of bitter almonds. Investigations have shown these complaints to be correctly based; we discovered, that if saccharine was exposed to high temperatures for a time it decomposed easily, and that one of the products of this decomposition was the carrier of this taste, which was also clearly perceptible to the olfactory organs. By means of alterations and improvements in the manufacture, we have succeeded in removing this drawback. In order to prevent any saccharine being sold that was overheated and had thereby acquired the bad taste just mentioned, and with a view to exercising the strictest control possible, each separate quantity of prepared saccharine, prior to leaving our factory, is carefully examined and tested as to its taste, sweetness and purity in the laboratory and kept back if it does not reach the highest standard of excellence.

The precaution and care observed in the manufacture of saccharine should, however, not be omitted later on when used in households or utilised in industrial establishments. Although we draw special attention to this in the directions for use, yet it may be advisable to point out now, that whenever saccharine is put into cold water and boiled with the latter, the disagreeable taste in question is easily produced, particularly so if the boiling or cooking be continued for some length of time.

Saccharine must, therefore, be put into hot fluids only after the latter have been boiled and removed from direct contact with the fire.

In judging of the taste of saccharine it is of importance to consider that it has no body (volume), at least none worth mentioning. Solutions of saccharine are, therefore, very thin and operate differently on the nerves of taste than the more consistent, glutinous sugar solutions. The conformity of taste of both is, however, remarkable, whenever an otherwise indifferent body is added to the thin saccharine solution, which makes the latter slimy and equal in consistence to the sugar solution. Comparative practical experiments have proved that it was impossible then, even for the finest palate, to distinguish between the two solutions. Proof was thus furnished that it was not in sweetness by which they differed.

In the clinique of the medical university of the Royal Charité at Berlin the experiment was successfully made by Professors Dr. Leyden and Dr. Gerhardt in the department for Females, to sweeten the beverages of a large number of patients with saccharine as it is now made, without their knowing anything about it. Not a single one remarked any difference in taste.

At the general assembly of German sugar manufacturers on 17th & 18th May 1888, Director Boegel-Bielau reported that the saccharine made at present equalled in taste a very fine solution of refined sugar.

The sweetness of the saccharine articles offered for sale by us varies, as already stated, according to the kind between 275 times and 500 times greater than that of commercial sugar. There is no apparatus such as the polarimeter, for sugar, to determine the exact sweetness of saccharine; we are still quite dependent in this respect on tongue and palate and a test with them is far less difficult and more reliable than most people are inclined to believe, provided largely diluted solutions of saccharine are made and then compared with corresponding sugar solutions. Saccharine does not ferment, as will be shown in a latersection, nor is it subject to any other change; **the sweetness of saccharine of all varieties is therefore perfect and enduring.**

Solubility. As saccharine has never to be partaken of in a solid condition but always adequately diluted, its solubility is a matter of secondary importance.

Saccharine does not dissolve much in cold water, in warm water it is a little more soluble. It is quite soluble in boiling water. The saccharine solutions have an acid reaction, and from a concentrated solution produced by using warm water, the saccharine separates on cooling in fine, needle-shaped (acicular) or short crystals. Saccharine is more easily soluble in alcohol than in water, still more so in ether; but even in water its

solubility can be greatly augmented by constantly neutralising the solution with carbonate or bicarbonate of soda, which must be added very carefully. If a solution of this kind be acidified with hydrochloric acid, the saccharine reprecipitates.

Dr. A. Stutzer of Bonn discovered that:

»500 parts of distilled water of + 15° C. dissolve about 1 part of saccharine.«

Professor Dr. Mosso of Turin confirmed the fact that 0,4305 grms. of saccharine dissolve in 100 ccm. of distilled water at a temperature of + 25° R.

Dr. Jessen of Würzburg discovered that in order to dissolve 1 part of pure saccharine 259 parts of water were required, therefore 3,867 grms. of pure saccharine dissolve in 1 lit. of water; on the other hand 1 part of easily soluble saccharine requires only 1,826 parts of water to dissolve it, in 1 lit. of water, therefore, about 548 grms. will dissolve.

We have discovered the following proportions as correct for the solubility of the different forms of saccharine in different fluids.

I. **Pure Saccharine.** In 1 lit. of water of the ordinary temperature 2,5 to 3 grms. of pure saccharine will dissolve.

In alcohol, according to its strength and in 1000 parts, various quantities of saccharine dissolve, as for example:

Alcohol of	10	20	30	40	50	60	70	80	90	100%
Saccharine	4,5	6	9	15	22	23	24	25,5	24	23 grms.

Since pure saccharine, as already mentioned, is not a single substance and the acids it contains vary in solubility, some of it easily separates again from aqueous solutions. These precipitates are the less easily soluble para compounds, therefore not sweet, and whenever they occur they must be filtered off. If importance be attached to clear, bright solutions, refined saccharine should be used.

II. **Refined Saccharine.** In 1 lit. of water at the ordinary temperature 2,5 grms. of refined saccharine dissolve, and 3 grms. in lukewarm water, without leaving the slightest residuum. In 1000 parts of alcohol of the following strengths

	10	20	30	40	50	60	70	80	90	100 %
dissolve	4	6	9	12	16	20	39	28	27	26 grms. of ref. sacch.

The solubility of saccharine in alcohol is, therefore, much more considerable than in water and rises with the strength of the alcohol up to 80 % of the latter in the case of pure saccharine, and up to 70 % in that of refined saccharine, but diminishes again in higher strengths.

In aqueous solutions of various substances the solubility of refined saccharine remains constant independently of their concentration, thus for instance in 1 lit. there dissolve

10	20	30 % aqueous sugar solution
4,5	4,5	4,5 grms. of refined saccharine.
10	20	30 % aqueous starch-syrup solution
5	5	5 grms. of refined saccharine.
10	20	30 % aqueous glycerin solution
5	5	5 grms. of refined saccharine.

The same may be said of its solubility in oils and fats, in which saccharine dissolves with difficulty, for in 1 lit. of salad oil, or poppy-seed oil, cod liver oil, melted butter or fat only 1 grm. of refined saccharine dissolves. On the other hand the solubility of saccharine in weak acids rises with their concentration, thus in 1 litre of

5	10	15 % of tartaric acid dissolve
5,5	5,5	6 grms. refined saccharine.
5	10	15 % of citric acid dissolve
5	6,5	10 grms. of refined saccharine.
5	10	15 % of acetic acid dissolve
5	7	8 grms. of refined saccharine.

III. & IV. **Easily soluble saccharine and easily soluble refined saccharine** both dissolve with great ease and in considerable quantity in cold and warm water, also in all aqueous solutions, are difficult of solition in alcohol and are not soluble at all in strong acids. The easily soluble saccharine dissolves in both forms perfectly, and does not leave any residuum; the solutions are neutral.

V. **Saccharine Tablets** dissolve easily and quickly with slight effervescence, since some carbonic acid is set free; the solutions are of a feeble alkaline nature.

The solution is different according to the form of the saccharine and the purpose for which it is used; thus for instance, when saccharine is to be used in the manufacture of liqueurs it has to be dissolved in a different manner from that employed for its solution when intended for use in brewing. In the directions for use we mention the most suitable method of solution in each particular case.

In the manufacture of aqueous solutions that have to be kept for any length of time, the fact must not be overlooked that it is in general necessary to use best distilled water and none containing lime, secondly it must not be forgotten that the saccharine must not be boiled with the fluid in any case, but put into the latter when hot and the vessel then removed from the open fire.

Body. When dissolved, the volume of a product unites with the fluid and increases the consistency of the latter; professionals therefore speak of the »body« of fluids when they wish to express condition, and say the liquids have become thicker, more glutinous, or, to use the technical phrases, »fuller, rounder and smoother«. Body in fluids was always considered by manufacturers of liqueurs etc. as indispensably necessary — it has been looked upon hitherto as the standard of quality in many of their products.

Saccharine possesses no body, at least none worth speaking of, when dissolved in fluids, for its intense sweetness admits only of its being used in weak solutions. Owing to this, beverages sweetened with saccharine operate, in comparison with sugared drinks, quite differently at first on the nerves of taste; this has often been stated in prejudice of saccharine and set down as a disadvantage.

What would people say, if saccharine were as old as our century is and sugar an invention of to-day? Would they not complain about attempts to make beverages that are to quench our thirst, but which only result in the production of thick and slimy sugar-concoctions, adhering to the tongue, parching the mouth and exciting thirst? It is evident that the »body« of which there is so much talk is not a consequence of any desire to possess it, but it is the mere result of imperative necessity. Sugar has been as yet the only serviceable sweetening substance and therefore it *had* to be used in the manufacture of sweet beverages. To have this so-called body in drinks is a custom forced on us, therefore. Time and custom have had the effect to be expected, »body« has come to be considered a desirable quality in our beverages that gives them the stamp of excellence, and thus what might have been considered a vice, is praised as a virtue!

Science in its progressive research has discovered in saccharine a new sweetening substance that pleases the palate by its sweetness without its possessing a most undesirable quality common to sugar. This quality has greatly contributed, we do not hesitate to say, to limit the use of sweet beverages in households. That peculiar adhesive, paste-like after-taste so erroneously termed »body«, is the quality in question. In some countries dry wines and champagnes are preferred to sweetened ones. Before the invention of saccharine it was, however, impossible to avoid the use of sugar in some drinks. This fault has now been remedied, and in course of time and by dint of increased knowledge the public in general will gradually be cured of this desire for »body« in drinks. Glutinous lemonades etc. will cease to be relished and their peculiar after-taste will no more be tolerated.

For manufacturers of sweetened beverages this change will be most agreeable too, for setting aside the technical difficulties and trouble combined, in the use of sugar, the latter is always dangerous to prepared beverages as it makes them inclined to turn or spoil. Saccharine has quite the contrary effect on beverages, not only does it keep them from spoiling or turning, but owing to its antiseptic qualities and non-fermentation, it also tends to make them keep extraordinarily well.

We shall recur to this most important point when treating of the application of saccharine in the various branches of industry.

Acidity. Saccharine is an acid, as already mentioned, and turns blue litmus-paper red.

In determining the acidity, Dr. Jessen found that in order to neutralize 10 ccm. of a 1‰ saccharine solution 5,8 ccm. of a 1/100 normal potash-solution are required. 1 grm. saccharine requires, therefore, 0,3248 grm. K O H to neutralize it.

Chemically speaking, saccharine possesses a strong acid character distinguishing it from most other organic acids. It expels carbonic acid and sulphuric acid from their salts; on boiling an acetate with saccharine, acetic acid escapes. It can be boiled for a long time with diluted acid or alkalis without losing its sweetness; even at a pressure of several atmospheres and a temperature of 150° it does not change in its solutions. With strong concentrated acids alone, such as hydrochloric acid, aqua regia and sulphuric acid it is destroyed after protracted action; the same may be said of caustic liquors that destroy everything else of organic character. Easily soluble saccharine reacts absolutely neutral.

Melting-point. Saccharine melts at about 210° C., is partially decomposed and emits a peculiar smell resembling that of bitter almonds. As already communicated in speaking of the solubility of saccharine, decomposition with the accompanying taste and smell are perceptible at temperatures under 200° even, and therefore we draw attention to the fact that it is advisable not to expose saccharine for any length of time to temperatures above 100°, or its pure sweet taste is affected. The occurrence of the taste of bitter almonds is not necessarily the result of exposing the whole mass of saccharine to excessive heat. To induce it, all that is needed is that particles of saccharine may adhere to the sides of the boiler, begin to burn, decompose and finally melt. These particles spread the odour through the whole of the saccharine in the boiler — the saccharine detaches them from the sides in its agitation — and the entire fluid sweetened with this saccharine thus acquires an unpleasant, indeed a repulsive flavour.

Crystallisation. Refined saccharine crystallises from water in little rhombic plates that appear to belong to the monoclinic system; by a twin-shaped growth of the above by slow crystallisation there arise from dilute solutions spear-like aggregations. From absolute alcohol and concentrated acetic acid saccharine crystallises in compact, thick prisms.

Seen through a microscope common trade saccharine proves to be a mixture of two bodies; if as much as will lie on the point of a knife be dissolved in a dilute solution of soda and extracted again with hydrochloric acid, it will be discovered under the microscope that there are two varieties of crystals: the spear-like, deformed, thick saccharine crystals in company with a minority of needles concentrically grouped in spheres, and consisting of para-sulphamine benzoic acid.

Antiseptic qualities. Saccharine may be said to have two qualities not characteristic of other sweetening substances ~~for it~~ it is unfermentable; indeed it is **the only unfermentable and permanent sweetening substance;** secondly it operates antiseptically, prevents decomposition and fermentation ~~which quality makes it most suitable in the manufacture of beverages, preserves etc. and gives it the preference over all its rivals.~~ ~~Saccharine~~ is therefore not only remarkable for its intense sweetness, but ~~also that~~ in contradistinction to other sweetening substances it does not spoil ~~but~~ on the contrary ~~possesses the effect of an eminent~~ conserving medium.

Saccharine has the quality of preventing the processes of decomposition and fermentation or of retarding them in common with other bodies, with the difference that these bodies destroy the functions of the organism more or less, whereas saccharine, as will be shown in the following section of this work, exercises no injurious effect on the organism and no influence on the change of matter.

The conserving effect of saccharine may be traced to its chemical nature. Saccharine is an acid and works antiseptically as such. The acidity of a 0,32 % saccharine solution corresponds to a 0,3 ‰ sulphuric acid solution. This is the reason why neutralised saccharine solutions or those made of easily soluble saccharine are less preservative than sour solutions made of the pure product article. On the other hand, the conserving effect of saccharine may be attributed to its origin, for it is a derivate of benzoic acid and as such is related to salicylic acid.

Many scientists of celebrity have made the preservative action of saccharine the subject of a close investigation, and we

on our part have always attached great value to a thorough explanation of the matter, for conserving mediums influence more or less the functions both of human and animal organisms and consequently must be regarded in the light of dangers to both, to health in short. In the chapters treating on the action of saccharine on both human and animal organisms and showing its harmlessness, we shall furnish proof that this general presumption is not justified in the case of saccharine.

It would take up too much space to describe all the experiments that have been made to determine the preservative action of saccharine; we must, therefore, confine ourselves to communicating the most important results attained by these experiments.

Stutzer discovered that a meat peptone solution kept in a warm room (temp. 20° C.) for 12 hours became turbid, offensive in smell and contained bacteria, but when saccharine was added to it to the extent of 0,01 % decomposition with development of bacteria did not take place until 24 hours, with 0,02 % in 48, and with 0,01 % in 60 hours.

A 5 % solution of starch sugar, to which phosphate of potash and nitrate of ammonia were added and thus formed a favourable nutritious solution for bacteria, became turbid in 12 hours and contained both fungi and bacteria: with an addition of 0,5 % of saccharine, decomposition was retarded for 3 days, with 0,1 % for 4 days, with 0,2 % for 8 days.

A 3 % solution of sugar, also mixed with phosphate of potash and nitrate of ammonia, became turbid in 12 hours and contained both fungi and bacteria, but when 0,05 % of saccharine was added the decomposition of the sugar and formation of bacteria were checked for 48 hours, and with 0,10 % for 72 hours.

Professor Dr. Landolt reported at the general assembly of the Association of Beet-root sugar industry held at Hanover on 21st & 22nd May 1886 on the antiseptic qualities of saccharine as follows:

A 3 % meat solution that developed without the addition of saccharine fungi in 1 day, showed none before 1½ days when 0,02 % saccharine was put to it, with 0,04 % not before 4 days, with 0,1 % not before 13 days and with 0,2 % of saccharine not before 25 days. — In a cane-sugar solution mixed with small quantities of potassium phosphate and ammonium nitrate, fungi appeared in 3 days, when 0,02 % saccharine was added not before 4, with 0,05 or 0,1—0,2 % no signs of decay were visible in 14 days. — Milk that curdled at a temperature of 16° in 18 hours, did not curdle before 24 hours when 0,1 % saccharine was added, with 0,2 % in 47, with 0,3 % in 70 and with 0,4 % not before 120 hours. In the conserving of fruits and in keeping milk, saccharine would, therefore, prove very serviceable.

In Paris Mr. P. Mercier has studied the effect of saccharine on bouillon, on the peptonizing of albumen, on the conversion of starch by diastase into sugar, and on the ammoniacal fermentation of urine.

The results of these investigations may be abridged as follows:

1) Saccharine has not an injurious effect either on the peptonizing of albumen with pepsine, nor on the conversion of starch by means of diastase.

2) Of all antiseptica used for comparative purposes, saccharine alone could prevent the putrefaction of urine and formation of hydrococcis.

3) The effect of a solution of 3 % is completely to prevent the development of micro-organisms in bouillon. This 3 % solution is more effective than one of 15 ‰ boric acid or one of 1 ‰ of carbolic or salicylic acid.

4) Saccharine retards or prevents the fermentation and putrefaction of organic matter. A saturated solution of 3,20 gr : 1000 prevents the development of microbes completely. It checks the latter but little however, when neutralised.

At Antwerp Professor Dr. H. van Heurck has made various and protracted experiments with saccharine.

We may mention the following:

1) A small bundle of hay was cut in two parts and each of them put into a separate vessel. The latter remained open exposed to air and dust in a room the temperature of which varied from 15° to 20° C.

One of the vessels was filled with pure water, the other with a solution of 3 ‰ saccharine.

The experiment was commenced on 10th January 1888.

After a lapse of 3 days the water not containing saccharine was covered with bacilli and shortly afterwards the whole mass began to putrefy.

To-day, 3d May — that is to say 4 months later — the vessel containing the water mixed with a solution of saccharine, remains still untouched — the water has turned yellow from the hay in it, but its taste is agreeable and it possesses an agreeable odour like cumarin.

Some days ago saccharine was mixed with the water that contained none previously and which had a very bad smell. On the following day the smell was much less, in ten days' time the water was odourless and clear; the entire mass was disinfected and lay at the bottom of the vessel.

2) Beef broth with the fat removed was warmed with a mixture of 3 grms saccharine per litre, and in order to protect it from dust was put into a vessel and covered over with ordinary paper. Since 16th January this broth remains unchanged and has retained its aroma (up to 3d May).

3) One litre of barley beer was treated with 3 grms saccharine and exposed to the air. This beer has remained quite unchanged, has not fermented again, and this is after a lapse of 6 months.

4) A piece of raw meat weighing about 250 grms was on 25th January put into a vessel containing 500 grms of a 3 ‰ saccharine solution. In 8 days the solution was renewed because the lower part of the fluid had become turbid owing to the blood issuing from the meat. Since then the meat has remained unchanged, has almost the appearance of boiled beef, and the saccharine solution is perfectly clear.

Professor Van Heurck kindly placed the subjects of his experiments at our disposal, and thus we were enabled to exhibit the articles (hay, bouillon, beer and meat) preserved with saccharine and kept for 6 months, at the International Exhibition of Brussels in 1888, and thus afforded all visitors to the above exhibition an opportunity

of inspecting them and of forming their own conclusions as to the antiseptic and preservative effect of saccharine.

Professor Dr. Salkowski reports in the Virchow Archives on his investigations in this direction:

1 per cent peptone solutions (Pepton. depurat. of Grübler), prepared with a cold saturated saccharine solution were kept in open vessels at about 30° C., the evaporated water being replaced from time to time. So long as the observations lasted no signs of putrefaction were visible: several months later the solutions were still odourless and had only lost their brightness somewhat because of the dust that had fallen in. When filtered through paper, they were quite clear and remained unchanged.

The solutions made with water, for comparison, began to putrefy in 24 hours, were quite putrefied in 48 hours and had become filled with long and short chain-like films which were kept in constant motion.

Chopped meat stirred up with water (25 grms meat to 100 of water) were at a temperature of 30° quite putrefied in 24 hours; mixtures containing a cold saturated saccharine solution instead of water, were still odourless after 24 and even 48 hours — after 72 hours a faint putrefactive odour could be remarked and in 96 hours it was stronger.

Professor Dr. Mosso and Dr. Aducco report as follows in a treatise on the therapeutic use of saccharine:

As a derivate of benzoic acid, we were by no means surprised to observe that the urine of those animals, to which saccharine had been given, began to putrefy much later and that their excrements smelt far less offensively than they usually do. It seemed to us probable that a substance such as benzoic acid sulfinide, which in addition to its sweetness has the advantage of not exercising any injurious effect on the organism, and no influence on the change of matter and which, as we found occasion to mention in an earlier work on the subject, possesses the quality of passing unchanged into the urine — we thought it possible, that such a substance could be used in the place of other agents, which are able to retard or prevent putrefaction and fermentation, but destroy at the same time in a greater or less degree, the functions of the organism.

These exhaustive investigations furnished the following results:

I. **The action of saccharine in alcoholic fermentation.** The experiments on the influence of saccharine on the alcoholic fermentation of grape-sugar show that saccharine in a dose of 0,16 per 100 greatly diminishes the activity of beer-(lees) yeast. This anti-fermentative effect of saccharine is manifested both at a temperature of 30° C. and at one of 16° C. only, and continues for some time.

II. **The effect of saccharine on the alkaline fermentation of urine.** The experiments tended to prove clearly that saccharine has a retarding effect on the fermenting process of urine kept below a temperature of 37° C., this anti-fermentative action being still greater when non-neutralised saccharine solutions were used.

III. **The action of saccharine on the decomposition of pancreas infusion.** Saccharine considerably retards the putrefying process of a pancreas infusion and checks the development of decomposing bacteria.

IV. **The effect of saccharine on the fermentation of milk.** In a mixture of equal parts of milk and 0,32% or 0,16% saccharine solu-

tion, the fermenting process of milk (both at 16 ° and 36 ° C.) begins later than in a mixture of equal parts of milk and distilled water.

V. **The action of saccharine on pepsine.** a) If there exists in a pepsine fluid saccharine to the amount of 0,16—0,932 % the peptonising of the coagulated albumen is retarded but not checked. b) If the quantity of saccharine is reduced to 0,0064 % the activity of the pancreas secretion is not influenced in the least.

VI. **The effect of saccharine on ptyaline.** Saccharine as a dose of 0,16—0,23 % both in acid and neutral solutions, diminishes the amylalytic effect of the diastase of the saliva. A neutral saccharine solution proves more effective.

Professor Dr. Kornauth of Vienna reports in his »Studies on Saccharine«:

Influence of saccharine on beer-yeast (saccharomyces cerevisiae). By adding 0,05 grm of saccharine = 5 % of the yeast used the propogative force decreases, whereas by a further addition of 0,04 grm of saccharine no further reduction of great importance is observable. On using 0,005 and 0,01 grm of saccharine the propogative force increases, which must be ascribed to the acid nature of saccharine. A decrease of propogatvie power occurs when soluble saccharine is used but not before 0,1 grm is applied to the yeast.

According to Dr. Michaelis of Waldenburg 0,5 % of saccharine prevents decomposition of urine and 0,3 % saccharine destroys the streptococcus puerperalis in its development.

Professor Dr. Constantin Paul of Paris presented to the Académie de Médecine a communication on saccharine as an antiseptic in connection with the digestive organs. For the latter saccharine is a valuable antiseptic since it is not injurious. In a dose of 0,20 grm it causes no complications of any kind in the nourishment of the body; it possesses particular, antiseptic qualities, which make it a most serviceable medicament in treating diseases of the mouth and stomach and probably of the urinary passages too.

In a dose of $^1/_{200}$ it prevents the ammoniacal fermentation of the urea for 7 days: it further checks the development of fever microbes and of those known by the name staphylococcus pyogenis, the bearer of the purulent infection. It can be used in tooth-powder and to make a solution for cleansing the stomach.

Professor Dr. L. Roesler of Klosterneuburg near Vienna came to the following conclusions in his investigations on the antifermentative and conserving qualities of saccharine:

I. **Its effect in checking fermentation.** By adding 20 ccm of alcoholic saccharine solution corresponding to 0,5 grm of saccharine to 1 litre of wine the fermentation was stopped completely.

II. **Its prevention of mould formation.** A 20 ccm alcoholic saccharine solution corresponding to 0,5 grm of saccharine added to 1 litre of wine suppresses formation of mould entirely.

III. **The stoppage of acetous fermentation.** An alcoholic saccharine solution of 20 ccm (= 0,5 grm saccharine) added to 1 litre of wine prevented the latter from getting mouldy or sour and kept it quite clear.

Dr. Jessen came to the following conclusions in his experiments on the anti-bacterial effect of saccharine:

I. **Effect on the ammoniacal fermentation of urine.** The result showed that saccharine purum in doses of 0,01 % prevents the

appearance of alkaline fermentation for 24 hours, in stronger doses for several days up to several weeks.

II. **Effect of saccharine on bacteria in the lactous fermentation.** The result proved saccharine purum in concentrations of 0,02 up to 0,1 % retards the action of lactic acid bacteria somewhat energetically, and further that saccharine solubile in concentrations of 0,02 up to 0,2 % hinders the germination of the above bacteria.

III. **Influence of saccharine on the putrefaction of albuminous fluids.** In quantities of 0,1 % pure saccharine prevents putrefaction of albuminous fluids, whereas saccharine solubile in concentrations of 0,2 % seems to have no influence in this respect.

IV. **Influence of saccharine on the increase of fungi in water.** The investigations in this direction furnish proof that saccharine purum decidedly checks the development of fungi in water and the stronger the concentration the more is this the case.

V. **Influence of saccharine on the development of certain diseases.** Saccharine purum possesses in a moderate degree the ability to check the action of fermentation and putrefaction; on pathogenic organisms operating on a nutritious part it has no influence. A weak checking effect on the part of saccharine solubile on lactic acid bacilli could alone be determined.

Professor Dr. Paschkis of Vienna discovered in his experiments with pure saccharine for the preservation of milk, that:

1) 50 ccm of pure milk mixed respectively with 0,3 %, 0,5 % and 1 % of saccharine, the temperature being 14°, curdled respectively in 7, 9 and 16 days, whereas the controlling tests curdled in the space of 24 hours.

2) That 40 ccm of milk mixed respectively with 0,4 %, 0,8 %, 1 %, 2 % and 3 % of easily soluble saccharine curdled respectively in 48 and 96 hours and the others not even after 7 days — the first three tests had become very sour after 24 hours, the remaining ones only slightly sour.

3) On another occasion milk was mixed with a 20 % saccharine sodium solution in such proportions that test a. contained 0,5 %, test b. 1 %, test c. 2 %, test d. 3 %, test e. 5 %, test f. 10 % of sodium saccharine. After 24 hours the controlling test curdled, tests a., b., c. were sour, test d. and e. slightly so, and test f. was neutral. a. curdled in 11 days, b. in 13, c., d., e. and f. (the latter became slightly sour in 10 days) were dried up by about 1/3 in 34 days, but not curdled.

4) In pancreas infusions with pure saccharine in them no smell of putrefaction was perceptible after a lapse of 7 days; urine, too, did not putrefy in 14 days with a mixture of 0,2 up to 1 % of saccharine in it.

Dr. Paschkis obtained similar results in very thorough experiments on the putrefaction of beef-tea or broth. Whereas the controlling solutions were putrefied in 3 days, the solutions treated with 0,5 and 1 % of saccharine were not decomposed in 4 weeks and retained the agreeable odour of broth. Solutions mixed with 2 % remained free from mildew and putrefaction till they dried up. He says:

»The anti-putrefactive effect of saccharine is surprising; when mixed with 0,5 % of saccharine meat peptone or yeast peptone solutions did not putrefy after standing for some weeks, that is to say they remained perfectly clear and smelt agreeably of meat broth.«

Although in these statements all the investigations that have been published on this subject, are by far not given, yet those described will suffice. We would gladly have confined ourselves to still fewer, if we had not entertained the desire, even at the risk of wearying our readers, to furnish ample proof to all who do not know saccharine how thoroughly this product has been investigated, and that our communications are not merely made with a view to praising our own article, for they are simply the outcome of scientific research.

The nutritive value of saccharine.

Saccharine serves as a spice like salt, pepper, mustard, vinegar, vanilla etc. and it has therefore no nutritive value. Other spices were never expected to have any value in this respect, yet nevertheless the lack of nutriment in saccharine has been actually set down as a fault of this product.

Saccharine entered the lists as something perfectly new, and so something had to be detected in it that could be pronounced a fault, if only for the sake of its critics! Failing to find anything else the opposers of this excellent product objected to its having no nutritive value, very wisely supposing that this want would be clear enough to superficial readers! Objections of this kind are both unjust and unreasonable as all disinterested persons will see. Spices are used to flavour, to give a certain taste and are used for that very reason in the smallest possible quantity. Even if salt, pepper, mustard etc. were the most nutritious of articles, their taste would be an obstacle to our partaking largely of them; a man trying to live *e. g.* on mustard would be considered of weak intellect! Spices are substances used with the intention of improving the taste of our food and are added to the latter in minute quantities forming but mere fractional parts of the nutriment necessary to support the human body, so no weight is attached to the nutritive value of spices; and even if the latter had any such value it could never be of much importance under any circumstances.

Why, we ask, should saccharine, a sweetening spice, be forced in as an exception? The answer to this question is not difficult! There used to be only one sweetening spice and that was sugar, and as that happens to have in addition to its sweetening quality a certain nutritive value, some people imagine they are justified in expecting the same of saccharine, but they quite overlook the fact that sugar is used far more as a sweetening substance than as nutriment. The public have

got accustomed to take this nutrimental value as a matter of course because it happens to be present in sugar, but nobody thinks of eating sugar as food to support the body. The nutriment found in sugar can be replaced by other edibles far cheaper, better and more beneficial to health than sugar, but the sweetening property of this spice cannot well be dispensed with and therefore its nutrimental value is taken into the bargain. The actual value of sugar as nutriment is of a rather dubious nature. On the occasion of a discussion on saccharine, Professor Dr. Stokvis, Chairman of the Netherlands Supreme Sanitary Council, referring to this point said:

»Saccharine cannot replace sugar completely; it leaves the body unchanged and is, therefore, not a nutriment; but properly speaking sugar is not one either, for of the 400 to 500 grms of carbohydrates that a grown-up person requires daily only 20 grms are eaten in the shape of sugar in Holland, and in Germany about 9,5 grms.«

What importance the scientific world attaches to sugar is sufficiently well known. Medical men caution many against a liberal use of sugar, in other cases it is forbidden as injurious and dangerous.

What eminent therapeutists think of sugar as a nutriment and its action in respect to human health is shown in the following extracts.

In his work on hygiene — see page 433 — Dr. Max Reimann says:

»Sugar generally and sweets in particular should be avoided as they greatly accelerate the growth of fat, can be dispensed with and are not beneficial to the digestive organs.«

Professor Uffelmann, Rostock, says in his handbook on the private and public hygiene of children — see page 261:

»It is of equal importance to use precaution in respect to the victuals containing an abundance of organic acids and sugar. The former ruin digestion most easily, although they are not so injurious when infancy is over; if sugar is not digested at once, when eaten in large quantities, it is quickly converted into the above acids.«

Ernst von Brücke observes in his work on physiology, vol. I, page 357 (Vienna 1885) — on digestion:

»We cannot possibly substitute sugar for starch as a nutriment, for it cannot be partaken of in such quantities owing to the disorders it calls forth in the alimentary canal, partly owing to the great attraction for water, which sugar has especially in concentrated sugar solutions, partly owing to the ease with which the sugar passes into the lactic acid fermentation. It is well known that sugar coming into the stomach increases the acidity very rapidly, whereas starch on coming into the stomach occasions the formation of lactic acid only very gradually, for it passes through the phases of conversion into dextrin, then sugar and finally into lactic acid. It is, therefore, an erroneous theoretical view of the matter to try to make people fat or to nourish

them with large quantities of sugar. It is not the quantity of sugar eaten that produces fatness, for sugar could not be partaken of in any such quantity for any length of time, that it must be partaken of, if it is to serve as a substitute for starch. If sugar be partaken of in too large quantities diarrhoea is the result, and a falling away ensues, and of this we can convince ourselves by experiments on animals.«

Dr. von Hüttenbrenner, director of the Carolinen Kinder-hospital (hospital for children) and lecturer at the Imp. and royal university in Vienna, says in his work on the hygiene of children (Vienna 1888) — see page 146 — (stomalis aphtosa. Thrush, disease of the mouth):

»Little children have generally a mouth-wash of borax (borac. ven. aqu. dist. 100.0) administered to prevent at the same time the growth of fungi (thrush). The addition of syrup (or any kind of sugar) or of honey-juice should be avoided, for they soon turn sour on warming and always do become so whenever remnants of them are left behind in the mouth.«

These remarks will suffice to show that it was a decided mistake to object to saccharine on the ground of its having no nutrimental value, and we might now close this chapter, if there did not happen to be some scientists of great renown, who made use of this point as a motive for the aggressive position they took up with respect to saccharine.

By reason of a »Rapport du Comité d'hygiène et de salubrité de la Seine« dated 22nd June 1888 the importation of saccharine into France was forbidden. This report given as it was without an examination of the product, was vehemently attacked later on, rejected as not justified by the Netherlands Supreme Sanitary Council and confuted by a number of learned men. Even the president of the Comité d'hygiène acknowledged his error and stood up for the perfect harmlessness of saccharine, but said that the reason of his proceedings was the lack of nutrition in this product. As this occurrence called forth a dispute in the leading medicinal journal of France, it may be of interest even to circles not connected with the matter, and for that reason we will not refrain from publishing the polemic:

Translation of certain articles in the »Journal de Médicine de Paris«.

(Edit. 6 of 10th February 1889.)

Saccharine. The French Government, which without doubt dreads the consequences that the use of saccharine might have for the national industry, has come to the determination, as is known, to prohibit the importation of this substance into France. We should never have thought of criticising this measure, if it had not been based on a wrong supposition — on the injuriousness of saccharine.

Mr. Dujardin-Beaumetz and several other therapeutists who now consider saccharine injurious, were at first its warmest advocates, that is to say before the Government gave them to understand that it was necessary to prohibit the use of it.

We admit that the French State has due reason to dread the substitution of saccharine for sugar, for it derives a regular revenue of more than 200 million francs from the sugar tax. We believe, however, that fiscal measures might have been adopted based on considerations touching the budget and not based on scientific examinations that are not seriously entertained in any other country.

In consequence of this the Netherlands Government has been discussing the possible dangers which might arise for public health from the habitual use of saccharine, and has requested the opinions of the several provincial sanitary boards on the subject. The latter have weighed together the conflicting opinions on the matter and have decided in favour of the use of this new body. The Supreme Sanitary Council, being entrusted with the matter and having instituted a very strict investigation, has just declared that from a hygienic point of view it has no occasion to advise the prohibition of saccharine for nutritive purposes.

To this we add that the English, American and German Governments, after studying the saccharine question in full earnest, consider saccharine as a perfectly harmless spice and as a useful substance for preserving provisions owing to its eminent antiseptic qualities.

(Edit. 7 of 17th February 1889.)

Is Saccharine injurious?

Worthy colleague!

In the latest edition of the »Journal de Médicine de Paris«, I find the following passage relative to saccharine:

»Mr. Dujardin-Beaumetz and several therapeutists, who now declare saccharine to be injurious, were at first the warmest advocates of it, that is to say before the Government gave them to understand that it was necessary to prohibit the use of it.«

Allow me to enter my protest against this perfectly groundless reproach; in the saccharine question I have always upheld the view that the therapeutic standpoint must be kept separate from that concerning public health, and I have often expressed myself clearly enough on this point both in the Academy and also before other learned societies.

Considered from a therapeutic point of view, saccharine is a valuable acquisition and we cannot but praise its use both as an antifermentative medicament and above all in the hygiene of sufferers from diabetes.

If, on the other hand, we come to consider the public health, we should reject saccharine, not because it is injurious, but because it is not a nutriment in itself and further because it may serve to deceive the consumers, as the possible adulterant of victuals.

Without departing from the logic of facts, one can, as you see, condemn saccharine as a deception in nutriments and yet acknowledge it to be a most valuable medicament. That has always been my aim.

I remain etc. Dujardin-Beaumetz.

We publish the letter of our eminent therapeutist with the greatest pleasure and gladly declare that our reproach was not meant in a bad spirit.

We confirm the fact that Mr. Dujardin-Beaumetz shares our opinion and that he acknowledges saccharine to be a medicament and a spice not of an injurious nature.

As to his observations with respect to nutriment, we entertain the same opinion as Mr. Beaumetz that this substance cannot replace sugar. Since saccharine then is a valuable substance, with what right is its importation into France forbidden? That the State raises a duty on this product is but right, but that its importation should be prohibited seems to us to say the least, arbitrary.

The editor.

(Edit. 9 of 3d March 1889.)

Mr. Editor in Chief!

In Edition 6 of your esteemed paper we have read with great interest your article on saccharine and also in Edition 7 Mr. Dujardin-Beaumetz's letter, and return you our best thanks for the excellent service you have rendered the cause.

The circumstance that one of the leading authorities in physiology and therapeutics, your great countryman, Mr. Dujardin-Beaumetz, had taken up a debatable position, according to the statements of the Press at least, as to the question of the harmlessness of saccharine, was certain to prove an obstacle in the solution of this question; the recent declaration of that gentleman in Edition 7 of your paper must however be regarded as of great assistance in this matter, in which the opinions of the Comité d'hygiène publique et de salubrité du département de la Seine and of the Comité consultatif d'hygiène publique en France are still alone.

After Mr. Dujardin-Beaumetz has declared saccharine to be harmless and a valuable acquisition from a therapeutical point of view, the scientific part of the controversy is settled for us; the second part is a question on which the Government has to decide. Without wishing to criticize the logical conclusions Mr. Dujardin-Beaumetz comes to, we regard the scruples, which are urged for the prohibition of the use of saccharine for sweetening victuals, as merely »vox et preterea nihil«.

Permit us, Mr. Editor in Chief, to explain our views more closely.

Saccharine is a spice, such as salt, pepper, mustard, cinnamon, vinegar etc. are. The use of these substances is not conditional to their being nutriments — it suffices that they make our viands more tasty.

Sugar is a substance having the qualities of a spice and a nutriment; there is, however, no reason to require both properties in other bodies because they happened to be united in one body. Nobody would think of requiring this in saccharine, if it were older than sugar. There is no reason either for not separating the sweetening value from the nutritive value, for

1) there are many people, especially in the wealthy classes, who avoid using sugar and must avoid it owing to its nutrimental property;
2) there are numerous patients, who have to avoid using sugar owing to the influence it exercises on the body with respect to digestion;
3) the nutrimental value of sugar is accepted as such simply because it happens to be there; it would not be rational either

from an economical point of view, as from a hygienic standpoint it is neither right nor possible, to take the carbohydrates necessary for the maintenance of the human organism in the shape of sugar;

4) it is quite indifferent whether saccharine possesses any nutrimental value or not, for the quantities in which this substance are taken are so minute, that the nutritive value never would arise, even if saccharine were a concentrated nutriment of great value.

We request you to open the columns of your esteemed paper for our opinion also, and to accept the assurance of our sincere respects.

Salbke-Westerhüsen o. Elbe, 21st February 1889.
Manufactory of Saccharine.

Fahlberg, List & Comp.

The chemical physiological action of saccharine and its effects upon the animal organism.

The chemical physiological action of saccharine and its effects upon the animal and more especially the human organism have been investigated in a much more searching manner than its preservative properties, by scientists of all nations.

Long before the practical utilisation of the invention of saccharine, scientists of celebrity had taken an interest in this product, to which we first drew their attention, inciting them to a thorough study of the subject and placing at their disposal for experimental purposes sufficient quantities of the substance which at that time was not purchasable. The object in view was to ascertain the chemical physiological action of saccharine, so that conclusions could be arrived at as to its utility as an article of food, and its harmlessness confirmed beyond all doubt. Before this was done we could not proceed to erect an extensive manufactory intended solely for the production of saccharine. But this accomplished, the desire naturally was next to produce the substance in large quantities, to find a market for it and to make it serviceable for the various branches of the industry of Food-stuffs.

We had, it is true, confirmed our own opinions as well as those of several of our friends by a continuous and uninterrupted daily personal consumption of saccharine for years, and even in the largest quantities it can ever be partaken of as a sweetening substance by human beings, that saccharine exhibits no observable influence either on the physiological or the psychical functions of the human organism; but as we were not disinterested, this experience could and did not satisfy us; we were not content until strict and impartial scientists had confirmed our experience fully and unreservedly.

The scientific articles published since then on this subject are so uncommónly numerous and so voluminous that they would fill a volume were they all reproduced word for word, and published. We must content our readers by assuring them

that without exception*) they mutually agree in their results and confirm our observations fully and completely. We will now give an abridged account of the results of the most important trials.

Dr. A. Stutzer's experiments furnished the following results:

I. **The effect of saccharine on the digestion of protein substances by means of the gastric-juice. Experiments with cocoa-cakes, meat and bread:**

a) Saccharine had in no case a preventative action on digestion.

b) Saccharine, when used practically as a sweetener in combination with other nutriment in the proportion of 1 : 1000, can have no injurious effect on the processes of digestion.

c) Even in relatively large quantities exceeding those very considerably in which it is used, saccharine retarded the digestion of the protein stuffs in a slight degree only, but did not check it by any means. In a longer process of digestion, the digestibility of the proteids — no matter whether saccharine had been partaken of or not, and even if taken in a proportion of 1 part of saccharine to 2 parts of meat-powder — was raised gradually from 95½ to 96%. A more favourable result of digestion by means of the gastric-juice could not be attained under any circumstances even if no saccharine had been taken.

II. **The effect of saccharine on the conversion of starch-flour into sugar by means of diastase.** In a volume of 0,04 to 0,16 grm in 100 ccm of fluid and in connection with sugar at the same time, saccharine accelerated the solution of the malt in an astonishing manner and worked most favourably.

III. **What influence does saccharine exercise on the general condition of the living animal organism?**

Experiments with rabbits: 0,5 grm per day. The condition was normal and very good.

Experiments on dogs: Dose, 5 grms per day. General condition normal.

Stutzer came to the following conclusions:

As these animals consumed a dose 50 times larger than a human being would take in a day, saccharine cannot have an injurious effect on the general condition or health of men.

Professor Dr. Salkowski, Berlin:

I. **Effect of the saliva ferment on amylum.** Saccharine neutralized the effect of the ferment on amylum completely or retarded it at least considerably. This retardative effect depends, however, solely on the acid reaction of the solution. When instead of the original

---

*) The analytical chemist of an Austrian Association of sugar manufacturers proved an exception — perhaps it was lack of judgment on his part in physiology, perhaps he considered it more in keeping with his position to his Association — anyhow he arrived at false conclusions from the results obtained by his experiments. Professor Dr. Lehmann, Würzburg, Professor Dr. Kornauth, Vienna, and Dr. Jessen of Würzburg, the most efficient authorities to undertake the task, refuted his conclusions so thoroughly and successfully, that we merely mention this exception for curiosity's sake.

solution another exactly neutralized with carbonate of soda was used, not the least difference was observable between the tests with and without saccharine: in both cases the carbohydrates formed, were reduced with equal rapidity.

II. **Peptonizing of albumen by means of gastric-juice.** Saccharine does not disturb the effect of the pepsin in the least.

III. **Digestion of amylum by means of pancreas.** Saccharine prevented saccharizing, but failed to do so whenever the solution was exactly neutralized beforehand. As this process in the body always takes place with neutral or weak alkaline reaction, the prevention stated in the experiments is of no importance.

IV. **Trypsin effect.** In mixtures with and without saccharine the solution of the fibrin ensued at 40° with equal rapidity. The total result of the experiments may be said to have shown that even in saturated solutions saccharine does not disturb the digestion of albumen.

V. **Experiments on animals.** Dog, weight of body 6650 grms, 1 grm of saccharine per day, after 7 days 2 grms of saccharine per day. The general health of the dog remained unaltered the whole time, abnormalities in respect to digestion or the nervous system were not observed, the dog kept well and lively. Evacuation of excrements did not take place till the seventh day — they were of the same nature as common meat excrements. The urine was examined almost daily for albumen and sometimes for sugar; neither was found and the urine remained bright and clear. At the end of the experiment the weight of the body was 7100 grms or 450 grms more than at the beginning, the animal was weighed on the 11th day after fasting 24 hours.

It may be deduced from the above that saccharine does not influence unfavourably the digestion of meat and fat, nor the resorption; nor does it bring about an increased secretion or loss of albumen as benzoate of soda does.

A second experiment on a dog the body of which weighed 6500 grms that got a daily ration of 250 grms meat, 250 grms bacon and 1 grm saccharine had a similar result.

It seemed to me advisable to make some more experiments on rabbits to ascertain all about the digestion of the carbohydrates.

A rabbit weighing 1926 grms received for 12 days besides its ration of potatoes, bread and carrots a daily dose of 0,15 grm saccharine — the preparation was pumped into the stomach partly dissolved, partly suspended in the water, on the last day the saccharine was completely dissolved with the aid of a little carbonate of soda. There was nothing remarkable to be observed in this animal either, the excrements and the urine being quite normal. At the conclusion of the experiment the weight was 1864 grms, a little reduced therefore, but rabbits generally fall away when kept in cages.

Another rabbit weighing 2103 grms that also got a dose of 0,15 grm saccharine daily for 12 days, remained in normal condition and weighed at the conclusion 2075 grms.

Taking the experiments on dogs as a basis, a human being weighing 60 to 70 kilogrms. could take without any harm a dose of 10 to 20 grms of anhydrous benzoyl sulphouic imide. Allowing the possibility that the substance might operate far more powerfully on men, an injurious effect cannot possibly take place with a dose of 0,1 or 0,2 grm per diem, more than which is quite out of the question.

Further experiments were made to ascertain the development of the antiseptic effects in the alimentary canal. It would take up too much space to describe them here and now. Salkowski expresses the result of them in the following words:

»It must be admitted that the results of the experiments tend to prove that there need be no apprehension of injury to health in the use of saccharine.«

Professor Dr. Mosso, Dr. Aducco and Dr. H. Mosso of Turin report as follows on the physiological effects of saccharine:

The object of our investigations was above all to ascertain:
1) The rapidity of absorption.
2) The general effect of saccharine.
3) Its effect on the assimilative processes in nutrition.
4) The way in which it is eliminated from the organism.

In order to answer the above questions, we have made experiments on frogs, dogs, guinea-pigs and human beings; the results obtained agreed in all experiments.

I. **Experiments on frogs.** We have kept frogs for a month in a saccharine solution after carefully neutralizing the latter and renewing it every 2 or 3 days. The frogs kept remarkably well and never exhibited the slightest difference to other frogs which we kept for comparative purposes in pure water. The contents of stomach and urine tasted sweet. We have made numerous experiments also in connection with the injection of considerable doses of concentrated saccharine solution under the skin on the back, without being able to observe the slightest disturbance of the functions. Neither heart, breath, nerve centres nor muscles displayed any alteration. Only in the course of 15 minutes the urine was found to be a little sweet.

II. **Observations on dogs.** (1st series of experiments.)

1) No disturbances were observable in a dog that received 37 grms saccharine in 10 days.
2) The weight of the dog remained unchanged.
3) In the daily discharged urine no change was perceptible in respect to quantity, density, reaction and content of urea, hippuric acid, sulphuric and phosphoric acid.
4) An increase in the secretion of chlorine was observed.
5) The saccharine passed over into the urine without decomposing and sweetened the latter.
6) The urine sweetened by saccharine commences to putrefy much later than normal urine.

(2nd series of experiments.) It was proved on the other hand:

1) That the proportion between the quantity of food partaken and the quantity of urea eliminated in the urine and the sulphuric acid remains the same, even if saccharine be mixed with the food partaken.
2) That the nourishment proceeds normally even if saccharine is taken with the food, can even be improved, so that the bodily weight is considerably increased.

(Note: The dog weighed 16 000 grms, in 11 days 19 000 grms; its bodily weight had consequently increased by 3 kilogrms in that time.)

III. **Observations on guinea-pigs.**

1) The saccharine appeared in the urine after its introduction in a space of time varying from 15 to 30 minutes.
2) Seven hours after a dose of 0,01 to 0,02 grm saccharine in the stomach the substance was not entirely absorbed.
3) The blood was never found to be sweet.

IV. **Experiments on human beings.**

1) Saccharine taken even in doses of 5 grms at one time caused no disturbance, as none of the functions of the organism varied in their physiological course.

2) Saccharine does not pass over into the saliva.

3) Saccharine does not pass over into the milk.

4) Half an hour after taking saccharine the urine has a strongly sweet taste.

5) 24 hours after taking 5 grms of saccharine the urine is no longer sweet.

V. Conclusions arrived at.

1) The experiments made with dogs prove that the saccharine introduced into the animal organism passes over into the urine without undergoing any change.

2) Saccharine taken several days running and in large quantities has no influence on the assimilative functions.

3) The variations in the composition of urine in the normal condition are observable too, when saccharine is taken.

4) Saccharine passes exclusively over into the urine.

5) Saccharine does not pass over either into the milk or into the saliva.

6) If introduced into the stomach or subcutaneously, it is very quickly absorbed, and is found again in the urine after half an hour.

7) Saccharine is a perfectly harmless substance both for human beings and for animals.

Privy Councillor Prof. Dr. Leyden of Berlin said in a lecture held on saccharine in April 1888 in the Society for internal medicine:

»Saccharine agrees exceedingly well with the human and the animal organism, possesses no poisonous qualities and does not disturb digestion.«

According to the experiments of Drs. Fragner & Schreiber of Vienna »On Pepsin« (Pharmaceutical Post, edit. 46. Vienna, 11th Nov. 1888):

0,05 grm pulv. pepsine dissolve 5,0 grm albumen in 4 h. 30 m.
0,05 grm pulv. pepsine + 0,05 grm saccharine dissolve 5,0 grms albumen in 4 h. 30 m.
0,05 grm pulv. pepsine + 0,1 grm acid. carbol. dissolve 5,0 grms albumen in 5 h. — m.
0,05 grm pulv. pepsine + 0,1 grm hydr. chlor. nit. dissolve 5,0 grms albumen in 5 h. 30 m.

Saccharine does not influence the digestion of albumen therefore, provided far larger quantities than are actually requisite are not used. But even if the amount of saccharine taken were far larger and its antiseptic properties much more powerful, it must not necessarily be taken for granted that the process of digestion in the body would be influenced thereby, for it must not be overlooked that, strange to say, saccharine leaves the body quickly and unchanged and differs in this point very materially from benzoic acid and salicylic acid. It is a characteristic peculiarity of saccharine, that it is absorbed in the body remarkably quickly and is passed out through the kidneys unchanged and complete; half an hour after being taken it leaves the body again with the urine or is in the bladder.

Professor Dr. Constantin Paul of Paris made the Académie de Médicine the following communication on saccharine as an antiseptic in the alimentary canal:

Saccharine is a most valuable antiseptic in the alimentary canal, because it is not injurious. Taken in a dose of 0,20 grm it occasions no disturbances in the nutritive processes.

Thomas Stevenson, M. D., F. R. C. P., London (lecturer on medicine and chemistry at Guy's hospital) and L. C. Wooldridge, M. D., D. Sc., M. R. C. P., London (Ass. Physic. and lecturer on physiology at Guy's hospital):

1) Concerning the harmless nature of saccharine we are not in doubt. Reliable analysts on the Continent have ascertained that, and we have confirmed their observations. We gave a lean dog for five days a dose of 2 grms saccharine per diem (corresponding in sweetening power to more than one pound of sugar) in addition to an unlimited daily ration of food. The animal gained in weight and no uncommon symptoms were observed. We mixed large quantities of saccharine among the food of mice. The latter eat ad libitum of the mixture for a long time undisturbed, and not in a single instance had it any particular effect on the health of the animals.

2) As saccharine most decidedly possesses antiseptic qualities, and if applied in sufficient quantities is able to check the process of fermentation, we tried its effect outside the body on fermenting solutions and found that 0,1% saccharine has no retarding influence on the peptonic digestion of the fibrin, whereas 0,25% decidedly retard it and 1% checks it considerably. 0,1% saccharine is equivalent to 30% sugar — a dietetically impossible amount. The diastatic solution of starch was not prevented by 2% saccharine. The ammoniacal fermentation of urine is retarded when saccharine is added direct to it or when saccharine is taken as a medicine, which is a very weighty matter for clinical medicine. The putrefying process of a pancreas mixture was not prevented or checked, we found, by the addition of saccharine up to 1%.

Observations as to the action of saccharine outside the body in the exciters of fermentation in digestion are, however, of no importance in determining the effect produced by saccharine when partaken with food, for the presence of a constantly tolerably powerful saccharine solution in the digestive medium is then conditional, and this condition is not fulfilled when saccharine is taken, for this substance is quickly absorbed and discharged again with the urine. In order to ascertain whether saccharine influenced digestion the following experiment was made. Two dogs that had fasted for 30 hours were both fed with 11 oz. (about 300 grms) of lean uniformly chopped and divided beef. These 300 grms meat contained 69 grms (= 23%) of dry firm component parts. Dog No. 1 weighed 21 lbs. and got no saccharine; dog No. 2 weighed 15½ lb. and got 1 grm saccharine (equal to 300 grms sugar in sweetening power) in its meat. Five hours and a half after taking the food the dogs were killed with chloroform and the contents of the stomach and of the entrails of each animal were carefully removed. The small intestine was empty in both cases, with exception of the duodenum, which contained a lot of the digested matter coming from the stomach; at the lower end just above the great gut there were remnants of food apparently of older date. The dry weight of contents of the stomach and duodenum of dog No. 1 was 23 grms or 33% of dry weight of the meat, whereas the dry weight of the same part of dog No. 2 (which had got saccharine in its food) was 21 grms or 33% also of dry weight of the meat. To all appearance the 1 grm saccharine given to the animal had not had the least effect on the

process of digestion. One of us had besides taken daily considerable quantities of saccharine without feeling any unfavourable effects whatever. The saccharine used by us was »easily soluble saccharine« whose sweetening capacity is equal to about $^{9}/_{10}$ of pure saccharine.

Conclusions arrived at:

1) Saccharine is perfectly harmless even if taken in quantities exceeding by far the amounts that would be taken in ordinary diet.

2) Saccharine does not influence or prevent the process of digestion, if taken in anything like reasonable quantities.

3) Our own experience teaches that saccharine may be taken for a long time without disturbing the process of digestion or any other function of the body, therefore, there is no reason to suppose that a continuous use of it would be detrimental in any way.

Dr. Mercier of Paris reports by reason of his observations:

»When taken in large doses of several grammes daily and for some length of time, it does not influence the functions of the organism. The portion coming into circulation is discharged completely and unchanged in the urine.«

Dr. Edgar Gans of Carlsbad has made very exhaustive experimental investigations on the influence of saccharine on digestion in the stomach and intestines and has arrived at the following results:

The author proves on the strength of 22 experiments, that the retardation of digestion in the case of albumen observed by Pouchet is owing to a purely mechanical effect of saccharine when used in a pulverized state, and that the retarding of the digestion becomes quite normal again as soon as saccharine solution is added. This effect of pulverized saccharine is caused by the adherence of some particles of saccharine to the albumen lamina which thus deprive the gastric juice of part of its pepsin, an occurrence that was observed many years ago in the case of a number of other substances. The author comes to the conclusion, that in a chemical sense saccharine does not prevent digestion by any means, and advises the solution of saccharine before use, or, the use of the sodium salt of saccharine.

The experiments comprised besides the influence of saccharine on the caseum ferment secreted by the stomach glands. As in the case of the pepsin experiments, it was proved that saccharine does not obstruct in the slightest degree the caseum ferment, and consequently the conclusion arrived at was that saccharine does not alter or impede in the least the digestive working of the stomach.

The experiments on the influence of saccharine on intestinal digestion were made with human intestinal juice taken from a patient according to Boas' method.

These investigations brought to light results interesting in two respects; on the one hand as to the influence of saccharine on the conversion of albumen and on the other as regards the antiseptic properties of saccharine.

The first named observations were confined to ascertaining the influence of saccharine on the tryptical ferment of intestinal juice; and the author takes it for granted that the conclusions arrived at may hold good for the diastatic ferment which decomposes fatty acids.

The results of 6 experiments were quite analogous to those obtained in the case of pepsin and caseum ferment; when saccharine solution or the sodium salt of saccharine was used, the digestion was not influenced in any way.

The investigations made in 9 separate cases of intestinal evacuations on the anti-putrescent effect of saccharine on the intestine showed the following results: »In 2 to 4 days even the portions without saccharine became fetid and discoloured, whereas those with saccharine have up to date, after 3½ weeks, not the least bad smell and are not discoloured.« The author then continues: »I have had besides repeatedly occasion to observe the beneficial influence of saccharine on diarrhea, so that it would seem to me a most valuable curative in decomposing processes of the intestinal canal.«

I believe I am able to state as the result of my experiments, that saccharine and its sodium salt, taken in the proper form and suitable doses do not exercise any injurious effect on the process of digestion in the stomach or intestines, and further that this new sweetening substance possesses the capacity of preventing decomposition of the contents of the intestine.«

The celebrated analytical chemist Professor Dr. L. Nothomb of Brussels says:

»The first 20 grms were absorbed by a dog, 15 grms of this being introduced by subcutaneous and intra-veinal injection. The injections were made daily in doses of 1 grm each. The remaining 5 grms saccharine were given twice in doses of 2½ grms each in little meat balls, which were introduced into the oesophagus of the animal. During all these experiments the dog remained quite well, in 1 to 2 hours after the injections he conducted himself as usual.

Twelve hours after digesting the last dose of saccharine the dog was killed and the obduction, which was carefully carried out, did not show the least abnormality.

The other 20 grms I took myself in doses of 1 grm per diem in my food or coffee etc.; my victuals have not been sweetened in this way for the last week.

I can assure you I experienced no abnormal symptoms during the whole time and feel perfectly well at present.«

From the medical department of Professor Drasche at the Imp. & Royal general hospital in Vienna a very exhaustive work entitled »On Saccharine« has been published by Drs. Armin Petschek and Th. J. Zerner, from which we extract the following passage bearing reference to the question this chapter treats of:

Our researches were directed to the discovery as to whether saccharine had any injurious influence whatever on the human organism.

In order to answer the questions put to us, we examined first of all the influence of saccharine on the saliva, stomach and pancreas ferments, whether saccharine hindered their effect and whether digestion was ruined thereby. It was shown that the results obtained on all persons that were experimented upon, proved to be identical.

The results of digestion, even after doses of 5 grms saccharine, did not differ from those that we obtained before using saccharine. In spite of the large quantity of saccharine sodium salt the digestive power of the gastric juice remained normal. The sodium salt of saccharine has therefore even in large doses no influence on the digestive power of the gastric juice. It is the same with healthy and unhealthy people.

From the above we may draw the conclusion that saccharine — we mean the easily soluble sodium salt of saccharine — has no injurious effect on the human organism, all the more so as no unpleasant complications in the respiration, pulse or kidneys were ever observed by us. To this we shall refer later on. We had under observation

a large number of individuals who took for the space of eight to ten weeks doses of saccharine daily varying from 5 to 10 grms without the least harm. Their appetite was good, general health all that could be desired and on weighing no loss was found.

Dr. Jessen reports in his treatise so often mentioned on saccharine and its effect on the human and the animal organism as follows:

I. **Its effect on general health.** Various other authors having already proved that saccharine does not operate when given in small and large doses injuriously on animals, I did not consider it advisable to occupy myself long with such experiments particularly so as the results of my observations were the same as others.

A strong rabbit weighing 1670 grms was given in addition to its ordinary food and by means of the stomach-pump a dose of 5 grms saccharine solubile. On another occasion a rabbit weighing 2220 grms received a similar dose. Neither animal showed any change in the least, the weight increased, the voracity was undiminished, the urine contained no pathological ingredients, the excrements were normal. The dose given to the first named animal was in the proportion of 3,0 grms to 1 kilogrm of the animal. According to this a human being weighing 70 kilogrms could take a dose of 210 grms saccharine solubile without any harm. In sweetening capacity this would equal a volume of 63,0 kilogrms sugar. I have certainly not taken these tremendous doses, because the taking of saccharine in concentrated form is accompanied, owing to its aromatic after-taste, with unpleasant sensations. It should be remarked here, that only in strong dilutions does saccharine possess the purely sweet and not over-intense taste of sugar. Nor should it be forgotten that saccharine is by no means a nutriment but solely a flavouring substance. I have, however, repeatedly taken 5 grms saccharine solubile per diem, which equals a sweetening capacity of 3 lbs. of sugar, without remarking any disturbances. If we remember besides the fact, that a dose of 0,03 grm of saccharine solubile suffices to sweeten a cup of coffee — the quantity prescribed by the manufacturers amounts to about that — it is beyond question that the doses necessary for daily use can be taken into the organism without the least harm.

Observations were further made on the

II. **Effect of saccharine on the saccharization of starch by means of ptyaline.**

III. **Effect of saccharine on the peptonizing of albumin.**

IV. **Effect of saccharine on the utilization of nutriment.**

The results of these observations are comprised in the following concluding remarks:

1) Saccharine is a spice of eminent sweetening capacity and particularly so »easily soluble saccharine«, a substance that may be used in daily life in a variety of convenient ways.

2) »Easily soluble saccharine« is without any influence on the saccharization of starch by means of ptyaline, and retards the peptonizing of albumin in a very slight measure. This property it has in common with sugar, alcohol and probably a number of other spices.

3) The utilization of nutriment, especially of milk, is not influenced preventatively even by large doses of saccharine solubile.

4) During a three-monthly use of saccharine in doses of 0,1 to 0,2 grm daily I have not been able to discover any indications of an injurious effect either in the case of five strong men, or in that of two boys and two girls.

5) Very large separate doses (5 grms) have never left behind them any symptoms of disturbances either in human beings or animals.

The sugar analyst Stift is set to rights in respect of his erroneous opinion mentioned at the beginning of this chapter by the author in the following words:

In his work styled »Experiments on the Influence of Saccharine on Digestion« Herr Dr. Anton Stift has been led to consider saccharine injurious to the health owing to its retarding influence on the ptyaline and pepsine effects. He has first of all overlooked the fact that the retarding effect on the saccharization of starch by means of ptyaline is only the effect of acid, that this property can, therefore, be avoided by using easily soluble neutralized saccharine. At any rate the conclusion come to that saccharine is injurious to health owing to the retardation of the peptonizing of albumen is not justified. The taking of flavouring substances — and what is saccharine but spice? — in large quantities is always accompanied by secondary effects either on the digestive apparatus, on the nervous system or on the kidneys. As to the peptonizing of albumin in particular, Ogata*) under Pettenkofer's directions proved that a quantity of 10 grms sugar added to 100 grms meat is able to retard digestion in a dog's stomach very greatly in the first half hour.

Professor Dr. W. Jaworski has also made very extensive experiments with saccharine at the university clinique of Prof. Korczynski at Cracow. The objects of these researches was to throw light on different points and among others on the question:

»What influence does saccharine exercise on the separate functions of the human organism after both an occasional and also a continuous use of it and to what extent do the facts so far observed agree with our experience?«

Introductory remarks:

I. To begin with, we must mention, that in the cases of none of the persons experimented on have we observed either after a six months' use of saccharine any disturbances of the organs of sense or of the nervous system or after separate doses of 50 grms. In order to avoid any errors in respect to the subjective symptoms, the patients of the clinique were not made aware of the properties and nature of the preparation and, therefore, took it as a medicine.

II. Neither the smallest nor the largest doses (50 grms) of saccharine sodium salt had any effect on the circulatory functions. The pulse remained unchanged both in regard to beat and strength, both in individuals with normal and with abnormal action of the heart. The sphygmographic views taken on the radial artery of 4 healthy and 2 feverish persons and of 1 suffering from mitral disease showed perfectly identical curves both before and 1/4 to 1 hour after taking saccharine sodium.

---

*) Archives for Hygiene, vol. 3, page 204.

Ogata shows in this chapter that sugar permits the peptonization in the first half hour, whereas alcohol converts only 30 % of albumen into peptone. Is this unknown to Herr Dr. Stift? He will surely not risk a flight into physiological space merely for the sake of saccharine?

The publisher.

In our experiments on persons we have not observed any alterations whatsoever in the temperatures after taking saccharine sodium.

The researches were extended to the following points:

1) Influence of saccharine on the amylolysis.
2) Influence of saccharine on the digestive organs.
3) The effect of saccharine on intestinal digestion.
4) The effect of saccharine on the urinary organs.

Conclusions:

After compilation of our clinical observations and experience on saccharine sodium, we may assert that:

I. **Saccharine sodium is not productive of any disturbances** either in the sensory organs or in the nervous system, nor in the organs of circulation, respiratory or urinary organs, even if taken in quantities of 100 grms daily.

II. **In the digestive organs a dose of under 25 grms daily,** produces no disturbances. Doses of 25 grms and above do certainly occasion diarrhetic evacuations, nevertheless even in doses of 100 grms daily these symptoms are not bad and disappear as soon as the saccharine is given up. The purgative effect of saccharine-sodium appears to be less than that of an equal quantity of common salt.

III. **Saccharine sodium appears to have no influence** (indifferent) on the course of acute and chronic diseases. Medium doses of 5 to 10 grms daily might be used as an antidiarrhoetic as these doses have produced constipation in some of the persons experimented on.

IV. **Nourishment is not lessened by saccharine sodium**; the bodily weight either remains the same or increases.

V. **Saccharine sodium does not pass over into the saliva** but into the urine and most probably unchanged, as for instance prussiate of potash does about half an hour after taking it. If large doses of saccharine are taken, part passes out with the faeces and part is still to be found in the urine 30 hours later.

VI. **If the medium daily quantity of saccharine-sodium** necessary to sweeten food be set down at 0,3 grm = 84 grms sugar in sweetening capacity and the largest daily quantity at 0,5 grms = 140 grm sugar, the entire annual consumption of saccharine-sodium as a spice for one person would amount to 109 grms or 172 grms. These quantities are less than those taken by the persons we tried the experiment on, in a few days. One of these individuals consumed within 3 days 520 grms saccharine-sodium, a quantity which ought to last according to our calculation as a sweetening medium for 4 to 5 years. The effect of such quantities of saccharine-sodium given as a necessary addition to food and drinks, seems according to our researches and experience to have no effect on the functions of the organism, of minimum influence on the digestive organs, and to be in consequence symptomless and at any rate far less injurious than the spices used as flavouring substances in our kitchens, such as pepper, ginger, cinnamon, vanilla, nutmeg, anise, mustard etc.

Dr. G. Vulpius of Heidelberg says:

»Even daily doses of 5 grms and more of saccharine cause no disturbance of the assimilative functions, nor any other injurious influence. Both in the case of internal and subcutaneous application saccharine is quickly absorbed, does not pass over into the saliva nor into the milk, but appears in about half an hour in the urine, through which it is completely eliminated as unchanged saccharine in a comparatively short space of time.«

Professor Dr. Paschkis of Vienna concludes that part of his exhaustive work on saccharine of interest to us with the following sentences:

> In respect to digestion it must be remarked that all experiments cited as yet have reference to concentrations, such as will probably never occur in using saccharine for the purpose of sweetening food. When will it ever happen that the contents of the stomach show a quantity of respectively 0,1 % and of 0,25 % saccharine? Taking the contents of the stomach at 500 grms — the stomach can contain 2 to 3 kilogrms fluid — 0,1 % saccharine would amount to ½ grm. Smaller quantities than the above (for instance 0,5 % = 62 grms sugar, the contents of the stomach being as above) have no influence, play no part in the process of digestion, as I have ascertained by a number of experiments. It would seem, therefore, that the much dreaded opinion that quantities of this sweetening substance when used as a spice could prevent digestion and in consequence nourishment, is without foundation, especially so as the substance leaves the organism unchanged and quickly besides, an advantage it has without doubt over other spices with which it ought to be classed.«

Professor Dr. Kornauth of Vienna made some feeding experiments on rabbits, dogs, pigs and ducks, and by reason of his numerous and very detailed researches in this direction he comes to the following conclusions:

> »If pure saccharine be administered in food in practically quite impossible doses to dogs, ducks and pigs, and for a long period even, it does not leave any injurious effect on their organisms observable in any respect, and just as little is the co-efficient of utilisation of the food decreased thereby.«

These excerpts will suffice to characterize the working and effect of saccharine in and on the animal and the human organism. A short perusal of the observations shows that they are divided into two large groups or classes, in so-called artificial digestive experiments made outside the organism in apparatus, and in practical digestive experiments which are tried direct on living individuals to whom the saccharine is administered in their food or injected by some means. On the whole the results of these artificial and practical or natural experiments agree. Minor deviations cannot surprise anyone, and even important differences — which do not occur in the case of saccharine — would not seem strange to physiologists and experts, for in artificial digestive experiments there is always a constant, tolerably strong solution of saccharine in the digesting medium, whereas in natural (practical) experiments the digesting medium is strongly diluted, on the one hand, while on the other, saccharine does not operate constantly in the body, but is quickly absorbed and discharged again with the urine. In addition to this, the acid reaction of saccharine in the artificial experiments is of material consequence, whereas in the organism certain processes occur only when alkalinity (or at least complete neutrality) exists, the acid effect of the saccharine being thus neutralized.

The material communicated herein in such abundance will serve to show all disinterested persons, that on the one hand, saccharine is nothing new to scientists, that it has been on the contrary more thoroughly investigated than most other bodies have ever been, and on the other hand, that saccharine is a mere spice not exercising the slightest detrimental influence on the organism either in a physiological, chemical or psychological sense.

Whoever takes a special interest in the nature and course of the experiments the results of which we have just communicated he must be referred to the literary review appended to this little work. We have besides had large editions of separate copies of the most eminent works printed and published for the greater convenience of persons interested in the matter, and providing they are not out of print, we shall be glad to forward them on application.

The effect of Saccharine on the organism after long and continued use of it.

The experiments communicated in the preceding chapter prove that saccharine exercises absolutely no influence on the functions of the organism and remains quite indifferent, being discharged after a short stay in the body with the urine without undergoing any change, so that it could be recovered from the latter again.

Since saccharine is used as a sweetening substance and as an accessory and is taken as such in combination with other substances, the objection seems justified that these experiments and observations extended over a limited space of time only, and that the possibility is by no means excluded, that after a period of continuous, uninterrupted use an injurious effect might be manifested.

Although we know from our own experience that this possibility is really excluded, for both we and a number of friends have used saccharine exclusively and daily as a sweetening medium for the last 12 years, yet this is not proof positive for the impartial and disinterested.

This point too has been duly taken into consideration by scientists and so we venture to cite some cases now, which will show in a most striking manner, that the partaking of saccharine even in uncommonly large doses has no influence at all on the functions of the human organism, much less injurious effects.

Professor Mosso and Dr. Aducco say:

»It might be said in objection that a protracted use of this substance could possibly occasion symptoms which we had no opportunity of investigating owing to the comparatively short duration of our researches. This objection has merely an apparent value, when we come to consider that we gave a dog in only 10 days 37 grms saccharine (11,1 kilogrms sugar) without any injury to the animal, and that we have both taken daily as one dose for a long space of time 5 grms saccharine each (1½ kilogrms sugar) without being able to observe the least change in any bodily function.«

After continuing their experiments the same investigators conclude a year later a second treatise on this subject with the words:

»It is obvious that saccharine has a wide field, for in addition to its eminent antiseptic qualities, it has a very pleasant taste and can be used constantly, or for long periods, without injury.

Dr. E. Stadelmann of Heidelberg examined saccharine in its effect and when used constantly by individuals in the medicinal clinique of the Grand Ducal University, in respect to both healthy and sick persons, and he says:

»Appetite, respiration, pulse and bowels were always perfectly normal, the psychical functions, sleep and thought were quite uninfluenced, on the part of the motor and sensory nervous system there was not the slightest anomaly observable« etc.

At the end of his very voluminous work on the subject Dr. E. Stadelmann lays down the following rules:

1) Saccharine is perfectly harmless for human beings even if large doses are taken continuously and even if these doses surpass by 10 to 20 fold those that people would take, provided saccharine were universally in use.

2) Subsequently, many months after cessation of medication not the slightest injury to the patient could ever be traced to saccharine.

Professor Dr. Constantin Paul of Paris states in the »Progrès Médical«:

»Saccharine is so harmless that doses of it of 5 grms have been given daily to a dog without producing any disturbance in the animal's health. A man has taken 155 grms in 43 days without ill consequences. There is therefore no reason to fear the common doses generally taken, viz. 0,20 grm saccharine.

The experiments on animals prove it not to be detrimental. It has been ádministered to patients to the amount of 153 grms in 40 days without any ill result. Diabetic sufferers, after using it for 5 months, have not felt the least harm from it.

We have had an opportunity of observing that this product was used by a whole family consisting of 7 adults and 5 children without any injurious consequences and without occasioning even the slightest irregularity in any of the members.«

Professor Dr. Bruylants of Louvain says:

»I have taken pretty large doses of saccharine daily, up to 3 grms, without any disorder occurring. Other investigators have obtained similar results. The process of digestion was not disturbed in the least by the saccharine.«

Professor Dr. Van Heurck, Antwerp, writes:

»Mrs. N. v. K., who is just 75 years old to-day, has been using saccharine for the benefit of her health for these two years and without feeling any ill effects from so doing.«

Drs. Armin Petschek and Th. Zerner, Vienna, state:

»When taken in doses of 10,0 grms a day, for several weeks and months not the slightest alteration in the functions of the organism was observable.«

Dr. Jessen of Würzburg says:

»I put another question, which was whether the continuous use of saccharine solubile was accompanied with ill consequences in the case

of human beings. In order to investigate this I have experimented on nine persons from 15th April to 20th July. These nine persons consisted of myself, the servant of the hygienic institute, three strong men and four children, two of the latter being girls, the others boys, one 10 and the other 12 years of age. These nine persons took in the space of time from 15th April to 15th May 0,1 grm saccharine solubile in an aqueous solution each every day, from 15th May to 20th July 0,2 grm of the same preparation each per diem. In sweetening power these doses equalled respectively 30 and 60 grms of sugar a day, quantities that greatly exceed the average amount consumed. In addition to an exact control of the subjective statements of the persons undergoing the experiment, the weight of each, and the urine was examined from time to time. Apart from the trifling variations in weight, which could be traced back in their increase to the greater volume contained at the time in the intestinal canal, and in the decrease to the same cause and to the great heat prevalent during the experiment, no alterations could be observed objectively; and above all the urine contained neither albumen nor sugar at any time. Symptoms were never observable of disturbed digestion which might have been imputed to pathological circumstances. The state of health even during and with fatiguing work was permanently good. It may be concluded from these experiments that the three-monthly use of saccharine solubile without interruption and in tolerably large quantities did not occasion any disorder whatever.«

Professor Dr. Jaworski of Cracow puts the following question:

»What are the largest doses of saccharine that can be taken without injury to the human organism?«

Preliminary remark: It was soon obvious that in order to answer this question experiments had to be made with very large doses, much larger ones in fact than had ever been used by other investigators. In some cases, therefore, separate doses of 50 grms and daily ones of 100 grms were administered with a view to attaining any notable result. On the other hand permanent disturbances in any function of any organ did not occur in any single individual even after the largest doses — limited as these were by the quantity at disposal — for instance after consumption of 520 grms of saccharine sodium in 9 days.

Experiments: In order to illustrate the effect of large doses of saccharine sodium most clearly, we will cite the following particulars about the experiment on a relatively healthy man of 29 years of age, in whom a tumor lienis traceable to a blow was found, after recovering from attacks of malaria he had been subject to years before. The patient exhibited no other abnormalities, nor did he complain of any other disorder. The temperature of the body was normal during the whole time the man was under treatment. He took 520 grms saccharine sodium in nine days, most of it in separate doses of 50 grms of each twice a day. Such large doses have never been administered in any published as yet.

For the first two days of his stay in the clinique the person experimented on took a medicamentum indifferens (aqua foeniculi in drops) which was administered during the whole period he was under observation; his diet was the same from day to day. When taken into the clinique his bodily weight was 57 kilogrms; the average amount of urine discharged 1400 ccm and its specific weight 1,020; no abnormal features were present in the urine. The saccharine sodium doses were dissolved in 250 ccm of distilled water and introduced into the stomach by means of a tube.

On 30th April the patient took early on an empty stomach and in the above manner 15 grms saccharine sodium and at 4 p. m. 20 grms

more. The urine discharged at 5 p. m. had a specific gravity of 1,018, the daily quantity being 2300 ccm, the increase being attributable to the introduction of 500 ccm saccharine solution; no abnormal results in the case of the urine.

On 1st May the person experimented on was given 25 grms early and 30 grms more of saccharine sodium in the afternoon. During the forenoon there was a copious, firm white evacuation not containing anything abnormal. The food residuum seemed to be well digested. Fifteen hours after the last dose of saccharine sodium the latter was discovered in the urine. The quantity of urine discharged was 1700 ccm, specific gravity 1,021. During the night there were two fæcal discharges and another early in the morning, which examined by microscope showed strips of slime and fascicles of muscles, some of which were striped distinctly, others not at all.

On 2nd May 60 grms of saccharine sodium in 2 doses of 30 grms each were given early and in the afternoon. In the evening were 2 evacuations of the same quality as the previous day.

On the 3rd and 4th May no saccharine was administered. The daily discharge of urine amounted to 1700 ccm with a specific gravity of 1,021. The fæces were normal during these days.

On 5th May the patient took 60 grms saccharine sodium in 2 doses. During the day there were three watery evacuations. The microscopic examination showed numerous fascicles of muscles with distinct cross stripes, strips of slime, granular degenerated leucocythena and some cylindric epithelia.

On 6th May 60 grms saccharine sodium were given in 2 doses, the daily discharge of urine amounting to 1600 ccm and 1,023 specific gravity, quality normal. On the other hand there were four stools of the same nature as on the preceding day.

On 7th May 100 grms saccharine sodium were administered in 2 doses. Four evacuations occurred, as on the day before.

On 8th and 9th May no saccharine sodium was given. There was only one stool per day. The bodily weight amounted to 58 kilogrms. Appetite very good, no dyspeptic disorders and no weakness in spite of the diarrhea of several days' duration. On the following days doses of 50 grms and 100 grms saccharine sodium were given in order to obtain certainty whether in the case of this individual the diarrhetic evacuations were not accidental, as in the case of other patients, to whom a dose of hardly 25 grms saccharine sodium was given, constipation was often observable. Even the latter days of the experiment showed, however, regularly diarrhetic stools after doses of 50 grms saccharine sodium.

We observed in the case of this patient that after doses of 50 grms saccharine sodium this substance was still to be found in the urine 25 hours later, the last traces disappearing in 30 hours. The presence of saccharine in the urine was proved according to C. Schmidt (Report to the German Chem. Asso. in Berlin 1887, vol. 14, p. 601) by converting it into salicylic acid in the following way: the urine acidulated with sulphuric acid was shaken out several times with sulphuric ether, the latter was evaporated, the residuum was heated for a long time with excess of soda-ley till a deep brown colour was attained, the melt was treated with hydrochloric acid, shaken out with ether, and the solution was tested for salicylic acid by means of solution of ferric chloride.

With respect to the case just described it must be remarked that for 2 to 3 hours after large doses of saccharine sodium an alkaline urine was discharged. It may be taken for granted, therefore, that a large portion of the sodium split off from the saccharine was set free and had brought about the alkalinity of the blood and urine.

The person thus experimented on was observed for 4 days more, after taking the last dose. He did not complain of any disturbances either whilst taking the saccharine sodium nor yet after leaving it off, and his bodily weight which had amounted to 57 kilogrms before the experiment proved to be 58,4 kilogrms at its conclusion. In the case

of other individuals, to whom saccharine sodium was also given, there was no instance of a decrease, but generally a slight increase observable in the bodily weight. The same result was obtained by E. Salkowski too, in his experiments on dogs. Nourishment seems, therefore, not to be decreased even when large doses of saccharine are taken.

The consequences of a long continued use of saccharine sodium were observed in the case of a family consisting in 7 healthy members, 5 adults, a child of 2 years old and an infant of 4 months, whose mother had, however, taken saccharine sodium. The infant nursed at its mother's breast may be left out of consideration here; the other persons took it willingly and said that it tasted far sweeter than sugar. The family in question used for sweetening food and drinks from the month of March to September — for 6 months — 300 grms of saccharine sodium. The consumption of this substance as a substitute for sugar during a period of six months was, therefore, 50 grms saccharine sodium per person. During the whole time in which the saccharine was used, no abnormalities in the functions of the organism occurred either with the adults or the children.

From our private practice we know of another patient, a female, who suffered from diabetes melitus and had used nothing else than saccharine for sweetening purposes for three years, and she relished it just as much as she used to do sugar. Among the many persons, who to our knowledge have used saccharine, we know, besides the case just mentioned above, another diabetic female sufferer who could not bear the taste of saccharine and preferred to take her coffee and tea unsweetened rather than use it.

Both in our private practice and in the clinique we have used saccharine sodium often and for a long time in the case of adults and for infants as a corrective in mixtures, with the same success as syrupus simplex. For this purpose, according to the taste of the medicine 0,01 to 0,05 grm saccharine sodium suffices for 100 grms of fluid.

In addition to these reports that concern the one particular point *viz.* the observations made on the influence of a long, uninterrupted use of saccharine, there are at our disposal communications from persons of all classes and nations, who have used saccharine without any ill consequences for years; in reality this question could not be answered better or more strikingly than by the results of practice. The saccharine sold in trade for these 7 years was consumed in that period by human beings to the amount of many tens of thousands of kilogrammes and partaken with and without their knowledge in daily doses of 1 to 5 centigrammes without the least observable effect.

Setting aside the case of some French sugar-refiners with whom saccharine did not agree, if their statement be credited, it may be said that not a single instance is known in which saccharine has exercised an injurious influence on the functions of the human organism.

The Harmlessness of Saccharine.

After the publication of so much exhaustive evidence as that contained in the preceding chapters, a further chapter treating on the harmlessness of saccharine might well be omitted. Certain reasons make it advisable, however, to discuss this question as thoroughly as possible.

The tenet that **saccharine is a perfectly harmless sweetening substance exercising no injurious effects whatever on the body, and which is discharged from the latter, after a short stay, unchanged and not decomposed and in its entirety, through the urine and faeces, that it is absolutely indifferent, as regards the functions of the body, and finally exercises no influence on assimilation or on digestion,** is confirmed unreservedly.

Scientists have set down and accepted this tenet by reason of the numerous and thorough scientific experiments and researches, and experience has corroborated it.

The objection might be raised that saccharine possesses eminent antiseptic qualities, and that every such medium is injurious in course of time. This objection is not tenable as soon as the sweetening capacity of saccharine comes to be considered, for the latter prohibits the use of large doses and merely permits the giving of small quantities. The Imp. & Royal Hygienic council of Vienna has forbidden the use of conserving media in wine, such as salicylic acid, but allowed that of saccharine for the following reasons.

> In the small quantities in which saccharine can be used in the various sorts of wine to make them agreeable and enjoyable, saccharine may be termed harmless by reason of the results of research and experience known as yet. It is, therefore, quite superfluous to limit the allowable additions of this substance.

It is moreover of a fact the greatest importance that saccharine is discharged from the body in the shortest space of time and without undergoing any alteration or conversion.

What induces us to enter more closely into the question as to the harmlessness of saccharine, may be ascribed to the circumstance that shortly after saccharine was offered for sale it met with great opposition in certain quarters and rather

irregular means were even not considered unworthy of employment in its much desired suppression. The strife has long since been decided in fav ur of saccharine, but every now and again we come across some publication on the subject, which ought to have been forgotten long ago.

Dr. Worms of Paris sent in a report to the »Journal des fabricants de sucre« in April of 1888, in which he asserted that in the case of 3 diabetic patients, to whom a daily dose of 0,10 grm of saccharine had been given for 15 days running, an unpleasant feeling combined with indigestion had been observed. For us and for most medical men, we believe, there is nothing surprising in this fact, for it is well known that any change in the nutrition of diabetic sufferers, and especially of those accustomed to a strict diet, exercises an influence on their digestion and general health. The same thing can be asserted at once of medicines and edibles to which the patients have not been accustomed; the physician attending on them goes very cautiously to work in such cases and effects the change he desires very gradually. Trifling errors in diet even are productive of alarming disturbances in the digestive functions of such patients.

We can, however, generalize our views and setting aside the special case of those afflicted with diabetes point to the fact known to almost everybody that in regard to the digestion of the various kinds of food, delicacies, spices, etc. the use of which is never questioned, natures differ greatly. Sensitive natures are gifted with a natural instinct forbidding the partaking of certain things and — whether consciously or unconsciously — each individual avoids what does not agree with him. Hence some for instance eschew beer or spirits of any kind, others coffee, bread, potatoes, tobacco, sugar, various spices, etc. In all large towns there are to be found associations the members of which avoid meat, and declare they have come to the full enjoyment of health only after adopting vegetarian diet, and not until then. In many cases in which nature does not rebel against the partaking of certain kinds of nutriment, the physician is but too often forced to forbid their use.

The remarks of Dr. Worms were eagerly seized upon by the chauvinistic Press and quite a violent storm of indignation broke out against saccharine and its manufacturers. For Dr. Worms, however, and the French sugar refiners who backed him up and even yielded themselves up to him as subjects to experiment on, the matter assumed a very unexpected and shameful turn.

Urged by eminent and impartial scientists and medical periodicals to produce credible evidence for his assertions, Dr. Worms stated that his researches had been confirmed by the

celebrated Dr. Pavy of London, who enjoys a world-wide renown as a specialist for diabetes. An answer to this statement was not long in appearing. Under the title »Saccharine: a revocation«, the medical journal »Lancet« (edit. 3rd Nov. 1888, page 887) published the following letter:

To the editor of the »Lancet«.

In an article of your latest edition you say that it is difficult to ascertain the real position of saccharine and refer to communications published of late in various journals and in which saccharine is spoken of unfavourably by reason of the report of a committee of Parisian physicians. As my name has frequently been mentioned in France in connection with this affair, I solicit permission to declare through the medium of your journal, that the opinion imputed to me and spread as such, is quite untrue. The fact is as follows:

Last summer Dr. Worms of Paris called on me. In the course of conversation saccharine was mentioned and I was asked whether I had observed any bad consequences from the use of it by diabetic patients. — A short time after this interview I received a copy of the »Bulletin de l'Académie de Médecine« containing a statement of Dr. Worms to the Academy to the effect that I — as he learned from me — like himself, had observed digestive derangements in a number of patients after a prolonged use of saccharine. The following copy of the letter I wrote immediately to Dr. Worms will best show what are the real facts of the case:

»I was astonished beyond measure to read in the »Bulletin de »l'Académie de Médecine« your repetition of what was said by me »on the occasion of your visit to London, for it was in direct oppo»sition to my statements, and it is incomprehensible to me how such »a mistake can have occurred. I said that, according to my ex»perience, disorders of the stomach had never been caused by the use »of saccharine and that I was frequently in the habit of recommending »its use. I declared that I had at times come across people, who »complained of a not very agreeable after-taste and sometimes of a »long, lasting sweet taste in the mouth, but with exception of these »effects, which can hardly be classed as disorders of the stomach, I »had never observed that saccharine had been the subject of com»plaints of any kind. Out of consideration to those who may be de»terred by your statement from enjoying the benefit that is offered »them by the use of saccharine, steps should be taken on your part, »I think, to correct these erroneous statements and to say what is ac»tually the fact.«

In answer to this letter Dr. Worms wrote to say this misunderstanding was attributable to the circumstance that, in his opinion, this continuous sweet taste in the mouth should be considered a disorder of the stomach and that he would find occasion (as he did later on) to send in an explanatory report to the Academy. But a report once published seldom loses by reproduction. The profit is often great, and the following excerpt from a Parisian paper of later date shows the distortion of facts that ensued in this case:

»Le docteur Pavy de Londres, connu par ses nombreux travaux »sur le diabète, estime que les diabétiques soumis à la Saccharine »paient bientôt, par des maux d'estomac et des troubles intestinaux »le léger adoucissement apporté à leur dur régime.«

In my conversation with Dr. Worms I merely wanted to say, that the slight aromatic or almond-like after-taste peculiar to the first product but no more to be found in the product made of late did not suit the taste of many persons. We are accustomed in sugar to a substance possessing a sweet pure taste, and if an aromatic false taste be added to it, it may be agreeable to some people but not suit the palate of others. I have, however, seldom heard the last-named ob-

jection. I have never believed that the continuance of this sweet taste could ever be taken for anything else than a physiological symptom. This was and is still my view of the matter. Owing to the intense sweetness of saccharine the nerves of taste are exposed to the possibility of being excited by being brought in contact with too large a quantity of this product. The effect is, as in the case of other savoury substances, a duration of the impression, which stands in proportion to the intensity of the influence exercised.

Although I had not the least intention to express more than I really said, yet my words have been so construed, as if I had said that saccharine causes derangement of the stomach; they even go so far as to assert that diabetic sufferers have to pay the penalty of this trifling improvement in their strict diet with disturbances of the stomach and intestines in a short time. In another place it is asserted that I had told Dr. Worms lately that I had ceased giving my diabetic patients saccharine owing to its having lessened their appetite and strength gradually. It is not my business to make conjectures as to reason of these false representations, but there is evidently some secret force or other in action to discredit the product in question among the public and not exactly conscientious means are being used to attain this object.

Sugar when used with food serves not only to make the latter palatable and to augment the taste, but is also a nutriment.

Saccharine answers the first of these purposes, but has no such property as that last mentioned; it can, therefore, never be a substitute for sugar or replace the latter in general. Considered as a sweetening substance saccharine has a wide field for itself, and I really see no reason why the use of saccharine should be forbidden to those for whom it is advisable in the place of sugar, and especially so if we come to consider its perfect harmlessness. For diabetic patients it must be regarded as a great acquisition, and against obesity it is likely to render good service. There are besides other persons who want to avoid using sugar — with or without feasible reasons — and in saccharine they have found a means of carrying out this wish without making any sacrifice in respect to taste. It is an astonishing property in saccharine to be able to excite the nerves of taste as it does, and in such a splendid way, as we may say. In other respects it exercises no influence whatsoever. It has never been convincingly proved that saccharine has irritating or directly injurious qualities. Derangements of the stomach are spoken of vaguely without proof or any reliable reason for doing so and without being able to trace them back to saccharine.

Characteristic above all of the manner of proceeding against it is the complaint that owing to its antiseptic qualities saccharine checks digestion. In answer to that it may be said that saccharine is quickly absorbed by the digestive system and discharged from the body quite unchanged and consequently does not remain in the parts in which it could work in the manner imputed to it. Provided such were not the case either, saccharine is used for sweetening purposes in such minute quantity that it is not large enough in itself to develop any material power in the direction alluded to.

There is in reality no valid reason for saying that substances mixed with our food as spices and possessing antiseptic qualities have besides the power to exercise a retarding influence on the fermentative processes in the organized body. Salt, vinegar etc. are all substances counteracting the change of matter; when used for preserving purposes this peculiar quality of theirs is in reality turned to account.

I have written this letter merely as an act of justice and have not been induced to do so from any other reason. A storm of indignation has broken out against saccharine by reason of the assertion that fatal consequences have arisen from the use of that substance,

and I have been falsely represented as having a part in it. To remain silent under such circumstances would be tantamount to agreeing to the assertions now in circulation.

Grosvenor Street W.
London, 29th October 1888.

I am, dear Sir
yours truly
F. W. Pavy.

Even in France everybody turned against the aggressors then, and our treatises published on the question of the harmlessness of saccharine teem with opinons and remarks contradicting those of Dr. Worms in a surprising manner.

The most humiliating thing for him was, however, that in the medical academy at Paris, on the very same spot on which he commenced his attacks on saccharine in April of 1888, his conduct was subjected to a most annihilating criticism just a year later.

The »Journal d'Hygiène« of Paris of 13th June 1889 (edit. 664, page 278) published the following article hereon written by Dr. de Fournès:

The treatment of diabetes. (Before the Academy of Medicine.)

In No. 661 of this journal Dr. Echo, when reporting on the lecture given by Dr. Jules Worms before the Academy of Medicine on the treatment of diabetes, characterized this lecture as a puffing manoeuvre not in keeping with the dignity of the academy and concluded his remarks with the following words: »We must confess that this record, the echo of which resounded loudly in all organs of the Press subservient to the haute finance, revealed nothing new or nothing original for us.«

We report to-day on the discussion that ensued on the tribune of the Rue des Saints-Pères in the meeting of 21st May, and hope to prove that the critical estimation of this lecture by our esteemed collaborator is very mild in comparison to the energetic confutations of Messrs. Dujardin-Beaumetz, Germain Sée and Albert Robin.

Then follows the detailed report of the discussion that proved anything but flattering to Dr. Worms. It would occupy too much space to publish it here so we must confine ourselves to an extract of the remarks bearing reference to saccharine. The literal translation is as follows:

Dr. J. Worms has urged the necessity of prohibiting saccharine in the treatment of diabetes, that is indeed one of his finest deeds of heroism! Dr. Dujardin-Beaumetz opposes this view with the following remarks:

»Quite in agreement with the proposition of prohibiting saccharine as a nutriment, because this otherwise perfectly harmless substance does not conduct to the body anything calculated to sustain life, yet I must own that saccharine is an excellent acquisition for the hygiene of diabetic sufferers and that a large number of the latter reap great advantage from the use of saccharine. It allows diabetic patients to sweeten their beverages, in particular their coffee and tea. Sugar can be dispensed with in the coffee, which is so animating for diabetic sufferers, but it is almost impossible to enjoy the last-named drink when deprived of its sweet taste.«

At last people in Paris have come to see in what light they are to regard Dr. Worms and his way of treating scientific questions; what is pronounced to-day to be a mere manoeuvre unworthy of the Aca-

demy, sufficed a few months ago to sanction the adoption of the severest measures against a foreign product and served as a motive for the action, etc.

In Holland the Government called on the Sanitary Board to pass an opinion on Saccharine. The presidents of these provincial boards that form together the supreme hygienic council of the kingdom assembled in December of 1888 and debated on a report to the Government, from which we extract the following passages:

Injurious consequences in the use of saccharine have not been observed as yet; human beings can bear strong doses of 2 to 4 grms daily quite well.

Experiments have already been made with it on children by Dr. Rüger: he discovered that infants nursed artificially increased in weight when their food was sweetened with saccharine in place of sugar.

The sweet taste of saccharine excites the nerves of taste: by over-excitement, digestion can be deranged; perhaps the assertion of the French is attributable to this circumstance (this would, however, have to be attributed to an improper use of saccharine).

Saccharine cannot supplant sugar completely; it leaves the body unchanged and is, therefore, not a nutriment; but properly speaking sugar is not one either, for in Holland there are only 20 grms sugar to the 400 to 500 carbohydrates required daily by every adult.

The decision of the Comité consultatif d'Hygiène publique in France which declares itself against the substitution of saccharine for sugar, is consequently not justified.

The meeting agreed hereon unanimously to report to the Government: that from a sanitary point of view it did not seem necessary to restrict the use of saccharine by any legal measures.

Some sugar-analysts in Austria (Dr. Stift, Strohmer) seemed inclined to follow in the footsteps of Dr. Worms and to carry on a policy of interests; they failed most signally in the attempt.

The well known Professor Dr. Suess of Vienna, formerly rector of the Imp. & Royal University, touched on this point in a great speech made in the Austrian House of Deputies on 30th Marh 1889; he said:

»In conclusion, Gentlemen, let us now speak a word about science. There are irresistible things. The aversion of nations, the interests of separate individuals, the power of leading statesmen, vanish before these. This is best observed by contemplating the vast material progress for which science has paved the way. You know, Gentlemen — these are commonplace things — there was a time when we did not want to have railways in Austria etc. Chemists have now discovered a new body and called it saccharine. It is produced from coal-tar. Its chemical composition is quite different from that of sugar, but it possesses a 300-fold greater sweetening power, and with one-third of a decigramme a cup of coffee can be sweetened. The ministers of finance shake their heads, and the sugar-manufacturers lay their heads together. In France, saccharine has been declared injurious to health; but there is no truth in such a declaration. (Laughter, on the benches of the Left.) It is the same old story over again, Gentlemen! Pater Doblhamer cries out »Belial!« and the sugar-boilers call out »Belial!« too. It is the same thing again. (Laughter.) The one party says: burn the heretics; the other cries out: »String up the analytical chemists.« (Hearty laughter.) It all comes to the same thing. (Just so! from the benches of the Left.) It is

of as little use declaring saccharine injurious to health, as it is to declare mere ideas dangerous to health, come they will, and are irresistible too (Quite right! from the benches of the Left.), and science, Gentlemen, illuminates the whole world in all languages, in all nations.« (Lively, continuous applause. The orator is congratulated from all sides. Uproarious and continual applause from the galleries.)

After receiving in November 1887 a very favourable report from the college of Professors of the medical faculty of the Vienna University, the Imp. & Royal Supreme Sanitary Council at Vienna expressed its opinion on saccharine in two documents at great length and with much explicitness. They run as follows:

I. Excerpt from the opinion of the Imp. & Royal Sanitary Council dated 14th July 1888.

All observations known as yet and made upon healthy persons and patients (diabetic) as well as on animals, agree therein that commercial saccharine is not poisonous, leaves the organism unchanged for the greatest part and exercises at the most a slight antiseptic effect.

For this reason it cannot be termed injurious to health, in particular so as, owing to its uncommonly great sweetening capacity exceeding that of cane-sugar by about 280 times, it need be taken in only very minute quantities.

Just as certain is it on the other hand that saccharine possesses no value as a nutriment and cannot be considered a substitute for sugar, or carbohydrates. It must, therefore, be looked upon just as a spice, as a substance able to call forth very considerable sensations of taste even with minimum doses.

As carbohydrates are, however, offered in abundance in the shape of food to human beings, it does not seem justifiable to prohibit the importation of saccharine because this substance does not happen to be a nutriment. All the more stress must be laid on this, as many persons and not exactly sick persons have to avoid the use of carbohydrates from dietetic reasons, but are not inclined to forego the sweet taste that agrees well with them.

II. Excerpt from the opinion »On the Influence of the Use of Saccharine on Health« dated 15th November 1889.

History of saccharine, concluding remarks:

1) The observations made hitherto on healthy and sick persons, likewise the experiments on animals, have furnished evidence that saccharine does not exercise any injurious effect on the organism;
2) saccharine has absolutely no nutritious value; in consequence of its taste-effect the same importance as a complement to food and delicacies may be claimed for it as for other spices. For persons who have to refrain from using carbohydrates (for instance diabetic patients) saccharine is a welcome substitute for sugar according to the experience of eminent practicians, and, therefore, its dietetic value is not to be disputed;
3) for the above reasons objections from a sanitary point of view cannot be urged as motives for prohibiting the importation of saccharine.

Opinion, concluding remarks:

1) That experimental researches have not shown any reason as yet to pronounce saccharine as a substance injurious to health.

They prove that it agreed well with the animals experimented on even when given in large daily quantities of several grammes.

2) That there is not a single instance to prove that saccharine has an injurious effect on healthy persons. Even the French committee failed to show such a case, although this substance has now been in constant use (in families) for some years in different countries and is added to various kinds of food and delicacies.

Even direct experiments and particularly such on one's own person with large doses do not bear out the assertion by any means that saccharine has a detrimental effect.

3) That in the case of patients too, especially of diabetic sufferers, in the majority of the cases communicated, no derangements of any kind were observable after the use of saccharine and even after uncommonly large doses of it.

That there is at present no reason to alter the decision of the Supreme Sanitary Council of 14th July 1888 which is further supported by the researches communicated since then.

In Germany Privy Councillor Professor Dr. Leyden of Berlin gave the following declaration on the »Harmlessness of Saccharine« based on the use made of saccharine in the medical university clinique of the Royal Charité Hospital at Berlin:

Since February last Fahlberg's saccharine, obtained direct from the firm of Fahlberg & List of Leipsic, has been used in the first medical university clinique of the Royal Charité Hospital at Berlin, both in the case of a whole number of patients and convalescents and also temporarily for healthy persons. The saccharine was first tried as a spice for sweetening food and drinks in order to ascertain how it suited the taste of each separate individual, how it agreed with them and whether the use of the substance was accompanied with inconveniences and disadvantages. At the same time saccharine was tried from dietetic and therapeutic indications in the case of diabetic patients. By reason of these experiments and the experience gained, we testify at the express wish of the firm of Fahlberg & List of Leipsic that Fahlberg's saccharine agrees well with patients and healthy persons, that no detriment to health whatsoever is combined with the use of it and, above all, that saccharine has proved perfectly harmless to the human organism after a lengthened, continuous regular use lasting even 5 months in the case of some of our patients. For diabetic patients saccharine showed itself a most desirable and useful improver of their dietetic regimen, as it furnished them with a means of sweetening and flavouring both their solid nutriment (bread and cake for diabetic sufferers) and also their liquid food and delicacies (soups, coffee, tea) without carrying carbohydrates (sugar) to the organism. The kind of saccharine used in this institute was the solution neutralized by carbonate of soda, also that in the practical form of pastilles that contain 0,05 Fahlberg's saccharine to 0,02 natr. bicarb.

The daily dose, adapted as it was to suit the taste of each individual patient, amounted on the average from 0,15 up to 0,2 saccharine. Larger doses also agreed well with the patients and did not produce disturbances of any kind.

Berlin, 15th July 1886.

The Directorate of Ist Medical Clinique.
Prof. Dr. E. Leyden, Privy Med. Councillor.

From the opinion of Professor Dr. Lehmann of Würzburg we abstract the following passages:

The Government would have the right and obligation to prohibit the use of saccharine, provided any direct detriment to health could be proved by the use of it.

Spices of any kind if taken in extraordinary quantities, are injurious to health, as indeed many articles of food would be, more especially such nervous stimulants as tea, coffee, tobacco, and alcohol. I venture to assert that in proportion to the minute quantities in which saccharine can be used as a spice, it is remarkably harmless. Taking 0,2 saccharine equal to 60 grms sugar as a large daily dose, one 25 times greater and even 50 times greater is without any visible effect; but who could take a dose of any other kind of spice 25 or 50 times greater than the common daily quantity, much less of a larger quantity, without serious consequences? Who, for instance, can take 750 instead 30 grms of common, or 750 instead of 30 grms of sugar, or who can smoke 50 cigars daily instead of 2. It is not easy to find a spice or luxury that can compare in absolute harmlessness with saccharine.

As cane and grape sugar are physiologically equal in value, and as on the other hand a complement of saccharine is quite harmless, I, for my part, can have no direct objection from a hygienic point of view to saccharine.

Privy councillor Professor Dr. Sell of the Imp. Board of Health at Berlin stated at the ninth annual meeting of the »Free Association of Bavarian Representatives of practical Chemistry« assembled at Erlangen from 15th to 17th May,

that experiments made by the Imp. Board of Health proved that no injurious effects followed the use of saccharine. At this meeting too, its harmlessness was stated as a fact by other authorities.

We may now conclude the chapter »On the harmlessness of saccharine« and add to it a list of names of those scientists and physicians, who have rendered a great service to our product by their scientific researches and given us valuable assistance in our endeavours.

In **Germany**:

Prof. Dr. Sell, privy governm. councillor, of the Imp. Board of Health, Berlin.
Prof. Dr. E. Leyden, privy med. councillor, Director of the 1st med. Univer. Clinique of the Royal Charité Hospital, Berlin.
Prof. Dr. Gerhardt, privy med. councillor, lecturer on medicine at the Royal Frederic William University, Berlin.
Staff surgeon Dr. Herrlich, physic. of the female depart. of the Royal Charité Hospital, Berlin.
Prof. Dr. Brieger, physic. in the 1st med. Univer. Clinique of the Royal Charité Hospital, Berlin.
Prof. Dr. E. Salkowski in his work: On the Operation of so-called Saccharine in the Organism (from the laboratory of the pathological Institute in Berlin). Virchow's Archives for pathological anatomy, physiology and for clinical medicine.
Prof. Dr. Heinrich Fresenius, Wiesbaden.
Prof. Dr. Landoldt, privy councillor, lecturer on physics and chemistry at the Royal Frederic William University, Berlin.
Prof. Dr. Th. Clemens, Halle.
Prof. Dr. Lehmann, Director of the hygienic Institute of the Würzburg University.
Prof. Dr. Külz, lecturer on medicine at the grand ducal Marburg University.
Prof. Dr. Liebreich, lecturer at the Royal Frederic William University, Berlin.
Prof. Dr. Brasack, Aschersleben.

Prof. Dr. Kaemmerer, chairman of the municipal laboratory of Nuremberg for the testing of food and delicacies.
Dr. F. Jessen, assist. of the hygien. Institute of the Würzburg University.
Dr. Th. Roth, medic. councillor and district physic., Gössnitz.
Dr. Heinemann, Meiningen.
Dr. Michaelis, Waldenburg.
Dr. A. Stutzer, Director of the chem. experim. laborat. in Bonn: Saccharine, Examination of its chem. physiol. action.
Dr. Paul Niemeyer, Sanit. councillor, Berlin.
Dr. C. Rüger, Bonn, in his work: On Saccharine, Reklam's periodical on General Hygiene. No. 16 of XIII. annual set 1888.
Dr. E. Stadelmann, lecturer on medicine. On the Harmlessness of Saccharine after continuous use by human beings. (From the med. clinique of the Heidelberg University.)
Dr. C. Bischoff, Public Analyst, Berlin.
Dr. G. Vulpius, lecturer at the Heidelberg University.

The following practitioners (physicians) too:

Dr. Goliner, Erfurt.
Dr. Scheurer, Hanover.
Dr. Grüneberg, Cologne.
Dr. Mulert, Bruel.
Dr. Neustadt, Höxter.
Dr. Haike, Guben.
Dr. Adelheim, Trier.
Dr. Kutner, Guben.
Dr. Th. Weyl, Berlin.
Dr. Hartmann, Altona.
Dr. F. Elsner, Leipsic-Schoenefeld.
San. councillor Dr. Lüppers, Bertrich.
Dr. Knitzler, Darmstadt.
Dr. S. Hirschfeld, Erlangen, and many others.

In **Austro-Hungary:**

Prof. Dr. Vogl, Up. sanit. councillor and court council., Vienna.
Prof. Dr. von Barth, Up. sanit. councillor, Vienna.
Prof. Dr. Drasche, Lecturer, Director of the Imp. & Royal General Hospital and Sanit. Council., Vienna.
Prof. Dr. Kornauth, Lecturer, Vienna.
Prof. Dr. Birnbacher, Gratz.
Prof. Dr. Ed. Suess, Lecturer at the Imp. & Royal Vienna University.
Prof. Dr. Ladislaus von Wagner, Budapest.
Prof. Dr. W. Jaworski and Dr. J. Rosenzweig in their work: »Clinical Researches and Experience of Saccharine-sodium«. From the med. University Clinique of Prof. Korczynski, Cracow.
Privy councillor Dr. v. Renz, Wildbad.
Dr. H. Paschkis, Lecturer at Vienna.
Dr. Arnim Petschek and Dr. Theodor Zerner in their treatise »On Saccharine«. Central period. for hyg. Therapeutics, Vienna, 1888.
Dr. Rosenfeld, Director of IVth med. Department of the Imp. & Royal Hospital Wieden, Vienna.
Dr. Ludw. Alex. v. Nékám, Assist. at the hygien. Institute, Teacher of Hygiene and School-Board physic., Budapest.
Dr. Edgar Gans, Physic. of the Watering-place Carlsbad.
Dr. Fragner, Vienna.
Dr. Otto Schreiber, Vienna.
Dr. G. Hornung, Gross-Luckow (Moravia).
Dr. Max Vogel, Meran (Tyrol).
Dr. M. Abeles, Carlsbad and Vienna.
Dr. J. Fantl, Krumau, Bohemia.

Dr. Arnold Pollatschek, Carlsbad.
Dr. Schnée, Carlsbad.
Dr. Hans Hirtenhuber, Imp. & Royal Regimental Surgeon, Zala-Egerszeg.
Dr. Fürstenberg, Imp. councillor, Gratz.
Dr. Berghammer, Imp. councillor, Vienna.
Dr. Neubauer, Carlsbad.
Dr. Josef Haunold, District physic., Morav.-Trübau.
Dr. Hammerschlag, Vienna, and many others.

In **Italy**:

Prof. Dr. A. Mosso, Dr. Vitto. Aducco and Dr. Ugol. Mosso in their works: 1. Physiological investigations of the effect of benzoyl sulphonic imide or saccharine, Turin, 1885. 2. Therapeutic use of benzoic sulfinide or saccharine, Turin, 1886. (From the laboratory for physiology of the Turin Royal University.)
Prof. Dr. Bufalini, Lecturer at the Sienna University.
Dr. Zaeslein, Genova.
Dr. Dante Torsellini, Lecturer at the Royal Sienna University, in his work: »Saccharine in Food«. Milan, 1889.

In **Switzerland**:

Prof. Dr. Eichhorst, Director of the med. Clinique of the Zürich University.
Prof. Dr. Oskar Wyss, Director of the General Hospital, Riesbach.
Prof. Dr. Hofstetter, Director of the Canton Hospital, Lucerne.

In **Belgium**:

Prof. Dr. Bruylants, Lecturer at the Louvain University.
Prof. Dr. H. van Heurck, Lecturer at the Antwerp University.
Prof. Dr. Th. Plucker, ord. Prof. at the Liege University.
Dr. E. van der Schrieck, Antwerp.
E. Anseel, Chemist to the Law Courts and Municipality, Antwerp.
Prof. Dr. L. Nothomb, Lecturer at the Royal Academy of War, Brussels.
Prof. E. van Houtte, Antwerp.
Dr. Albert van Vyve, physician to the Law Courts, Antwerp.

In the **Netherlands**:

Prof. Dr. Stokvis, Chairman of the Up. Sanit. Board, Amsterdam.
Prof. Dr. Forster, Sanit. Councillor, Utrecht.
Dr. Hoorn, Sanit. Councillor, the Hague.
Dr. Leignes Rakhoven, Sanit. Councillor, Overysel.
Dr. Jan Huygens, Lecturer at the Utrecht University, in his treatise: Original Researches on the Influence of minor Saccharine Doses on Men.

In **England**:

Prof. Sir Henry Roscoe, London.
Prof. Dr. Farquharson, London.
Dr. F. W. Pavy, London.
Prof. Attfield, London.
Dr. Thomas Stevenson, Lecturer on judic. medicine and chemistry at Guy's Hospital, London.
Dr. L. C. Wooldridge, Lecturer on physiology, London.
Prof. James Little, President of the King's & Queen's College of Physicians«, Director of the Adelaide Hospital, Dublin.
Rev. C. H. Spurgeon, London.
Dr. J. F. Janson, Whitehaven.
Dr. Robert Hellon, Seascale.
Dr. C. J. R. MacLean, Yeadon.

Dr. Macnaughton Jones, Examiner and Professor at the Royal London University.
Prof. Dr. Lord T. Lauder-Brunton, London.
Prof. Dr. John Dougall, Lecturer at the Royal Med. High School, Glasgow.
Prof. Dr. Henry Fennyk, Director of the Saint Por Hospital, London.
Prof. Dr. Jewell, of the Royal Institution, London,
and many others.

In the **United States of North America:**

Dr. Louis Weyland, New York.
Dr. L. Wolff, New York, and many others.

In **France:**

Prof. Dr. Constantin Paul, Member of the Academy, Paris.
Prof. Dr. Dujardin-Beaumetz, Member of the Academy, Paris.
Prof. Dr. Reynier, Director of the Broussais Hospital, Paris.
Dr. de Pietra-Santa, Laureate of the Institute of France, Member of the Academy, Paris.
Dr. Bouchard, Paris.
Dr. Fournès, Paris.
Dr. Echo, Paris.
Dr. Degoix, Paris.
P. Mercier, Laureate of the École supérieure, Paris.
Dr. Edward Warren-Bey, Paris.
Dr. Lutaud, Member of the Academy, Paris.
Dr. Ch. Kügler, Docteur of Sciences, Paris, and many others.

To one and all of them we beg leave to express our most sincere thanks for the interest exhibited in our product.

The Action of Saccharine on the Animal and Insect World.

The observation that insects, and dogs too, have an aversion to saccharine was first made by Hager and confirmed later on by Berthelot and Liebreich. Although it is universally known that animals in general, and insects in particular have a dislike to spices and aromatic substances, yet French journals eagerly seized on this circumstance and endeavoured to utilise it as striking evidence against saccharine; they spoke about the natural instinct of animals, and advised the public to let themselves be guided by it. Neither the credulous reader nor the philosophic editor for a moment thought of the application of saccharine for so-called »Death to Flies« or Fly-papers (blotting-paper saturated with arsenic acid) and that it furnishes a first-rate weapon for fly-slaughter!

The celebrated French national economist Francisque Sarcey dwells on this subject in his clever treatise (La Saccharine jugée par Francisque Sarcey) in the XIX^ieme Siècle, and says:

> It is stated that flies and bees, both good judges of sugar, show the greatest disgust for saccharine. Insects will not even look at it, and for what reason? Because they do not find the requisite nutriment in it, because they do crave as men do for sensations that are agreeable enough but quite superfluous for the maintenance of life. One of our most eminent artists to whom they attempted to prove the danger of using saccharine, exclaimed: »And how about my dog? Do you imagine he would take a glass of absinthe if I tried to persuade him ever so much to do so?«

In order to prove that an instinctive aversion is not in play here, we are at present rearing 6 puppies on saccharinized milk. The animals are now about 8 weeks old, take their food with good appetite and enjoyment, and are growing strong. One of these dogs has been getting 1 grm of easily soluble saccharine these four weeks. He devours the sweetened food with great delight and has outgrown the others that have got no saccharine during that period.

How various the tastes of animals are is best proved by the statement, that poisoned wheat sprinkled with a solution of saccharine is quickly devoured by rats and mice. There

is now actually a speciality in trade under the name of »Saccharine wheat poison«, and it is considered one of the surest means of exterminating rats and mice, for these animals never refuse it, but devour it most ravenously.

The above assertion has been refuted by several persons. Pure saccharine, *i. e.* saccharine in solid undiluted form is not touched by most animals, it is true, and these creatures evince therein more sense than many men, who put everything into their mouths that appears eatable. On the other hand hardly any animals make a difference between sugared food and that properly saccharinized. We have seen compotes and fruits preserved with saccharine, covered with flies, bees etc.; dogs and cats also enjoy saccharinized milk. Our observations have been confirmed by many investigators, thus by Mosso, Rüger, Jessen, and others.

On this point Professor Dr. Kornauth expresses his opinion in the following words.

> As to the aversion to saccharine asserted by Hager as characteristic of ants, by Fischer and Rabow of wasps, by Liebreich and Stift of dogs, it must have reference to their special experiments, for our dogs did not exhibit the slightest dislike to saccharine when they had got accustomed to sweet food, and the same is true of a pig that was experimented on, of which mention will be made later on.
>
> It should be mentioned here, that Voit in his »Physiology of Assimilation« states that in many cases the dogs he experimented on had an aversion to raw meat, others to boiled meat. But from these cases nobody will think of coming to the conclusion that dogs have a dislike to raw or boiled meat in general.
>
> Even if animals do not take saccharine, that is no proof of an aversion to this substance on their part, for, as Francisque Sarcey says, insects, for instance, do not touch saccharine, because they do not find in it the nutriment they require, nor do they crave for sensations, as men do, that are undoubtedly agreeable but quite superfluous for the maintenance of life.
>
> To build up any hypotheses on the subjective tastes of animals is a risky matter at any time.

The Presence of Saccharine.

(Re-actions of saccharine.)

Inquiries are often made as to the presence of saccharine in different substances and nutriments which are preserved or sweetened with it. Owing to its great sweetening capacity, very minute quantities of it suffice to give another body, whether solid or liquid, an agreeably sweet taste, or at least a mild and pleasant, though not exactly a distinctly sweet flavour. Under such circumstances it is not always an easy task to prove the presence of saccharine; it is based on distinct chemical re-actions, which involve a profound knowledge of the subject.

It is not our office to submit to an exhaustive scientific criticism all the methods proposed by analysts, some of which are extremely complicated, others again less exact. For the sake of completeness, we will nevertheless make brief mention of them and give the precedence to a method of which we always make use and have found by practical experience to be the simplest and best to prove the presence of saccharine in food stuffs since it can be employed even by the uninitiated and without requiring any particular knowledge of such experimental science.

This method is based on the fact that saccharine possesses a quality distinguishing it from other sweetening substances, from all kinds of sugar in fact by being easily soluble in ether. Saccharine can therefore be extracted from the substance containing it by means of ether, and its presence proved by the taste.

If the substance under analysis happens to be a solid body it must be finely powdered, moistened with a few drops of hydrochloric acid or sulphuric acid, shaken up in a separating funnel with ether, or extracted by means of ether in a Soxhlet's apparatus, the ethereal solution evaporates and the residue is dissolved in water. If the aqueous solution tastes intensely sweet the substance contains saccharine. Fluids treated with saccharine are acidulated with a few drops of sulphuric acid and extracted in the separating funnel in the

way just described. In this manner Jessen succeeded in detecting pure saccharine in a dilution of 1 to 90 000, the easily soluble variety, in one of 1 to 76 000. This is the simplest qualitative test.

Herzfeld and Reischauer use the following method for the quantitative determination of saccharine:

They acidify the mass with phosphoric acid, extract with ether, distil the latter and fuse the residue with a mixture of saltpetre and bicarbonate of soda (1 to 6) which converts the sulphur of the saccharine into sulphuric acid and allows the quantity to be ascertained. By means of this method Reischauer asserts he can determine the amount even if there be less than 0,1 % of saccharine present. This very complicated method is not quite so trustworthy, however, for the possibility is not excluded that other organic substances containing sulphur may be present when they will also be extracted by the ether and thus lead to false conclusions.

The remaining reactions are only qualitative ones, depending on colour tests.

E. Börnstein pulverizes the substance to be analysed, moistens with sulphuric acid, shakes with ether, distils the latter, treats the residue with a little resorcinol in excess, adds a few drops of concentrated sulphuric acid and heats the mass until it acquires a dark green colour. A splendid orange yellow dye possessing strong fluorescence towards green, is formed. According to our experience this is the sharpest colour reaction characteristic not only of saccharine but also of a number of other organic substances, so that this method is not adapted to prove absolutely the presence of saccharine.

C. Schmidt melts the ethereal residue with caustic potash for half an hour at 250° C., dissolves the melt in water, acidifies with sulphuric acid and extracts with ether. He then evaporates the ether to dryness, takes up the residue with water and adds ferric chloride. The salicylic acid resulting from the fusion, with the ferric chloride yields a very characteristic violet colour. Schmidt asserts that he has proved the presence of 0,5 % saccharine in wine, which is confirmed by Bragioni. In our opinion the value of the method is very limited, for in many kinds of provisions there are tannic acid and tannin, which produce salicylic acid when fused with potash. Besides this, the analysed substance may contain salicylic acid, and in the case of wine and beer it is very necessary to ascertain beforehand whether they do not contain salicylic acid. A similar method but just as little suitable, has been proposed by R. Kayser.

Bruylants recommends for the analysis of beer a similar method. He neutralizes with bi-carbonate of soda, evaporates to a syrup, adds a threefold volume of alcohol, filters off the residue and washes with alcohol. The latter is then completely evaporated, the residue dissolved in water, acidified with phosphoric acid, extracted three times with ether; the latter is removed by distillation and the residue neutralized. The presence of saccharine can then be proved by tasting or by conversion into salicylic acid. Bruylants acknowledges the weak point in his method himself, and as salicylic acid is often found in beer he advises mixture of the aqueous residue with a little excess of mercuric nitrate, washing the precipitate that ensues, drying and treating it in the well known manner with resorcinol.

E. Alessandri removes the alcohol from the wine, decolourises with dioxide of lead or bone-black, evaporates one half, precipitates the anhydride with mercuric nitrate, washes the precipitate, dissolves it in boiling alcohol, dilutes the solution, precipitates the mercury with hydric sulphide, filters, evaporates the filtrate and treats with resorcinol, as Börnstein does. L'Orisi did not succeed in proving the presence of saccharine by this method in quantities under 1 %.

Tests for the Purity of Saccharine.

The temptation to adulterate a product of great monetary value with other substances generally proves too strong for some persons. Saccharine is a white, amorphous powder resembling many other bodies such as sugar, flour etc., and for this very reason it readily lends itself to sophistication with them, without any chance of detection of the fraud with the naked eye.

In order to guard our customers against adulterations we will now communicate some methods of detecting them that can be used by anybody, and that furnish certain proof of the genuineness of the article.

The public can only protect themselves against adulterations by purchasing the saccharine in our own packages which are described and illustrated in this book.

Testing pure saccharine as to its purity.

1) Pure saccharine must above all possess the sweetening capacity warranted, *i. e.* it must be 300 times sweeter than the purest sugar, than even crystallised white sugar candy. 1 litre of pure well-water containing 20 grms of candied sugar dissolved in it, possesses the same sweetness as 1 litre of pure well-water in which 0,067 grm of saccharine is dissolved. To prove this, both solutions should be made and tasted.

2) When ignited, pure saccharine should leave an almost imperceptible, white ash-residuum which must not amount to more than 0,3 or 0,4 % when mixed with sulphuric acid.

3) Pure saccharine must dissolve clear and bright in solution of caustic potash, caustic soda and ammonia, also in mono- and bicarbonate of soda or potash, and in the three last-named solutions it must effervesce. The solution may have only a slightly yellow colour, in strong concentrations at the most a pale yellow colour like that of hock, nor ought it to be changed by boiling.

If the solution turns dark (brown) when boiled, that is a sure sign of its being adulterated.

4) In concentrated sulphuric acid the saccharine must dissolve when warmed and communicate to the acid a slightly yellowish hue. The colour of the solution must not be altered by

long and gentle heating; should the solution turn dark brown or black after a long but gentle heating, the saccharine is adulterated with flour or cane-sugar or other substances the nature of which must be explained by an analyst.

Testing refined saccharine as to its purity.

Refined saccharine must be compared with crystallised white sugar-candy in the way just explained and possess a sweetness of 500 to 1. The amount of ash left after its being burnt must not be more than 0,2 to 0,3 %.

Testing easily soluble forms of saccharine.

Easily soluble saccharine consists of about 90 % saccharine and 10 % soda, consequently compared with sugar-candy it possesses a sweetness 275 times greater than that of the latter, and in a refined state it is even 450 times sweeter.

Easily soluble forms of saccharine must dissolve in water quickly, and to perfectly clear and neutral solutions. From concentrated solutions it is precipitated by mineral acids as a white powder, the form most difficult of solution. When ignited it leaves behind a considerable ash-residue which amounts to 33 or 34 % after treatment with sulphuric acid.

Part II.

Saccharine in Trade.

General remarks on its introduction — Forms of saccharine — Weights (measures) and modes of packing — Prices and Selling terms — Trade-mark and control — Agencies — Trade notes — Duty tariffs — Awards.

General remarks on its introduction. About seven years ago the first attempt was made to open up a market for saccharine and to carry on an extensive sale of it — since then it has become an article of trade universally prized and has managed to make a way for itself throughout the civilized world.

As soon as we were convinced beyond doubt of the harmlessness of saccharine, for certainty as to this point was necessarily the basis of all operations towards a practical realization of our plans, as soon as patents had been applied for and acquired in most civilised countries, a company with adequate capital was soon formed under the firm of Fahlberg, List & Co., Saccharine Works, a manufactory built at Salbke-Westerhüsen on the Elbe and devoted exclusively to the wholesale manufacture of saccharine. As soon as work was started here and after numberless technical difficulties had been overcome, unavoidably connected with such complicated chemical processes, then at length the first attempts were made to find a market for this substance and to push its adoption in those branches of industry in which it was destined to play a leading part.

At starting we found but little encouragement. Now and then one manufacturer resolved on making a trial with it under the seal of secrecy, and more from curiosity than from any real interest, much less from conviction of the value of our product.

In 1885 saccharine was laid before the general public at the International Exhibition in Antwerp and at the International Inventions Exhibition in London, and though some practical men evinced a lively interest in the new sweetening agent, yet this interest was merely of a nominal kind; such indeed as might be expected of a product in its first stage of development when still made in small quantities in a laboratory and experimental station, but not manufactured on a large scale. After passing into its second stage, when produced in large quantities, and then offered for sale to manufacturers, our statements as to its value and superiority encountered as a rule suspicion, prejudice and distrust mingled with ridicule.

Had we been swayed in the least at that time by the small measure of success attendant on our endeavours, saccharine would have declined into oblivion. It would have been regarded as a scientific curiosity, but never would it have acquired such eminent practical importance as it actually has now. But convinced as we were that its manifold useful qualities not combined in any other body would eventually ensure its universal adoption and the recognition of its merits, we worked on undauntedly and perseveringly, opposed all the countless proofs of ill-will with incontestable evidence of its folly, removed existent and deeply rooted prejudice, made known our product by all the means at our disposal and at a great sacrifice of time, money and labour, and are now rewarded by the knowledge that our perseverance was fully justified and that in the future we have to await still greater results.

Better than words can express, does a glance at the two illustrations on the first sheets of this little work show what has been attained in the eight years just elapsed. These illustrations represent the factories of 1886 and 1893. They show, as just remarked, what has been attained in that time, that the factories have gradually grown up to a stately establishment by the erection of increased plant, new buildings and these have occasioned the purchase of more land.

It would not have been possible for us to do all this alone in such a short time! Both from the learned world and from intelligent and practical business-men in various branches of industry we have found vigorous assistance, and now we regard it as a peculiarly pleasant duty and one we gratefully fulfil, to express our deeply felt acknowledgment of the many proofs of kindness and public spirit shown us on numerous occasions. It was in particular a proof of a kindly disposition to assist us by experiments in the utilisation of saccharine for the different branches of industry which could not be made by ourselves, but only by clever and experienced commercial men. Nothing could

have assisted us more in our endeavours to make the utilisation of saccharine more general than the many-sided and well ascertained practical experience of manufacturers.

Forms of Saccharine. Prior to entering into a more detailed description of saccharine, it would seem advisable to make our readers acquainted with the article as sold to the public, so that they may know in what quantities and measures (weights) it can be bought, what the external appearance of the latter is, at what prices and on what conditions it is to be had.

As already stated in Part I of this work, saccharine is made up and offered for sale in different forms.

Weights (measures) and Modes of Packing. The gramme has been adopted in general as the unit of weight for the various quantities sold, but the manufacturers are willing, if particularly requested, to furnish their product in quantities according to other units of weight, though they have none ready in stock. Obtainable at all times are:

I. **Refined saccharine** and

II. **Pure saccharine**

in parcels of 25, 50, 100, 250 and 500 grms and of 1, 2, 5 and 10 kgrms.

III. **Easily soluble refined saccharine** and

IV. **Easily soluble saccharine**

in parcels of 15, 25, 50, 100 and 200 grms and of 1/4, 1/2, 1, 2, 5 and 10 kgrms.

V. **Saccharine tablets (wafers)**

in parcels of 25, 300 and 1000 tablets (wafers) and of 1/4, 1/2, 1, 2, 5 and 10 kgrms.

Saccharine is sold in such parcels (weights) and in original packages provided with our trade-mark and legally protected and differing according to the kind of saccharine they contain. As our original packings in an uninjured state are solely a sure guarantee for the purity and genuineness of the product, particular attention should be paid to that on buying it. Annexed we publish small illustrations combined with short descriptions of our different original packings.

I. **Refined Saccharine** is sold to the public in narrow-necked bottles of white glass provided with tin-capsule lids made to screw on and inlaid with cork, the stoppers being fastened with a black and white string and by means of stamps to the glasses. The stamp for weights of 25, 50 & 100 grammes has a white S on a blue ground, for those of 250, 500 & 1000 grammes it has our trade-mark in red on a black ground.

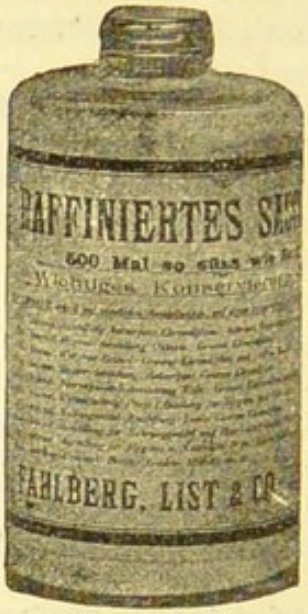
25 grms

50 grms

100 grms

250 grms

500 grms



1000 grms

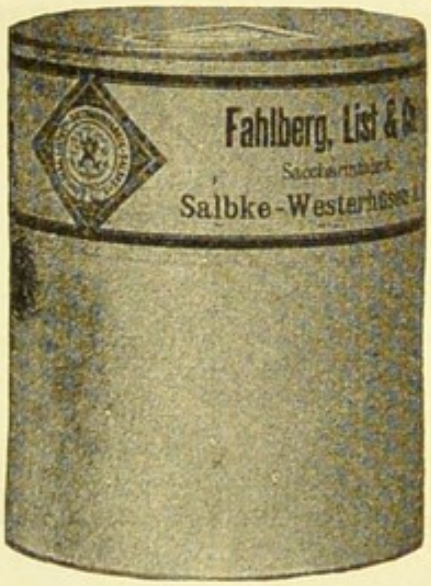
The labels of four-cornered, oblong shape encircle the round glasses almost completely, have also the trade-mark on them and the text in red and black print on yellow paper.

In addition to these glass packages, refined saccharine intended particularly for industrial porposes, sea-transport and for use in large quantities is sold also in round tins; the cover of the latter consists of a lid rotating on a pivot in the centre of the upper end. The lid is hermetically closed besides by a trade-mark stuck over it; whenever the tin has to be opened, the trade-mark must be moistened carefully and removed.

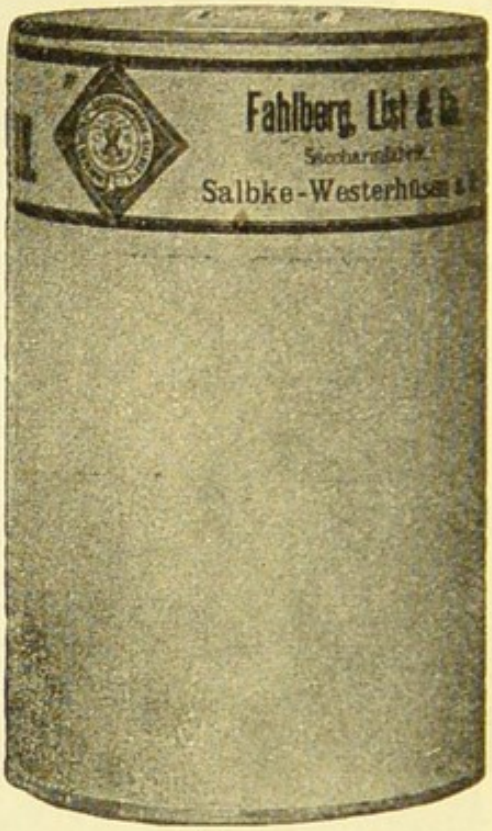
1/4 kgrm

1/2 kgrm

1 kgrm



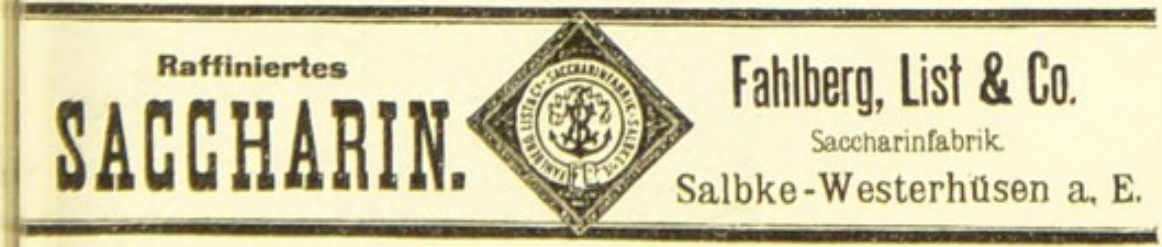
5 kgrms



10 kgrms

The labels on the tins of 1/4 up to 1 kgrm are broad strips covering the latter along their full length; in the middle of the strip is the trade-mark and round about it the text in black and red print. Those on the tins of 2, 5 and 10 kgrms are, on the

contrary, narrow strips with the trade-mark in black and two bills, one of which indicates the net-weight and the other the gross-weight and tare.



II. Pure Saccharine is made up in wide-necked bottles of white glass provided with a tinned white-metal lid made to screw on, and inlaid with cork; the trade-mark being stamped on the lid. The latter is fastened to the glass with a stamp such as has been described already.

50 grms

25 grms

100 grms

250 grms

500 grms

1000 grms

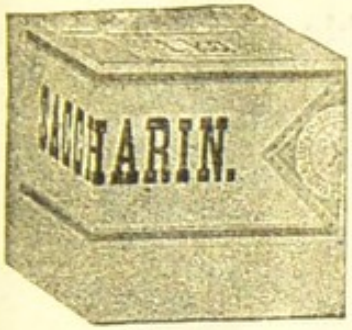
25 grms

The labels are in coloured print and lacquered over; they show the annexed illustration.

50 and 100 grms

250, 500, 1000 grms

In addition to these glass bottles, pure saccharine like the refined substance is also packed in zinc boxes of a square shape; the four-cornered opening or hole is at the side in one



1 kgrm

2 kgrms

5 kgrms

10 kgrms

of the 6 surfaces and is shut by a tin slide running in a groove, a trade-mark covering the whole.

The labels consist of strips, trade-marks, bills with weights and tare on them, just the same as for refined saccharine, the trade-marks being, however in red.

III. and IV. Refined easily soluble and easily soluble Saccharine is sold in narrow-necked bottles of white glass provided with nickel-plated tops of white-metal made to screw on, and inlaid with cork; the bottles are three-cornered and taper

15 grms

25 grms

50 grms

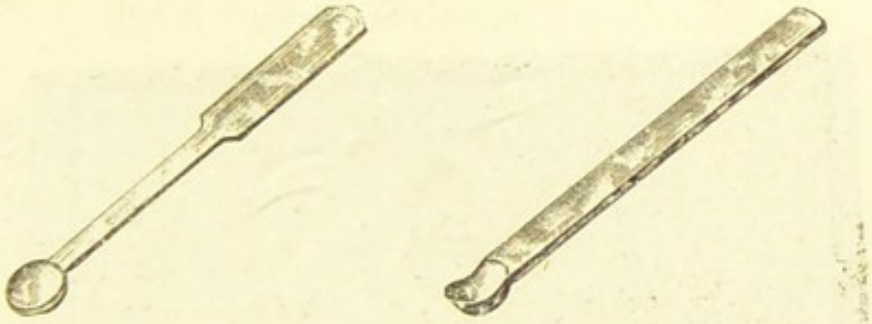
100 grms

200 grms

upwards, thus offering three surfaces each of which has a label on it. These 3 labels are the same for all weights (quantities)

and differ merely in size; the labels illustrated are those for bottles of 50 grms.

These bottles together with directions for use and little measure-spoons are made up in small three-cornered parcels, all quite similar in every respect except as to size.



With the aid of these little measure-spoons the smallest quantity of saccharine so often required in households and in daily use, for instance to sweeten a cup of tea, coffee etc. or a glass of grog, punch etc. can be taken out easily without its being necessary to use the scales.

The outer packing. Refined easily soluble saccharine is in regard to packing, quite similar to the common easily soluble saccharine, but in the colour of the print it differs, for that of the refined is blue-yellow, whilst that of the common kind is black-red and furthermore the text is different.

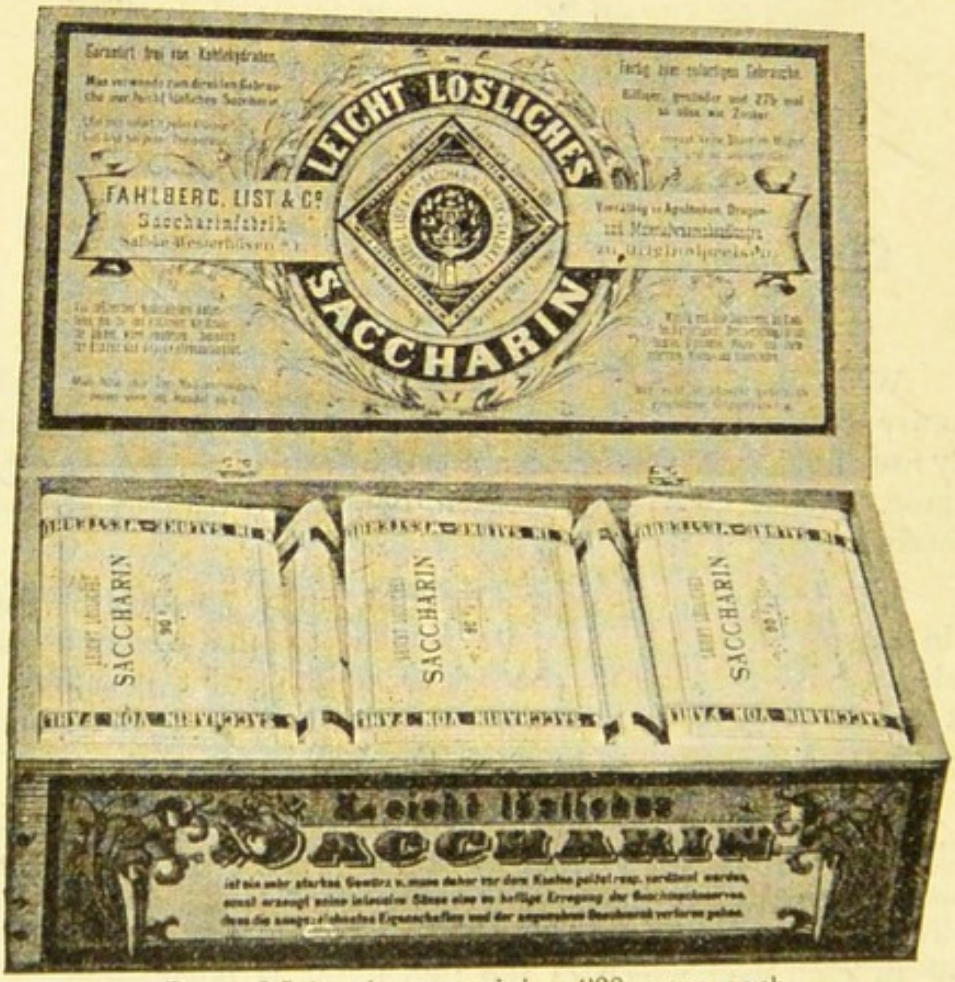
The two kinds or forms sold by us both of the refined easily soluble saccharine and of the common easily soluble substance, the pulverised and the granulated kinds do not differ outwardly in regard to packing; the contents of the glass (bottle) show in each case which of the two forms is before one.

Complaints are frequently made concerning these two forms which, as already pointed out in the first part of this work, are quite equal in respect to quality, sweetening capacity and price. A want of preciseness in the ordering of the goods is always the cause of such complaints. In giving an order for easily soluble saccharine it should, therefore, always be stated exactly whether the refined substance is wanted and whether it has to be granulated or pulverised.

If intended for re-sale (retail) the little parcels are packed in original-boxes of 1/2 and 1 kgrm. The following wholesale quantities are furnished:

1	box	with	5	bottles	of	200	grms	each	1	box	with	5	bottles	of 100 grms each
1	„	„	10	„	„	100	„	„	1	„	„	10	„	„ 50 „ „
1	„	„	20	„	„	50	„	„	1	„	„	20	„	„ 25 „ „
1	„	„	40	„	„	25	„	„	1	„	„	33	„	„ 15 „ „
1	„	„	66	„	„	15	„	„						

The smooth planed boxes with hinged lids are provided with labels in coloured print; those containing refined easily soluble saccharine have the word „refined", printed in blue colour on them.



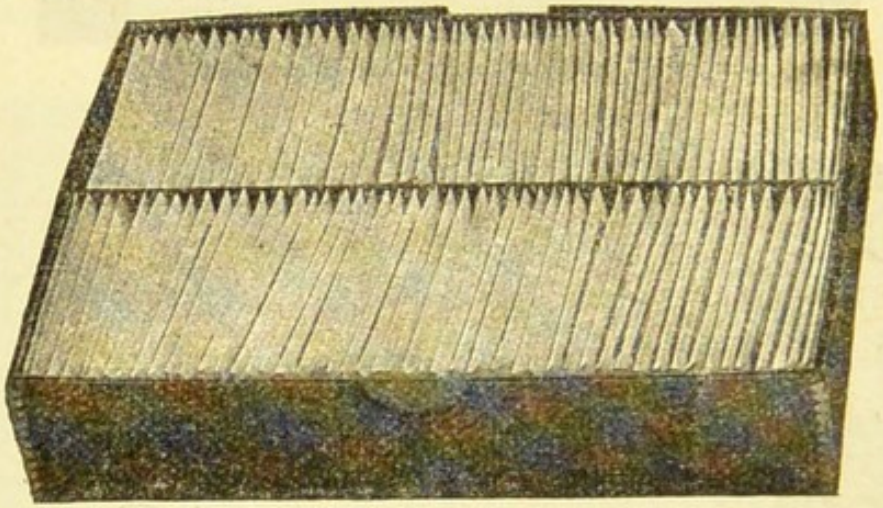
Box of 5 bottles containing 200 grms each.

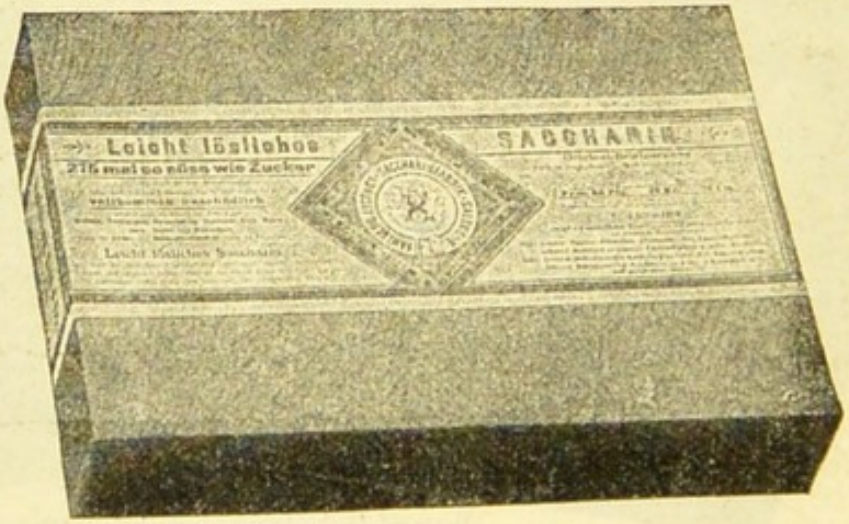
Box of 33 bottles containing 15 grms each.

Box of 40 bottles containing 25 grms each.

In order to give everybody an opportunity of purchasing the smallest quantities of saccharine for a trial without being put to any great expense, and to make him at the same time independent of the retailer, and to have full certainty in respect to the purity and quality of the product he wants to buy, we furnish the easily soluble kind of saccharine in a so-called „letter-packing“ containing 3½ grms or the equivalent of 1 kgrm of sugar.

This letter-packing contains in a little pocket 1 gummed letter with 3½ grms of easily soluble saccharine, 1 measure-spoon and 1 prospectus together with directions for use therein. We sell original cardboard boxes containing 50 or 100 of these letters to retailers.

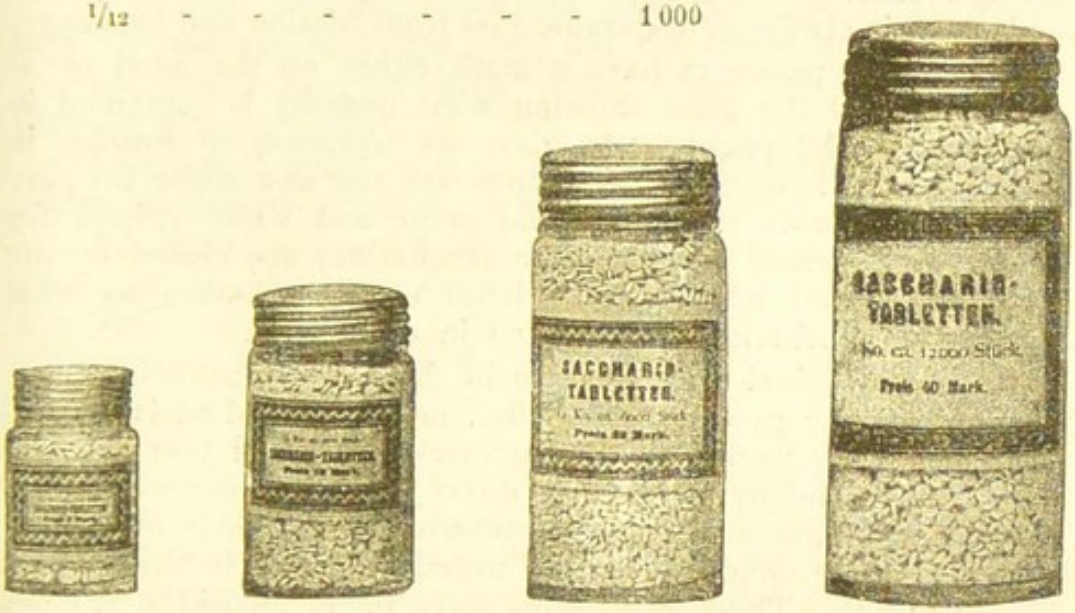




Refined, easily soluble saccharine and easily soluble saccharine are also packed like refined saccharine in round tins and like pure saccharine in four-cornered zinc boxes of respectively $^1/_4$, $^1/_2$, 1, 2, 5 and 10 kilogrammes each. The packing is exactly the same as that already described with the only difference that all labels have the words »easily soluble« on them

V. **Saccharine cakes** (wafers, lozenges, or tablets) are also packed like pure saccharine in wide-necked glass bottles provided with metal tops inlaid with cork and with lables in black-red print. They contain:

1	kilogrm	of	cakes	(wafers)	or	about	12000
$^1/_2$	-	-	-	-	-	-	6000
$^1/_4$	-	-	-	-	-	-	3000
$^1/_{12}$	-	-	-	-	-	-	1000



The tops of these bottles are fastened with stamps in the same way as those containing pure saccharine.

In order to offer everybody an opportunity of buying this product in the smallest quantities too and in the original packing and to allow of its being carried conveniently in the waistcoat-pocket we have adopted the following method of packing it:

Little glass tubes in cases each containing 25 saccharine tablets and directions for use

and glass phials in cases each containing 300 tablets and directions for use.

These packages have soon come into great favour and are furnished to retailers in original boxes containing the following quantities:

1	box	containing	50	glass	tubes	with	25	cakes each
1	-	-	100	-	-	-	25	- -
1	-	-	10	glass	phials	-	300	- -
1	-	-	25	-	-	-	300	- -

We sell besides saccharine tablets packed loosely in quantities of 5 or 10 kilogrms in square zinc boxes, as we do pure and easily soluble saccharine, but only if specially requested for the tablets are likely to spoil when packed in this way, and there is always considerable loss from friction and breakage.

All glass packages have a mark either on the label or at the bottom of the glass showing what quantity is contained in each glass. All packages in glass are wrapped up besides in silk-paper. These paper-envelopes are red and white for pure and easily soluble saccharine and green and white striped for refined and refined easily soluble saccharine, are closed by the trade-mark and have a little label on them indicating what amount of saccharine is contained in each glass.

These original packages are in themselves a sufficient guarantee that the goods are genuine, and we would advise buyers to reject other packages as counterfeit, provided they are not sold abroad and by our agents direct. In some cases we have allowed our agents in foreign countries to use their own packages for our products, and were urged to do so in the interest of the public. These exceptions were found advisable in cases in which high rates of duty and the expense of carriage raised the prices of our products made up in small quantities so much, that we deemed it necessary to forward large quantities to such countries and to have the packing of small quantities done on the spot.

Price and selling terms. Prices of saccharine are fixed as follows:

I. Refined Saccharine:

25	50	100	250	500	1000 grms
5,—	9,—	16,—	39,—	76,—	150,— M.

II. Pure Saccharine:

25	50	100	250	500	1000 grms
3,50	6,—	11,—	26,—	51,—	100,— M.

III. Refined Easily Soluble Saccharine:

15	25	50	100	200	250	500	1000 grms
3,50	5,—	9,—	16,—	31,50	39,—	76,—	150,— M.

IV. **Easily Soluble Saccharine:**

15	25	50	100	200	250	500	1000 grms
2,50	4,—	7,—	12,—	22,50	26,—	51,—	100,— M.

V. **Saccharine Cakes:**

1/12	1/4	1/2	1 kgrm
5,—	12,—	22,—	40,— M.

Tubes containing	25	0,25	M.
Phials -	300	2,50	-

The above prices include receptacles and all other packing, also original-boxes if sent in them, free from the factory at Salbke-Westerhüsen on the Elbe.

Packing is not charged but not taken back either (in part payment).

If special packing cases are necessary for large orders they are charged at prime cost, but not taken back.

Our terms are net cash; small sums are made payable through the post-office.

Discount is given on large orders which like the preferential prices allowed to retailers, is subject to special agreement.

All our agents are bound to sell at the factory prices given above; in no case may they sell our products at lower prices. Any case coming to our ears of their being offered for sale at lower rates will be followed by the immediate cutting-off of the discount, preferential prices and any other special allowances granted by our firm.

In foreign countries the prices for saccharine are naturally dependent on the duty tariffs and other expenses combined with the importation of our products, but we exercise a strict control over the actions of our agents in this respect and the prices they charge are always fixed with our consent.

Trade-mark and Control. As already stated, all our packages are provided with our legally registered trade-mark. The latter consists of 2 Ss facing and worked into each other and fastened to an anchor encircled cartouch-like by a band bearing the inscription: Fahlberg, List & Co. * Saccharinfabrik * Salbke a. E.

With a view to the further protection of our customers we have adopted a system of control that has proved most effectual for years. Every packing above 200 grms is provided with a number stamped in the metal tops of the glasses and in the bottoms of the boxes, so that it cannot be rendered invisible. Exact lists of these numbers are kept when the goods are forwarded, so that if complaints are made we know the purchasers of those quantities of saccharine and the

firms they have been sold by at once, provided, of course, the person making the complaint states the number in question. Furthermore, we know exactly from which lot of saccharine the parcel was made up, when passed from the factory into the warehouse, in what condition it was — every quantity of saccharine leaving our works is accompanied by a detailed analytical test-note — and when forwarded to the buyer or agent.

Regulations concerning the exportation of saccharine. In all packages above 200 grms there are besides little round bills placed at the bottom of the glasses or boxes and bearing the notice: »Not for exportation to etc. . . . .«

This prohibition of exportation is not a legislative measure of any government, but is contained in the terms of contracts we have entered into with our agents in the respective countries and is a condition of the licences granted. Similar notices are to be found on all invoices.

The following firms are entrusted at present with our agency in foreign countries:

Europe:

General Agency for Great Britain, Ireland, Spain, Portugal, Australasia and British Africa etc.:
»Wilson, Salamon & Co. Ltd., London, 165 Queen Victoria Street EC.«

Agents general for Belgium and Holland:
»H. F. Van Heurck & Co., Antwerp, 14–22 Rue de la Santé.«

Agent general for Austro-Hungary:
»Julius Jalowetz, Vienna II/I, 20 Kaiser Josephstrasse.«

Agent general for Russia:
»Geo. Ad. List, Moscow.«

Agents general for Scandinavia:
»Johs. Nielsen & Falck, Copenhagen, 6 Amaliegade.«

Agent general for Switzerland:
»Robert Wirz, Basle, 74 Gartenstrasse.«

Agencies general for: Sicily — »Carlo Pauly, Palermo.«
Luxembourg — »J. Glesener, Wiltz.«
Danubian States — »L. Stempel, Vienna II/II, 78 Praterstrasse.«
Russian Poland — »J. Korál, Warsaw, 11 Orla.«

America:

Agency general for the United States of America:
»Schulze-Berge & Koechl, New York, 79 Murray Street.«

Agency general for Canada:
»Stephan Huebner, Toronto, 93 Sherbourne Street, and Montreal, 67 St. Sulpice Street.«

Agency general for the Argentine States:
»Arturo O. Diesel, Buenos Ayres, 785 Casilla de Correos.«

Asia:

Agency general for Japan and Corea:
»M. Raspe & Co., Yokohama.«

Agency general for East India:
»Bertie-Smith & Co., Bombay.«

We are now very desirous to further agents in other transmarine countries; persons desirous of accepting the office will please apply direct to us.

Trade notices: All agents general, and all agencies acting under them in the chief centres of their district keep a stock of our products, and are in a position to communicate all desirable information on saccharine and forward printed reports and directions for use in all languages.

It is most advisable to apply direct to our office for special reports, which together with samples are always forwarded free of charge, on application.

The products of the saccharine factory of the firm Fahlberg, List & Co., Salbke-Westerhüsen on the Elbe are sold, in international trade according to the purposes they are to be used for by apothecaries, grocers, druggists and general dealers. To places and countries in which our firm is not represented the goods are forwarded direct from the factory itself; orders from foreign countries are executed only on receipt of the invoice amount or on their being accompanied by satisfactory references.

In order to facilitate business with transmarine firms that have no agent of their own or branch office at Hamburg, we have opened at that place, Kl. Bäckerstrasse 1, an office and warehouse under the firm: »**Fahlberg, List & Co., Saccharinfabrik, Salbke-Westerhüsen a. E., Filiale für Hamburg und Export**«, which is in regular connection with export firms.

Import Duties on Saccharine. The import duties on saccharine in the countries it is sold in, are as yet very different, as the following list shows:

	Duty Tariffs:	Duty in German currency per kilogrm.
Europe:		
Belgium	140 francs per kilogrm	M. 112.—
Denmark	33½ oere per lb.	- —.76
Germany	duty free	duty free
Finland	21,20 Marks per 100 kilogrms	M. 18.—
France	prohibited	prohibited
Greece	0,20 drachms per oka	M. 63.—
Great Britain	duty free	duty free
Holland	5% ad valorem	M. 5.—
Italy	duty free, but only for apothecaries.	
Luxembourg	5% ad valorem	M. 5.—
Norway	duty free	duty free
Austro-Hungary	10 fl. in gold per 100 kilogrms	M. 20.—
Portugal	15000 reis per kilogrm	- 68.10
Roumania	duty free	duty free
Russia	2.4 rouble in gold per Pud gross	M. —.48
Sweden	5% ad valorem	- 5.—
Switzerland	100 francs per 100 kilogrms	- —.80
Servia	10% ad valorem	- 10.—
Spain	prohibited	prohibited
Turkey	8% ad valorem	M. 8.—
Africa.		
Egypt	10% ad valorem	M. 10.—
British Bechuanaland	12% -	- 12.—
Cape Colony	12% -	- 12.—
Morocco	10% -	- 10.—
Orange Free State	12% -	- 12.—
Tunis	8% -	- 8.—
Asia:		
Bomare, Aruba, Saba etc.	10% ad valorem	M. 10.—
China	5% -	- 5.—
Curaçao, Dutch Colonies	1¼% -	- 1.25
Japan	5% -	- 5.—
Corea	7½% -	- 7.50
Dutch East India	6% -	- 6.—
Siam	3% -	- 3.—
West Indies	1¼% -	- 1.25
Australia:		
British New Guinea	10% ad valorem	M. 10.—
Queensland	15% -	- 15.—
South Australia	10% -	- 10.—
Tasmania	12½% -	- 12.50
Victoria	duty free	duty free
West Australia	12½% ad valorem	M. 12.50
America:		
Argentine States	25% ad valorem	M. 25.—
Bolivia, Chili	25% -	- 25.—
Brazil	48% -	- 48.—
Costa Rica	duty free	duty free
Ecuador	25 centav. per 100 kilogrms gross	M. 1.—
Guatemala	duty free	duty free
Honduras	24 centav. per lb.	M. 2.14
Canada	20% -	- 20.—
Columbia	30 centav. per kilogrm	- 1.21

America.

	Duty Tariffs:	Duty in German currency per kilogrm.
Mexico	0,75 pesos per lb.	M. 6.85
Nicaragua	0,15 - -	- 1.37
Paraguay	45% ad valorem	- 45.—
Peru	45% -	- 45.—
San Salvador	0,30 pesos per kilogrm	- 1.21
Uruguay	31% ad valorem	- 31.—
Venezuela	125 centes. per lb.	- 2.23
Unit. Stat. of North America	25% ad valorem	- 25.—

In calculating the duties on value 100 Marks was accepted as the price per Kilogramme.

Experience has shown that the imposition of high import duties on saccharine was a mistake on the part of many governments and deprived them of the possibility of creating a good revenue by the importation of this article, and furthermore they have only given encouragement to smuggling into their countries thereby. For instance, in Belgium saccharine is offered in the newspapers at a price of 125 francs per kilogrm and publicly sold for that sum in spite of there being a duty of 140 francs per kilogrm on it, which would necessarily raise the selling price to 265 francs.

Awards.

Saccharine was awarded the highest distinctions and first prizes at all exhibitions in which it was exposed.

1885. »International Exhibition at Antwerp«: Diploma of honour.
»International Exhibition for Inventions at London«: Diploma of honour.

1888. »International Hygiene Exhibition at Ostende«: Grand diploma of honour.
»International Exhibition at Brussels«: Grand diploma of honour and gold medal.

1889. »International Brewery Exhibition at Antwerp«: Grand diploma of honour.
»International Hygiene and Nutriments Exhibition at Cologne o. Rh.«: Grand diploma of honour with gold star,
»International Exhibition at Paris, Department for Hygiene and Nutriments«: Grand diploma of honour.
»International Hygiene and Nutriments Exhibition at Tunis«: Grand diploma of honour.

1891. »International Exhibition for Provisions and Household Implements at Berlin«: Diploma of honour.
»International Exhibition for Hygiene and Nutriments at Vienna«: Diploma of honour of Ist class with special mention.

1892. »International Wine Market at Berlin«: Diploma of honour with gold medal.
»International Hygiene Exhibition at the Hague«: Diploma of honour.

Superiority and Advantages of Saccharine.

The superiority of saccharine over other sweetening substances and the advantages connected with its use, will be treated of at large, when we come to speak of the various purposes for the attainment of which the utilisation of saccharine is warmly recommended. It is intended to give a short enumeration only of the advantages and superiority of saccharine in this chapter; they may be divided into three large groups, into those of a sanitary or hygienic nature, into those of an economic or mercantile kind and lastly into such as are of a practical or technical character. They are as follows:

I. Superiority and advantages of saccharine from the sanitary or hygienic stand-point:

1) **Saccharine is an excellent dietic**; in comparison to other spices it is most remarkably harmless.

2) **Saccharine is perfectly indifferent**; it does not influence the functions of the body, a thing which cannot be said of sugar, for instance.

3) **Saccharine is not a carbo-hydrate**; it can, therefore, be taken without detriment by those suffering from diabetes, glycosuria etc.

4) **Saccharine does not decompose in the body**; it is discharged again by the act of nature, does not engender fat and has no nutritious value.

5) **Saccharine does not exercise a retarding influence on digestion.**

6) **Saccharine does not promote digestion.**

7) **Saccharine does not form any acids,** and for that reason does not incommode the stomach or intestines and can be taken without detriment by those suffering from complaint of the stomach, by convalescents and by people with weak digestion.

8) **Saccharine prevents abnormal fermentation of the digestive organs,** and consequently prevents flatulence, looseness of the bowels, diarrhea, disordered stomach etc.

9) **Saccharine disinfects the cavity of the mouth** by stopping and checking the growth of oidium lactis (scurvy, thrush in children) and leptotrix buccalis (tartar, caries) and the fermentation and decomposition of food-residua in hollow teeth, without injuring the mucous membrane or the teeth.

10) **Saccharine is discharged with the urine**; it, therefore, exercises its antiseptic effect on the urinal canals, prevents ammoniacal fermentation of urine, irritation of the urinal canals in cases of a diseased bladder etc.

II. Superiority and advantages of saccharine in economic and mercantile respects:

1) **Saccharine is cheaper than sugar**; the use of it is, therefore, combined with a considerable saving of expense.

2) **Saccharine is purer and cleaner than sugar**; it contains the sweetening material in a pure form, whereas sugar contains many impurities, which have to be paid for, are not only quite useless but also occasion much work. Females that have to boil sugar in the preserving season know well enough what loss is caused by these impurities.

3) **Saccharine allows of a considerable saving in transport.** Sugar is bought at market prices free from the refinery, warehouse or vessel, expenses for freight, for conveyance from and to these places and to the place of consumption are unavoidable. When saccharine is used these charges are saved; if saccharine and sugar are used half and half, the half of the carriage for sugar is saved, of course.

4) **Saccharine permits of a considerable saving in storing space and rent,** as $3^1/_2$ kilogrms of saccharine have the same effect as 1 ton of sugar and their dimensions are very small.

5) **Saccharine keeps products from spoiling** and this signifies protection from great losses, in particular is this the case with breweries in the hot season, and also for products intended for exportation to hot climates.

6) **Saccharine improves the state of goods considerably** and consequently makes them fitter for consumption, better able to compete, and increases their sale.

7) **Saccharine renders rational management possible,** that is to say, **considerable saving in labour, time and trouble.** Only half of the sugar need be stirred up and treated in a very troublesome way; saccharine dissolves in a minute. We have often been assured that this aspect of the case alone would suffice to induce many manufacturers to use saccharine, even if the price of it were the same as that of sugar.

8) **Saccharine has a fixed price.** This point should not be underrated, for the unvarying price of saccharine, in contrast to the fluctuations in that of sugar, affords the buyer the enormous advantage of covering his wants as may be needful, and saves him loss of interest on his money and above all a considerable amount of vexation.

9) **Saccharine does not allow of loss in storage,** whereas in the case of stored sugar loss both in respect to quantity and quality is not avoidable.

10) **Saccharine prevents after-fermentation,** a material point for all industries in which fermentation plays a leading part and often occasions great loss of material and glass-packing.

III. **Superiority and advantages of saccharine in practical and technical directions** — these cases are naturally similar to the preceding:

1) **Saccharine simplifies the methods of work,** as will be shown in speaking of the utilisation of this substance in the various branches of industry.

2) **Saccharine renders a quick return of capital possible** in the fermentation industries as it accelerates readiness for bottling.

3) **Saccharine does not influence the taste**; as it possesses no »body«, it does not make the products thick, greasy or glutinous, nor does it give them a stale, mealy taste but invests them with pure sweetness alone.

4) **Saccharine possesses constant sweetness** which never changes, whereas sugar easily ferments and loses its sweetness.

5) **Saccharine products are durable and unchanging,** whereas those treated with sugar easily spoil or lose in taste and appearance.

6) **Saccharine protects against abnormal fermentation** which plays a great part in all trades in fermented products and occasions almost insurmountable technical difficulties. Saccharine operates most powerfully as a conservative against putrefaction.

7) **Saccharine makes the aroma more perceptible.** This is a fact of which anybody can easily convince himself; it is in all probability owing to the want of body in this substance. Saccharine mixed with sugar furnishes a thinnish and less glutinous syrup that does not cover and veil the effect of the essences and aromatic bodies on the palate and nerves of taste so much as pure sugar syrup does.

8) **Saccharine effects a saving of 13 to 20 % of acid** in sparkling (effervescing) beverages, which must also be attributed to the want of body; the acid is made more perceptible to the nerves of taste. The fluctuations from 13 to 20 % are dependent on the strength of the acids used and on the nature of the beverages.

9) **Saccharine mixed with sugar produces a much clearer syrup** than sugar alone; this again is attributable to the want of body and, therefore, to greater fluidity in the syrup.

10) **Saccharine Syrups have no sediment or deposit and do not crystallize.** Dullness, want of brilliancy, deposits etc. are mostly the results of a more or less intense fermentation to prevent which the antiseptic qualities of saccharine suffice. Saccharine syrup made according to our prescription never deposits or crystallizes.

Whoever makes experiments in either one or the other direction can easily convince himself of the correctness and exactness of the foregoing statements, provided our directions are strictly adhered to.

Utilization of Saccharine.

The possibility of the utilization of saccharine is, of course, of a very manifold character, for wherever and whenever it is desirable to use a wholesome sweetening or mild conserving medium, saccharine can be utilized to advantage in the place of substances as yet employed. In addition to this, it can be used in those cases in which other substances could not be employed for imperative reasons whether of a dietetic or technical nature. We would go far beyond the compass of this little work were we to discuss each case separately, for sweetening substances are utilized in such manifold ways. We must, therefore, restrict ourselves to the treatment of the utilization of saccharine in general, to mention in particular which sorts of saccharine (in trade) should be chosen in the different cases, and to dwell at large on the use of saccharine in cases in which experience and a strict adherence to special directions is necessary. We shall speak briefly on the utilization of saccharine in the following order:

I. **Utilization of saccharine in households and in daily life.**

II. **Utilization of saccharine in pharmacy.**

III. **Utilization of saccharine in medicine.**

IV. **Utilization of saccharine in the industries.**

1) In the starch-sugar industry.
2) As a taste corrective in various industries.
3) In the manufacture of beverages.
4) In the manufacture of conserves.
5) In baking and confectionery.

I. Utilization of Saccharine in Households and daily Life.

1) **In general:** Saccharine can be utilized most extensively in households; for economic reasons because saccharine is considerably cheaper than sugar; on practical grounds because all nutr ment treated with saccharine is thus preserved from putrefaction, and owing to its utilization being simple and convenient; and lastly on dietetic grounds, because saccharine is more wholesome than sugar, deos not decompose, neither forms acid, as sugar dœs, nor causes fermentation in the stomach and intestines.

Only easily soluble saccharine and saccharine cakes (wafers) are for use in the household; the former for large quantities of food and for delicacies, and the latter for exact measures, for instance to sweeten a cup of coffee, a glass of punch, etc.

Saccharine can be recommended for sweetening coffee, tea, milk, grog, punch, fruit beverages, hot ale, spiced and herbal drinks. All these beverages are greatly improved in taste by its use, since the aroma is not affected in the least by it, nor does saccharine veil the fragrance, as sugar does, but allows it to develop in full force; then again all these beverages are rendered more wholesome. It is universally known, we suppose, that the fruit and wine drinks so much liked in hot weather and the warm spirituous mixtures, such as grog or punch, of which people are so fond all along the sea-coast, agree in general so badly with their admirers, because they are prepared with uncommonly large quantities of sugar that engender a superabundance of acidity in the stomach, which in its turn proves very troublesome and often causes heart-burn, sickness and diarrhœa.

The utilization of saccharine in the kitchen or rather in cooking can be warmly recommended to housewives particularly in making fruit-juice, stewed fruits, compotes, in preserving fruit for the winter and in preparing fruit preserves of plums, apples etc. so much liked in some places. All these delicacies are greatly improved thereby both in taste and durability. As every housewife makes these conserves etc. according to her own recipe, exact directions for use cannot be given, we may refer our readers, however, to the comprehensibly written work

of Frau Lina Morgenstern, »Saccharine in Households and for Patients, with 100 recipes« that can be had of us or from any retailer, free of charge. It may besides be mentioned now, that the saccharine should be dissolved before it is applied and well stirred up to make it sweeten uniformly; the quantity of saccharine used to suit individual taste must be determined by taste, and in the case of fruit due allowance should be made for its sweet or sour nature.

2) **In particular cases:** In many cases the utilization of saccharine may not only be warmly recommended, but would seem even necessary, and hence deserves the greatest attention of housewives and their medical advisers.

We refer first of all to those cases in which sugar is forbidden for dietetic reasons. Such cases will be treated of, as may be seen from the preceding chapter, in one of the following sections of our work, in that on the utilization of saccharine in medicine. Every housewife that has in her family one or more patients suffering from disorder of the stomach, obesity, diabetes or any other chronic complaint requiring very strict regimen, should introduce saccharine in her household as a sweetening substance out of consideration for her patients and in order to make it easier for the latter to adhere strictly to the diet prescribed for them. For children in particular it is very hard to abstain from what they see others around them enjoying so much.

Saccharine is destined to act a leading part in the **rearing of infants** that are not suckled at the mother's breast but nourished artificially.

In reading statistics of deaths the enormous mortality of infants must astonish us. Deaths in earliest infancy must naturally be more numerous than at a more advanced age, but they would not be so considerable as they actually are, if they were not due to quite special circumstances; in the animal world mortality in the suckling age is nothing like so great, although the conditions are analogous in both cases. If we come to inquire into the reason for this greater mortality, we discover that most infants and especially those of the poorer classes of the population die of exhaustion from diarrhœa, the result of catarrh of the stomach and intestines. Numerous investigations of children's faeces prove that this looseness of the bowels is brought about by a powerful fungoid formation or organism, productive of abnormal fermentation and consequently of derangement of digestion and nourishment.

The development of the micro-organism in question is called forth by the presence of a particularly suitable fostering ground for its cells. Sugar is the best fosterer of this and other fungi, consequently the use of sugar in the food of infants is objectionable

and should be avoided by all means. In its place, saccharine can be used, as already proved, to the very best advantage, for

Saccharine gives milk, gruel and other nutriment for children an agreeable sweet taste and prevents acidification;

Saccharine without influencing digestion prevents fungoid development in the stomach and intestines and consequent abnormal fermentation, looseness of the bowels, cold on the stomach and makes the food pleasant to take;

Saccharine hinders fungoid excrescence in the cavity of the mouth (known as thrush in infants).

In our families we have used saccharine as sole sweetening medium for milk in the nourishment of infants and found it attended with the best results. The children have not only thriven normally and developed splendidly but were also quite preserved from those numerous illnesses to which nearly all children are subject. Our experience in this direction was confirmed from other quarters.

Prof. Dr. H. Van Heurck writes to us, as follows:

Professor J. N. of Antwerp has a child, born this year but in such a weak state that great apprehension was felt as to its living. The daily administration of saccharine, however, not only dispelled all anxiety in this respect but even effected a rapid development in the child; the little thing has never suffered from gastric acid nor diarrhoea, is always merry, lively and well and its physiological condition proves it to be protected against the minor attacks and illnesses with which children of its age have continually to contend.

The following tables showing the growth of the child in each successive month, are far more eloquent than words.

The child was born on 17th of January 1889.

On the 16th of February when saccharinized milk was first given it, the child weighed 2550 grammes.

Since then the infant has not got any other kind of food; it has been weighed naked month by month and the increase in weight is as subjoined:

on 16th March	it weighed	3550	grms
- 17th April		4220	-
- 15th May		4730	-
- 17th June		5200	-
- 15th July		6000	-
- 15th August	its weight was	7000	-

Dr. C. Rüger of Bonn publishes, in the periodical for public and private hygiene »Gesundheit« (No. 16 VIII annual set, 1888) founded by Dr. med. Reklam, a comprehensive article on his researches with saccharine, in which he expresses himself on this point as follows:

A child (boy), 3½ years old, was given thrice daily 0,03 grm soluble saccharine in a mixture of coffee and milk or in pure milk. The urine was kept in a glass and measured. It amounted in the first 24 hrs. to 750 ccm, on the second day to 800 ccm, and in a week the average quantity for 48 hrs. was 1550 ccm. The urine was evaporated and from the residuum that remained constant and was dried at 100° C. the saccharine was extracted with alcohol. Even the remark-

ably sweet taste indicated a large amount of saccharine. It was found to weigh 0,715 grm, so that there was merely a loss of 5 milligrms on the whole. The entire amount of saccharine had passed through the little body without exercising the least effect in any respect whatever thereon, without causing any signs of discomfort, without producing or undergoing decomposition or any alteration, for the substance partaken of by the child was discovered to the full extent in its urine again. — In a family with which I am acquainted saccharine was employed to sweeten the milk for two infants and the gruel, soup etc. for one of them later on too — it was done at my wish and with the best results as I have been informed. Both children — a boy of 1¼ year and a girl of 4 weeks — were given saccharine with their first artificial food and the use has been continued without interruption since then; both children have thriven well and evince a decided partiality for dishes seasoned with this substance.

I think, therefore: that if such a tender organism as that of a child can bear a long, continuous use of saccharine and develop fast and strong at the same time, this fact speaks more in favour of the perfect harmlessness of saccharine than all results obtained as yet by experiments made on grown-up persons.

These instances will suffice at present. Not unintentionally have we gone so much into detail on this point, and it would afford us the greatest satisfaction to have contributed thereby in bringing about a change of opinion on this question.

For similar reasons the utilization of saccharine in the preparation of food of convalescents cannot be too urgently recommended.

Drs. Petschek and Zerner of Vienna touching on this in their treatise so often cited, say:

Although considerable doses of sodium-saccharine were frequently administered during the whole fever, yet no decrease of appetite occurred nor was there any increase of the existent dispepsia, notwithstanding that it is just in fever maladies that the stomach generally participates in the illness of the entire organism; the reason of its remaining unaffected must be ascribed to the harmlessness of saccharine in respect to digestion. Our experience in regard to convalescents speaks in favour of the harmlessness of saccharine, for with the cessation of the illness an increase in bodily weight could be discerned, a thing that always occurs in convalescence from fever maladies.

In all such cases refined easily soluble or easily soluble saccharine should be used. —

Among the particular cases of daily life in which the substitution of saccharine for sugar seems imperatively necessary are those, in which the use of sugar must be dispensed with owing to its being too voluminous and too heavy as to permit of its being conveyed — on journeys and wherever there is want of space. If we consider that 2 kilogrammes of refined saccharine equal in sweetening capacity 1 ton sugar, our assertion will require no further explanation. Tourists, soldiers in warfare and at the manœuvres, explorers on their travels etc. can convey the sweetening substance they require for many months in the form of refined saccharine or saccharine tablets

in a space limited to a few cubic centimetres. In addition to the saving of space there is a 300 to 500-fold reduction in weight and a very material economy. Another great advantage in favour of saccharine wafers and also of easily soluble kinds of saccharine is that they make hard water soft owing to the soda they contain. Hard spring water can then be used to make coffee, tea etc., these spices being perfectly extracted and thus utilized.

For the above reasons saccharine should never be overlooked in the fitting-out of expeditions to uncivilised countries, in caravans too and in the provisioning of ships and large bodies of troops it should be remembered. The necessary quantities of sweetening substances can surely be better protected against the inclemency of weather and against damage in conveyance when in small compact vessels than in casks; the hygienic part of the question, which all leaders of expeditions must consider in particular, is not even taken into account hereby, although the bodily welfare of all taking part in such expeditions deserves primary attention, expecially when they are exposed to dangers of all kinds. In the chapter treating on the utilization of saccharine in medicine it will be proved that though not exactly a remedy, saccharine is nevertheless an excellent preservative against fever, scurvy etc.

II. Utilization of Saccharine in Pharmacy.

Saccharine as a taste corrective. Both pharmacists and medical men have long been searching in vain for a spice possessing intense sweetness — a taste-corrective in short — and for this special purpose the extraordinary sweetness of saccharine can be turned to good account.

Only in the very fewest of the many cases in which it is desirable to remove or conceal the intensely bitter or disagreeable flavour of a medicament can sugar be utilized, for the volume would be increased beyond measure thereby. Wafers were, therefore, resorted to and unpleasant tasting preparations were enveloped in them. However good this expedient may be, it cannot be used in diseases of the throat etc. nor yet in the case of little children; for then the medicaments have to be made up in a solution (quinine) that ruins the appetite of the patients for a length of time. — Such inconveniences can be thoroughly remedied by the utilisation of saccharine, as minute quantities of it suffice to remove a bitter or unpleasant taste completely, or at least to diminish it greatly.

A physician writes to us, for instance, that he administered quinine in the form of pastils made up with saccharine and cocoa or chocolate, to children, and that his little patients, in expectation of getting fine chocolate sweetmeats, welcomed him most joyfully, whereas before they used to cry when compelled to take quinine.

It is of special importance that the benzoic sulfinide forms salts with the alkaloids, in which the bitter taste of the alkaloids is lessened materially. — If such an alkaloid be mixed with saccharine in equal parts, a salt of pleasant taste is obtained, the effect of which is the same in corresponding doses, as that of the pure alkaloid. — The sweetening capacity of saccharine has been the object of exhaustive research. —

Mr. C. F. S. Thompson of Manchester communicates the following results to the Pharmaceutical Journal:

»90 drops of a 1% saccharine solution conceal the bitter taste of a solution of 1/3 grm quinine sulphate completely and give an agreeable taste. 30 drops of the same solution sweeten about 1 grm fer. tincture, and 20 drops are necessary to conceal the salty taste of 5 to 7 grms bromide of potassium.«

Dr. Hans Hirtenhuber, Imp. & Royal regimental surgeon of the hussar regiment Graf Radetzky, No. 5, writes to us:

Zala Egerszeg, 7th December 1888.

With respect to the therapeutic use of saccharine (easily soluble kind) I can report chiefly on the use of this preparation in the treatment of children:

»I made use of saccharine as a corrective for quinine and tannin »solutions; these medicaments were then willingly and even eagerly »taken by children and never produced any derangement or showed »themselves detrimental, not even in the case of infants, and after »being used for months. The preparation was taken by children that »had obstinately rejected the same medicaments before, when sweet»ened ever so much with syrup.

»Your saccharine-wafers are so much in favour in my household »that there is a kind of longing among the members of the family to take »saccharine in tea and coffee.«

Dr. Paschkis states in his treatise »Contributions to a knowledge of the effects of saccharine«:

Of peculiar importance in practice are the combinations of saccharine with alkaloids. It is well known that these combinations can be formed by mixing certain quantities of the latter and of saccharine in an alcoholic or aqueous solution, and by letting the latter crystallize or in addition to these neutral alkaloids by producing saccharine-acid alkaloids (the acid saccharine salts). It was evident from the first that these combinations would have the effect of the original bases. In order to satisfy myself I produced saccharine-strychnine and saccharine-cocaine; the former is a crystallizable salt not difficult of solution in water, which exhibited the strychnine effects both on warm and cold blooded animals; the bitter taste of strychnine was almost gone. The saccharine cocaïne too, a combination easily soluble in water and alcohol but not crystallizing, was produced and showed the anaesthetic effects of the basis on the cornea and on the tongue in a most decided way; its taste is aromatically sweet. Finally I produced saccharine quinine and acid saccharine quinine; both of these crystallize and are hard to dissolve in water, the former in particular; the solution of the latter is fluorescent. The taste is intensely sweet, but that of the quinine is not overcome, but merely concealed; a few minutes after taking it, the intense bitterness of quinine predominates but in a less degree than when quinine is mixed with sugar.

Saccharine as a dietetic: For the reasons already discussed the utilization of saccharine is of great importance in all pharmaceutical products on the dietetic value of which weight is laid, for instance in the preparation of medicaments for children and convalescents, in products intended to raise the tone, of a tonic nature in short, such as medicinal wines, stomach cordials etc.

Saccharine ~~should~~ may besides be substituted for sugar in the making-up of all medicines, in which it is necessary to make the volume of the latter as small as possible to enable patients to swallow them with ease.

As an addition to preparations that serve to preserve the teeth, such as tooth-powder, washes etc. generally made of myrrh, calamus, radix iridis etc. and other materials of an un-

pleasant taste, and then mixed with sugar, saccharine is worthy of recommendation, for it not only improves the taste of the preparation but has besides in its favour the great advantage of not irritating the nerves of the teeth of or checking the fermenting and decaying processes by means of its antiseptic capacity.

List of Saccharine Recipes: At our request Dr. Kade Oranien Apothecary (F. Lutze, proprietor) at Berlin made out for the Wiesbaden Exhibition in connection with the 60th meeting of German naturalists and physicians an excellent compilation of Pharmaceutical Saccharine Preparations, on which the author, Herr F. Lutze, reports as follows:

> In order to facilitate the utilisation in general of saccharine as a sweetening substance in the making-up of doctor's prescriptions, it seemed to me advisable to reduce it at once for this purpose to forms the sweetening value of which bears a certain proportion to Sacchar. album and Syr. simplex. These forms will serve as a guide in prescribing, physicians being thus enabled to judge of the quantity of saccharine requisite for sweetening in separate cases; prescription will unquestionably be greatly facilitated thereby. — I prepared for mixtures a saccharine solution in dilute alcohol and for powders a saccharine mixture with mannite, both being in such proportions that 1 grm of the solution or of the mixture (powder) corresponded in sweetening capacity with 10 grms sugar or 15 grms syr. splx. — I propose the acceptance of these two saccharine mixtures as a standard to go by and to denominate them respectively Solutio saccharini and sacch. mixtum pro recept. — These two saccharine mixtures are to be found under these signatures in the exhibition; any objection to their use in prescription is not likely to be raised, for the indifferent vehicles used in their preparation must be considered perfectly irrelevant owing to the minute quantities in which it is necessary to add them to medicines.
>
> The following formulæ exhibit the character of both mixtures.

1) Chin. sulf. 0,5.
   acid. sulf. dil. q. s. ad sol.
   ol. menth. pip. gtt. V.
   sol. saccharini 10,0.
   aq. destill. ad 100.

2) Chloralhydrat 5,0.
   tr. cort. aur. 2,5.
   sol. saccharini 5,0.
   aq. destill. ad 100.

3) Natr. salicyl 5,0.
   Cognac 20,0.
   sol. saccharini 5,0.
   aq. destill. ad 150.

4) Acid. hydrochlor 1,0.
   sol. saccharini 5,0.
   mucilago gummi arab. 30,0.
   aq. destill. ad 200.

5) Flor. Koso pulv.
   Saccharin. mixt. aa 10,00.
   ol. de cedro. gtt. XII.

6) Rad. rhei. pulv.
   Saccharin. mixt. aa 10,0.
   ol. foeniculi gtt. IV.

7) Natr. bicarbon.
acid. tartar. aa 9,0.
Saccharin. mixt. 2,0.

8) Fol. sennae plv.
Rad. liquir. plv. aa 20.
frct. foeniculi plv.
sulfor. lot. aa 10.
Saccharin. mixt. 6,0.

The medicinal mixtures prepared according to the above formulæ are also shewn in the exhibition in order to furnish proof of the perfect and convenient substitution of saccharine in prescription in the place of sugar. — The two last of the above mixtures represent at the same time the pulv. acrophorus and the pulv. liquiritiae comp. in the pharmacopœia, both being reduced to half their volume owing to the substitution of saccharin-mixt. in place of sugar.

With a view to demonstrating the further utility of saccharine in pharmacy I have further prepared a number of other medicaments all of a more or less unpleasant taste with the above saccharine mixtures or pure saccharine, and have selected and exhibited the subjoined preparations as representatives of the separate groups of medicaments, and have added to some of them, according to quality and taste, some essential oils etc. as additional correctives.

Tinctures.
Tinct. Strophanthi. — Tinct. chinae comp. — Tinct. anticholerica.
Tinct. valerianae.

Liquors.
Liquor ferri acetici. — Liquor ferri albumin.

Medicinal wines.
Vinum chinae. — Vinum chinae ferratum. — Vinum coca.
Vinum condurango.
All without the addition of glycerin.

Oils and Balsams.
Ol. jecoris Aselli. — Ol. ricini. — Balsam. copaivae.

Extracts.
Extr. filicis. aeth. — Extr. hydrastis. canadens. — Extr. cascarae sagradae.

Pills. — Wafers. — Pastils.
Pilul. Rhei. — Pilulae aloes. — Tablettae strophanthi. — Tablettae rhei.
— Trochisci chin. sulf. — Trochisci chin. sulf. c. cacao.

With the above collection of pharmaceutical preparations I hope to have shown in outline the use of saccharine in pharmacy.

Dr. Paschkis of Vienna has made some mention about the prescribing of saccharine in his exhaustive work on that substance. He says:

»There is no particular difficulty connected with the prescription of saccharine. If we consider that saccharinum purum corresponds to about 250 parts of sugar and saccharinum solubile to about 225 parts, then in all prescriptions, in which sugar is not only a corrective but

at the same time an excipient, some indifferent powder or other, as gum or tragacanth can be added to compositions to obtain the necessary quantity, or else the separate doses can be made correspondingly less. Substances incompatible with saccharine are but few; alkaline substances accelerate its solubility, acids precipitate it from its solutions. It is advisable in all cases to prescribe saccharinum solubile, and not to abbreviate the word but to write it out in full to avoid the possibility of its being mistaken for »saccharum«.

Subjoined I now add a few examples of formulae most commonly in use:

Rp. Saccharini solub. 1,8
Aq. destill. 250,0
Solve calore, filtra.

S. Simple saccharine solution; it corresponds in sweetness with syrupus simpl. Ph. austr. VII.

Rp. Saccharini puri 10,0
Natri bicarbon. 5,0
Aq. destill. 1000,0
Coque ad perf. solut., filtra.

S. 1 percent saccharine solution. 100 grms correspond in sweetness to 250 grms sugar, 1 grm corresponds with 2,5 grms sugar, 0,4 grm corresponds with 1 grm sugar.

Rp. Rad. Rhei cont. 25,0
Kali carb. 0,5
Inf. e. Aq. destill. 300,0
Colat. expr. 250,0
adde
Saccharini solub. 1,8

DS. Syrupus Rhei, corresponding in sweetness with the officinal.

Rp. Tinct. cort. aurant. . . . 10,0
Sol. Saccharini sol. simpl. . 70,0

DS. Syrup. cort. aurant.

Rp. Fol. Sennae 35,0
Fr. Anisi stell. 2,0
Inf. c. Aq. dest. ferv. . . 350,0
per hor. duas Colat. . . . 250,0
adde
Saccharini solub. 1,8
Mannae 100,0

DS. Corresponds with the Syrupus Sennae c. Manna d. Ph. austr. VII.

Rp. Amygd. dulc. 25,0
Saccharini solub. 0,7
Aq. destill. 250,0

F. l. a emulsio.

S. Emuls. amygd. corresponding with the Ph. austr. VII.

Rp. Amygd. dulc. 80,0
- amar. 20,0
Aq. destill. 200,0
Saccharini solub. 1,5

S. Emuls. Amygd. concentr. almost corresponds with Syrup Amygdal. of the Ph. austr. VII.

Instead of the last of these prescriptions the Mixtura Amygdal. comp. saccharinata mentioned below and prepared from the Pulv. Amygd. comp. saccharinatus might be used in preference.

Rp. Amygdal. dulc. 60,0
Pulv. Gummi acac. . . . 8,0
Saccharini solub. 0,1

M. S. Pulv. Amygd. comp. saccharinatus (according to Attfield).

Rp. Pulv. Amygd. comp.
Saccharinati . . . . p. 1,0
Aq. destill. . . . . p. 10,5

DS. Emuls. (mixtura) Amygdal. saccharinata.

Rp. Pulv. rad. Ipecac.
- opii . . . . . aa 5,0
- gummi acac. . . . 40,0
Saccharini solub. 0,2

DS. Dower's Powder with Saccharine.

Rp. Pulv. fol. Sennae
- - Liquir. mund. aa 10,0
- fr. foeniculi
- sulfuris . . . . . aa 5,0
Saccharini solub. 0,2

DS. Compound liquorice powder given in half doses as the officinal.

Rp. Pulv. Natrii bicarb. . . . 20,0
Saccharini solub. 0,25
Ol. citri. . . . . gtt. XV
M. Div. in p. aequ. No. XII.

D. To be given in blue paper.

Rp. Acid. tartarici 24,0
Div. in p. aequ. No. XII.

D. To be given in white paper.
S. For effervescing lemonade.

Since this, however, a change has taken place to a certain extent, for we now manufacture a refined easily soluble saccharine which is 450 times sweeter than sugar and deserves in pharmacy the preference over saccharine in all other forms; this circumstance produces however the only difference of reducing the quantities of saccharine used, by one half exactly, for the easily soluble saccharine employed at that time was only 225 times sweeter than sugar

Mention must be made here of the treatise styled »The Place of Saccharine in Pharmacy« by Prof. Attfield of London. Saccharine was adopted by the British Pharmacopœia in the year 1890.

III. Utilisation of Saccharine in Medicine.

Numerous treatises based on scientific research and devoted to the therapeutic utilisation of saccharine have already been published; sufficient experience on this question has, however, been acquired at the sickbed too.

The object of this little work is not to give our readers a scientific medical report on saccharine, so long as we can limit our remarks on this subject to what is imperatively necessary, and refer medical men to the numerous articles published on it in medical journals. We shall touch only on those cases in which saccharine should be used, and reproduce some authenticated statements.

Saccharine in dietetic regimen. In speaking of the utilisation of saccharine in households it was said expressly that there are illnesses and certain diseased states of the body which are either completely cured by the strict observance of a suitable diet and by a manner of living that operates against the consequences of the disease, or are at least kept within such bounds that the general health of the patient remains good for a long time in spite of his diseased condition. There are for instance persons suffering from obesity that regain a normal condition by a suitable diet and are thus restored to general bodily welfare, to health in short. Many diabetic patients live to a good old age by a conscientious adherence to the regimen prescribed for them, although they cannot be cured of their complaint. A general diet cannot be laid down for each disease, as already stated; it has to be regulated for each separate individual and each special case and according to the physical condition of the patient, and even the observance of a diet laid down by the physician should always be controlled by the latter.

Dietetic regimen is a penance, without doubt, for a patient, and the latter is sure to be thankful if his food can be made more palatable and more varied by the utilisation of a harmless indifferent spice.

It is proverbial that forbidden fruits taste sweetest, and in no case is this saying more appropriate than in that of persons

limited to a certain diet. A great desire in particular arises for sweet things even in persons who did not care in the very least about them so long as they were enjoying good health. The desire gradually develops into a need and if not satisfied in time it exercises a great influence on the mental condition of the sufferer; his cheerfulness and good humour disappear and after that he loses his appetite, a thing that may have serious results. A diabetic patient writes as follows:

»The dreadful monotony of his diet robs a diabetic sufferer of his appetite and frequently produces digestive derangement. It is, therefore, of the greatest importance for all suffering from diabetes that of late a substitute for sugar in their different viands has been discovered in the shape of saccharine, by which substance the fearful uniformity of their diet can be varied materially.

Saccharine has a similar but a much more intensely sweet taste than sugar has; in other respects, however, there is no similarity and it may be used without detriment by all diabetic patients for the purpose of sweetening their food.

May these saccharine preparations afford all diabetic patients, for whose use and benefit these lines are written by a fellow-sufferer, a wholesome and agreeable variation in their monotonous diet!«

The superior of an official suffering from diabetes wrote to us the following letter before saccharine was obtainable in the trade:

Berlin, September 1886.

In the middle of July last I took the liberty of applying to you with the request for a certain medicine called saccharine for our bookkeeper, Herr Fuchs. In fulfilment of my wish you had the kindness to take the trouble personally to send Herr Fuchs 20 grms of saccharine.

By doing so you rendered the sufferer in question an inestimable service. By using saccharine he could again enjoy eatables of different kinds that were forbidden him before; to the immense benefit of his health his nutriment is now of a more varied nature, and he again feels a desire to live and hopes for ultimate recovery. The medicine has, in short, exercised a most beneficial effect on the body and the mind of the patient, and has been the means, I may say, of keeping him alive up to the present.

Herr F. returns you his warmest thanks for your kindness. But the authorities, in whose service the patient is engaged, have to thank you too for preserving the life of such an able man.

The quantity of medicine you kindly sent is almost used up and so Herr F. ventures to request you, his benefactor, most respectfully to assist him in procuring once more a medicine not obtainable anywhere else, etc. etc.

The Berlin Edison Company.

Krumau, 8th August 1886.

You had the kindness to forward me a short time ago, on 15th July, a sample of saccharine, I return you my best thanks and congratulate you on your splendid invention. I feel convinced that diabetic sufferers cannot thank you too warmly. To my regret I am in such a position myself, but since making use of your saccharine I have revived in consequence of the variety in my diet prepared with this substance. Almond cake, pudding, coffee, tea etc. everything can be

sweetened with it and no detrimental effect has come under my observation.

I have finished the sample, having intentionally used a great deal, and would now request you to furnish me with a further supply, etc.

Dr. Julius Fantl.

Risstissen, Wirtemberg, 26th April 1886.

For several months now I have been making numerous experiments with your saccharine (for dietetic purposes in the case of diabetic patients) and have obtained completely satisfactory results with it. Even in the making of creams etc. saccharine has been used direct and proved quite a success, for nobody was able to distinguish between the articles prepared with it and those sugared in the ordinary way, etc. etc.

Freiherr von Stauffenberg, Member of the Imperial and National Diets.

Saccharine in the treatment of diseases and diseased conditions. Saccharine is of the greatest importance in the following medicinal cases:

Diabetes melitus and glycosure, obesity and in particular cor adiposum; rheumatism, gout, neuralgia and sciatica; disorders of the stomach and intestines of all kinds, as pains in the stomach, eructation, vapours, superabundance of acid, gastrectasis, diarrhea, catarrh, disease of the small intestine etc., disease of the cavity of the mouth and gums, decay of the teeth; disease of the bladder, stone in the bladder, lumbago and all disorders of the urinary canals; and in ophthalmic diseases.

In all these cases the great benefit to be derived from the use of saccharine has been proved by untold observations in the practical treatment of patients.

Too few observations have, however, been practically made with respect to a great many other diseases; it may nevertheless be accepted as a certainty that the utilisation of saccharine would be attended with success in diphtheria, croup, hooping-cough, disease of the tonsils and throat, lipomatosis, chronic otitis media suppurativa, rhachitis, osteomalacy, scorbute (scurvy) and as a prophylactic against fever in unhealthy climates.

The following short communications from medical practice will serve as documentary proof:

Notes on saccharine in the treatment of diabetes and glycosuria.

Erfurt, 22nd May 1888.

Referring to your favour of 9th inst. I beg to inform you that I have tested the saccharine wafers you forwarded me. As the result of my observations I can safely say that this preparation is an excellent dietetic medium in the treatment of diabetic patients as it lessens the torments of thirst and diminishes the feeling of hunger they are subject to. With these patients too a decrease in the urine discharged

and in the quantity of sugar it contains is observable consequent on the use of the saccharine wafers. Sufferers of this category have been fortunate enough to find in your saccharine preparations, especially in the wafers, a substance which they can use in the place of sugar without having to run the risk of suffering from any detrimental consequences.

Your preparation has furthermore proved an excellent delicacy for convalescents from severe attacks of fever, for it agreed well with them and acted as a tonic.

These results induce me to recommend your product most warmly in practice etc. etc. Dr. med. Goliner

Prof. Eichhorst of Zürich held at Zürich lately a lecture styled »Practical Experience on Diabetes simplex and melitus« before a meeting of the cantonal Zürich Association of Physicians, and spoke as follows about saccharine:

»In the treatment of diabetes melitus three points in particular are to be considered: dietetic regimen, medicamental therapeutics and treatment with waters. All physicians agree on one point, I think, *i. e.* that the dietetic treatment must form the basis of all other therapeutic measures and that all endeavours prove unsuccessful, if the most careful attention is not paid to diet. Differences of opinion are not likely to arise either in respect to the adherence to the following principle in dietetic regimen: albuminates and fatty substances as much as possible, sugar and carbo-hydrates as little as possible. Whoever recollects from his practice how hard it is for diabetic patients to abstain from sugar in eatables and drinks for some length of time, is sure to attach immense importance to the fact that a substitute for sugar has been discovered in saccharine, which can be used in case of diabetes without the least harm for any length of time. I have in treatment at present three sufferers from this disease whose urine I have controlled for respectively 15, 6 and 3 months and in whom an uninterrupted use of saccharine has not called forth either any inconveniences, much less any morbid appearances, nor yet any increase in the amount of sugar discharged with the urine, nor finally led to the re-appearance of sugar in the urine in the two cases cured meanwhile.

The well-known manufacturer of chocolate at Zürich, Sprüngli, has had in my opinion the very happy idea of sweetening cocoa with saccharine and offers this article for sale under the name of saccharine cocoa. It is well known certainly that cocoa contains a considerable quantity of starch-flour, nevertheless in all the cases of diabetes melitus, in which I permitted the use of saccharine cocoa as a morning and evening beverage, the volume of sugar discharged with the urine remained unchanged, and in those in which the urine was freed from sugar the latter did not re-appear.

We have received the following friendly letter from Dr. Schnée, médicin du Consulat Impérial et Royal d'Autriche-Hongrie dans les Alpes-maritimes et la Principauté de Monaco.

Consulting physician at Carlsbad. Paris, 23d Nov. 1888.

In respect to your inquiry about the effect of saccharine as sodium salt on the digestion and entire organism, I beg to inform you that my observations may be summed up as follows: all my patients suffering from diabetes melitus and simplex and of whom there are a considerable number, that make use of saccharine as a substitute for sugar have taken a liking to it after having got accustomed to the peculiar taste (that the preparation had at first) of this substance.

A derangement of digestion or any other symptoms indicating a disordering influence have never come under my observation since the substitution of saccharine for sugar.

Graz, 9th December 1888.

Saccharine can be recommended in preference for diabetic patients, for their diet imposes such abstinence on them in many respects, that they look upon this substance as a perfect boon. The form of the wafers in which it is made up greatly facilitates the use of saccharine in all places.

Dr. Fürstenberg, Imperial Councillor.

Dr. Alb. Van Vyve, a well known and much consulted physician to the law courts at Antwerp has communicated his experience with saccharine in a long letter, from which we are authorized to publish the following passages:

»You have requested me to state without reserve what I, as a practical physician, think of saccharine.«

»It is beyond doubt that this substance cannot call forth any unfavourable symptoms in respect to digestion, even after a continuous use of it in daily doses varying between 0,5 and 1 grm.«

»I have had four patients suffering from diabetes simplex under treatment for a year now; all of them have taken saccharine as a substitute for sugar in their beverages and eatables and they have done so without any detriment. One of them, whose clinical history as a patient I have explained to you in a special communication, had been ill for 3 years and showed all symptoms of diabetes resulting from a diseased liver. I put him on a very strict diet; for 3 months he took daily a dose of about 1 grm saccharine in combination with a powder, and without feeling any inconvenience or any derangement whatsoever. The latest analysis made by a very respectable apothecary of the town with the aid of a polarimeter did not show the least sign of sugar. Considering my limited sphere of observation I do not venture to set up a hypothesis as to the direct healing effect of this interesting product.«

Saccharine against gout, sciatica etc. The celebrated preacher, the Rev. C. H. Spurgeon, expressed spontaneously the following opinion accompanied with a request to publish it with a view to making saccharine more popular:

»It must be of great importance to persons, for whom sugar is injurious, to be able to sweeten their food with another and equally agreeable substance. For gouty persons saccharine answers exactly the same purpose as sugar, although it is not sugar, nor does it contribute to nourishment. I look upon the discovery of saccharine as a great blessing as far as my own health is concerned; and I am only one among thousands.«

Dr. Heinemann of Meiningen says:

In a case of gout, from which a very corpulent gentleman suffered, the partaking of saccharine without interruption for a long time brought about improvement.

Saccharine against disorders of the stomach and intestines:

Your saccharine-cocoa, which you had the kindness to forward me free of charge, I have prescribed to suitable patients in our hospital for children here, and now beg to inform you that I am quite content with your preparation. It was gladly taken, and in a very bad case of chronic catarrh of the intestine, the patient being not a very young child, it proved remarkably successful, much more so than when common cocoa was used. It was repeatedly observed that diarrhoea ceased after the use of saccharine-cocoa, whereas when the ordinary product was given it returned.

I have in consequence come to the conclusion that this saccharine-cocoa is a very valuable dietetic remedy sure to prove very important both to certain patients and to medical men.

Riesbach, 4th Februar 1888 Yours respectfully
Prof. Dr. Oskar Wyss.

Prof. Dr. A. Birnbacher writes as follows:

Graz, 9th May 1889.

You did me the favour to forward a sample of your saccharine some time ago, and I consider it my duty to confirm in accordance with the truth that from the day of receiving your sample up to the present both I and my family (children included) have used exclusively your soluble saccharine to our tea and coffee and have done so without any injury to our health. The fact in itself is all the more important as I, for my part, have a very sensitive digestive system.

The anti-saccharine movement now cropping up even here makes it, in my opinion, all the more a bounden duty to communicate such results as the above and to permit you to publish them.

In the Lucerne hospital there are patients suffering from disorder of the stomach and unable to take sweetened food, who are nourished with soluble saccharine-cocoa. This nutriment, says the head physician, Dr. Hofstetter, not only pleases the patients but has besides proved very useful and easily digestible and is most worthy of recommendation, especially in all cases of catarrh of the stomach. It showed itself effective in the very worst cases of chronic catarrh of the stomach and intestines.

Hoxter, 10th December 1888.

In reply to your inquiry I beg to say that your saccharine preparations have rendered good services not only for diabetic patients, but also for those suffering from chronic diseases of the stomach; the saccharine wafers are in particular much liked by the patients.

Dr. Neustadt.

One of our customers, Herr Max Rieck of Hamburg, who employs saccharine exclusively for the manufacture of saccharine-cocoa for patients suffering from diseases of the stomach etc., says in his prospectus:

»A Hamburg physician (we do not mention names, but shall be glad to refer other physicians to their colleagues practising here, who will without doubt communicate results to private inquirers) wrote to us on the 9th April as follows: Your Hansa saccharine-cocoa has rendered excellent service in the treatment of diabetic cases by lessening the tortures of thirst and hunger of the patients very considerably. In addition to that a material reduction in the urine and consequently in the sugary contents of the latter was observable. I no longer doubt the success of these experiments.«

»Another physician informs us that Hansa saccharine cocoa has rendered excellent service in typhoid cases; it agreed well with the patients both when the fever was at its height and during convalescence and it acted as a tonic.«

»In cases of diarrhoea it has been observed that they were checked much quicker by using Hansa saccharine cocoa than by taking sugared cocoa; the use of the latter brought diarrhoea on again. For this reason we have to make »acorn saccharine cocoa« for some cliniques, because the astringent qualities of acorns are turned to better account in it than in sugared cocoa.«

»A much employed Hamburg physician sent us the following further opinion:«

»The experiments made by me were in notorious cases of diabetes partly cured at the bathing-place Neuenahr. The result of the experiments was very satisfactory, completely so, I may say. Analyses of urine undertaken by myself and an apothecary of this place furnished very good results; in one case of diabetes, in which there was no discharge of sugar for the time being at least, not a sign of sugar was detected after the use of your Hansa saccharine cocoa; in others there was no increase discoverable. All my patients hailed the permission on my part to use your saccharine-cocoa most joyfully.«

Saccharine against disease of the bladder etc. On the capacity of saccharine in regard to prevention of ammoniacal fermentations in the urine in cases of chronic cystitis. By James Little, M. D., president of the King's and Queen's College of Physicians in Ireland, Physician to the Adelaide Hospital. (Read in the department for medicine on 20th April 1888):

The method of treating chronic cystitis has been considerably improved of late years and consequently the ability of this disease to bring about changes in the kidneys and thus undermine the vital power has materially decreased. The chief place in the list of improvements is due in my opinion to the manufacture of catheters which can be easily used by the patient in person without danger and by means of which the collecting of urine in the bladder is avoided. At the same time physicians have recognised the necessity of keeping the instruments introduced into the urine-bladder as clean as possible, a precaution that was overlooked some years ago. In consequence of the introduction of catheters, which operation is performed without pain or violence, a great relief has been effected in my conviction, and decompositions in the urine can be prevented by rinsing out the bladder with warm water or antiseptic solutions. But it has always seemed to me, perhaps because I am a physician and not a surgeon, to be better to keep the urine as free as possible from medicaments passing through the mouth, and to limit surgical operations to the greatest extent possible; this practice I have always adhered to, especially in cases of elder persons under my treatment and when chronic cystitis formed part of their ailment. Unfortunately many such sufferers have besides a weak stomach in addition to an irritable urine-bladder and the majority of the remedies suited to counteract the acrimony of the urine have the disadvantage of being distasteful and of causing sickness. This may be said for certain of the remedies chiefly used some years ago, as quinine, ferric chloride solution, benzoic acid, and benzoate of soda. Boric acid, which has been more used of late does not cause sickness so easily and is best given in lemonade.

During the last three years I was summoned from time to time to a lady of about 80 years of age who was confined to bed in consequence of a chronic disease of the bladder and of a frequent and painful discharge of urine. With the urine came always a quantity of

matter; it was besides always ammoniacal if decomposition was not prevented by medicine. Accompanied with great pain the lady had repeatedly discharged phosphated bladder-stones, of which there were many in the bladder, I do not doubt, but she had persistently refused to be operated on in any way, except allowing the occasional introduction of a thin catheter or the rinsing out of the bladder by a lady who attended constantly on her. Quinine and boric acid taken in pretty large doses always cleared the urine; but about three months ago her stomach got so irritated that these remedies could not be administered, nor could the bladder be rinsed out any more with a warm sublimate solution because the introducing of the catheter caused great pain. The consequence was that the urine became so acrimonious that the smell of it reached even to the staircase and the nurse was frequently obliged to leave the sick-room to avoid being overcome with sickness. In the face of these difficulties it occurred to me to try saccharine. I prescribed three wafers of it daily. In the course of three or four days the urine did not burn any more. The patient has continued the use of saccharine since then (in spite of her weak stomach the saccharine has agreed well with her for three months) and the urine has not become ammoniacal again, although there is little or no difference in the amount of matter contained in it.

Since the preceding case has occurred under my treatment, I have had four times occasion to observe the effect of saccharine on patients suffering from ammoniacal urinal discharge. They were all men; one case was that of a lamed gentleman with catarrh of the bladder, one case of chronic cystitis with enlargement of the prostate gland and two cases in which there had previously been stricture of the urinal canal that had been successfully removed by a surgeon but without preventing the urine from being ammoniacal. In all these cases saccharine was of great benefit, the use of it being combined, however, with the daily use of the catheter by the patient himself to avoid the collecting of a urinal residuum in the bladder, a precaution without which in my opinion no medicament can prevent decomposition of the urine in the bladder.«

Extract from a report on experiments made at the Broussais Hospital in Paris under the direction of Dr. Reynier.

These experiments lead to the conclusion that saccharine taken internally will cause the disappearance of matter in the urine of patients suffering from cystitis etc.

One of the most interesting observations is that of a patient suffering for a long time from purulent pleurisy, in whose case it was considered necessary to order pleurotomy and a pleuritic fistula.

In the case of this patient whose sufferings had been very great from the 7th of February an injection with saturated saccharine solution was made every third day. From the very first injection a visible improvement took place, and a month later, on the 8th of March, the patient was cured of an illness that had been deemed incurable.

Extract from a clinical lecture on the »Value of more modern remedies in connection with the Pharmacopœia for Sexual and Urinary Disorders, given by Mr. Harry Fenwick at St. Peters's Hospital for stone and urinal diseases (taken from the »Hospital Gazette«, 7th April 1888).

Saccharine is very effective in diseases of the urinary tract. It is in particular very useful in cases of mucous cystitis. Mr. Fenwick reports on two cases, in which it was not found possible to cure patients of mucous cystitis with the ordinary medicaments, but who were completely restored by administering doses of 5 grains of saccharine in alkaline solution. The same gentleman has found it also of service in cases of nephritic stone, and it alleviates pain in the hips, for

certain. Saccharine is said to be discharged with the urine in nearly the same state as that in it was taken in. The beneficial effect is probably to be ascribed to its causing a greater discharge of urine and to its soothing antiseptic effect in the mucous secretion of the membrane in the urinary canal.

Saccharine in ophthalmic diseases. (Vienna Medical Press, 18. November 1888).

— At the meeting of the Paris Société de thérapeutique on 24th Oct. Constantin Paul reported on the experiments made by Dr. Trousseau with Saccharine as an antiseptic in ophthalmic diseases. Having convinced himself by experimenting on the eyes of rabbits and dogs of the absolute harmlessness of this substance for the cornea, he tried it in solutions of 1 to 500 and 1 to 250 on 30 patients and in operations. Saccharine bandages renewed daily and daily washings with saccharine solution were tried successfully without any reaction. The nucleations healed under saccharine quite without reaction, it was the same with 3 cases of iridectomy, 8 extractions of cataracts and in different operations of the eyelids. In conjunctivis catarrhalis saccharine proved very effective.

Saccharine in the treatment of various diseases: Prof. Dr. Jaworski, Cracow, lays down the following principle at the end of his treatise on saccharine, basing it on his experience:

From a medical point of view we must warmly recommend the use of sodium saccharine as a sweetening substance in the place of sugar in many diseases, as diabetes melitus, obesity, gastrectasis combined with a lack of hydrochloric acid, in cancer (stomach), in catarrh of the small intestine accompanied with vapours and diarrhoea; further as a sweetening substance for children's biscuits, even for healthy children suffering from a momentary disorder of the digestion by eating too much cake, and finally as a corrective for medicines instead of common syrup.

Dr. Max Vogel, Meran (Tirol), writes to us:

The saccharine made in the manufactury of Messrs. Fahlberg, List & Co. has never shown the least symptom of any injurious effect under strictest observation, the taste, however, was unpleasant to many persons if the saccharine was not cooked with the food.

The new easily soluble saccharine does not possess this disadvantage, except in very strong and not common concentrations and even then in a minor degree.

Saccharine is likely to act a great part in children's diseases as: diphtheria, croup, or hooping cough. The conviction is gradually gaining ground that the seat of the evil is to be sought in the intestines in these illnesses. In the case of hooping cough it has been proved beyond doubt that food containing sugar should be avoided as much as possible. Saccharine might be of good service in this respect, for it acts antiseptically and the children would not miss the sweet taste they are accustomed to.

It is moreover not impossible, though it must first be tried, whether a saccharine solution cannot be added to vegetables, such as cabbage etc. in the place of sugar, also to beans, peas, lentils etc. to prevent or lessen flatulence.

From the medical department of Prof. Drasche in the Imp. & Royal general hospital in Vienna the following report on saccharine prepared by Drs. Armin Petschek & Th. J. Zerner, assistants of the above department, has been published

In regard to the utilisation of pure saccharine it seems to be limited to that of an antiseptic, whereas its sodium salt is likely to prove of good service in many cases, such as diabetes melitus and lipomatosis, as a substitute for sugar.

The antipyretic capacity of saccharine proves to be weak for even pretty large doses do not reduce the temperature by more than $^1/_2$ to 1°. It showed itself most effective in the intermittent fever of phthisis and in the remission period of typhoid abdominalis as doses of 1,0 saccharine given at the time of remission delayed the exacerbation a little, and if administered when the latter was at its height the remissions in fever were considerably longer.

In two cases of chronic otitis media suppurativa on both sides injections with a concentrated solution of pure saccharine proved very effective, as the otorrhoea that had withstood a boric acid treatment for a long time was checked in a few days, so that we would recommend saccharine for further experiments in this direction.

We could register the best success in cases of abdominal catarrh combined with fermentative symptoms, no matter whether the milk, butter or acetic acid fermentations were consequent on dilatation or atony of the stomach or caused by hypacidity of the liquids of the stomach. Individuals whose stomachs showed the most striking symptoms of abnormal fermentation, and in whom fermentations were to be found by emptying the stomach of its contents at almost any time of digestion, found themselves tolerably well after using saccharine. Doses up to 5 grms had to be administered, it is true. Most favourable were the results when the taking of saccharine was accompanied with a rinsing out of the stomach. The method of proceeding was as follows: in the sixth or seventh hour of digestion after the chief meal of the day the stomach was rinsed out, and in the meantime doses of saccharine from 0,30 up to 1,0, according to the nature of the illness, were given every 1 to 2 hrs. Under this treatment the fermentative processes in the stomach ceased in a few days, the symptoms, such as eructation, pains in the stomach and vomiting were no longer observable, but re-appeared soon when the saccharine was disused, and disappeared again when the above treatment was repeated.

Saccharine showed itself very effective too against abnormal fermentative processes in the intestine that led to croaking of the bowels, meteorism and diarrhoea; and in the sulphuric ethers in the urine and in their proportion to the preformed sulphuric acid we have a good standard to judge of the effect of the saccharine. The symptoms of disease in the intestine improved rapidly on administrating doses of 0,25 to 1 grm every other hour.

Owing to this quality of checking ferment and putrefaction, saccharine is well suited as a substitute for sugar in all cases in which fermentations in the stomach and intestines have already occurred or where there is a disposition in that direction. In catarrhal or dyspeptic conditions of the stomach the use of sugar in the food should be avoided as much as possible, for its presence in the stomach is productive of abnormal fermentations and deranges digestion still more, whereas saccharine, as just mentioned, operates as a check to fermentation, and as it far surpasses sugar in its sweetening capacity it need but be used in very minute quantities to sweeten nutriment of all kinds. Saccharine is for this reason an excellent dietetic medium.

But not only in the diseases mentioned above does saccharine prove so effective in this direction; it is equally serviceable in all those constitutional diseases in which carbo-hydrates have to be excluded from the food owing in part to their tendency to oxidise easily, as in the case of obesity, and partly because they bring about an increased discharge of sugar, as happens in diabetes melitus.

In the Harvey-Banting cure abstinence from sugar acts a leading part, for owing to its tendency to oxidise easily sugar promotes the

growth of fat. The strict observance of dietetic prescriptions, in which abstinence from this, that or the other kind of food or delicacy is of great importance, is a great restraint on the patient in the course of time and very irksome, so that any substance must be gladly accepted that seems suited as a substitute for anything we have been accustomed to enjoy and from which we reluctantly abstain. However much these fat reducing cures may differ from each other, they nearly all agree at least in the avoidance of sugar.

The regulating of the diet is difficult even in the above cures, but how much more so is it when, as in diabetes melitus, the patient himself throws obstacles in the way. It is in this case the adherence to a certain diet that comes in question, to a certain dietary to which patients have to submit for the remainder of their lives. Individuals thus afflicted can often not bear the idea of eating or drinking everything unsweetened, so recourse has been taken frequently to various substances, as glycerin for instance, as a substitute for sugar, but even this has usually proved a failure. To our regret we have of late not been able to observe cases of diabetes melitus direct, but we know, however, of cases in which patients have been making use of saccharine for months and even for a year without being able to attribute any derangement to its account. Several of these sufferers assured us that they were not able to detect any difference between dishes sweetened with sugar or saccharine. We had also an opportunity of examining the urine, and can state that in spite of saccharine being used, but under strict observation of the prescribed diet, a decrease in the discharge of sugar in the urine was observable. This is a fact of immense importance, for by using saccharine diabetic patients can greatly enlarge their bill of fare and enjoy many things that used to be forbidden them because they had to be prepared with sugar. The invention of saccharine has thus placed many things within their limit and makes it considerably easier for diabetic patients to submit to the strict dietetic regimen imposed on them.

In other constitutional ailments too, as rachitis, osteomalacy, scorbutic etc., likewise in the different affections of the mouth, in which there is danger of tumors forming, of caries of the teeth, swelling of the gums, and in which it is apprehended that the above would be fostered by the production of the butyric fermentation, saccharine is sure to prove a valuable substitute for sugar.

Dr. Heinemann, pract. physician, wrote to us as follows:

Meiningen, 22nd May 1889.

Evident and most surprising service was rendered by saccharine in a case of derangement in a patient, attributable to a highly developed gastrectasis. I had certainly to prescribe at times frequent doses (of 1 cgr with nat. carbon. every 20 to 30 min.) and on the whole 10 to 15 doses a day for an entire month. The medicament allayed the pains and inconvenience in a most agreeable way for the patient.

Celebrated men have published so much and such very important truths on the use and benefit of saccharine, that there remains little more to be said on the subject.

In cases under my observation the utilisation of saccharine has never proved inconvenient or injurious in the least. In catarrh of the bladder the application per os did not show itself particularly effective in my cases, but I am inclined to believe that the rinsing out of catarrhally affected bladders in combination with the application per os would and is sure to furnish better results, even really good ones too. In a case of gout, the sufferer being a very corpulent party, the continuous use of saccharine for some length of time effected recovery.

I employed saccharine in preference as a gargle, especially as a prophylactic for children, and shall use it in future in many cases too for children inclined to tonsil and throat affections, my prescription being a prolonged and energetic use of the gargle every morning and

evening. I can besides recommend saccharine as a taste-corrective in using quinine, bromine salts and — creosote!

The latter I administer after the following formula against phthisis:

Rp. Creosot fagin. 3,0
Ol. jecor. asell. 200,0
Saccharine 0,1

S: 3 times daily 1 tablespoonful (for adults).

A second transmittance of saccharine and particularly of saccharine wafers would be very acceptable and would acquire you the gratitude of many poor people!

Although the material at our disposal is by no means exhausted, yet these communications will suffice, we think, and therefore we conclude our remarks on the utilisation of saccharine in medicine with a wish that our product may render service in many cases to suffering humanity.

IV. Utilisation of Saccharine in the Industries.

In the various branches of industry for producing food of all kinds, both sweetening and conserving substances are used in manifold ways. As saccharine unites in itself both virtues in an eminent degree, a vast field is opened for its utilisation in these same industries. It is at present largely in use in many of these manufacturing branches, has gained a firm footing in them and is looked upon as an indispensable, valuable raw material indisputably advantageous to use. This chapter is devoted to these industries.

It is evident that it would be a matter of impossibility to touch on all these branches separately and in detail; each of them possesses its own special literature and even that does not contain everything worth knowing about them, for in no other trades do we so often find as in the industries devoted to the manufacture of food and delicacies that each expert works on the lines of his own experience, which in the course of years he has found out to be the best, the most advantageous and convenient.

We must consequently restrict our remarks on these industries to the utilisation of saccharine in them and to the directions and hints combined therewith, and even in this our statements must be of a general character. Tastes differ in all countries and nothing is more calculated to excite astonishment than to observe the national drinks of a country, placed side by side, and to taste them. It may even be asserted that every district, indeed almost every town has its own particular taste in respect to eatables and drinks, the explanation of this being that taste, like education, manners and customs, is a matter of training from childhood. The great difference in taste of the population in different districts, even in different towns and villages is but a remnant, something that has passed over from the good old times in which communities were more shut off from each other and, owing to a want of means of communication, were above all dependent on whatever was produced within their confines; whatever came from other places was looked upon as *foreign*. This was especially the case with food the conveyance of which could not

be thought of, as it usually spoiled on the way owing to the length of time that it took, and because the carriage made it too dear. It is well known that in Prussia at the time of the Great Elector a letter was often several weeks on the way and the postage amounted to 100 times as much as it does now.

Differences in taste are to be explained from the circumstances just described, climatic, local and other circumstances determining directions of taste in respect to one and the same article of food or delicacy. We considered it advisable to recall these well-known facts to the memory of our readers to let them serve as an explanation why all the communications and recipes contained in the following chapters do not suit all cases. The former are intended to illustrate the methods of utilizing saccharine in different industries, the latter, on the other hand, must be accepted merely as examples. In the case of saccharine as in that of every other novelty, each manufacturer must endeavour to find out what is most suitable for his branch and individual case and in his experiments can make use of our directions. We feel convinced and we can promise that every manufacturer, who is not prejudiced against novelties and acts on the principle of trying everything and selecting the best, will not experimentalize in vain with saccharine and will soon discover the latter to be a product, the utilisation of which ensures both great pecuniary advantages, simplifies manufacture most materially and above all improves his productions to his own profit and to the benefit of his customers.

1. Utilisation of Saccharine in the Starch-sugar Industry.

In discussing the utilisation of saccharine in our various industries the first place is due to a branch for whose further existence and development saccharine is of fundamental importance, whose products on the other hand are of the greatest value for the future of saccharine, as they alone are suited to give saccharine the body it needs in so many cases.

The branch we mean is the starch-sugar industry.

The main object of the starch-sugar industry is to extract from plants the starch they contain and above all to obtain this substance from such plants as are grown on a large scale by our agriculturists owing to the abundance of starch found in them. The substance thus extracted is then converted into starch-sugar either by means of sulphuric acid or diastase or else in some other way; the product of this process is produced by nature too in various sorts of fruit and in grapes, in addition to fruit and grape sugar.

In the beet-sugar industry there is extracted from the beet-root all its juice, and thus 10 to 12 % of beet-sugar is obtained, whereas in the starch-sugar industry the starch contained in cereals and maize amounting from 50 up to 65 % is extracted, and that in potatoes, estimated at 15 to 22 %, and this product is then converted into starch-sugar.

Starch-sugar, called glucose or dextrose, is a product fully equal in value according to its origin and nutritiousness, to raw or beet-sugar — or sucrose as it is also termed —, and physiologically speaking even superior to the latter, for raw sugar must first be converted in the process of digestion in the body into invert sugar, but this conversion is not necessary with starch-sugar. Besides this, starch-sugar is materially cheaper than beet-sugar, for the cultivation of those plants from which starch-sugar is obtained does not require such a good soil, nor such an excellent condition of the latter in respect to its nutrimental capacity, whether natural or artificially produced by means of manuring chemicals, nor finally such tilling of the soil and careful rearing of the plants, as the cultivation of the beet-root does.

If in spite of all this, starch-sugar is not so extensively used as beet-sugar the reason for it must be attributed to the much greater sweetening capacity of the latter. This serves as confirmation of an assertion we made on another occasion, viz. that beet-sugar owes its more extensive, more general utilisation solely to its sweetness, and not to its value as a nutriment. Glucose is also sweet, as everybody knows, but not sufficiently so to serve as a sweetening substance unless employed in excessive quantity.

The deficiency in sweetness is consequently the reason of starch-sugar being excluded from general utilisation as a sweetener in daily life and limits its use to certain industries and in them, further, to the manufacture of articles inferior in sweetness and consequently in value and price. It is employed solely because it can be furnished cheaply in bulk, it is therefore a kind of adulterating substance for the dearer sugar. From a technical stand-point however, it deserves the preference to beet-sugar for the starch-syrups can be worked up direct by a warm or cold process, whereas sugar has to be boiled down to syrup in a very complicated manner; and then again starch-syrup retains its liquid condition, whereas the sugar contained in beet-sugar syrup easily crystallizes.

On comparing the chemical formulæ of these two bodies we find their composition almost identical:

Starch-sugar (Dextrose) = C_{12} H_{24} O_{12}.

Raw sugar = C_{12} H_{22} O_{11}. In its chemical composition starch-sugar has therefore only — H_2 O — a molecule of water more, and the problem for chemists is consequently to extract from starch-sugar this same molecule of water, and thus to convert a body of inferior sweetness and consequently of less value into a sweet and for that reason more valuable substance, *i. e.* raw sugar. However easy the problem may seem, its solution has not yet been found! The conversion of starch-sugar into raw sugar has remained a scientific problem unsolved by technical men, and its solution, like the manufacture of diamonds by the crystallisation of carbon, belongs to the unfulfilled desires of future generations!

The same object can, however, be attained by mixing starch-sugar in suitable proportions with another body which gives it the sweetness it lacks, and saccharine, a body possessing such intense and pure sweetness as it does and as it possesses alone, is peculiarly well adapted for the purpose.

According to reports on the experiments made, $^1/_2$ to 2 parts of saccharine are requisite to give 1000 parts starch-sugar the same sweetness as an equal quantity of beet-sugar has. Syrups made

according to this rule are equal in all respects to those of raw or beet-sugar owing to the addition of saccharine.

One would have thought that the starch-sugar industry must necessarily regard saccharine in the light of a very acceptable auxiliary ingredient and that it would make the most extensive use of it with a view to improving its product and in order to make it equal in value to sugar.

This is actually the case in a certain measure in some countries. Strange to say, however, these are countries in which the starch-sugar industry is carried on on a very limited scale. A general utilisation of saccharine in the manufacture of starch-sugar in those countries has never been adopted, because they have a most flourishing sugar industry paying a heavy tax on its products, whereas starch-sugar is not subject to taxation; it was, therefore, apprehended that an equally heavy tax would be imposed on starch-sugar so soon as it began to compete in earnest with beet-sugar, by being saccharinized! This reason would not in reality form an obstacle; the truth is, the starch-sugar industry of these countries is in a very depressed state, for it uses potatoes as a raw material, and the crops have been very bad of late years. In normal years one-half of the potato crops was used for eating and feeding purpose, one-third was consumed in distilleries and finally one-sixth was at the disposal of the starch industry and a fraction of this latter quantity was worked up in the manufacture of starch-sugar. In consequence of the extremely bad crops, of late a very small quantity of potatoes could be used for making starch-sugar, for the prices of this raw material rose to such a height that most manufacturers considered it advisable to close their works.

Granted on the one hand that such considerations together with other untoward circumstances have checked the general utilisation of saccharine in the starch-sugar industry of certain countries, yet on the other hand it would seem inexplicable that the starch-sugar manufacturers of other countries, in which the circumstances just described do not exist, should not readily have adopted the use of saccharine.

Our remarks refer in particular to the United States of North America.

In the United States many thousands of bushels of maize and other cereals are daily converted in factories into starch-sugar by the aid of sulphuric acid. There is no domiciled beet-sugar industry in the United States; more than one hundred million dollars are paid by that republic every year to European countries and the colonies for sugar: for the consumption of sugar in the United States is enormous. It amounts per annum and per head of the population to 45 lb., whereas in England,

which country consumes the largest amount of sugar, relatively speaking, in all Europe, the annual consumption per head of the population reaches only to 29 lbs.; in France the quantity is 9 lbs. and in Germany but 7 lbs.

The United States are consequently the greatest consumers of sugar in the world, and though they have no home beet sugar industry, yet their starch-sugar industry is very great and flourishing and far surpasses that of any other country.

In the first years of its manufacture, saccharine was very dear and the price of it was so high, owing to the considerable import duty raised on it in the United States, that starch sugar saccharinized in a proportion of 2 to 1000 was not low enough in price compared to European beet-sugar, which has been greatly reduced in price of late years, as was necessary to allow of its being taken into general and extensive use and thus contribute to the rise and development of the starch-sugar industry, which could have been expected under other circumstances.

In the meantime a great change of affairs has set in and moreover in favour of saccharine.

Owing to great improvements and the perfection attained in the manufacture of this substance, saccharine is now considerably cheaper than it was, and the refined article offered for sale at present possesses in comparison to the pure substance such an augmented sweetening capacity, that when added even in a proportion of $^3/_4$ to 1000 it produces starch-sugar fully equalling beet-sugar both in sweetness and taste; in respect to price too this starch-sugar offers such enormous advantages that all industries utilising sugar are bound to make use of it.

Starch-sugar saccharinized in a proportion of $^3/_4$ to 1000 is only about $^4/_5$ of a cent per pound higher in price than common, non-saccharinized sugar, in spite of the high import duty.

It is not to be denied on the other hand that, owing to the abolition of the import duty raised prior to the MacKinley Bill being in force on beet-sugar brought to the United States, a considerable reduction in the price of that article has taken place; there is, however, no reason to doubt that if the matter were laid in a business-like manner before the Government of the United States and good reasons were adduced, the import duty of 25 % ad valorem on saccharine would be abolished, provided it seemed in the interest of the home starch-sugar industry to do so. It is in the interest of every government to support and promote the producing power of its country, in this case, it is in particular the interests of maize growing farmers and the starch-sugar manufacturers that need support; it is further the bounden duty of a government to protect the home industry

whenever the latter is threatened by a similar foreign industry, not opposed by a home industry of the same kind. In this case too not even protection comes into question but merely the placing of two industires on an equal footing. We do not doubt for an instant but that such a loyal Government as that of the United States will not hesitate to grant the home starch-sugar industry the same terms as the foreign beet-sugar industry enjoys, and will be all the more induced to do so as the public revenue will not be diminished one cent thereby, for saccharine was raised to such a price by the duty imposed on it that it could not be utilised for sweetening starch-sugar. We must repeat what has just been said in few words: it would be merely an act of justice and fairness, if the Government of the United States would permit in the interest of the American starch-sugar industry the importation of saccharine duty-free after it has allowed beet-sugar from abroad to be imported without paying any duty. The American starch-sugar industry, oppressed as it is by the abolition of the import duty on beet-sugar, would not only prosper again by allowing saccharine free entrance to the country as it did before the passing of the MacKinley Bill, but would certainly assume dimensions never dreamt of before. A combination of circumstances so favourable for the products of this industry would then occur as have never been known before in the sugar trade, for after the abolition of the duty on saccharine the price of saccharinized glucose might be only $^3/_5$ cent per pound higher than that for the unsweetened article.

Directions for use. Refined saccharine only, as already stated, is utilised. The method of utilisation is as simple as possible.

The requisite quantity of saccharine is calculated, and then dissolved in a corresponding quantity of distilled water, the solution being slightly warmed and thoroughly stirred up meantime. Directly after the juice has been added the saccharine solution comes into the vacuum and is boiled down to 42° Bé.

a. Methods for the Preparation of saccharinized starch-sugar syrups on a small scale.

Owing to the dislike on the part of glucose makers to use saccharine, a want of good saccharinized starch-sugar syrup was often felt in the market, and so a number of small manufacturers, who were not blind to the advantages of using this syrup and did not care to take their supply of capillary syrup from any other source, hit upon the idea of covering up their wants in starch-sugar syrup in the customary way, by saccharinizing the latter themselves. We often receive inquiries about

directions for the preparation of a really serviceable saccharine syrup and now communicate the following methods.

Put into a bright polished or well tinned copper boiler 90 kgrms of the best white starch syrup of the same consistence as that commonly used, and heat till it boils gently. It should be remarked that if this is done over a direct fire the liquid may easily acquire a yellowish colour owing to particles of the syrup being spirted above the level of the latter and adhering to the sides of the boiler. If steam is at hand to allow of the boiling being done by a closed coil or jacket, it can be used to great advantage, for no alteration in the colour of the syrup can then take place. These remarks are intended only for cases in which it is necessary to make a perfectly clear syrup.

As soon as the syrup is boiling properly it must be removed from the fire and 100 grms of refined saccharine are strewn upon the syrup (see quantity given above) and the whole is then mixed up well with a wooden spatula. The relatively light saccharine powder shows a tendency in the stirring to adhere to the upper sides of the boiler, it is therefore advisable to strew it right in the middle of the boiling fluid and to continue the stirring in small circular movements until the powder is quite mixed up with the syrup. The saccharine is then left to dissolve, but the stirring must be continued all the time. If the boiler is in a light room the dissolving can be watched, if not it is better to convince one's self by taking out a sample every now and then. During the boiling of the syrup and before it is saccharinized water may be added to replace that evaporated. At last, so much boiling water is added as may be necessary to make up the exact quantity of 100 litres when the syrup is cold, and then also to measure it. Boiling water is used in preference as it mixes more easily.

If it is not considered desirable to use pulverised refined saccharine owing to its scattering, the requisite 100 grms can be added to 1 litre of hot distilled water and stirred up into a uniformly pasty mass, then added to the syrup and the whole treated in the same way as that just described.

Should the saccharine not be completely dissolved in the syrup the mixture must be boiled gently once more to make it dissolve; such occurrences should, however, be avoided as much as possible.

In the proportion stated above 1 litre saccharine-syrup corresponds, as experience teaches, in its sweetening value to 1 kgrm sugar or to 1 litre sugar-syrup containing 1 kgrm sugar, and can be utilised in the same way.

This saccharinized starch-syrup, which we shall term in future saccharine starch-syrup I. for the sake of brevity, is

peculiarly well suited for use in conserving fruit, for fruit juices and the better kinds of cordials.

If the cordials have to be of an inferior quality they are as a rule not so thick; such a syrup can be prepared according to the following directions:

Boil 40 litres of water and when boiled add 125 grms refined saccharine, pour in to this, 60 litres of boiling capillary syrup (exactly 90 kgrms) and stir the ingredients up until they are all thoroughly and uniformly mixed. The mixture furnishes 100 litres of saccharine syrup corresponding in sweetness to 100 grms of sugar exactly and to 100 litres of sugar-syrup (1 kgrm sugar and $^1/_2$ litre water to 1 litre syrup).

In the ensuing chapters this syrup will be termed: Saccharine starch-syrup II.

Saccharinized capillary syrups offer the great advantage of not crystallizing and of retaining their sweetening capacity to the full.

In addition to this they are considerably cheaper than sugar syrups and can be worked up direct either by a cold or warm method.

b. Methods of preparing saccharinized sugar-syrups.

In many countries the utilisation of starch-sugar is not possible owing to a want of a home starch-sugar industry and because the importation is rendered impossible by high duties. Further, the products of starch-sugar factories may rise so much in price consequent on a corresponding rise in the raw material induced by a failure of the crops, that the utilisation of starch-sugar is a matter of impossibility in many branches. Finally there are industries in some countries, in which potatoes are used to make starch-sugar, that do not employ potato starch-sugar on principle in the manufacture of particularly fine articles of the nutriments branch, because it does not suit the taste of the consumers. Although this prejudice cannot be considered justifiable in all cases, yet it is not to be denied that there are some potato-syrups offered for sale by small makers that have an insipid, and by no means pleasant taste. Generally speaking such syrups are made and sold by so-called juice-boilers, persons who prepare a kind of capillary syrup by mixing starch-sugar syrup with molasses and thus produce an article calculated to bring discredit upon really good starch-sugar products.

In all such cases the preparation of saccharine sugar-syrups is to be recommended. These are syrups that contain saccharine in combination with sugar in relatively equal proportion, half and half that is to say, in respect to the sweetening capacity.

The preparation of such saccharine sugar-syrups is very simple.

1) Boil first of all water and sugar in a pan covered with

a steam-jacket; when the syrup is at the boiling point stir in the saccharine and let the mixture run into a cooling-vessel.

2) Dissolve the sugar in the way just described, put the quantity of saccharine measured off beforehand into the cooling-vessel and let the boiling syrup run upon it.

3) It often occurs that there is not a pan provided with a steam-jacket at hand, in which case the saccharine is put into a boiler and boiling water is poured on to it until it dissolves; then the sugar is put in and dissolved and the mixture increased by adding water until the requisite quantity of syrup is obtained.

Warning: Never, under any circumstances, should the saccharine be put into cold water and boiled with the intention of dissolving it, for partial decomposition ensues in such cases.

In some places it is the custom to prepare the syrup with cold water to avoid the trouble of cooling it; in such cases, put the saccharine into the syrup boiler, pour boiling water on it in a proportion of 5 litres to every 30 grms, add the sugar to it then, and finally cold water to make up the requisite quantity.

Syrups made according to the above-mentioned methods with saccharine and sugar, when tested with the saccharometer will show half the weight only, but they will prove just as sweet, as if the instrument indicated the double thereof without saccharine.

It should not be overlooked that 1 kgrm sugar dissolved in 10 litres water, increases the quantity of syrup by about $^1/_2$ litre. If a manufacturer dissolves, therefore, 50 kgrms sugar and intends to add 25 kgrms of sugar and the relatively equal amount (50 grms of refined or 85 grms of pure) saccharine, he must add 25 half or 12 full litres of water more than he used to add in order to obtain the same amount of syrup. The relative sweetness of saccharine (2000 grms = 1000 kgrms sugar) is calculated so as to make up this deficiency.

Only refined or pure saccharine should be used to prepare syrups that contain sugar and saccharine in relatively equal quantities.

The following tables may serve as a guide for the preparation of syrup mixtures:

Instead of dissolving:

sugar					sugar				refined saccharine
$2^1/_2$ kilogrms	=	5	lb.	use	$1^1/_4$ kilogrms	=	$2^1/_2$ lb.	+	$2^1/_2$ grms
5 -	=	10	-	-	$2^1/_2$ -	=	5 -	+	5 -
10 -	=	20	-	-	5 -	=	10 -	+	10 -
$12^1/_2$ -	=	25	-	-	$6^1/_4$ -	=	$12^1/_2$ -	+	$12^1/_2$ -
25 -	=	50	-	-	$12^1/_2$ -	=	25 -	+	25 -
50 -	=	100	-	-	25 -			+	50 -
100 -				-	50 -			+	100 -
200 -				-	100 -			+	200 -
250 -				-	125 -			+	250 -

If pure saccharine has to be employed, instead of dissolving:

2½	kilogrms	sugar	take	1¼	kilogrms	sugar	+	4⅕	grms	pure	saccharine
5	-	-	-	2½	-	-	+	8⅓	-	-	-
10	-	-	-	5	-	-	+	17	-	-	-
12½	-	-	-	6¼	-	-	+	21	-	-	-
25	-	-	-	12½	-	-	+	42	-	-	-
50	-	-	-	25	-	-	+	84	-	-	-
100	-	-	-	50	-	-	+	167	-	-	-
200	-	-	-	100	-	-	+	335	-	-	-
250	-	-	-	125	-	-	+	418	-	-	-

Finally in the preparation both of saccharine starch-syrups and saccharine sugar-syrups and also in the utilisation of saccharine generally in the different branches of industry, attention should be paid to the faintly acid reaction of saccharine. If enamelled or tinned boilers and pans are not at hand for the purpose, care should be taken that the saccharine and the mass worked up with it does not remain longer in metal vessels than is indispensably necessary. Copper vessels should not be used under any circumstances.

2. Utilisation of saccharine in various industries as a taste-corrective.

In a number of branches saccharine can be utilized to great advantage in improving the taste of industrial products, in all cases, we may say, in which these products have acquired a certain taste by the use of some indispensable substance in their make. It is often desirable then to remove this generally unpleasant flavour, or if that be not possible, to conceal or at least modify it. These branches and their articles are more numerous than we are apt to believe. An improvement in the taste of such articles has been made with sugar, but at the expense of durability and wholesomeness; but even this expedient could not always be resorted to because such enormous quantities of sugar were necessary for the purpose, and the volume was increased too much thereby. It is not possible for us to enumerate all cases worth mentioning, so we shall limit our remarks to a few which we select as examples.

The manufacture of cocoa. Cocoa derived from the nut of the chocolate tree has a bitter taste that is improved by the use of pretty considerable quantities of sugar. The component parts of cocoa are: albumin, fat and carbo-hydrates, and are very nutritious substances when used as food in general and as nutriment in particular for a weakened organism, but their value as such is greatly lessened when partaken in combination with acid-forming substances such as cane or beet sugar. Privy councillor Professor Dr. Curschmann of Leipsic was the first to suggest a remedy and to propose cocoa sweetened with saccharine instead of sugar, as it has not a bitter taste, is quite void of sugar and does not acidify in the stomach. This suggestion was acted on by several cocoa manufacturers, and there are now so-called saccharine cocoas in trade that are much liked and even preferred to the famous Dutch cocoas; they have proved most serviceable both to healthy and sick consumers, in the worst cases of catarrhs of the stomach and intestines, for diarrhœa and bad digestion and are very effective for badly nourished persons. Saccharinized cocoa furnishes at all times an agreeably sweet and aromatic beverage quite

uniform and never unpleasant in taste, that can be taken for years without palling upon the appetite. According to the opinions of medical celebrities this saccharine cocoa may be recommended not only in the cases just named but also and in particular for raising the vital powers quickly and counteracting loss of appetite in persons suffering from pyrexia, measles, chlorosis etc.

Easily soluble saccharine products are used for this purpose; according to the sweetness either $^1/_2$ to 1% of easily soluble or $^1/_3$ to $^1/_2$% of refined easily soluble saccharine is mixed carefully with the pulverized cocoa.

In addition to the opinions published on page 112 of this work, the following will suffice:

> The undersigned readily certifies that the saccharine cocoa from your factory placed at our disposal for the patients of our medical clinique and in particular for diabetic sufferers was gladly taken by the latter, and was used with the best results in the case of a girl afflicted with diabetes melitus and from whose urine the sugar had been successfully removed, for not the least sign of sugar was observable even after a prolonged use of your saccharine cocoa.
>
> Yours respectfully
>
> Zürich, 2nd Sep. 1888. (signed) Prof. Dr. H. Eichhorst, Director of the Medical Clinique.

Dr. Niederstadt of Hamburg wrote:

> Whenever the attendant physician wishes to raise the vital powers, to remove organic derangements and weakness of digestion and has to combat at the same time against want of appetite (for instance in cases of fever, the measles, diarrhoea, chlorosis in girls, combined with weak digestion) the Hansa saccharine cocoa is sure to be effective.

Dr. Ratjen, head physician for cases of internal disorders, at the Marien Hospital in Hamburg (20th July 1888) says:

> I willingly prescribe your Hansa saccharine cocoa in cases of weakened activity of the stomach. It has proved of special service to me in fever cases. During the present epidemic (measles) here, children have usually refused to take any sustenance when the fever was at its height, when the illness broke out too, but as a rule they gladly took your saccharine cocoa.

The Hansa Saccharine Cocoa Factory mentions besides the following physicians who have expressed a very favourable opinion on the use of saccharine cocoa: Verein für Gesundheitspflege (Association for Hygiene) Hamburg, Professor Dr. Curschmann, Head physician Dr. Ratjen, Head physician Dr. Scholz, Head physicians Dr. Hofstedter and Dr. Keller, Dr. Niederstadt, Dr. Ulex, Dr. Gilbert, Dr. Marquard, Dr. Wimmel, Dr. Filsinger, Dr. Paul Müller, Dr. Crone, Dr. Bein, Dr. Knopstück, Dr. Struwe, Dr. ten Doornkart, Dr. Menig, Dr. Tolks, Dr. Goliner, Dr. Neustadt, Dr. Wachsmann etc.

Cod-liver oil and other oils, fat, margarin etc. can easily be sweetened with saccharine. It is used on the one hand in large quantities ($^1/_4$ to $^1/_2$ %) to give the oils a sweet taste and to render them more palatable and agreeable for children, for instance in taking cod-liver oil, and on the other hand it is employed very sparingly, as in the manufacture of margarin, in order to give it a mild and pleasant but not a sweet taste. If the substance to be sweetened is warmed the saccharine dissolves in it quickly and to perfectly clear solution. Refined saccharine is used for the above purpose.

Mustard. The rather simple way of preparing mustard for the table consists in putting some mustard-seeds into a mill and after adding a few drops of wine-must or vinegar, in grinding them until they are converted into a uniformly pasty substance, to which a little flour and different spices, are finally added. Mustard is salted and sweetened separately to give it the proper piquancy and to temper the flavour. Of late this has been done to great advantage with saccharine, for setting aside the much greater cheapness of the latter, a substance is mixed among the mustard then that keeps it from fermenting and spoiling and staves off decomposition for a long period. For consumers saccharinized mustard is preferable from a dietetic point of view to sweetened mustard, as it strengthens the stomach and promotes digestion. It will be especially welcome to diabetic patients who do not like to miss mustard from their fatty meat dietary.

Pure or refined saccharine is used in this case; experience showing that 4 to 6 and 3 to 5 grms respectively, suffice for 1 cwt. of mustard.

It is most advisable to dissolve the saccharine in the wine-must or vinegar to be put in the preparation, and to work it up with it; if water is preferred to either of the above fluids the saccharine can be dissolved in it.

Tobacco for chewing is made of very strong Virginia leaf, treated with different kinds of sauces after fermentation and then spun in rolls as thick as twine or even as thick as one's finger, or else pressed into cakes. Even fermented tobacco has a sharp, biting taste and therefore it is prepared with certain sauces both to make it suitable for chewing and in order to temper the flavour. These same sauces are prepared with sugar, which could be replaced in a most profitable way by saccharine, as our New York friends assure us. To our regret we cannot speak from experience on this mode of utilising

saccharine, but after what has been already said on the antiseptic effect of saccharine and on the disinfection of the cavity of the mouth, and further by reason of what remains to be said on the preparation of tooth-pastes, mouth-washes etc., it would seem to us as if the preparation of these flavours for chewing tobacco with saccharine, is very feasible. According to the nature of the flavours to be used, whether they are to be thick or thin, either saccharine in an easily soluble form or in the shape of saccharinized starch-syrup should be employed. An exact description of the said syrup is given on page 126 of this work.

In the manufacture of perfumery and in particular that of **tooth-waters, pastes, powders** and **mouth-washes,** the correcting of the taste of various important substances, such as myrrh, radix viridis, calamus and others of a very bad taste, is an important matter. By the removal of one evil another was produced, in concealing the nasty taste with sugar the teeth suffered, for sugar affects the latter, causes fermentation in hollow teeth and promotes the growth of the organisms and bacteria contained in the cavity of the mouth.

In such cases saccharine is of inestimable value, for it does not affect the teeth or irritate the nerves of the latter, and on the other hand does all that is expected of it. It improves the taste of the preparations and makes them keep well, a very important point in non-spirituous tooth and mouth washes. At the same time saccharine disinfects by means of its antiseptic effect and stops fermentation and putrefactive processes in decayed teeth.

Subjoined, we publish some recipes taken from the Journal für Zahnheilkunde (dental hygiene):

Recommended as antifermentative preparations:

Rp. Saccharini 2,0
Spir. Vini dilut. . . . 200,0
Ol. Menthae pip . . gtt. X

M. D. S. 1/2 to 1 teaspoonful to be used for rinsing the mouth.

Rp. Tinct. Myrrhae . . . 5,0
Spir. Lavandulae . . . 95,0
Saccharini 1,0

M. D. S. As above.

Rp. Aquae Coloniensis
Aquae Rosarum . āā 5,0
Saccharini 1,0

M. D. S. As above (is a milky, dull fluid).

Rp. Aq. Cochlear
Aq. destillat . āā 50,0
Sacchar. solub. . . . 10,0

M. D. S. Diluted with an equal quantity of water, in tablespoonfuls for rinsing the mouth.

Alcoholic solutions can also be used as tooth tinctures, for touching the gums etc., if it is not preferred to add saccharine to one of the tinctures generally used, for instance:

Rp. Tinct. Myrrhae
Tinct. Benzoës
Tinct Chinae . . . āā 15,0
Saccharini 0,05
Ol. Caryophyllor. . . . 1,0
M. D. S. Tooth-tincture.

As a tooth-powder Paschkis prescribes.

Rp. Calcii carbonici praecip. 28,0
Rhiz. Calami subt. pulv. 2,0
Saccharini solub. . . . 1,5
Ol. Menthae pip. . . gtt. X
M. finely pulverized. D. S. Tooth-powder

In all the mixtures just given, the volume of saccharine is large and the taste of it intensely sweet, so that immediately after using it the mouth should be rinsed with water.

If saccharine has to serve merely as a taste-corrective in the place of sugar, much smaller quantities of it should be prescribed, for instance:

Rp. Natrii biborac. . . . 10,0
Aq. destillat. 450,0
Aq. Menthae 50,0
Saccharini solub. . . . 0,3
M. D. S. Mouth-wash.

Rp. Tinct. Calami
Tinct. Mastiche . āā 5,0
Spir. frumenti 50,0
Ol. Caryophyllor. . . . 0,2
Saccharini 0,02
M. D. S. 10 to 20 drops in a glassful of water for rinsing the mouth.

Rp. Pulv. Oss. Sepiae . . 20,0
Pulv. Magnes. carb. . . 10,0
Saccharini solub. . . . 0,02
Carmini 0,2
M. finely pulverized. D. S. Tooth-powder.

It must be mentioned besides and in conclusion, that the utilisation of saccharine in the pickling of meat of all kinds, especially of ham, has proved a great success and may be considered not only as a perfect substitute for sugar which has been commonly used for this purpose so far, but has besides many advantages in its favour: it is cheaper than sugar, makes the pickle and the meat soaked in it keep exceedingly well, gives the latter an excellent flavour and prevents its getting sticky and drity, on the outside in particular.

We have had no opportunity as yet of gaining any experience in the utilisation of saccharine in this direction, yet judging by

the highly satisfactory results obtained in this direction by our customers in the United States, we feel justified in recommending saccharine for use to the large meat preserving companies of South America, Australia, etc., and thus draw especial attention to the matter.

Refined easily soluble saccharine is used, provided the pickling or salting be done with fluids, but ordinary refined saccharine, if this operation is to be carried out in the dry way by strewing salt over the meat. According to the former method, which is most generally adopted for pickling large quantities of meat, the pieces of meat intended for salting are packed in an iron cylinder, out of which the air is pumped, and the pickle poured in. The latter consists of a concentrated salt solution containing besides saltpetre and other spices, 1—2 kilogrms of sugar to every 100 litres of fluid. In the place of sugar, 2 to 2,5 grms of refined saccharine to every kilogramme of sugar, can be used. It can be added direct to the pickle or added to the latter in the shape of an aqueous solution to avoid weighing off such small quantities. If 25 grms of refined easily soluble saccharine are dissolved in 1 litre of water, this solution corresponds to about 25 lb. (English) sugar; to every 100 litres of pickle 100 ccm. of this solution must be added. — In pickling meat with a saline mixture, the meat is packed in barrels and a layer of salt strewn between each layer; to every 100 kilogrms of meat 5 kilogrms of a mixture are used, this mixture consisting of 16 parts of common salt, 0,5 parts of saltpetre and 1,5 to 2 parts of sugar. Consequently for pickling 100 kilogrms of meat are required: 4350 grms common salt, 150 grms saltpetre and 500 grms sugar, or, if saccharine be used in the place of the latter, 1 grm of refined saccharine. This method of pickling is not to be recommended, since important nutritious substances are absorbed from the meat by the pickle that forms in course of time.

3. Utilisation of Saccharine in the manufacture of beverages.

This branch of industry is subdivided into so many minor branches that we consider it necessary to classify them into two groups for the sake of clearness:

firstly, those in which beverages are prepared by mixing and working up different ingredients, and without alcoholic fermentation therefore;

and secondly, those in which beverages are manufactured by fermentation.

Among the first of these two groups we must count:

a) the manufacture of artificial mineral waters, lemonades, effervescing lemonades and certain beverages resembling beer,

b) the production of liqueurs (cordials), cognac (brandy) and essences.

Among the second group:

a) the manufacture of all sorts and descriptions of beer and fermented beverages resembling beer,

b) the production of wine, fruit and berry wines and also champagnes.

Before proceeding to mention the various ways in which saccharine is used in these branches, we will say a few words about a process forming a more or less important feature in this industry, for the manufacture of part of the beverages mentioned above is dependent on it. This process is

Fermentation. Of all chemical processes none is so difficult, complicated and uncertain in its effects and its course as this. It is a subject with which volumes upon volumes could be filled; as we restrict ourselves in this work more to practice than to a scientific or theoretical discussion of such subjects, we need only touch upon this point so far as it concerns the industries to be spoken of.

Fermentation can arise either from the chemical decomposition of sugar into alcohol and carbonic acid (alcoholic fermentation) and is then produced by yeast, or else it may be a consequence of the growth of germs and sprouts arising from

plants that engender fermentation and are akin to yeast in their physiological structure or allied to it.

Alcoholic fermentation is made use of in these branches of industry in the preparation of spirits, beer and wine; wine-dealers or producers leave the process of fermentation entirely to nature — the yeast-cells contained in the air and coming from it into the juice of the grape develop in the latter and bring about the process of fermentation; beer-brewers and distillers on the other hand assist nature in alcoholic fermentation and accelerate the commencement of the process by putting yeast into the liquids intended to ferment. The yeast requires cultivation, and so there has to be a regular growth maintained.

Other fermentation produced by fungi (mildew) and bacteria are of no use from an industrial point of view, are more productive of harm in fact; but as they occur everywhere and particularly in fluids containing sugar, they are consequently of great importance, for manufacturers of beverages have to counteract their formation and development as much as possible. These fermentations are what is termed in common parlance putrefaction, and differ vastly according to the ferments from which they originate, and are called after them: butyric acid, lactic acid, acetic acid, foul and slimy fermentations, etc. The ferments and their organisms capable of germination, or even dirt from lack of cleanliness, may get through the medium of the air, into the bottles. Utilisation of impure sugar, water, etc., may also bring these organisms into the beverages. The influence of any such fermentation called forth by the possibilities just named, is always disadvantageous and injurious in all cases, no matter whether the process occur in carbonic acid waters or any other beverages, for it occasions dullness, precipitations, loss of sweetness, completely spoils aromatic essences and essential oils and ruins the products altogether, so that it causes at once loss of money and reputation, for the makers.

It is self-evident, therefore, that a suitable preventative is of great and material importance to manufacturers of beverages.

Many of the causes of a fermentation that has in its train the putrefaction and spoiling of products, all in fact that arise from lack of cleanliness in the apparatus or other things, from bad fastenings or stoppers, from germs and organisms contained in the water, are more or less under the control and survey of the manufacturer, for he need but keep his apparatus, pipes and boilers clean, wash and rinse his bottles carefully, remove all air from the latter in filling them, close them well and clean the water thoroughly by boiling or filtering it, to ensure the certainty of running no risk from occurrences such as those just mentioned.

In the manufacture of beverages, however, the following contingencies may occur:

1) In all cases in which alcoholic fermentation and its proper course of development are absolutely necessary, the process can be disadvantageously influenced by other fermentations, for the germs producing the latter may happen to be in the majority and check the yeast by their rapid growth in its development, hinder its taking effect, suppress and choke it by their rankness of growth.

2) Injurious fermentations can arise in beverages in which none whatever are required; in such cases alcoholic fermentation must be reckoned amongst the detrimental ones.

The question is therefore still unanswered, how all these objectionable fermentations are to be prevented that owe their origin to fermentation organisms traceable to unclean sugar or to other known causes. There are two ways of effecting this:

1) by using conserving substances, such as salicylic acid etc., which however increase the expense of production in all cases mentioned above under 2;

2) by decreasing the fermentative capacity of sugar, either completely by substituting saccharine for sugar, or in part by using saccharine instead of one half of the sugar. As saccharine is lacking in body and as due regard must be paid to the taste of the consumers — the taste acquired by habitual use, we mean, — the last-named case, the replacement of one half of the sugar by a corresponding quantity of saccharine, is the more preferable and is what we recommend and treat upon in particular, in the following chapters.

By using half sugar and half saccharine instead of the quantity of sugar employed as yet the sweetness of the syrup is as intense as it ought to be, the expense of production is considerably lessened and the mixture is as reliable in its effect as any conserving substance, for saccharine is able to put a stop to any endeavours on the part of the sugar to ferment, in a most effective manner.

We have repeatedly and continually drawn attention to this quality of saccharine, and surely its value cannot be overestimated by manufacturers of beverages; but as we had not gained sufficient practical experience on the antiseptic effect of saccharine, we hesitated hitherto to guarantee this effect and have not attached that weight to the question which it so richly deserves. The unanimous opinions of all our customers — the latter have kindly allowed us to lay numerous opinions on the subject before our readers — relative to this point have dispelled any doubts that may have existed. They domonstrate that

the preserving property of saccharine,

setting aside all its many other tried advantages, raises saccharine to a level with the greatest improvements ever made as yet for the benefit of all branches of industry for the production of beverages. In our opinion the time is not far off, in which the utilisation of sugar in the manufacture of certain beverages will cease entirely. One good reason for the fulfilment of this forecast is to be found in the fact, that the possibility of fermentation, — the dread of all connected with this branch, — can be considered a thing of the past so long as saccharine is used; fermentations caused by negligence and lack of cleanliness are of course excepted.

So long, however, as sugar remains in use, it must not be overlooked that the poorer its quality the greater the danger of foul fermentation, and further that beet-sugar, although it is cheaper than the best refined cane-sugar, possesses at least 12 percent less sweetening capacity, so that the seeming cheapness is not reality but to that extent, deception. More sugar has, therefore, to be used to make up for this deficiency in sweetness, and every additional pound of it increases the danger of fermentation.

In concluding our remarks on fermentation, we will make mention in a few words of a peculiar kind of fermentation sporadic in its way and spreading as quickly as cholera or small-pox. It is called viscous fermentation and appears as a gelatinous body rapid in its growth, that attacks all bottles, implements and portions of the machines and spreads throughout the whole factory. Our object in mentioning it is merely to point out to manufacturers that the very greatest cleanliness is the only safeguard against it.

---

a. Utilisation of Saccharine in the manufacture of carbonic-acid waters, lemonades, effervescing lemonades etc.

At present there is no branch of business free from envious and dishonourable competition; it is beyond doubt besides that the mineral waters' industry has more to suffer by far from this evil than most branches. It is really difficult to say why manufacturers keep on reducing the prices of their products in favour of the consumers but to their own ruin; and yet it is a fact that their existence is conditional on this method of doing business. No wonder then that makers eagerly seize on anything offering the possibility for reducing expense. Some economise at the expense of the quality of their products and use less syrup, others utilize inferior ingredients, others resort to other practices just as useless. A saving in expense is undoubtedly effected thereby, but it is out-balanced by the consequent loss of custom. A saving that is really effective does not simply mean a reduction in expense or a gain at the expense of the consumers, but must necessarily ensure a continuance of excellence in the quality of the products so as to ensure an increase of custom. This object can be attained solely by the utilisation of saccharine which improves both taste and durability of the beverages and offers a clear profit of 15 to 20 percent for the manufacturer.

The proof of this assertion is to be found in the preceding chapters and on page 92, in which the superiority of saccharine and the advantages attendant on its use are explained in full.

We will, however, refer once more and in particular to one advantage to be derived from using saccharine, because it is of vast importance to manufacturers of carbonic-acid waters; what has been said of the economical and other advantages (page 93) need not be repeated.

It has already been explained that it is not necessary to add so much acid to saccharinized syrups as to those made exclusively of sugar in order to attain equal results. The reduction in quantity (of acid) is, of course, dependent on the taste of the consumers; 13 to 20 % may be accepted as an

average amount. A corresponding reduction in the quantity of other ingredients must be made, for saccharine produces a full and complete development of aroma.

Refined or **pure saccharine** are utilized in this branch, either alone or half and half with sugar in the shape of saccharine starch-syrup or saccharine sugar-syrup, the preparation of which has been explicitly described (see page 126 to 128). To which of the varieties recommended the preference should be given depends on local circumstances, and as this work is published for an International Exhibition we cannot enter into details on this point. Our remarks must be limited to assuring all interested persons that the syrups we recommend have proved most serviceable; the choice of them we must necessarily leave to manufacturers. In all cases the selection must be guided by the prevalent taste and is dependent on the nature of the beverage to be made.

The following directions and hints can, however, be repeated:

The acid reaction of saccharine should never be left unheeded, only tinned and enamelled boilers may be used; should the latter not be at the disposal of the maker, he must be careful not to keep the saccharine syrups longer in the metal vessels he uses, than is unavoidably necessary.

If saccharine has to be utilized alone, all that is necessary is to pour boiling water on the quantity measured or weighed off for immediate use. The preparing of the syrup is, therefore, as simple as can be and not combined with any further trouble.

In case saccharine has to be worked up half and half with sugar the syrup must be prepared according to the directions given on page 128; due regard must be paid to the fact that 1 kilogrm of sugar dissolved in 10 litres of water increases the quantity of syrup by about $^1/_2$ litre.

The sugar utilised for these purposes must be of the best quality and as pure as can be. Sugar treated with ultramarine and termed technically »blued sugar« must not be used. To dissolve the sugar in the cold is a great mistake and moreover objectionable, for water always contains germs or bacteria engendering fermentation; the only way to exterminate the latter is by boiling the water. The boiling of the sugar is also objectionable. The safest way of preparing the syrup is to boil the water long enough, and then to put in the sugar and saccharine. In this way alone are all attendant dangers avoidable.

Recipes for carbonic acid beverages of all descriptions. It is a matter of great difficulty to give positive recipes and directions for the manufacture of beverages, for so much has to be taken into consideration, viz. local taste, custom, the

method of preparing them and finally the demands made on them by the buyers or consumers. Differences in all these particulars are to be found in all districts and in all manufactories and each individual maker has to take them into account.

We have made a number of attempts in this direction and have manufactured samples of the most saleable carbonic-acid waters for exhibition, and seeing that these articles found universal favour we consider that it may be acceptable to interested persons to learn the methods of preparation we followed in making them. We do not claim to have attained perfection or to have produced anything new, but simply intend to show what superior, delicious beverages can be made with the help of saccharine; we have endeavoured to manufacture a first rate article and publish our experience in the hope that it may prove useful. We communicate the result to our readers in this spirit and with this desire.

Class I. Beverages free from sugar. Whatever the ultimate form may be in which a sweet beverage is offered for sale, the first step in manufacture will always be the preparation of the syrup.

In manufacturing carbonic-acid waters containing saccharine as the sole sweetening substance, the method of proceeding is the very simplest imaginable.

Taking 1 grm of pure saccharine to 0,35 litre of water (or 1 grm of refined saccharine = $1^2/_3$ grm of pure saccharine) as a standard and following the directions given on pages 17 and 128, dissolve in boiling water:

17,5	grms	pure	or	10,5	grms	refined	saccharine	to	obtain	5	litres	syrup		
35	-	-	-	21	-	-	-	-	-	10	-	-		
87,5	-	-	-	52,5	-	-	-	-	-	25	-	-		
175	-	-	-	105	-	-	-	-	-	50	-	-		
262,5	-	-	-	157,5	-	-	-	-	-	75	-	-		
350	-	-	-	210	-	-	-	-	-	100	-	-		
437,5	-	-	-	262,5	-	-	-	-	-	125	-	-		
525	-	-	-	315	-	-	-	-	-	150	-	-		
612,5	-	-	-	367,5	-	-	-	-	-	175	-	-		
700	-	-	-	420	-	-	-	-	-	200	-	-		
1050	-	-	-	630	-	-	-	-	-	300	-	-		
1750	-	-	-	1050	-	-	-	-	-	500	-	-		

and strain the solution through a cloth; no further filtration is necessary. Generally speaking the preference can be given to the refined saccharine.

Lemonade (its composition).

Soluble essence of citron	40 grms
Soluble essence of lemon	24 -
Crystallized citron acid	48 -
Syrup (see above)	5 litres.

Directions: Dissolve the acid in the syrup whilst the latter is still hot; after cooling completely add the essences, filter and add 45 grms of the mixture to 300 grms of carbonic-acid water and keep it under a pressure of about 85 lb.

The above directions stand good for all recipes of this class.

Ginger-beer (effervescing).

Soluble essence of ginger	64 grms
- - - Spanish pepper	1 -
- - - citron	32 -
Crystall. citron acid	40 -
Syrup (see page 140)	5 litres.

Fruit-water (effervescing).

Soluble essence of pears	2¾ grms
- - - pine-apple	2¾ -
Liquid saffron	3½ -
Orange colour	3½ -
French tartar	7 -
Citron acid	48 -
Syrup	5 litres.

Orange Tangerine.

Soluble tangerine essence	96 grms
Orange blossom water*)	64 -
French tartar	3½ -
Orange colour	10 -
Citron acid	40 -
Syrup	5 litres.

*) or soluble orange peel essence ½ grm.

Raspberry.

Soluble essence of raspberry	128 grms
Raspberry colour	32 -
French tartar	3½ -
Citron acid	40 -
Syrup	5 litres.

Ginger Ale.

Soluble essence of ginger	128 grms
- - - Spanish pepper	3½ -
- - - orange	64 -
- - - tangerine	64 -
- - - citron	32 -
- - - rose	1¾ -
- - - orange peel	1¾ -
Citron acid	40 -
- colour	3½ -
Raspberry colour	1¾ -
Liquid saffron	1¾ -
Syrup	5 litres.

Note: If a slightly aromatic, spicy taste is required, add 3½ grms of soluble all-spice.

In connection with this, we must not omit to point out another opening for carbonic-acid waters; **we mean the manufacture of these waters for medical purposes.**

Body is required in general in beverages, as we have already remarked. In spite of this, we publish the preceding list of recipes for beverages made exclusively with saccharine

and therefore sugarless, and our reason for so doing is because in many cases the partaking of sugar is strictly forbidden by medical men; this point has been treated of in another chapter of this book. A passing glance at the list on page 107 will suffice to show how many hundreds or even thousands of people are obliged to forego the enjoyment of a glass of lemonade or ginger-beer; the drinking of beer and of all other beverages containing sugar is also prohibited for the same reason, so we feel justified in asserting that, if it were possible to obtain a kind of lemonade or a beverage of any other description »warranted free from sugar«, there would be a great demand for it. The idea is not novel, but the practical utilisation of it was confined to a few special manufactories and the high price charged for such beverages — 5s. a dozen — naturally limited the consumption. Since saccharine has become cheaper than sugar there is absolutely no reason why these beverages should not be sold at ordinary prices, and a profitable business might certainly be done in them.

Class II. Carbonic-acid waters with saccharine and sugar.

Taking it for granted that 1 litre of the syrup used as yet in the manufacture of lemonade contains 0,6 kilogrm sugar, then the proportions would be as follows when a mixture of saccharine and sugar in relatively equal quantities, is used:

In order to manufacture		5	10	15	20	25	50	100	litres of syrup
Saccharine	refined in grms	3	6	9	12	15	30	60	
	or pure - -	5	10	15	20	25	50	100	
Cryst. sugar in kilogrms		1,5	3	4,5	6	7,5	15	30	
Water approximately, in litres		4	8	12	16	20	40	80	

The sugar is dissolved after one of the directions on page 125 and the saccharine is stirred in. As already stated, the volume is increased on the one hand, by the sugar, on the other hand the water diminishes by evaporation etc. Should the quantities of water stated in the above recipes not be sufficient therefore, so much more must be added, until the required quantity is obtained. If the syrup is not to be so sweet, more water must be used, the concentration of the sugar being then less of course.

If practicable, the acid must be dissolved in the syrup while the latter is still hot, for by adding the acid in this way the volume is not increased and the original strength of the syrup is maintained. The quantity of fluid added in the shape of the acid solution compensates for the quantity evaporated.

All the following recipes are calculated at a rate of 50 grms of syrup for every bottle of lemonade; the filling-in is performed under pressure.

Lemonades:	A.	B.	C.
Soluble citron essence	64 grms	48 grms	32 grms
- lemon essence	— -	16 -	— -
- orange essence	— -	— -	32 -
Citron acid (crystal.)	64 -	56 -	48 -
Syrup (see page 142)	5 litres	5 litres	5 litres.

These three kinds of lemonade differ entirely in character (taste) as their compositions would indeed lead one to expect. A. is a good strong lemonade, B. is equally strong, whereas C. is a mild beverage for ladies and children, and can be further improved for this purpose by adding a dash of soluble orange-peel essence, say about $^1/_2$ grm to 50 litres of syrup.

The above lemonade can also be made with essential oils and according to the following recipes:

Lemonades:	A.'	B.'	C.'
Citron oil	$10^1/_2$ grms	7 grms	$5^1/_4$ grms
Lemon oil	— -	$3^1/_2$ -	— -
Orange oil . . .	— -	— -	$5^1/_4$ -
Citron acid . . .	64 -	56 -	48 -
Syrup (see page 142)	5 litres	5 litres	5 litres.

The best method of dissolving oils is to put them into a mortar and rub them in with carbonate of magnesia or pulverised pumice-stone and work them up to about the same consistency as cream with the aid of a little syrup; they are then filtered through a finely woven linen bag until perfectly clear, whereupon the acid is added, but not before that.

Other methods of dissolving oils are:

1) In spirit.

2) Pour them on to sugar and let them be absorbed first, then add hot water to the mixture. One drawback to this method is, that most of the aroma volatilizes owing to the heat, and the oil is not completely dissolved but rises to the surface of the syrup, floats upon it and is lost. Simplicity is the sole recommendation of this method.

3) Put the oil with a little syrup into a bottle, dissolve a couple of tea-spoonfuls of soda therein and then add an equal quantity of pulverized citric acid. Stir up well (by shaking the bottle) during the effervescence and pour the whole contents all at once into the syrup. This method is serviceable but hardly reliable, for a citrate of soda is formed, which does not improve the beverage.

By putting a few fresh, half-sliced lemons into the pan in the manufacture of these lemonades, the taste can be considerably improved.

Ginger ale (effervescing).

Soluble ginger essence	64 grms
- essence of Spanish pepper . . .	1 -
citron essence	32 -

Citron acid	48 grms
Syrup (see page 142)	5 litres.

Effervescing Fruit-wine.

Soluble essence of the jargonelle-pear (autumn pear)	3 grms
- - - pine-apple	3 -
Orange colour	4 -
Liquid saffron	3½ -
French tartar	3½ -
Citron acid	56 -
Syrup (page 142)	5 litres.

Kola Lemonade.

Soluble essence of kola	96 grms
- - - raspberry (fruit)	5½ -
Claret colour	11 -
Citron acid	48 -
Syrup (see page 142)	5 litres.

Raspberry.

Soluble raspberry essence	128 grms
Raspberry colour	32 -
French tartar	3½ -
Citron acid	48 -
Syrup (see page 142)	5 litres.

Tangerine Lemonade.

Soluble essence of tangerine	64 grms
Orange-blossom water*)	64 -
Orange colour	10½ -
French tartar	1¾ -
Citron acid	48 -
Syrup (see page 142)	5 litres.

*) or ½ grm of soluble orange-peel essence.

Sarsaparilla.

Decoction of sarsaparilla	128 grms
Sarsaparilla colour	64 -
Fluid carmine	3½ -
French tartar	16 -
Citron acid	80 -
Syrup (see page 142)	5 litres.

Ginger Ale.

Soluble ginger essence	128 grms
- Spanish pepper essence	3½ -
- orange essence	64 -
- tangerine essence	64 -
- citron essence	32 -
- rose essence	1¾ -
- orange-peel essence	1¾ -
Citron acid	48 -
- colour	3½ -
Raspberry colour	1¾ -
Liquid saffron	1¾ -
Syrup (see page 142)	5 litres

If a slightly aromatic spicy taste is required, 10½ grms of soluble essence of all-spice must be added.

In many cases the manufacture is limited to the production of carbonic-acid waters, the ready-made syrups and juices used in making different other beverages being purchased.

Further particulars about the preparation of various fruit-syrups and lemonade-syrups with different fruit aromas will be found on page 192 of this work.

Saccharine starch-syrup, of whose preparation we gave a detailed account on page 123, is employed in the manufacture of lemonades in precisely the same way and with observance of the same directions.

---

b. Use of Saccharine in the manufacture of cordials

with special reference
to the preparation of tonics, essences etc.

In the preceding chapters we have explicitly stated that saccharine is lacking in what is termed in distiller's phraseology, »body«. In strong alcoholic beverages body is indispensably necessary, for alcohol of itself has a very sharp burning taste that affects the nerves of taste in a most unpleasant manner and operates in an irritating way upon the mucous membrane and consequently requires veiling or concealing.

This object is attained by utilising large quantities of sugar, which makes the liqueurs or cordials extremely sweet and semi-fluid, but is productive of many evils, such as crystallising, spoiling etc. and raises the prices of the products immensely besides. However little weight may be attached to price in respect of fine cordials taken merely to promote digestion, yet it is all the more important with regard to inferior beverages which are drunk by the poorer classes, to stimulate and strengthen them. Such drinks they consume on a very extensive scale.

One glance at the long list of advantages in favour of saccharine which we publish on page 90 to 91 of this work, indicates its immense value in the manufacture of cordials and alcoholic drinks generally. The beverages we now speak of are all far sweeter and denser than those discussed in the preceding chapter, consequently syrups of quite a different composition must be employed in this case.

On the whole, the experiments made by us have proved that sugar cannot be dispensed with entirely in the preparation of superior fine cordials and specialities, whereas all other sorts of drinks can be made without cane or beet sugar and moreover of a quality superior to that which they are prepared in at present.

It would seem advisable, therefore, to divide these alcoholic beverages into two large groups, into superior specialities and into drinks consumed on a most extensive scale, and to describe their preparation separately.

In both groups or classes either refined or pure saccharine can be used extensively and is so in fact:

The manufacture of very superior cordials and specialities: In the making of the syrup used in the preparation of beverages belonging to this class, saccharine and sugar could be employed in equal parts, as is the case in the manufacture of lemonades (see Class II), but double the quantities of saccharine and sugar would have to be used in preparing the same quantity of liquid, for the syrup has to be in this case considerably sweeter and more consistent — say then to every litre of syrup $1^1/_5$ grms of refined or 2 grms of pure saccharine with 600 grms of sugar. The syrup is prepared in exactly the same way as that already described; and our experiments made with a syrup compounded according to the method given, showed that products of excellent flavour can be prepared with it, hence we can recommend it warmly. Its utilisation is, however, advisable in the case of less consistent cordials, but only such as are quickly consumed, for experience teaches us that a syrup composed like the one in question easily crystallizes, and consequently beverages made with it, cannot be kept long.

In order to guard against the crystallisation of the sugar and to prepare a syrup perfect in every respect, we would advise the substitution of starch-sugar syrup (capillary syrup, glucose) for one-third of the quantity of sugar employed. On the other hand, since glucose is much less sweet than sugar it is necessary to use correspondingly more saccharine; numerous experiments have shown that for every litre of syrup $1^2/_5$ grms refined or $2^1/_4$ grms pure saccharine, 400 grms of sugar and 200 grms of glucose are requisite to produce an excellent syrup for preparing very superior cordials that not only keeps well but also meets all other demands upon it. We need then for the manufacture of

		5	10	15	20	25	50	100 litres of syrup
Saccharine	refined, in grms	$6^3/_4$	$13^1/_2$	$20^1/_4$	27	$33^3/_4$	$67^1/_2$	135
	pure, - -	$11^1/_4$	$22^1/_2$	$33^3/_4$	45	$56^1/_4$	$112^1/_2$	225
Glucose	in kgms	1	2	3	4	5	10	20
Crystal sugar . . .	- -	2	4	6	8	10	20	40
Water	in litres	3	6	9	12	15	30	60

The weighing-off of grammes in quarters and halves may occasion some difficulty; in manufacturing, however — and these directions are intended for that purpose — it will seldom occur that syrup is prepared in quantities of 5 or 10 litres. We furnish these data merely with a view to facilitate small experimental trials in making which manufacturers do not like to run the risk of any loss of materials. In such cases, the trouble of weighing-off small quantities exactly will not be considered too great.

The preparation of the syrup has to be carried out in the following way: dissolve the sugar and the glucose in boiling water; as soon as it is completely dissolved and a homo-

geneous substance is obtained, add the saccharine, taking care, however, that the syrup is still boiling hot, then stir up well and filter through paper-pulp until the syrup is as bright and clear as crystal. In case of need the syrup must be brought up to the quantity required by adding water prior to filtering.

Recipes.

General directions: Mix syrup, water and colour together, then add spirit, cognac (brandy) etc. and last of all the essences. Let the mixture clarify by leaving it untouched for a few days, or else filter through paper-pulp.

If acids are used, dissolve them in water, add the syrup first and then the colour, put in the spirit and last of all the spicing ingredients. Let the mixture stand untouched to clarify for a few days, or else filter it clear through paper-pulp.

Cherry brandy.

Good brandy	5/8 litre
Spirit 60° P.	1 1/4 -
Water	2 -
Syrup (see page 147)	2 -
Claret colour	3 1/2 grms
Essence of morel	56 -
Essence of cherry brandy	3 1/2 -

Orange Bitters.

Tincture of gentian (fell-wort) root	128 grms
- - sevilla rennet peel	32 -
- - citron peel	32 -
- - calamus peel	32 -
- - coriander seed	16 -
- - cardamon	16 -
Best Jamaica rum	5/8 litre
Spirit 60° P.	5/8 -
Syrup (see page 147)	5/8 -
Water	3 -
Liquid saffron	3 1/2 grms
Orange colour	3 1/2 -
Caramel	7 -

Crême de Citron (Citron cream).

Spirit 90° P.	1 3/5 litre
Syrup (see page 147)	2 -
Water	1 3/5 -
Liquid saffron	1 3/4 grms
Caramel	1 -
Orange-blossom water	128 -
Soluble essence of citron	128 -
Citric acid	1 3/4 -

Crême d'Orange (Orange cream).

Spirit 90° P.	1 3/5 litre
Water	1 1/4 -
Syrup (see page 147)	2 1/2 -
Liquid saffron	5 1/4 grms
Liquid carmine	60 drops
Orange-blossom water	192 grms
Soluble essence of tangerine-orange	96 -

Other fruit aromas can be used in the place of citron or orange and coloured correspondingly, for instance:

Cream of pine-apple with pine-apple,
Cream of cassis with black currant,
Cream of vanilla with vanilla or vanilline,
Cream of peaches with peach,
Cream of mentha with peppermint.

White Curaçao.

Spirit 90° P.	1 3/5 litre
Water	1 1/4 -
Syrup (see page 147)	2 1/5 -
Soluble essence of white curaçao	64 grms
- - - vanilla	5 1/4 -
- - - orange	128 -
- - - all-spice	7 -

The same directions as those for cream of citron, see page 148.

Curaçao de Hollande (Dutch Curaçao).

Spirit 90° P.	1 3/5 litre
Water	1 -
Syrup (see page 147)	2 1/2 -
Caramel	14 grms
Liquid saffron	3 1/2 -
Essence of red curaçao	128 -
Decoction of sarsae comp.	3 1/2 -
Soluble essence of tangerine	7 -

Finest Kummel (cumin).

Spirit 90° P.	2 1/5 litre
Water	2 1/2 -
Syrup	5/8 -
Essence of cumin	9 grms
Soluble essence of carraway seeds	7 -

Mix well in the manner explained, stir up a handful of carbonate of magnesia amongst it and filter off through closely woven linen.

Cherry-water (brandy).

Spirit 90° P.	2 litres
Water	2 1/2 -
Syrup (see page 147)	5/8 -
Essence of cherry-water (brandy)	96 grms

Proceed as above; after filtering add 1 1/2 grms of tartaric acid.

Absinthe.

Essence of absinthe	64 grms
Spirit 90° P.	3 1/2 litre
Water	1 -
Syrup (see page 147)	5/8 -
Hore-hound, green	1 3/4 grms

In the preparation of alcoholic beverages care must be taken not to expose them to the air, for the alcohol loses in strength thereby. The longer they are kept the better they become.

In concluding these recipes, we will say a few words on the **manufacture of favourite tonics and strengthening beverages,** also **on certain restoratives,** which are certainly free from alcohol, but prepared with the same syrup just recommended by us for fine cordials, so in mentioning the manufacture of these beverages in any other chapter we only have to repeat what was then said.

The syrup for them is that described in its composition and mode of preparation on page 147; the use of this syrup is according to the same method too as was given for cordials, except when special directions are specified.

Lemon (or lime) juice (a well known remedy for scurvy).

Juice of unripe bitter lemons	1 2/3 litre
Water	1 3/4 -
Syrup	1 3/4 -
Fluid saffron	1/2 grm

The lemon juice must be run through a felt bag prior to mixture with the syrup. As soon as all ingredients are well mixed, the preparation must be filtered through paper-pulp once more.

The great disposition of lemons and citrons to ferment makes the addition of salicylic acid in small quantities indispensable. It is not possible to use sufficient saccharine to suppress fermentation for it would else make the beverage too sweet. About 8 grms of salicylic acid are put into 25 litres.

Citron Lemonade or Lemon Squash.

Bitter citron juice.	1 1/2 litre
Water	1 2/3 -
Syrup (see page 147)	2 1/3 -

Strain the juice through muslin but do not filter it. When the juice is mixed with soda-water the beverage will have the same dull appearance it has when just prepared with fresh, squeezed lemons.

In respect to keeping, salicylic acid can be used with the same effect as in the case of lemon juice.

Cloves.

Syrup (see page 147)	5 litre
Fluid saffron	17 1/2 grms
Caramel	10 1/2 -
Claret colour	7 -
Citric acid (cryst.)	32 -
Oil of cloves	10 1/2 -

Triturate the oil of cloves with a handful of carbonate of magnesia in a mortar, add some of the syrup (coloured beforehand) until a cream-like consistency is attained, add the contents of the mortar then to the remainder of the syrup and filter through finely woven linen. When quite clear, add the acid; not under any circumstances, however, should this acid be added before the magnesia has been entirely removed by filtration.

Peppermint.

Syrup (see page 147)	5 litres
Peppermint oil	5¼ -

Triturate the peppermint oil thoroughly with a handful of magnesia, add some syrup to it until a cream-like consistency has been attained and then filter through closely woven linen until the preparation becomes quite clear.

The making of cordials for daily use. In the manufacture of these drinks for which there is a great demand, the utilisation of saccharine in combination with starch-sugar syrup has proved extremely advantageous and has stood the test well. Whenever a serviceable saccharine starch syrup that can answer all demands made upon it is not procurable, it can be prepared according to the directions given on pages 124 & 125 and for this purpose either saccharine starch-syrup I or II should be chosen according as the consistency of the beverage in course of preparation has to be. Syrup II is not adapted for an article of trade as it is already diluted with water in preparation, consequently its volume and weight are so considerably increased that the expense for cooperage, transport, freight etc. would be far too high.

By using saccharine starch-syrup I the manufacturer has it in his power to give the cordial the consistency he chooses, for the syrup can be worked up just the same as sugar (1 litre saccharine starch-syrup = 1 kilogrm sugar); but saccharine starch-sugar II is already diluted when obtained and 1 litre of it is equal to 1 litre of sugar-syrup and has a sweetening capacity corresponding to that of 1 kilogrm of sugar.

In the manufacture of cordials and other alcoholic drinks the saccharine starch syrup is worked up in exactly the same way as that described in the preceding section.

The syrup is mixed first with water, and then the colour, spirit, brandy etc. are added in regular succession, and finally the essences, oils and tinctures are put in and the mixture is left to clarify or is filtered through paper-pulp.

In the case of weak, sweet spirituous drinks the saccharine starch-syrup can be added cold, as already mentioned; it is advisable, on the other hand, to add it when warm to dense, sweet cordials, for the parts are then more intimately mixed. In most cases dullness ensues on mixing the spirit with the syrup, or even if sugar or starch-syrup are used alone; it disappears, however, as soon as the water is added — in the case of punch-essences or sweet cordials in the making of which only spirit and syrup are used, the turbidity is removed immediately by adding a small quantity of water.

The beverages in question here are very numerous and are not prepared according to certain recipes as specialities, but differ almost everywhere both in colour and taste and possess

merely the name in common; hence we must give up any idea of communicating particular recipes for all cases. Acting on this we shall confine ourselves to specifying some compositions of spirit, syrup and water for the commonest alcoholic drinks, which are made if necessary into cordials by adding whatever colours and spicing ingredients are considered desirable, to suit the taste of the district or town in which it is intended to offer the beverages for sale.

Compositions of the above kind are termed in the trade brandies and are subdivided again into simple brandies or aqua vitæ and double brandies.

It must further be remarked that the brandies given in the subjoined list are, as to their compositions, those most commonly used and the figures are taken as averages; it is, however, probable that alterations may be necessary in the contents of spirit and water to meet requirements in some districts, according as the taste may be for weak or strong drinks.

Simple Brandies (Aqua vitæ).

100 litres at 30 %.

Spirit 95 % (including oils or essences) . .	32	litres
Saccharine starch-syrup I	3—5	-
Water	65—63	-

Double Brandies.

100 litres at 35 %.

Spirit 95 % (including oils or essences) . .	37	litres
Saccharine starch-syrup I	6—7½	-
Water	57—55½	-

Cordials, plain.

100 litres at 35 %.

Spirit 95 % (including oils or essences) . .	37	litres
Saccharine starch-syrup I	20—22½	-
Water	43—40½	-

Cordials, fine (Cream).

100 litres at 38 %.

Spirit 95 % (including oils or essences) . .	41	litres
Saccharine starch-syrup I	35—40	-
Water	24—19	-

Allasch, Russian.

100 litres at 45 %.

Spirit 95 % (including oils or essences) . .	47½	litres
Saccharine starch-syrup I	36	-
Water	16½	-

Chartreuse.

100 litres at 35 %.

Spirit 95 % (including essence)	36	litres
Brandy.	2	-
Saccharine starch-syrup I	40—42½	-
Water	22—19½	-

Benedictine.

100 litres at 40 %.

Spirit 95 % (including essence)	42½	litres
Saccharine starch-syrup I	37½	-
Water	20	-

Maraschino.

100 litres at 28 %.

Spirit 95 % (including oil or essence)	29	litres
Arack	2	-
Saccharine starch-syrup I	40	-
Water	29	-

The manufacture of ready-made essences. The products of distilleries commonly known in trade under this name are not the essences we mean, for the latter are preparations ready made for immediate use. All that is necessary is to add hot or cold water to them and they are ready for drinking.

It has not been possible as yet to make these beverages with sugar; they are intended for punch and other hot drinks, and the object in view was to keep them as intense as could be in respect to their alcoholic and sugar contents, and sugar in such a concentrated solution would be sure to crystallize.

The same syrup as for fine cordials (page 147) is either used or else a saccharine starch syrup prepared according to the directions on page 124, with the only difference (for the purpose of making it as concentrated and sweet as possible) that 150 grms instead of 100 grms of refined saccharine are reckoned for every 100 litres of syrup, so that the latter corresponds to a syrup containing 1¼ kgrms per liter (saccharine starch-syrup III). The proportionally larger quantity of saccharine is necessary, for the sweetness of the starch-syrup, which is taken into due account in the former case, remains the same in this. If the syrup has to be particularly dense the quantity of water added is reduced by 5 litres and that of the starch syrup raised correspondingly. Both syrups are worked up in the same way as that already described.

Extract of Punch.

Soluble essence of punch	112	grms
Caramel	24	-
Fluid saffron	5½	-
Syrup (see page 147)	5	litres

Filter through paper-pulp until quite clear.

Essence of Punch, common.

(100 litres.)

Spirit 95 %	40	litres
Jamaica rum or 4 litres of arack	3	-
Essence of punch extract	1	-
Saccharine starch-syrup	46	-
Water	10—9	-

Essence of Punch, extra strong.

(100 litres.)

Fine genuine Jamaica rum	40	litres
- - arack	10	-
Spirit 75 % (containing dissolved aromatic and flavouring ingredients: citron, pine-apple, vanilla etc.)	4	-
Saccharine starch-syrup III	43	-
Water with 450 grms citric acid	3	-

Saccharine is further of great value in the **manufacture of wine spirits, cognac** (**brandy**) **etc.,** the first-named being for local consumption and made wherever wine is produced on a large scale. In these products, as in those obtained by the distillation of spirit, rice, sugar and molasses: brandy, whisky, arack, rum etc., sugar is used to improve the taste and can be replaced by saccharine to the great advantage both of the makers and their products. Sugar makes all these preparations more or less viscous and dry, whereas saccharine keeps them thin and fluid and sooner ready for use and sale. It is not certain to what this can be traced back but it is a fact founded on experience that none of these spirits need be kept very long when saccharinized, whereas in all other cases they require to be.

Since the use of saccharine — refined saccharine is most preferable — is so very simple, for all that is required is to put the refined article into the store-cask in the minute quantities needed, all persons interested in the matter can easily convince themselves of its valuable influence by an experiment and without any expense, for samples will be forwarded on application.

c. Use of saccharine as an antiseptic in distilling.

It is well known to all who are practically employed in the manufacture of alcohol, what an uncommonly disturbing effect lactic acid and butyric acid, the products of and the organic acids arising from by-fermentation, have, on the course of the principal stage of fermentation. Considerable loss of product can be traced back to these undesirable by-processes, in particular do both stability and evenness of manufacture suffer through them. It is obvious that distillers have tried all means and ways to suppress and, if possible, to prevent all such unpleasant occurrences. Only by the utilisation of substances antiseptic in character can this object be attained. The latter must, however, possess the capacity of destroying the organisms germinated, else they are not adapted for the purpose, and in addition they must not exercise a disturbing effect of any kind on the yeast-cells.

In course of time various substances have been proposed as suitable antiseptics, in practical use, however, only fluorine combinations and perhaps the salts of sulphurous acid have proved effective. The first named, have in particular found favour and a considerable number of distillers have decided to use the hydrofluoric acid method. The sulphites have, it is true, a perfectly satisfactory effect, but their utilisation is opposed by one great drawback, and that is that all spirit produced by their aid acquires a smell of sulphuretted hydrogen more or less strong and not removable, and consequently the spirit is useless for most purposes.

However good the hydrofluoric acid method may be in many respects, yet it has its faults too, and so the search for better antiseptics had to be continued. In **saccharine** a substance seems to have been found likely to answer all expectations. The communications made by Herr Joh. Ernst Brauer in the »Deutsche Chemiker-Zeitung«, and in connection with them, the articles published on this subject by the well known Technologist on distilling, Professor Vincenz Th. Mayerstein, will justify our entertainment of the highest hopes.

The utilisation of saccharine as a powerfully active antiseptic in the distilling of spirit is quite an innovation, about which we cannot speak from our own experience but can merely communicate the results of experiments made by others.

In his researches Brauer mixed saccharine with yeast-mash and kept the mixture during the acetic fermentation period until cooling took place to a temperature of 33° and even 28°, which temperatures are known to be the most favourable for the development of the injurious bacteria, and thus tested the effect of this antiseptic in the most certain way. Although saccharine dissolves far better in alcohol than in hot water, yet in the case referred to no use could be made of an alcoholic saccharine solution, for alcohol aets injuriously on the yeast-cells.

2 grms of saccharine added to every 100 litres of mash checked lactic acid formation most effectively. The ripe yeast requires without saccharine 3,6 ccm of normal soda lye for its neutralisation, but when mixed with saccharine only 2,6 ccm are necessary. There is in fact a most remarkable suppression of the development of a bacterial fermentation produced by adding saccharine, and it may be accepted as beyond doubt that this new antiseptic substance operates most effectively. The favourable effect was observable too even in the chief mash tested with this yeast, for it also demonstrated considerably less acetification. The increase of acid during the fermentation of this mash amounted only to about one half of the ordinary quantity.

The amount of 2 grms of saccharine added to each hectolitre of yeast-mash — that is, the quantity used by Brauer — is however the largest permissible dose, for a certain decrease in the fermentative process of the yeasts can be observed even with it, which is equivalent to a delay in the operative effect of the yeast. This is, however, no reason for preventing the utilisation of saccharine, for the latter operates far more powerfully on the by-fermentations than on the yeast-cells and the advantage thus attained is of material importance. It must not be overlooked that a decrease in the production of acid is equivalent to a rise in the quantity of alcohol obtained.

So far as can be judged at present a dose of 1 grm of saccharine to every 100 litres of mash would suffice in most cases to attain the object in view.

We, personally, have gained as yet no experience in this direction, as already mentioned, but consider it nevertheless proper to publish the above communications taken from the Deutsche Chemiker-Zeitung, for we attach great weight to Brauer's researches and are prompted by a wish to draw public attention to the subject.

---

d. Use of saccharine in beer-brewing.

It is evident from our arguments on the anti-fermentative and antiseptic qualities of saccharine, and also from the brief outlines in which the fermentation and use of saccharine in distilling spirit have just been spoken of, that saccharine is undoubtedly an **excellent, perfectly harmless conserving substance** in all branches in which fermentation is a main factor; and experience teaches besides that in the leading branches of these trades, for instance in beer-brewing, it is **unsurpassed** and **beyond competition**, for

Saccharine prevents the development of lactic and butyric acids, mildew and other disturbing fermentations, also the growth of putrefactive bacteria, turbidity in the yeast, etc.

Saccharine prevents beers from turning sour and flat when stored or conveyed and hinders turbidity, produced in the warm seasons by micro-organisms.

Saccharine furnishes beer that keeps well in the wood or bottled, that remains perfectly clear, and retains its full taste and froth.

Saccharine preserves the natural pure aroma of malt and hops full and complete when $^1/_2$ grm of it is put to 1 hectolitre of beer.

Saccharine is just as serviceable too in the preparation of wine.

In connection with these introductory remarks we will now enter into details on the use of saccharine in beer-brewing, but we must say at starting that our statements are necessarily of a general character as they do not bear reference to any certain kind of beer. In the last 25 years the term beer has been used to classify numberless beverages made in all parts of the world and differing more or less in appearance, taste, composition and component parts, as well as in make.

Saccharine in all its shapes and forms can be utilized to advantage in the making of beer, the preference being given to the easily soluble, or to pure saccharine, according to the kind of beer and the object in view.

Easily soluble saccharine offers the advantage of dissolving easily under all circumstances, is besides perfectly clear and neutral, owing to which it is very productive and makes tho work simple,

clear and economical; pure saccharine, on the other hand, being less easily dissolved, requires more exact and careful treatment, but has in its favour the advantage of making beer keep better, and renders pasteurising needless; these qualities are of vast importance in the warm seasons, whenever the consumption slackens, on voyages, long routes, etc.

Experience has shown in general that pure saccharine is preferable for sedimentary, and easily soluble saccharine for surface, fermentation.

The superiority of saccharine consists in its combining with simplicity of use the prevention of turbidity, owing to its antiseptic powers, delay in the after-fermentation by reason of its anti-fermentative capacity, and regulation thereof, corresponding to the formation of carbonic acid, and its absorption. It thus remains quite unfermentative. It is not affected in the least by the yeast either, so the taste of the beer is not altered. The result of using saccharine is, therefore, that the beer keeps extraordinarily well and retains its full flavour.

In addition to these advantages of a technical nature, the use of saccharine is combined moreover with a hygienic one to the direct benefit of all beer-drinkers; and thus its importance cannot be overrated.

The use of other conserving substances without any very intense or predominant taste, in beer-brewing, is attended with the danger that when added in too large doses, they have an injurious influence on the health of the consumers without giving the latter a chance to guard against it. The danger we speak of is often imminent, for a brewer wishing to prevent such losses as he may have had, tries a conserving substance in order to proceed securely and overdoes the matter in his anxiety; the stronger the anti-fermentative effect of the conservative used the greater is the danger. It is beyond doubt that the regular drinking of a beverage too strongly preserved, must in time have a deranging effect on the digestive functions.

Saccharine is not only a safe conserving substance answering its purpose to the full, and of recognised mildness, but it possesses besides an intensely sweet taste that is not to be concealed by dilution and which prohibits the use of too large doses. It is utterly impossible to add more than 4 grms to 1 hectolitre, for beers with sedimentary fermentation $^1/_2$ grm per hectolitre is the ordinary dose necessary as a rule.

The Imp. & Royal Supreme Medical Board at Vienna attached special importance to this; the Board in question prohibited the use of salicylic acid in beer and wine in Austria, but pronounced the utilisation of saccharine as allowable, and remarked that the small quantities, which the intense sweetness of this preservative substance, permitted it to be added in, to beer and wine,

were perfectly uninjurious, and consequently it was superfluous to lay down a limit to the allowable quantity to be used.

It is obvious from the superior qualities of saccharine just communicated, that its most important capacity is to be found in the effect it exerts on detrimental fermentative matter, on bacteria, parasitical fungoid growths and so-called false fermentation and in its exercising no influence on the yeast plant, the proper promoters of fermentation. More especially is this the case with pure saccharine; even in the smallest quantities it shows this energetic effect, in which it resembles salicylic acid and is much superior to bi-sulphites of lime. When added in small doses, saccharine furthers the development of the yeast-plant, by working on the other bacteria and ferments that happen to be there, and by hindering the latter from outgrowing the yeast-plant and depriving it of its nutriment, that is to say from checking or neutralising the effect of the latter. By adding large doses of saccharine the effect of the yeast in fermentable fluids is retarded.

Owing to this conserving effect of saccharine, it is possible to make beers prepared with proportionally small doses of it keep much better, to protect bottled beer from depositing for a long time, and to make it stand any change of temperature during conveyance without losing either in brightness or clearness.

The conserving effect of saccharine on beer was first made an object of experiment by Professor Dr. Van Heurck of Antwerp. He reports as follows on it:

»1 litre of barley-beer was treated with 3 grms of saccharine and exposed to the air. The beer has remained quite unchanged and has not undergone further fermentation within the last six months.«

In practice such quantities as 3 % must, of course, not be used, nor is it necessary, for 2 to 3 grms saccharine per hectolitre suffice to make beer keep so well that it remains fresh and delicious to the very last glass from the barrel. The »Gazette du Brasseur« published at Brussels reports as follows upon experiments with small doses, such as will serve for brewing purposes:

»A ton of faro (a kind of beer much liked and consumed in Belgium) that easily turns sour and consequently spoils with extraordinary regularity, was treated with 3 grms of saccharine, exposed to a steady temperature of 20° and tapped. The beer preserved its excellent taste up to the very last glass.«

»Another ton of the same sort of beer brewed in the ordinary way without saccharine and treated in the same way as the one above, was quite sour at the end of the third day.«

Similar results are communicated by an expert, Professor Dr. Alois Schwarz:

»Respecting the conserving effect of saccharine, many experiments have been made already and all have proved that the substance possesses this quality. The most exhaustive researches in this direction have been made at the Imp. and Royal chemical-physiological experimental

station for wine and fruit culture at Klosterneuburg, and based on these it was stated in a very detailed opinion on the subject, that by adding 0,5 grm of saccharine to 1 litre of wine all fermentation, fungoid formations and acetification is completely prevented. To test the conserving effect of saccharine on beer the following experiments were made:

»Two kinds of beer, one of them the common clear lager-beer of 12,6 % and the other a dark Bavarian beer containing 14,5 % of extractive matters were mixed, in smaller and larger quantities with successively larger doses of saccharine in the following way: that to each litre were added separately 2, 4, 6, 8 and 10 ccm of an aqueous and of an alcoholic 1 per cent saccharine solution, so that the beers used in the experiments contained saccharine ranging from 0,002 up 0,01 %. The beer thus treated was bottled and put with other beer of the same kind not so treated with saccharine, but also bottled (patent stoppers) in a tolerably warm room and left standing for 3 months, its clearness, taste and effervescence being tested every now and then. The beer without saccharine and especially the light coloured lager-beer became turbid in 4 weeks and formed a thick deposit; the beers mixed with saccharine and even that with the small amount of 0,002 % only, were at the end of that time perfectly clear and bright, had kept their froth and showed a very slight sediment. By the end of the second month, when the unmixed beer was quite spoiled, that containing saccharine was still bright and quite drinkable; it was the same at the end of the third month, and the more saccharine the beer contained the brighter it appeared, and the less sediment was visible. It was indisputable too that the beer containing alcoholic saccharine solution had a finer appearance than that mixed with an equal quantity of aqueous saccharine solution. As to the taste of the beer mixed with saccharine, the samples containing 0,002 and 0,004 % saccharine had not the least by-taste though the beer tasted rather fuller; that with 0,006 % had a rather bread-like flavour; in the samples containing 0,008 and 0,01 % the taste of saccharine was quite perceptible.«

»It may be deduced from the above experiments that for conserving beer in bottles or barrels a quantity of 0,002 up to 0,004 %, *i. e.* 2 to 4 grms of saccharine per hectolitre of beer is quite sufficient, and further that this substance does not influence the taste of the beer in any injurious way but rather tends to make it fuller. If larger quantities should be used, which the experiments have proved however to be unnecessary, the beer is sure to taste of the conservative.«

The preserving of the taste of beer is a virtue ascribable then ot saccharine just as much as the preservation of the beer itself, is. This is of importance in many respects, for though it is possible to brew a beer answering all demands in regard to taste without any particular admixtures, yet it is not advisable to dispense with the conservative especially in the hot season, when the consumption is slow and in case of protracted conveyance, for the taste of the beer is sure to suffer without it. The law in force since August 1879 in Bavaria provides against such occurrences. It permits the utilisation of productive substances, *i. e.* clarifying and conserving bodies that do not give the beer a bad taste, but it strictly forbids the use of succedaneums. It should be mentioned in particular, therefore, that saccharine does not spoil the taste of beer but gives it a fine, fresh flavour and retaining its effervescent qualities.

Saccharine cannot replace any of the actual component ingredients of beer, and just as little can it turn beer of inferior

quality into a superior beverage or remedy the faults or the bad condition of spoilt beer, even in appearance, nor need we attempt any explanation of the matter as to this point.

Certain directions and especially any relating to the quantity to be added cannot be given in the utilisation of saccharine for brewing purposes, but the following rules can be laid down as a guide:

for beer with sedimentary fermentation use pure saccharine (saccharin. purum 300 times sweeter than sugar),
for beer with surface fermentation use easily soluble saccharine (275 times sweeter than sugar).

The quantity to be added is different according to the season and to the length of time that the beer has to keep. The minimum dose is $^1/_2$ grm and the maximum 3 grms to each hectolitre of beer. Beers for exportation require larger quantities than those to be consumed in a short space of time; the time of the year must be considered too; in the heat of summer saccharine proves a valuable preservative against the souring of beer.

It would seem advisable to devote a few lines now to beer-brewing in the tropics and to point out the immense value saccharine must have for brewers in such quarters of the globe.

Breweries in the torrid zones, particularly in South America, have to combat an evil peculiar to beer there, and called by experts »growing«. It causes great loss, is called forth by the lactic ferment and consists of a slimy or viscous conversion mentioned already on page 134 of this treatise. Its origin is traceable to a rapid development of the lactic ferment that completely chokes the yeast-plant. Viscous fermentation belongs to most dreaded of abnormal fermentations, and wherever it gets a firm hold it is difficult to eradicate. It is advisable, therefore, to oppose its growth by suitable preventatives, and of all such means saccharine combined with the greatest cleanliness, has proved the surest.

Herr E. Feuerstein, a master-brewer well known in the trade and a collaborator of the »Brauer & Hopfen Zeitung« published at Nuremberg, has studied this evil at its source in the breweries of South America, and had to struggle against it himself. He found occasion to test the effect of saccharine in this most obstinate of contingencies and expresses his views as follows:

»Saccharine is an excellent preservative against the so-called growing«, with which beers are attacked in the hot zones and cannot be too warmly recommended to brewers in those parts. Practical experience has taught me that even $1^1/_2$ to 2 grms of pure saccharine suffice for 100 litres of lager-beer to prevent viscous fermentation, par-

ticularly so if the quantity of yeast be increased and not 1/3 but 1/2 litre of good, strong, sound yeast per hectolitre be used. Salicylic acid has been used in such cases as yet, but saccharine not only replaces it as a conserving substance, but must also be preferred for rational and hygienic reasons. And why? Because

1) the conserving effect of saccharine on the lactic acid fermentation of beer is much stronger than that of salicylic acid; with 1 1/2 to 2 1/2 grms of pure saccharine per hectolitre of beer I attained the same as is attainable with 5 to 10 grms of salicylic acid,

2) saccharine is perfectly harmless, whereas salicylic acid is unwholesome when taken for any length of time and is even dangerous if administered in too large doses,

and finally because by using saccharine for bottled beer there is little or no deposit, and thus an evil very common in the tropics, is quite removed.«

Beer with sedimentary fermentation (lager-beer).

Solution of the pure saccharine. It is best to use 90 to 96 % alcohol for this purpose and to add 20 grms of pure saccharine to 1 litre of it and stir up well. To accelerate solution it is advisable to warm the liquid till the whole is dissolved.

Quantity to be added. For 1 litre of sedimentary fermentative beer 1/2 grm of pure saccharine is enough as a rule; hence if according to the preceding direction, 20 grms of pure saccharine be dissolved in 1 litre of 90 to 96 % alcohol:

1/4 ltr of this solution containing					5	grms of sacchar.	is	enough	for	10	hectol. beer
1/2	-	-	-	-	10	-	-	-	-	20	-
1	-	-	-	-	20	-	-	-	-	40	-

The dose can be added in any stage both during the mash and fermenting processes and during the storage; no special method of proceeding need be observed, and the saccharine can be put into either the mash-vat, or the hop-boiler, the ferment vessels, or the storage and the transporting casks.

If saccharine be used to regulate the fermentation — only pure saccharine is concerned here — it is put to the hot wort when the latter is let out of the copper into the cooler; the best way of adding it is to mix the measured-off quantity of saccharine in a pail of boiling wort and distribute it evenly. For each hectrolitre 1 to 2 grms are reckoned.

By this means the effect of the yeast is more uniform, neither too violent nor too weak, the developmenf of organisms and ferments detrimental to fermentation, is checked thereby, also turbidity etc.

If saccharine be used to conserve beer already brewed, it is safest to add it when the latter is in the store-cask after settling, but, if needs be, it can be put in 24 hours before bunging up the casks. By means of a siphon or hose 10 to 12 litres of beer are filled into a can for this purpose, the saccharine

solution is stirred up in it and the mixture is put back into the cask. A quantity of 1/2 to 1 grm per hectolitre is considered enough.

Beer with surface fermentation (brown and sweet beers).

Solution of the easily soluble saccharine. This operation is easily performed, for easily soluble saccharine dissolves perfectly in any liquid (alcohol excepted), no matter whether it be warm or cold. 20 grms of easily soluble saccharine can be conveniently dissolved, for instance, in 1 litre of water, or in wort.

Quantity to be added. There suffices for 1 hectolitre of surface fermenting brown beer, as a rule, the addition of from 1 to 2 grms of easily soluble saccharine. Every brewer assisted by practical experience will soon find out the quantity necessary for his brew.

In order to regulate fermentation, 2 to 3 grms suffice, and for conserving the ready made surface fermenting beer 1 to 2 grms of easily soluble saccharine are sufficient for each hectolitre.

The easily soluble saccharine can either be added direct, without dissolving it, to the boiling wort (by this means it is distributed very uniformly), or it is put into the transport casks, the latter method being advisable whenever importance is attached to the utilisation of the surface yeast.

For **Pale beer,** sugar and saccharine are best combined in a mixture in the proportion of 2 kilogrms of sugar and 6 grms of easily soluble saccharine per hectolitre of beer; beer brewed in this way retains its fresh flavour, effervesces splendidly and can be kept from 1 to 1 1/2 years in stock without bursting the bottles.

Wheat-malt beer, so-called Thuringian sweet-beer, is prepared from 1 hectolitre of common beer to which is added 6 grms of easily soluble saccharine, 1/2 kilogrm of sugar and 1/2 litre of fermenting wort. This beer is also distinguished by durability and a refreshing taste, when filled off into bottles.

On application we furnish a measuring-vessel for dividing and measuring off the saccharine solution, at a price of 1s. 6d. (37 1/2 cents). It is made in the shape of a glass cylinder and provided with a spout and a graduated scale (up to 150 ccm) and with an oak casing round it, so that it can be laid down or set up. It floats in liquids, is quite protected from breaking and can be easily read off.

Saccharine can be utilised in a similar way as with beer, in the preparation of all imaginable beer-like, fermenting beverages, both with respect to keeping, taste and economy of preparation. We are not in a position to describe at length all the beverages and the methods of making them. We can, however, inform our readers that saccharine

has proved most effective in the manufacture of beer-like, fermenting beverages etc., in England for making ginger-beer, ginger-ale etc., in Russia for producing kwas which is obtained by fermenting bread and fruits, and in Japan for the manufacture of soya and saggi, beers made from sorghum and rice.

In brewing beers that contain mere traces of alcohol (not above 3 %) and are considered free from alcohol by the custom-house, the utilisation of sugar is a *conditio sine qua non*, for the making of these beverages is dependent on the formation of carbonic acid and of alcohol besides, the latter being produced by the decomposition of sugar. The task set the maker of such beverages is by no means an easy one. As already mentioned in speaking of fermentation in a preceding chapter, there are several varieties of such processes which are injurious to brewed beverages, and in these cases as in others they have to be guarded against; the alcoholic fermentation too, on which so much depends, has to be watched with the greatest care and attention and must be confined to certain limits. The character of these beverages is altered by a too advanced stage of fermentation, resulting in too much alcohol, and in some countries such drinks are not considered free from alcohol and, therefore, duty free, if they contain in any stage more than 3 % of spirit. It is well known besides, that 1 lb. of sugar fermented completely in 5 litres of water is able to produce a solution containing 1 % of spirit. If then the alcoholic fermentation is allowed to proceed too far, it will be sure to lead to difficulties with the custom-house authorities, in countries in which duty on beers is raised according to the spirit in them, and the result will then be, penalties and unpleasantness.

Great care must consequently be directed towards keeping fermentation within a certain stage; at the same time it has to be considered that the longer these beers are kept bottled the more they ferment, till at last, if kept long enough, they may contain as much as 5 % to 7 % spirit. Again, acetous fermentation may set in, and the brewer runs the risk then of being punished for defrauding the Customs, his products may spoil thereby in addition and be returned, and the end of the matter is loss of money and reputation.

If one half only of the quantity of sugar be used and the other half be replaced for sweetening purposes by saccharine, then one half at least of the fermentable material (ingredient) is removed; secondly the antiseptic effect of saccharine retards the first or alcoholic fermentation for a few days. By using saccharine then, the danger of being prosecuted for an excess of alcohol in the beer is avoided; and the brew is preserved from acetous fermentation. The twofold danger just alluded to above is completely obviated by using saccharine,

and brewers are thus relieved. We, personally, have had samples of ginger-beer and hop-bitters that tasted after a twelvemonth just as mild and good in every respect as if they had been made the previous week.

It is well known in the trade that salicylic acid cannot be looked upon as a conserving substance for beverages of this kind, since it communicates a peculiar staleness to beer. Saccharine is a body that 1) lessens expense, 2) reduces the possibility by one half of alcohol being produced in excess, and 3) acts antiseptically on beverages; consequently it not only deserves approbation, but is also sure to get it! The conserving of beverages for any length of time was a thing unknown prior to the invention of saccharine.

The exportation of ginger-beer to the tropics and its consumption there was impeded by the impossibility of making it keep for any length of time. A lack of experience in this direction prevents our warranting it to keep with the aid of saccharine, we feel confident, however, that attempts to export ginger-beer prepared with this substance are sure to prove successful, and in the event of success a large market will be thrown open.

---

e. Utilisation of Saccharine
in the manufacture of wines made from grapes, apples, fruit and berries, and of sparkling wines and champagne.

In consequence of its intense and pure sweetness, saccharine proves the most suitable of all substances that can be used for sweetening the various kinds of wines generally known. Owing to its possessing certain advantages that make it superior to sugar, glycerin, honey etc., it would seem best adapted of all substances for the manufacture of wines from grapes, apples, fruit and berries. Saccharine is, therefore, of great importance for this branch of trade.

Before entering into details on the utilisation of saccharine in the manufacture of wines, we will make a few remarks on the treatment and improving of wines in general.

The question, whether wine should or should not be improved must be answered in the affirmative, for wine is a thing to be enjoyed and must consequently be in an enjoyable condition. The puritanical point of view that only the pure fermented juice of the grape can be called wine, is all very good, but not in any wise, compatible with reality for the growing of the vine and the ripening of the grape are not in the hands of men, but are determined by a higher power. In bad years, *i. e.* those with a cool and wet summer, nature produces a fruit that can at best be utilised in the preparation of vinegar. But this product has occasioned the same expense as the other, in a more prosperous year. It has grown in the very same soil, has extracted the same nutriment from the soil, and required the same laborious and expensive rearing and care, but it is not suited for the same purpose, because the necessary heat was deficient for the ripening of the fruit. To declare a product of this kind unfit for making wine of, would be tantamount to ruining the population of large districts in which the vine is cultivated, and it would lessen the income of the nation in an unheard-of way.

The product of a bad year must, therefore, be improved, and this must be done in such a way, if practicable, that the wine is altered as little as possible or not at all, in its character.

It has been considered the right thing so far to water the wine of bad years, in order to dilute and so reduce the acidity. This practice involves, however, the use of large quantities of sugar in order to give the wine the necessary amount of alcohol.

The producers intend to dilute the acid in the wine, but in doing so they dilute the latter itself, its aroma, its body etc. On the other hand it is well known that the richness and fire taken from wine by dilution is artificially replaced by the alcohol engendered from a greater addition of sugar, and its bouquet is also artificially restored by using essences and fruit-ethers. What is often termed a rational watering (diluting) and sugaring of wines necessitates the complete working-up of the latter, doctoring and adulterating in short. A wine worked-up in such a way can scarcely be called a natural product, for the result of such manipulation is quite an art-product in *optima forma*.

In contradistinction to the practices just described, the same result and even more can be attained by adding a few grammes of saccharine; faulty wines are not only made enjoyable thereby, but in the opinion of judges are improved, and that too without any alteration of the wine in composition and volume, and without influencing the effect.

Nowadays when the prosperity of whole districts cultivating the vine, is often threatened by a series of bad harvests and the trade openly speaks in favour of improving faulty wines, we, impressed as we are with the goodness of the cause, feel all the more inducement to make the benefit to be derived from using saccharine in such cases, more generally known and appreciated. It is an undeniable fact that all attempts made as yet to treat wine with saccharine have had the most favourable results, provided they were carried out properly. Old customers assure us that saccharine is quite indispensable for them, especially in the manufacture of apple (cider) and fruit wines. It has been found that a sour Country-wine can be ennobled surprisingly by saccharinizing it, and it thus acquires the taste of a fine, well-grown table-wine. Wine-growers cultivating vines and favoured by the position and the excellent chemical and physical nature of the soil of their vineyards, have been induced to speak against the use of saccharine, because they believe and are led to do so by the excellence of saccharinized wines, that the latter would compete successfully with genuine highest class varieties of wine and exercise an unfavourable influence on prices.

Others declared saccharine to be a body quite strange to wine and wine-like beverages and should not be added to them. This assertion is wrong chemically, for, as we found occasion to state in another chapter, it is composed of carbon, hydrogen, oxygen, nitrogen and sulphur and, therefore contains

no other elements than those that form human food and are partaken of daily in large quantities.

Besides this, saccharine is, as already mentioned, a weak acid (like carbonic acid), such as is used daily in households and in particular by wine-growers. Wine in itself too, contains a number of acids that are in part formed in the grape, as oxalic acid, malic acid, tartaric acid, glycolic acid, succinic acid and tannic acid, and others that arise in part in fermentation, as acetic acid, propionic and butyric acids, fumaric, stearic, capric, palmitic, œnanthic, caprylic and pelargonic acids etc., also propyl, butyl, capryl and amyl alcohols etc. and the ethyl ethers and alcohols of these acids that make up the bouquet of wine.

It is known further that the ashes of wine contain a great number of mineral acids, such as phosphoric, sulphuric and silicic acids.

If it be considered further that mere traces (atoms) of saccharine suffice to make acid wine enjoyable and delicious, it must be admitted that saccharine is far better adapted than sugar or any other substance to improve it and more suited to preserve it than salicylic acid or any other body.

We annex some statements on the utilisation of saccharine for the purposes in question; with respect to the quantities used these remarks are, of course, of a general character, for in sweetening wine due regard must be paid to the tastes of the consumers, and above all to the condition of the raw material to be worked up, *i. e.* of the fruits and to the constitution of the wine obtained from them. The kinds of fruit too, whether acid or sweet, must be taken into consideration, and on the other hand the weather in which they have ripened, for experience shows that the amount of sugar in the said fruits depends on whether the summer was hot and dry, or cool and wet. For such reasons we find it impossible to answer all inquiries as to recipes; we entertain no doubt, however, that satisfactory results will be attained by accepting the annexed directions as a guide for experiments.

As saccharine can be utilised owing to its intense sweetness, in relatively minute quantities, it does not give wine any »body«. This is an advantage in its favour compared to other sweetening substances, for wine is not improved by causing a viscous sensation on the gums and tongue. Wine should have only the »body« given it by nature.

Another superiority of saccharine is that it does not ferment of itself and prevents the development of yeast and of all other ferments and micro-organisms in wine or impedes them, at least according to the dose, whereas sugar brings about the very contrary. The only means to eradicate yeast completely is the so-called pasteurizing method which, though most effective

in the case of beer and milk and for other conserving purposes, cannot be used for wine because the l tter suffers in aroma or may lose it completely, on heating. There is consequently no prevention of the ability of yeast-cells to develop in fermented wine, and so it often happens that wines to which an excess of sugar has been added, and containing but little acid of their own, ferment again in the hottest season in the very bottles, and the result of this is turbidity and precipitation.

The antiseptic effect of saccharine is of material importance for all southern wines of great sweetness and largely alcoholized, in order to make them keep. Owing to the large amount of spirit in them most kinds of sherry, port and madeira are very strong, a fact which does not favour their consumption. In addition to this it makes them much dearer, for the height of the duty to be paid is dependent thereon.

The utilisation of saccharine simplifies work materially, for the saccharine does this conserving of itself and consequently no manipulation for this purpose is needed. A further great advantage on the side of saccharine is that it does not conceal or prejudice the natural aroma, the bouquet, of wine in the least, but on the contrary maintains and even develops it. The customary time required for the storage of wines is also shortened by using saccharine, and quicker returns of capital are attained thereby. As already mentioned there is no explanation for this fact as yet; that it is a fact and not a mere empty expression of praise, not fulfilling what it promises, can be easily proved to all wine producers by demonstration and practical experiment. All that is necessary for conviction on this point, is to take a bottle of acid, poor young wine, divide its contents, leave the one half in its original condition and to treat the other half with a small-sized dose ($1^1/_2$ to 2 grms per hectolitre of wine) of saccharine. After stirring the saccharinized wine up well, taste the two, and the experimenter will hardly believe that he has one and the same wine before him, and, if he had not done it himself, would scarcely believe that so simple a manipulation can effect such a change. We have repeatedly tried this experiment in the presence of very prejudiced and sceptical men of the trade, and were not a little amused to observe the shade of perplexity that passed over their countenances, at the rapid, simple and amazing change.

We have mentioned already that the quantities of saccharine to be used for each separate case must be determined by experiment, for the constitution of wines is very different, no matter whether made from grapes, apples, pears or berries.

Refined saccharine is used for the above purposes, 1 kilogrm

of it replacing 500 kilogrms of sugar; as a rule, 1 to 2 grms per hectolitre suffice. Although we know that the preference is often given by experts to easily soluble refined saccharine because it dissolves quicker and takes effect at once, yet, except in cases in which a small experiment has to be made to determine the effect of saccharine at once, we would not advise that saccharine be employed in this form. The trouble of dissolving refined saccharine is not great and is amply rewarded by its better perservative power. In addition to this, in using easily soluble refined saccharine the possibility is not excluded that the soda it contains may affect the colour of the wine.

Generally speaking it is best to put saccharine in all wines after fermentation is over, to add it to the young wines in the cask, the most suitable moment being shortly after clarification, about 2 weeks before bottling is commenced. Bottled wine can, however, be also dosed with saccharine.

Saccharine must never be mixed in its natural state with wine but always in the form of a solution. The best way to dissolve it is to put 3 grms of refined saccharine into a litre of the wine to be sweetened, which has been previously warmed. This solution is then added to the wine when still warm, $^1/_3$ to 1 litre of this mixture of wine and saccharine (1 to 3 grms of saccharine) sufficing for 1 hectolitre of wine. 3 grms per hectolitre is the utmost limit of the quantity to be added; in exceptional cases only, should such a quantity be used, and exceeded in none

In order to make a large quantity of saccharine solution that can be kept in a cask or a demijohn and from which the requisite amount can be taken at any moment, proceed as follows: dissolve 20 grms refined saccharine in 1 litre 95% alcohol (warmed beforehand, if possible) and stir up the solution thoroughly, filter it and fill off into a demijohn or cask and use it as may be necessary. Experiments have shown that of this 2% alcoholic solution

200 to 400 ccm sufficed to sweeten acid cider,
300 to 500 - - - - very acid cider,
50 to 100 - - - - less acid wine

and to give 100 litres in each case a mild and agreeable flavour. It was surprising to see how much more agreeable the wine tasted after only $^1/_2$ ccm of the above solution had been added to 1 litre of wine. One litre of this solution = 1 kilogrm refined sugar and, according to our experiments, 0,02 to 0,05 grm of saccharine (in less sour wines 0,01 to 0,015 grm) put to one litre of wine suffice to give the latter a full and agreeable taste.

The great value of saccharine has been fully recognised in the preparation of **fruit and berry wines,** and is considered indispensable for this purpose.

It is sufficiently well known that the disproportion in the composition of the juices of various sorts of fruit, especially in those of berries, is such even in the best of years, that they cannot be brought to ferment of themselves and to furnish a product serviceable in itself. In all of them the proportion of water to that of acid and sugar contained, is such as to call forth fermentation *i. e.* to make a drinkable beverage out of them, both water and sugar have to be added. Part only of the sugar added passes over into fermentation or rather is allowed to do so, for the juice must contain so much undecomposed sugar, no matter whether a table or a dessert wine is made out of that juice, that the product retains the sweetness required when ready for use.

Yeast-cells capable of development will still remain in young wine even after the most careful after-fermentation. The consequence is that these wines after being bottled ripe commence to »cleanse« again — more or less according to the kind of fruit used — occasion turbidity and deposit, and call forth a prickling sensation on the tongue, the surest sign of their not being sufficiently ripe for drinking. These are well known facts and frequently observable in dessert wines.

In such cases saccharine proves uncommonly serviceable, for provided it is used to replace sugar, the must can be started with a correspondingly small amount of sugar and the alcohol formation can be induced by adding yeast. Fermentation is greatly accelerated thereby. If the dose of saccharine is then added to the young wine, the latter is much sooner ripe for bottling and the sweetness is regulated by the quantity of saccharine used for the purpose, Exact proportions cannot be given, but practical makers will soon discover what suits their products best.

We have treated currant-wine with saccharine in the following way: to every litre of fermented clear juice we added $^1/_2$ litre of water in which 0,3 grm of refined saccharine had been dissolved previously; in this way we obtained from 1 litre of juice $1^1/_2$ litre of wine, 100 litres of which contained 20 grms of refined saccharine. We must remark, besides that the currants used for the purpose were extremely sour and bitter too. The wine thus produced had an excellent, pleasant taste, and the peculiar characteristic of saccharine not to conceal the aroma of the fruit was most conspicuous; the aroma of this wine was much purer and finer than that of a wine produced at the same time from juice treated with sugar.

In the preparation of bilberry-wine $^3/_4$ to $^5/_4$ grm of refined saccharine are added to every litre of juice. On an average 1 grm of saccharine is dissolved in 2 litres of hot water, and after cooling, this solution is mixed with 1 litre of bilberry juice, 3 litres of bilberry wine being thus obtained. The water

sweetened with saccharine must not be added to the juice till the latter is fermented and clarified, of course, for bilberry juice does not ferment easily and for that very reason it is advisable to add some sugar to the juice in order to accelerate fermentation.

In manufacturing effervescing wines, as sparkling wines, mosel mousseux, champagne, birch champagne etc. the method is as follows: dissolve in 1 litre of good brandy or vin d'esprit 20 grms refined saccharine, stir up well and filter off; of this solution

1	litre	=	20	grms	ref.	saccharine	=	10	kilogrms	sugar
10	ccm	=	0,2	-	-	-	=	100	grms	-
9	-	=	0,18	-	-	-	=	90	-	-
8	-	=	0,16	-	-	-	=	80	-	-
5	-	=	0,10	-	-	-	=	50	-	-

Reckoning 80 grms of sugar to each bottle ($^8/_{10}$ litre) of sparkling wine, 8 ccm of this solution suffice for sweetening one bottle (8 ccm = $1^1/_2$ tea-spoonful).

Refined saccharine in also applied to sparkling wines for foreign consumption in the following way: 25 grms of saccharine are dissolved in 1 litre of the best brandy heated beforehand in a warm bath and the fluid thus obtained is added warm. Of this solution

1	litre	=	25	grms	refined	saccharine	=	12,5	kilogrms	sugar
10	ccm	=	0,25	-	-	-	=	125	grms	-
9	-	=	0,225	-	-	-	=	112,5	-	-
8	-	=	0,2	-	-	-	=	100	-	-

If a cordial that keeps well has to be made, take only 10 grms saccharine to each litre of brandy or vin d'esprit.

We must not forget to mention that easily soluble saccharine is well adapted for a mixture of fresh fruit and wine.

In conclusion we annex the opinion of Professor Dr. Roesler, Klosterneuburg near Vienna, the well known director of the Imp. & Royal chemical physiological research station for the culture of wine and fruits. He has made numerous experiments on the utilisation of saccharine in the preparation of wine, and reports as follows on their results:

Analysis-book No. 1983.

After concluding the experiments made at the wish of the firm of Fahlberg, List & Co., Saccharine Factory, Salbke-Westerhüsen o. Elbe and with their saccharine, the questions put by the said firm can be answered as follows:

1) There is no law in Austria forbidding the adding of saccharine to wine.

2) If saccharine has been added to wine and a declaration to this effect is made by the producer or seller, no objection can be raised to this from a legal point of view.

3) A natural wine improved with saccharine is not to be termed either an artificial wine or yet a half-wine product but a »natural wine improved with saccharine« in the proper interpretation of the edict of 21st June 1880.

4) In opposition to the legal aspect of the use of salicylic acid, alcohol, glycerin, grape and cane sugar, that on the admissibility of saccharine is as follows:

The utilisation of starch-sugar (grape sugar) in the manufacture of wine or wine-like beverages is forbidden by § 3 of the Austrian law just cited. With regard to salicylic acid and glycerin the Supreme Board of Health has declared itself against their use as admixtures in wine. But in respect to saccharine the same Board has expressed an opinion to the effect that the small quantities of saccharine, which can be added to wines to make them agreeable and enjoyable, may be pronounced harmless according to the observations made and experience gained so far. The opinion on the admissibility of saccharine is the same as that concerning alcohol and cane sugar, *i. e.* that no objection can be raised to these admixtures from a legal point of view provided the declaration is in order.

5) The authorities can from their point of view merely pass an opinion on the admissibility of a saccharine admixture in wine, and such has been done as above stated. Whether saccharine is a suitable substance for use in a rationally managed cellarage with a view to check after-fermentation and to conserve wines (with due regard to transmarine exportation and conveyance), can be determined solely by scientific and practical experiment.

6) The experiments made at the Imp. and Royal research station in Klosterneuburg as to the ability of saccharine to improve or ennoble wine in taste, absolutely and relatively and in comparison with honey, grape sugar, glycerin and cane sugar, showed the following results:

A dose of 0,001 % saccharine improves a poor sour wine perceptibly, one of 0,002 % very considerably and a dose of 0,006 % most remarkably. A dose of even 0,004 % makes wine tolerably sweet.

If, therefore, a mere improvement has to be made in the wine a larger dose than 0,003 % (= 3 grms per hectolitre) is not advisable. Only in the case of very bitter clarets can a larger dose be admixed under certain circumstances, but never one exceeding 0,004 % (= 4 grms per hectolitre). Saccharine is, as is well known, 300 times sweeter than cane sugar, but in these experiments it proved almost 400 times sweeter than honey, grape sugar and glycerin.

7) The following experiments made at the Imp. and Royal experimentalizing station in Klosterneuburg on the anti-fermentative and conserving effect of saccharine showed the following results:

a. Anti-fermentative Effect.

Experiments were first made with saccharine easily soluble in water. 1 kilogrm of damask raisins was extracted with one litre of water, and to each ½ litre of wine 50 ccm of this extract 2 ccm of a fermenting fruit-juice to cause fermentation and finally different quantities of saccharine were added. After fermentation was quite over in the wine not dosed with saccharine, the wines were filtered and the quantities of extract in the filtrations were ascertained. The results were:

Saccharine per litre of wine	Extract in grms per litre
0,00 grm	22,6
0,10 -	22,2
0,30 -	23,7
0,50 -	25,9

The anti-fermentative effect of saccharine easily soluble in water is, as may be seen, very slight up to a quantity of 50 grms per hectolitre. Owing to the intensely sweet taste larger

doses of saccharine can, however, not well be added to wine under any circumstances.

Better results were obtained, on the other hand, by using saccharine disolved in alcohol and hard to dissolve in water.

For this purpose 2,5 grms saccharine were dissolved in 100 ccm of alcohol of 95 vol. % and corresponding quantities of this solution were added to the wine mixed with an extract of damask raisins.

Dose of saccharine to 1 litre of wine	Extract contained in the fermented wine grms in 1 litre	Unfermented sugar grms in 1 litre
0,0 grm	22,6 grms	1,1 grms
0,1 -	23,3 -	1,6 -
0,2 -	24,8 -	2,5 -
0,3 -	42,2 -	20,8 -
0,4 -	54,8 -	32,4 -
0,5 -	62,8 -	40,4 -

Fermentation began on 8th July 1889 and was over in the wine without a dose of saccharine on 18th July. As the sugar contents of this wine before fermentation amounted to 40,5 grms per litre, it is evident, that by adding 20 ccm of the alcoholic solution, corresponding to 0,5 grm saccharine, to 1 litre of wine, fermentation was completely suppressed.

In this case the amount of alcohol added was certainly 1,9 vol. %, which can always retard fermentation. But as the alcohol contents of the wine fermented without a dose of saccharine were 10,7 vol. %, they were raised in the latter to 12,4 vol. %, an amount that cannot suppress fermentation, as indeed is well known.

b. Prevention of mould.

It was observed that saccharine had in these experiments a similar effect on the development of mould as it displayed in those concerning fermentation. Saccharine easily soluble in water and employed up to a quantity of 60 grms per hectolitre did not prevent the formation of mould completely, but merely retarded it in proportion to the quantity of saccharine employed. The formation of mould was not completely suppressed before a dose of 20 ccm of saccharine alcoholic solution (made of saccharine hard to dissolve in water) had been added, containing 0,5 grm of the substance to 1 litre of wine, although the alcoholic contents of this wine, after being treated with saccharine, were only 10,5 vol. % and the extract contents 15,5 grms per litre.

c. Prevention of progressive formation of vinegar.

An attempt was made with a dose of insoluble saccharine in this case, to check the progress of acetous fermentation in wine, a wine containing 2,57 grms of acetic acid per litre being chosen. After 10 days the acetic acid contained in 2 samples of this wine, in one with and in one without saccharine, was determined and the following results were obtained:

Dose of saccharine to 1 litre wine	Acetic acid in grms in 1 litre wine
0,0 grm	23,1 grms
0,1 -	26,2 -
0,2 -	24,6 -
0,4 -	23,0 -
0,6 -	19,4 -

A dose of 60 grms of saccharine per hectolitre consequently exercised but little retarding influence on the formation of acetic acid.

On the other hand, it was proved in the experiments on the prevention of mould, that the wine samples treated with quan-

tities of saccharine dissolved in alcohol up to 0,4 grm became first mouldy and then acid (like vinegar), whereas the wine treated with 20 ccm of an alcoholic solution of saccharine (containing 0,5 grm of the latter) turned neither mouldy nor acid and remained quite clear.

8) In respect to the question asked about the importance and serviceableness of saccharine in the preparing of medicinal wines, artificial sparkling and fruit wines, fruit juices, marmalades, stewed fruit etc. the following remarks may be made:

The properties of a genuine unpressed wine are not to be found in a common wine sweetened with saccharine, just as little as in a sweet wine made from a common wine mixed with cane sugar. On the other hand saccharine can render good service in the case of medicinal wines that have a bitter or dry astringent taste without sugar, and hence for worm-wood wine, wine dosed with quinine, ferric preparations etc.

A dose of saccharine added to wine-like beverages and to fruit juices, marmalades, stewed fruits etc. cannot be objected to, provided the statement is made on the labels.

Saccharine is in particular to be recommended for sweetening such nutriments, beverages and delicacies as are preferred when sweetened, in all diseases in which sugar is considered injurious, *i. e.* in obesity, diabetes, complaints of the stomach etc.

9) The method of utilising saccharine as an admixture for wines is explained in the experiments just referred to. Only the alcoholic solution of the insoluble saccharine can be recommended.

Klosterneuburg, 24th July 1889. The Directors
signed by Prof. Dr. L. Roesler.

The Opinions of some practical men

on the Use of Saccharine in the Manufacture of Beverages.

---

a. Aerated waters, Lemonades, Effervescing Lemonades.

This branch of industry is most largely developed in Great Britain. Saccharine has come into extensive use here, and our agents general, Messrs. Wilson, Salamon & Co., Lim., 165 Victoria Street, London EC, to whose faithful co-operation we owe the subjoined opinions, write to us with respect to the latter:

A few introductory remarks are necessary to express emphatically of what great importance the following letters are in respect to the using of saccharine in the manufacture of mineral waters.

It is unanimously acknowledged that they form the most remarkable testimonial ever given by the trade and do great honour to those whose upright feelings and esteem for this the greatest of modern discoveries, have induced them to express their opinion, not only with the courage of conviction but also with decision and unanimity, in a way calculated to dispel doubt and prejudice.

These testimonials contain, however, a still greater internal value, for they prove that the trade in mineral waters of Great Britain is zealously endeavouring to be at the head of all progress in science and to lend encouragement to those who work for its improvement and prosperity.

These letters together with confidential communications from persons wishing to avoid publicity, justify our claiming for saccharine all that we have done.

Saccharine is on thousands of breakfast tables in this country and sweetens millions of cups of tea and coffee every year. It is used for this purpose because it never occasions acidity and heart-burn and is far more wholesome

in this respect than sugar. The medical faculty has officially pronounced it as perfectly harmless.

Now that it is adopted by the aerated water trade, the future of saccharine is secure in this direction; nevertheless we shall continue as before to send well qualified instructors to those customers who wish to know how to employ saccharine most advantageously, or we shall readily communicate to them by correspondence all the experience we have gained in the matter.

We confidently hope that the satisfactory issue of these testimonials coming, as they do, from manufacturers and consequently perfectly unprejudiced and impartial, will be important enough in the eyes of our readers to induce them to make a trial of saccharine for themselves. In the event of this they will be able to fully subscribe to what is stated in the following letters:

»We, the undersigned manufacturers of mineral waters at Sheffield and in its environs, after a long use of saccharine extending even to three years in some cases, find unqualified pleasure in acknowledging that the qualities of saccharine fully deserve the praise they enjoy. — The quality and taste of beverages sweetened in half with saccharine are quite the same as if they were prepared with sugar alone, with the great difference, however, of a considerable saving in money, time and labour. What has been said about the anti-fermentative and conserving properties of saccharine is just as true too.«

(signed) George Taylor, Trent Street, Attercliffe, Sheffield.
- B. Chapman, Effingham Street, Sheffield.
- Walter Oxley, 18 Earsham Street, Sheffield.
- W. Evans & Sons, Attercliffe, Sheffield.
- Gillot & Son, 23 Earldon Street, Sheffield.
- J. T. Shardlow, Worksop.
- J. J. Clayton, Mosborough.
- Charles Hayne, Rotherham etc.
- J. B. Arthur, Sheffield.

»After a continuous use of saccharine in the manufacture of aerated waters, it affords us, the undersigned members of the mineral-waters association of Northumberland and Durham, the greatest pleasure to express our perfect content with this product. We find it produces a pure, delicious, full beverage equalling in all respects those made entirely with sugar, and further we find your statements as to its conserving effects and the saving to be effected fully confirmed.«

(signed) James Kershaw.
- Douson Brothers.
- Wilson Brothers.
- John Baker.
- Shadrach Wells.

(signed) J. W. Hope.
- G. H. Steel.
- W. Roome.
- Edw. Longstaff.
- Ralph Hull.

»As we belonged to the very first firms that experimentalized with saccharine even in 1889 for the purposes of the mineral waters trade and have been constant users of it ever since, it may interest you to know that we, the undersigned members of the mineral waters asso-

ciation of Portsmouth, feel convinced and are urged by the authority emanating from a mature and experienced judgment to join the manufacturers of Sheffield and Newcastle in recommending this excellent product to the attention of the trade. Like your other friends, we have also found saccharine financially more economical, easier to dissolve and manipulate and less subject to fermentation than sugar, whilst producing at the same time an equally sweet full-bodied beverage, which is pure on the tongue, bright and clear as crystal.«

(signed) Oldfield Brothers.
- Webb & Salmon.
- Portsmouth Mineral Water Co.
- W. Passingham.

(signed) Dance & Smith.
- A. Wyatt.
- South Hants Mineral Water Co.
- A. M. Chignell.

From Mr. R. Foote, Liverpool.

»I have been using your saccharine for more than 18 months in the manufacture of mineral waters with the greatest success and testify to this effect by reason of the excellent beverages prepared with saccharine.«

From Messrs. H. H. Martindale & Co., Lim., Liverpool.

»We belonged to the first mineral waters manufacturers that made an experiment with saccharine, and our manager, M. J. Earl, a thoroughly practical man, praises it very much. He declares that a saving of 28% acid is made, that the utilisation of saccharine is more economical, requires less labour, prevents fermentation, gives the article more brilliancy than sugar and is purer in taste. The latter property is a warm recommendation for those who may still hesitate to try saccharine.«

From Mr. Edward Forrest, Liverpool.

»I have used saccharine for about a year now and find its utilisation comprises a vast saving in expense, time and labour, also a great improvement in the aroma, brilliancy and durability of aerated waters.«

From Mr. Walter Bramley, Liverpool.

»I have now been using saccharine for a considerable time and for all sorts of aerated beverages, and it affords me pleasure to be able to assure you that I fully concur with your statements on the favourable properties of saccharine. Saccharine produces a purer and more agreeable beverage than sugar does and presents a considerable saving in money, acid, time and labour.«

From Messrs. Hills, Chapman & Co., Old Kent Road.

»From practical experience extending over the last two years, we willingly assure you that saccharine used with sugar in the proportion recommended by you answers its purpose capitally. We use it for all syrups and brewed beers and have never had the least trouble with it.«

From The Richmond Bottling Co. (Dines & Williamson), Ltd., Richmond SW.

»We have used saccharine with great success for 2 years now. We have found it to prove a saving in all respects. We are perfectly

satisfied with the results attained, and if it were possible to say that one beverage really profited more by the using of saccharine than another, we should say ginger-beer both in the wood and in stone bottles. This is undoubtedly owing to the superior conserving properties of saccharine, which has made us give up the use of salicylic acid entirely.«

From the Bristol & South Wales Aerated Water Co., Bristol.

»After having used saccharine since October last for all our aerated waters, it affords us great pleasure to state that it has undoubtedly been of great advantage to us in many respects. First of all speaking financially it has saved part of the expense, reduced the quantity of acid and thereby lowered the price of manufacturing; secondly it saves part of the work and trouble in mixing the syrup owing to such a considerable power being comprised in so small a weight. Further it has proved advantageous by protecting our beverages from fermenting and spoiling which used to be a source of great unpleasantness, whereas since first using saccharine it has never occurred again. We have also found that saccharine improves the quality of our waters considerably, for they have fulness of aroma and body now, are surprisingly clear and not viscous in the mouth We are glad to be in a position to recommend a trial with saccharine to all desirous of making their aerated waters agreeable and popular, and they are certain to be satisfied with having done so.«

From Messrs. Dalgliesh, Williams & Co., Nottingham.

»In our opinion no manufacturer of mineral waters should work without saccharine; its brilliancy and purity are great and more to be esteemed than the undoubted saving obtained both in time and labour combined with a reduction of space neccessary for storing purposes. All beverages, both fermented and aerated ones, have a better aroma and taste purer to the palate than those prepared with sugar; they are actually improved in all respects, whereas our bill for acid is considerably reduced.«

From Messrs. J. Woods & Co., Aldershot.

»We have used your saccharine for a long time and find pleasure in stating that we are satisfied with it in all respects. For fruit-juices, aerated waters and also for patented non-inebriating ales and brewed ginger-beer it answers all our expectations. First of all we save £6 per ton of sugar, besides conveyance, rent of warehouse and labour; secondly all our products are just as good, if not better than those prepared with sugar, and thirdly the anti-fermentative properties and the brilliancy of saccharine are very important. It affords us pleasure to recommend saccharine to other firms.«

From Messrs. Taylor Brothers, Rochdale.

»We are very content with saccharine, our regular orders serving as the best proof of that. It is our opinion that a syrup can be prepared much cheaper with the aid of saccharine than with sugar alone, and besides that there is a saving of ¾ ounce of acid to every 2 gallons which runs up to a considerable amount at the year's end. It saves much time and labour too, for we prepare the syrup in the cold

way (the saccharine being dissolved beforehand in boiling water) in 1/4 hour ready for bottling and it keeps for any length of time. In our opinion a much more aromatic, brighter and purer beverage is produced with saccharine than with sugar alone. We make all our stone, ginger and hoarhound beers and hop bitter beer with saccharine and they are all excellent.«

From Mr. David Nicholl, Dundee.

»As my original order for saccharine does not satisfy my wants, I beg to hand you the order for another hundred-weight of saccharine.«

»I find it fully answers all demands of the mineral-waters trade and could not dispense with it myself in any case.«

From Messrs. W. E. Line & Co., Reading.

»Concerning saccharine. Conformable to truth we can state that we are quite satisfied with it in all respects and think there is no better proof of this than the fact that we have already used a larger quantity of it than expected at the beginning of the season. — We find the beverages keep well and remain perfectly bright and clear. The aroma is more perceptible, the body of the beverages is all that can be desired, and besides that a great saving in time, labour and ready money is effected. Even at the present low price for granulated sugar we save the equivalent of £ 3 per ton in favour of saccharine. We must add that we have been using saccharine now for two seasons without there having been a single case of fermenting or that a single bottle has been returned by the customers. We are glad to be able to inform you besides that our sales are steadily increasing which evidently shows that the public are in favour of saccharinized beverages.«

From Mr. C. Grove, Tiptow.

»I beg to inform you that after trying saccharine most carefully for several months I have come to the conclusion that if used according to your directions a considerable saving can be effected in expense, acid, time and labour. The difference in carriage to this part of the country is a very considerable item. —

That saccharine takes up so much less space in storing than sugar is a point of material importance for manufacturers of mineral waters. With pleasure I can inform you that according to my experience the quality of the articles is kept up in all respects and is fully equal to that of those prepared with sugar alone. You are at liberty to make any use you like of these lines.«

From Mr. L. W. Day, North Tawton, Devon.

»As a manufacturer of aeratad waters of twenty five years standing and as a man not very open to new ideas, I can after using saccharine for the last twelvemonth pass an opinion based on experience as to its merits. The saving in expense amounts to about 20%, whilst the saving in labour is just about the half. I find besides that saccharinized beverages quench thirst much better than those prepared with sugar alone, the satiated taste in the mouth is wanting, whilst aroma and body are excellent.«

From Mr. R. B. Straker, Hull.

»I find that saccharine in aerated waters possesses all the superior qualities you ascribe to it; as my chief articles, however, are botanical and other fermented beers I have most experience in that direction. I can only say that, although the beer I now brew is just as much liked, yet I am not in the least dread about getting into difficulties with the customs of which I always used to be so afraid.«

From Mr. F. C. Batchelor, Alresford & Alton.

»I have been using saccharine for almost two years now. I find that the preparation of the syrup with saccharine occasions less trouble, and that by using saccharine in combination with sugar I can prepare a much cheaper syrup than when using sugar alone for that purpose.«

From Messrs. Lascelles, Tickner & Co., Lim., Guildford.

»We still use saccharine in combination with sugar in the manufacture of aerated waters and have no fault to find with saccharine.«

From Messrs. C. & H. Gilbert, Brentford.

»It affords us pleasure to testify to the value of saccharine in the manufacture of aerated waters. We can confirm the truth of your statements as to the saving effected in all respects, and find the waters decidedly better than those prepared with sugar alone. We can safely say that saccharine satisfies us most completely in all respects.«

From Mr. J. O. Latus, Hull.

»I find saccharine good in all respects and corresponding with your statements.«

From Mr. James Lingard, Manchester.

»My experience of the use of saccharine during the past summer, as an antisepticum alone and without regard to advantages in a pecuniary respect, is sufficient to make me decide on continuing to use it. It has answered all my expectations. Please to forward the remainder of my order at the terms agreed on.«

From Messrs. R. Boardman & Co., Ashton-under-Lyne.

»After having used saccharine for more than two years now, it affords us pleasure to testify to the most satisfactory results we have attained with it. We fully coincide with your statements in respect to saccharine. It produces pure, sweet, full-bodied beverages less inclined to ferment than those prepared with sugar.

We should not like to return to the old method of boiling syrup under any circumstances.«

From Messrs. Furber & Co., Herne-Bay.

»Having used saccharine for the last two years we are glad to inform you that we are very much pleased with it. We find that we effect a saving of 25% in expense and acid, and also much in time, trouble and labour, that our beverages keep much better than when prepared with sugar and that their quality is far better now. It produces a pure beverage, the aroma of the essences is more perceptible, and in body it equals the syrups prepared with sugar.«

From Mr. A. F. Venables, Torquay.

»I consider saccharine a very useful substance in the manufacture of aerated waters; time, expense, labour and carriage are saved. It is very easy to work with it, and the character of the beverages is fully maintained. I shall certainly continue using it.«

From Mr. W. Spendiff, Dartford.

»I have been using saccharine for the last two years and would miss it with regret, for I find a great saving in expense, acid, labour and time can be effected with it, all of which are important points in a lively season. The quality of the beverages sweetened half with sugar and half with saccharine is much better than that of those prepared with sugar alone. In the case of brewed beers I have made the experience that it requires more time to get them to ferment, but after a careful brewing they taste and keep much better than if prepared with sugar alone.«

From Mr. George Hill, Wombwell near Barnsley.

»I have found saccharine to be superior to sugar in many respects. First of all there is a great saving in acid (greater cleanliness in using) and the work is cleaner. In addition I find that my articles keep now as long as can be desired, whereas before using saccharine I had great difficulty in making them keep.«

From Mr. W. H. Merrich, Smethwick.

»I have been using your saccharine for a considerable time in the manufacture of aerated waters and turned out goods of best quality with it.«

---

b. Beers.

In Germany and other states manufacturers are rather more narrow-minded and constrained in their own interests and are consequently more reserved with their opinions and testimonials. We certainly have received numbers of the latter, but all contain either the request not to mention names in publishing them or else they are given only under the condition of non-publication. Opinions published without the name of the persons they come from are worthless, so we are obliged to relinquish our intention to publish them; a few, however, peculiarly characteristic ones we cannot help annexing.

A brewer wrote to us:

»The effect of your saccharine was perfectly astounding. At a temperature of 12° R. in the cellar I obtained from young fresh casked beer in 10 days a perfectly bright, delicious and well effervescing article.«

E. K . . g.

»The beers brewed with the help of saccharine, last year, have kept extraordinarily well and had a splendid taste. In the beginning of November a cask of lagerbeer brewed in March was tapped; although it was not stronger than the others it kept extraordinarily well, had a fine, mild taste and might have been left till much older.«

F . . . . . K . . n.

»I use for surface fermentation beer, 1 grm per hectolitre and have had no mishaps as yet, which is very significant considering the summer is so warm.«

G. W. H. N . . . . .

»I, an old practical man, am extremely content with the results of using saccharine. The beers taste purer and fuller in body if 1 grm per hectolitre be used. The fermentations take place much more regularly too.«

A. W . . . . . .

»I have attained astonishing results with the saccharine made by your firm. Remindful of your offer, I bought from a druggist's here the quantity directed and was perfectly content with the very first trial. After that I bought saccharine direct from you and have brewed it in all my lagerbeer and even in that of March, which though not stronger brewed than the others was not tapped before the end of October, a thing I had not ventured to do without using saccharine. I now enter my cellar with a certain feeling of composure, for I am convinced that the beers stored there are sure to turn out well. They are drunk and relished too, for the fire in them combined with a fine, agreeable, full and brisk taste excite a desire for more. My guests assure me that the beer has never been so good in any year previously.«

N . . . . . P . . . . .

»After satisfactory preliminary trials your saccharine has been found to produce the best results in my mead-brewery.«

P . . . J . . . . .

»Last summer I made a trial with your saccharine on Berlin pale beer in order to see whether the substance made it keep; I left 5 bottles standing for 9 months and the result was quite astonishing. The beer was golden pale, the yeast was firm, the beer contained much carbonic acid and the taste was excellent «

H. K . . . . . ,

---

c. Wines.

»The use of saccharine has proved quite a success, the wines being brilliantly clear and of an excellent pure taste. I have added 1, 1½ and at the most 2 grms of pure saccharine to each hectolitre and have found the effect very excellent. The wines are decidedly much better and more durable.«

A. A . . . . . .

A large producer of wines wrote us:

»Wine whether good or bad must be used somehow, and as nature has made it. This year the grapes did not ripen and, with the exception

of a few cases (good position of the vineyards) are not serviceable for making a wine worth the drinking. The utilization of the harvest is a matter of vital importance for us and consequently we are compelled to sweeten the juice. Candy is too dear for inferior kinds. Even the simplicity and cleanliness connected with saccharine and the fact that it can be added in the cold, make it preferable to sugar.«

Another says:

»The saccharinizing of wines will put an end to adulteration and the diluting of them, and this ensures you the support of the authorities.«

»Several trials made within the last 2 years have furnished the most favourable results, so that I can warmly recommend the use of saccharine to anybody wishing to make a dry fermented wine rather milder, particularly so as it does not cause further fermentation but acts on the contrary as a preservative.«

A. H. D . . . . .

»Conformable with the truth I beg to inform you that the use of saccharine has turned out far beyond my expectations. I have also used it to great advantage with berry-wines and feel fully convinced that it can be employed with best success.« H. R . . . . .

»The result of using saccharine with currant-wines was very satisfactory etc.« C . . . J . . . .

»I find saccharine better than sugar not only in the preparation of wines but also of champagne, for the latter keeps better and longer and has an excellent taste. I would request you, however, not to publish this, as there are still people that have a prejudice against saccharine and who would deprive me of their custom if they were aware that I use saccharine.« A. H . . . . . .

---

d. Diverse.

»My cordials prepared with your saccharine are of most excellent quality and are readily bought.« A. H . . .

»Since using your articles my lemonades surpass in quality those made with sugar most considerably. I have to thank you for making the work easier and for being preserved from loss.«

R. L . . . . . .

»Competent judges were not able to distinguish the speciality made by me — brandy prepared with saccharine — from the best French brands and were full of its praise.« H. R . . . . .

»I have good reason to be content with the use of saccharine in my cordials. Your directions are followed without any difficulty and with best results.« A. M . . .

»The experiments made with saccharine in my manufactory of essences are very satisfactory.« V. H . . . . . .

»To my great joy I can inform you that with the aid of your saccharine I have at last been able to manufacture an extremely good and durable lemonade, and since using saccharine my customers assure me that they are served to their perfect satisfaction. As I use half sugar and half saccharine the lemonade keeps for a long time, whereas, when I still used sugar alone, there was a standing complaint that the lemonade turned thick in a few days and was not fit for use any more. I am quite content with the preparation of the lemonade syrup according to your directions. You may count on me as your regular customer etc.«

M. W . . .
Manufacturer of mineral waters, lemonades and cordials.

---

4. Use of Saccharine

in the manufacture of fruit conserves and fruit syrups (lemonade syrups), also in the preparation of stewed fruit, fruit-mashes and fruit-juices.

At the »Great International Contest« held at Brussels in 1888, we shewed in our exhibition, in which we endeavoured to illustrate the Uses of saccharine in the various branches of industry by articles prepared with that substance, a large collection of different fruit conserves, and some fruit-juices the beautiful appearance of which excited the admiration of numerous visitors. At the close of the Exhibition and after having stood under glass in the heat all the summer, the fruits had not only preserved their good and fresh appearance but had retained, as the Jury convinced themselves by actual tasting, an excellent flavour that made the natural aroma of the fruit remarkably perceptible.

Some manufactories of conserves did not expose their goods in the same condition as they sell them, *i. e.* prepared in sugar, for the latter would have fermented, acidified or crystallised; the firms in question had recourse to alcohol and prepared the fruit in spirit, rum or maraschino. The fruit thus conserved was not eatable nor did it even answer the purpose of pleasing the eye of the spectator; towards the end of the Exhibition it was almost colourless and had lost all shape by shrinkage, whereas the saccharinized fruits, even those in the glasses opened for the Jury, remained physically quite unchanged.

A fact like this, more eloquent than words, was acknowledged by the Jury by conferring the highest distinction upon us, the diploma of honour. These fruits have been exposed at various exhibitions since then, they have been conveyed all the way to Tunis, were sent to the exhibitions held at Berlin, Cologne, Vienna etc. and what is left of them — the greater part was consumed by the juries at the different places and lost by breakage in conveyance — will be exposed at Chicago and all persons interested in the matter can convince themselves on

the spot that they have retained the same beautiful fresh appearance as when they were taken direct from the boiler a few hours before.

Such success as this combined with the very satisfactory results of many manufactories of conserves, whose managers have used saccharine to best advantage, justify our recommending this substance for conserving fruit and in making fruit-juices, stewed fruit and fruit-mashes. Our readers will find on the following pages some details, the results of practical experiments, on the methods of using saccharine for the above purposes.

As saccharine is used in very small quantities owing to its uncommon intensity, and as it cannot confer body on juices, it is necessary to mix or work it up with a thickish fluid, and starch-syrup (fruit or potato syrup) is peculiarly well adapted for that purpose and is already used in the manufacture of preserves.

A saccharine starch-syrup is prepared in the way described on page 124 and kept ready for immediate use, the quantity required in each case being dissolved in hot water beforehand. If manufacturers wish to work according to their old directions, particular attention should be bestowed on the making of a syrup that corresponds approximately in its sweetening capacity to the sugar solutions which experience has shown to be the best. In practice sugar-boiling is still carried out in various ways; the proper method is undoubtedly that of preparing the sugar-syrups in such a way that a certain volume of the latter must contain when cold a certain weight of sugar.

The rational way of doing this is to reckon $^1/_2$ litre of water to each kilogramme of sugar, boil them and then add to the syrup so much water that 100 kilogrms of the sugar used correspond to 100 litres of syrup after cooling, in other words, that 1 litre contains 1 kilogrm of sugar.

Sugar and saccharine starch-syrups prepared in this way facilitate work uncommonly, for no further calculations are required.

A saccharine starch-syrup prepared according to our directions is fully equal to 1 litre of sugar-syrup containing 1 kilogrm of sugar and can be used in exactly the same way.

The advantages for the manufacture of preserves to be obtained by the use of saccharine syrup are above all to be found in the fact that makers are always in a position to keep on stock a serviceable syrup unchangeable in condition and highly concentrated. The danger of its crystallising, as thick sugar solutions do, is quite excluded, the sweetening capacity of saccharine starch-syrup is consequently unchanged, but in the case of crystallised sugar solutions there is always room for doubt in this regard. Sugar crystallises and eliminates by-products

in course thereof, at times, but if this syrup is used, there is no danger to be feared in such a direction.

Another advantage equally worthy of notice is the considerable saving to be effected in using saccharine.

The economy is due in part to the difference in price between saccharine syrup and sugar syrup and in part to the fact that the sweetness of the former remains constant and is not changed by boiling, whereas that of the latter is changed by boiling, as is well known, partly into inverted sugar, and loses in sweetness thereby.

In addition to this, saccharine syrup is characterised by its extraordinary durability; it does not ferment or acidify.

A fault peculiar to the refined sugar used in the trade is the amount of ultramarine it contains; in saccharine syrup this is quite absent. Ultramarine is not without effect and shows an injurious tendency in all products containing acids, but particularly so in fruit syrups by the development of sulphuretted hydrogen.

In using saccharine syrup the method is the same as that for conserving fruits with refined sugar, but without the boiling and skimming of the syrup; consequently it is simpler and more economical.

The fruit is cleaned and peeled, etc., in the usual way.

Fleshy fruit such as pears, cherries, apples, apricots, greengages etc. are first boiled soft in water and put into the syrup which is mixed with water to the extent of $^1/_4$ or $^1/_3$ of its volume and warmed; the whole is then boiled gradually and thoroughly. Berry fruit such as currants, raspberries, strawberries etc. may be boiled direct in the diluted syrup. The fruit is then filled into clean glasses and boiled in a steam- or water-bath in the ordinary way.

In the case of less aromatic fruits such as yellow (whitish) cherries, certain sorts of pears, currants, apples etc. it is advisable to add to the syrup small quantities of crystallised citric acid or some kind of fruit ether, essences or bergamot oil (essence) etc., especially if the potato syrup used is not quite pure in taste.

All fruit conserved with saccharine syrup remains unchanged, retains for years its beautiful fresh appearance, and its natural aroma and colour.

In making stewed fruit as a compote to be kept for use in winter it is advisable in many cases to use the saccharine without syrup for dietetic reasons. Use for this purpose the refined easily soluble saccharine introduced by us recently — it is 450 times sweeter than sugar — or take the easily soluble substance, 275 times sweeter, adding the corresponding quantity (in the place of sugar) in the proportion of 2,25 or 3,7 to 1000, *i. e.* $2^1/_4$ grms of the refined or $3^2/_3$ grms of the easily soluble saccharine for 1 kilogrm of best, refined sugar. Easily soluble saccha-

rine is dissolved in water, which is poured over the fruit filled into bottles preparatory to being boiled in a water-bath in the well-known way. Compote prepared in this way keeps well and does not acidify.

Easily soluble saccharine may be recommended in particular for making plum-jam and other sorts of fruit-jams. 3 to 5 grms are added to every 50 grms of fresh fruit after being dissolved first in hot water and not before the jam is almost ready; the mixture is then stirred up well until the water that the saccharine was dissolved in, is evaporated. Much depends on the stirring-up for the saccharine must be mixed up thoroughly to make the jam uniformly sweet.

Saccharine syrup is very good too in preparing fruit-syrups; the syrups made with it excel in purity of taste and in yield.

The method is exactly the same as that commonly used for making sugar-syrups. In all cases in which the utilisation of glucose offers no economy in price, owing to circumstances, saccharine and sugar can be made up into a saccharine sugar-syrup such as is described on page 125. Saccharine sugar-syrup has proved most advantageous too for preserving fruits and is used in the same way as common sugar-syrup.

Saccharine in its easily soluble condition may be recommended whenever certain preserves have to be prepared according to dietetic prescriptions for the use of diabetic patients and others who are forbidden to take sugar. We have appended for such cases some recipes from a work styled: »Saccharine in households and for patients. A study with 100 cooking, baking and conserving recipes« by Lina Morgenstern.

Apple compote. Medium sized (Borstorf) apples are cut in halves, the core removed with a knife, the slices rubbed over with lemon juice and then placed in water for 5 minutes. In the meantime refined easily soluble or easily soluble saccharine is mixed with boiling water already removed from the open fire, and when the latter is sweet enough but still boiling the apple slices are put into it. As soon as they are soft enough take them out and pour the juice over them.

Apple compote in the shape of jelly. Take some water, spice it with orange-peel, put some good finely chopped apples into it and let them boil down to a jelly, add a little finely cut lomon-peel and give it a taste of rum, then boil the whole for a while until the apple slices are almost transparent, remove the whole from the fire, sweeten to suit the taste with an aqueous saccharine solution, which must be stirred in well, pour the compote into a dish and smoothen it.

Cranberry compote. The berries are boiled without sugar and sweetened to suit the taste with saccharine instead of the

former, the saccharine being dissolved beforehand in warm water. The juice of the berries is then added to the solution, the preserved berries are put in and shaken up, till the juice is absorbed.

Both cranberries and all other fruits can be stewed to a conserve with saccharine, the durability being augmented by the anti-fermentative qualities of the latter.

Quince compote (highly recommended for diabetic patients). The quinces are finely peeled, the core removed and boiled down with the fruit; the latter is then taken out, the juice is passed through a sieve, sweetened with easily soluble saccharine and poured over the fruit. Quinces preserved with saccharine can be recommended also.

Hawthorn-berry compote (for urinal complaints) is prepared from the dried berries which must be washed well, soaked in cold water for 12 hours and then boiled quite soft. They are then removed from the fire and sweetened with easily soluble saccharine. Fresh berries can be stewed or boiled in their juice with saccharine instead of sugar; the seeds and hairs must be removed beforehand, of course.

Currant compote is very suitable for diabetic patients. Water is boiled first, and the currants put into then and boiled for 10 minutes over a low fire. As much saccharine as is necessary to sweeten the juice is then added.

Apricot or peach compote. The fruit is first peeled and stoned and then put into boiling water, some of the cleaned stones being added. They are allowed to boil till soft but not to disintegration. Sweeten to suit the taste with saccharine.

Rhubarb compote. The stalks of the edible rhubarb which taste rather like gooseberries and are more digestible than the latter, are peeled, cut into pieces, boiled soft together with saccharine-syrup and spiced with lemon-peel etc. Warm water is added to the saccharine-syrup used.

In conclusion we must mention a new method of conserving invented by the well known manufacturer of preserves, Herr Baumer of Perchtoldsdorf near Vienna, and based on the principle of altering the state of fruit as little as possible by boiling and of keeping it as much as can be in its natural condition. He advises the utilisation of refined and pure saccharine, as the preservative power of this variety is considerably greater than that of easily soluble saccharine. He boils the fruit only so long that the heat may penetrate to the middle of the fruit, then fills it into glasses, pours off the water and adds a solution of saccharine. The glasses are immediately closed, the main point being that they must be air-tight. He

has had special glasses made for this purpose, their shape being protected by letters patent. The saccharine solution utilised is made by pouring boiling water over refined or pure saccharine and stirring up the mixture, until the saccharine is completely dissolved. The solution is applied in a hot state. $1^1/_5$ grms of refined or 2 grms of pure saccharine are added to 1 litre of water.

We have tried this method ourselves and find it to be exceedingly good, and that the aim in view is attained.

Prof. Dr. C. Kornauth of Vienna reports in his »Study on Saccharine« as follows on this subject:

The Utilisation of Saccharine in the preserving of Fruit. For technical reasons Herr Baumer of Perchtoldsdorf near Vienna has endeavoured to substitute saccharine for sugar in the preparation of stewed fruits.

Compotes made by him in this way showed by chemical analysis the following figures:

Names of the Preserves	Juice		Fruit		grms of saccharine in the fruit	Sugar contained in the fruit and passed over into the juice
	grms	sugar grms	grms	sugar grms		
Cherries, black . . .	90,6	7,43	26,70	5,17	contained in mere atoms or traces	54,7 %
Cherries	27,5	14,93	50	4,6		76,4 -
Apricots, stoned . .	226,5	4,59	219,5	0,86		84,2 -
Pears.	40,0	0,77	105,0	0,10		88,5 -
Cherries, stoned . .	64,5	3,54	93,5	0,20		94,6 -
Apricots, whole . . .	116,5	4,38	245,5	5,21		45,6 -
Aschites	134,2	6,03	250	13,9		30,2 -
Massards	82,5	4,23	235,5	3,04		58,1 -
Apricots	142,0	5,85	205,5	0,35		94,3 -

Unfortunately the original amount of sugar in the fruits is not known so it must be estimated from the present amount of sugar in the juice, in which at first there was none, but only pure saccharine, and from that contained in the fruit now.

It would appear as if the sugar in the fruits is extracted by an osmotic process and communicated to the surrounding saccharine solution; on the other hand, but very minute traces of saccharine can penetrate the fruits, for saccharine is still less soluble in the acid cellular juice than in pure water.

That far more sugar exudes, as the tables show, from the chopped and stoned fruits than from those left intact, is a matter of course, if we consider the properties peculiar to the cuticles of fruit.

For diabetic patients whose physicians have forbidden them to partake of sweet fruit, fruits conserved in saccharine are a welcome substitute. It cannot be difficult either to remove the greatest part of sugar from fruit by repeatedly treating it in conserving with saccharine solutions, and without making the fruit taste stale either.

It should be remarked finally that the experiments made to utilize saccharine in the manufacture of **„sweet pickles“**, an article much liked and largely consumed in England and America, have shown satisfactory results and confirmed the value of this substance for such products. The method adopted was according to the reports sent us as follows: 5 grms refined or $8^1/_3$ grms pure saccharine are dissolved in 10 litres of vinegar, which is poured into a cask containing 25 litres of sour pickles prepared and spiced as may be customary; the vinegar must cover the pickles completely. The cask is then closed in the ordinary way. In this condition the pickles are ready for sale, have an agreeable flavour and keep well, for the saccharine exercises in this case too its conserving effect. Pickles prepared according to this method and kept long in stock, showed a most decided improvement and were vastly preferable to those prepared with acid or with sugar.

Manufacture of fruit syrups. In the preparation of simple syrup intended for later use in the making of fruit-juices and fruit-syrups, the method of proceeding is the same as that for making lemonade-syrups described on page 142, with the only difference that, as this syrup must be thicker and above all considerably sweeter, other proportions of saccharine and sugar are necessary.

Latest experiments prove that syrup intended for use in fruit-syrups must contain per litre $1^1/_2$ grms of refined or $2^1/_2$ grms pure saccharine + 400 grms sugar. In lemonade-syrups the proportion of saccharine to sugar is 1 : 1, whereas in syrups intended for use in the preparation of fruit-syrups the proportion is 2 : 1. Consequently for every

	5	10	15	20	25	50	100	litr. of syrup are required
of sacchar. refin.	$7^1/_2$	15	$22^1/_2$	30	$37^1/_2$	75	150	grms
of sacchar. pure	$12^1/_2$	25	$37^1/_2$	50	$62^1/_2$	125	250	-
of sugar	2	4	6	8	10	20	40	kilogrms
of water, about	4	8	12	16	20	40	80	litres.

The sugar is dissolved according to one of the methods given on page 128 and the sugar is put in and stirred up, or else — since double the quantity of saccharine has to be used — the saccharine is dissolved in boiling water, removed beforehand from the fire, the sugar is put in and stirred up, and finally the citric acid, or any other acid used in preference, is added, while the mixture is still hot.

If the quantity of water prescribed be not sufficient, so much more boiling water must be added as is requisite to make up the quantity of syrup that is wanted (see page 128_3).

We must warn the preparers of these syrups against adding the acids before the saccharine and sugar are completely dis-

solved and also from boiling the saccharine with the water, as partial decomposition then sets in.

Recipes.

In making fruit syrups according to the following recipes the methods prescribed for lemonades must be strictly adhered to. Products excelling both in taste and durability, will then be obtained.

Orange Syrup.

Orange essence	80	grms
Orange colour	3	-
Citric acid	64	-
Syrup (see page 142)	5	litres

Blackberry Syrup.

Blackberry essence	128	grms
Claret colour	3½	-
Citric acid	64	-
Syrup (see page 142)	5	litres

Citron Syrup.

Essence of lemon	64	grms
Liquid saffron	6	drops
Citric acid	64	grms
Syrup (see page 142)	5	litres

Raspberry Syrup.

Essence of raspberry (fresh fruit concentrated)	96	grms
Raspberry colour	7	-
Citric acid	48	-
Syrup (see page 142)	5	litres

Cherry Syrup.

Essence of winter cherries (alkegenyi)	80	grms
Claret colour	3½	-
Liquid carmine	3½	-
Spirit colour	1¾	-
Citric acid	48	-
Syrup (see page 142)	5	litres

Red Currant Syrup.

Essence of red currants	64	grms
Raspberry colour	1¾	-
Liquid saffron	12	drops
Citric acid	64	grms
Syrup (see page 142)	5	litres

Black Currant Syrup.

Essence of black currants	96	grms
Raspberry colour	3½	-
Claret colour	7	-
Caramel	1¾	-
Citric acid	64	-
Syrup (see page 142)	5	litres

Vanilla Syrup.

Vanilla essence	80	grms
Caramel	1	-
Citric acid	64	-
Syrup (see page 142)	5	litres

Ginger Syrup.

Essence of ginger	128	grms
Caramel	7	-
Citric acid	48	-
Syrup (see page 142)	5	litres

Pine-apple Syrup.

Pine-apple essence (fruit)	7	grms
Caramel	1	-
Liquid saffron	1 3/4	-
Citric acid	48	-
Syrup (see page 142)	5	litres

Strawberry Syrup.

Strawberry essence (fruit)	72	grms
Liquid saffron	1 3/4	-
Claret	5 1/4	-
Caramel	5 1/4	-
Citric acid	64	-
Syrup (see page 142)	5	litres

Elderberry Syrup.

Essence of elderberries	88	grms
- - pimento	5 1/4	-
Claret colour	1 3/4	-
Caramel	1 3/4	-
Citric acid	64	-
Syrup (see page 142)	5	litres

All these syrups must be filtered through paper-pulp prior to being filled off into bottles.

In conclusion we append some directions for preparing various **refreshing beverages** most liked in families in very hot weather and frequently manufactured and sold by makers of preserves.

Raspberry-vinegar. Take 5 kilogrms of good fresh raspberries, pour 5 litres of white wine-vinegar over them and let them draw for 48 hours. Filter through a filtering-bag and let the liquid run into a steam-pan, or, if there is none at hand, into a boiler and make it boil. Then add 9 grms refined or 15 grms of pure saccharine, filter again as soon as the latter is completely dissolved in the hot mixture through paper-pulp, and fill off into bottles. Linen paper can also be used for filtering.

Strawberry-vinegar or any other kind of fruit-vinegar can be prepared in just the same way. According to the sweetness or acidity of the fruit used, the quantity of saccharine added must be more or less as the case requires.

Fruit-juices are made according to the well known method. The fruit is mashed in a large basin with a wooden pestle and completely crushed and left standing well covered over for 24 hours; the mash is then passed through a juice-press or a linen cloth, and to each litre of juice thus extracted $1^1/_2$ grms of refined or $2^1/_2$ grms of pure saccharine are added, and thoroughly stirred up. As soon as the saccharine is completely dissolved in the juice, the latter is run off into bottles, glasses or pots which are covered over with parchment and placed in the cellar or some other cool place. In 5 to 8 days the juice is quite clear as a rule, and is then filtered through pulp or fine linen and filled into bottles, well cleaned and treated with sulphurous acid. The latter are boiled after that for a quarter of an hour in a water-bath, the corks are sealed (pitched) and bottles stored in the cellar. In this case too the quantity of saccharine added, depends upon the ripeness and condition of the fruit.

5. Utilisation of Saccharine in Baking and making Confectionery.

With respect to the utilisation of saccharine for baking purposes, confectionery etc. we now communicate the experience gained and observations made both by ourselves and also by experts in a series of experiments. We do so with a view of giving persons in the trade certain directions to go by in using this new sweetening agent, but we would add at the same time that much is yet left fore further experiment.

To begin with, it is advisable to utiiize saccharine in baking as a solution and not as a powder, for in the latter state it dissolves with difficulty: the utilisation of saccharine in its pure form is attended with difficulty owing to the minute quantities used; in a solvent state only, can this substance be finely and uniformly distributed.

Particular consideration should be attached to the fact that saccharine has no »body« and that the latter must be made up of other ingredients and moreover of such as have a nutritious value equalling that of sugar, so that the products made with the saccharine are not inferior to those prepared with sugar either in quantity or value as a nutriment.

If, for instance, 3 kilogrms of sugar are used in making a cake, these 3 kilogrms constitute a part of the dough and considerably increase it. If these 3 kilogrms of sugar were replaced by $6^2/_3$ grms of refined easily soluble or 11 grms of easily soluble saccharine (the easily soluble kinds alone can be used, as stated above), the dough would be lighter by 3 kilogrms, the cake would be smaller by the volume of the 3 kilogrms of sugar, but sweeter in proportion, — too sweet therefore. Both weight and volume of the sugar have consequently to be replaced.

The form in which sugar is to be replaced with regard to weight and volume, is a point dependent solely on prices. In the choice of these substitutes for sugar we must be guided by prices asked for them, in each separate country and at different times.

Starch-sugar syrup may be used as a substitute and a saccharine starch-syrup prepared after the directions on page 124; the quantity of flour, the chief ingredient of a batch, cake etc..

may be also increased, provided it is cheaper than sugar, which is usually the case. In the latter case saccharine is added in a solution which must be carefully mixed up with the dough, until the latter is completely and uniformly sweetened.

As solvents, both water and milk may be used, for any quantity of easily soluble saccharine refined or not, dissolves in them; it is advisable, however, not to make or use solutions which are too strong, because the thinner the saccharine solution is, the easier it can be divided and all the more uniformly is the dough sweetened.

In order to prepare aqueous solutions, take pure, boiled or clear distilled water; for milk solutions use good boiled cows-milk, and add 9 grms of easily soluble or 11 grms of refined easily soluble saccharine to each litre of fluid, which must have the ordinary temperature of the air or be warmed a little beforehand. After being stirred up well, a perfectly clear solution is obtained. The proportions are then as follows:

1	litre	water	or	milk	=	5	kilogrms	(=	10	lb.)	sugar
1/2	-	-	-	-	=	2 1/2	-	(=	5	-)	-
1/4	-	-	-	-	=	1 1/4	-	(=	2 1/2	-)	-
1/5	-	-	-	-	=	1	-	(=	2	-)	-
1/10	-	-	-	-	=	1/2	-	(=	1	-)	-

Solutions of any desirable strength can be made in the same way. As soon as required, the solution is added to the dough in exactly the same way as milk without saccharine used to be put in.

The solutions made according to these directions kept remarkably well. Milk without saccharine, for instance, curdled at 16° in 18 hours, with 0,1 % of saccharine not before 24 hrs., with 0,2 % after 47 hrs., with 0,3 % after 70 hrs., and with a quantity of 0,4 % of saccharine not before 120 hours.

Either the one or the other solution is used according as bread is to be made with water or milk.

Setting aside a very considerable saving, saccharine possesses many properties of great advantage in bread-baking etc.

The dough worked up with saccharine rises far better than that mixed with sugar because the latter obstructs the rising of the dough by its weight; for this reason the baked products seem larger in proportion, have a better appearance and the dough is lighter, whereas when made with sugar it is often hard and consequently not baked through and through, and further baking only makes the crust hard, and burns it.

It is not possible to detect any difference in taste between dough prepared with sugar and that worked up with saccharine.

Saccharine dissolved in milk or cream, may be recommended as peculiarly advantageous in making whipped cream, fruit ices, creams etc.

With respect to the utilisation of saccharine for certain baked products we have to remark further:

In baking with yeast it is advisable to work up the dissolved saccharine in the dough when only half ready, to ensure its being mixed up evenly. The fermentation of the dough is not influenced by adding saccharine-salt, furthered if anything, which must be ascribed to the effect of the bicarbonate of soda. The appearance of bread etc. made with saccharine is surprisingly fine; the colour is golden yellow; the crumb is of a whiteness not to be attained with common sugar. These peculiarities are best observable in so-called heavy baked wares, *i. e.* in those containing much butter and spices (raisins, lemon-peel etc.).

The utilisation of saccharine in solution is very advantageous too for muffins and rusks, and is evident on the first toasting. The twice baked products are finely porous and have an excellent colour.

In the manufacture of biscuits consisting chiefly of eggs, great caution must be observed in using a solution of saccharine to sweeten the warm mass or dough. The volume of cane or beet sugar is wanting in this case to give the mass a certain amount of consistency; the yield of the dough is therefore less and the appearance of the biscuits not so good, because the mass collapses on cooling. The use of saccharine starch-syrup, the preparation of which is described on page 124, can be recommended in such cases. It is added to the opened eggs as refined sugar is, stirred up with them into a consistent custard, and then treated as usual.

In the manufacture of different kinds of tarts, gingerbread and tea-confectionery also, saccharine can be employed to great advantage, further in making muffins, cakes etc.

The use of saccharine can be recommended in particular, whenever certain kinds of baked wares have to be made in conformity with prescriptions for diabetic and other patients, who are not allowed to take anything sugared. In such cases we annex in conclusion some recipes taken from a book styled »Saccharine in households and for patients. A study containing 100 cooking, baking and conserving recipes, by Lina Morgenstern«.

Citron Biscuits for diabetic patients. 4 yolks of eggs together with $^1/_{12}$ grm easily soluble saccharine (2 to 3 measure spoonfuls) and the rasped peel of a lemon are whipped to cream for half an hour, the juice of a lemon being added from time to time; the white of the 4 eggs whipped and 4 teaspoonfuls of wheat-flour are then added. The dough is baked thereupon in biscuit-moulds well buttered, or little biscuits are cast in the usual way on to a baking-tray, then

baked and covered with apricot marmalade prepared with saccharine. For the use of healthy people 4 to 6 tablespoonfuls of saccharine-syrup are put in the place of the saccharine.

Carlsbad cakes. 250 grms of butter are stirred up to a cream, 4 yolks of eggs, 4 spoonfuls of stiff cream, 2 tablespoonfuls of saccharine-syrup (or for patients $^1/_{10}$ grm easily soluble saccharine — or 4 measure spoonfuls), 1 tablespoonful of good yeast and 100 grms of flour are then added. The whole is worked up thoroughly, rolled out on a board into paste as thick as your finger, round cakes are cut out, which are left to rise a little and put on a baking board well buttered. 3 whites of eggs are whipped to a stiff cream, which is laid on to the cakes; chopped almonds are then strewn over and the cakes baked.

Poppy-seed rolls. Blue or white poppy-seed is scalded, ground up with boiling milk, sweetened with saccharine syrup or easily soluble saccharine to suit the taste, spiced with rasped peel of a lemon and vanilla, the yolks of some eggs are stirred in, and the stiff cream is mixed with the mass last of all. Little oblong cakes are formed, strewn with chopped almonds and baked.

Almond bread. Take 250 grms of fine-pointed, cut and dried almonds, 1 grm of easily soluble or $^3/_5$ grm refined easily soluble saccharine, 33 grms finely chopped orange peel, 33 grms lemon-peel and the stiff cream of 4 whites of eggs, mix the whole up well, spread the mass in about the thickness of the finger on a buttered baking-board, strew chopped pistachio-nuts over it, bake over a low fire and cut whilst hot into long four-cornered pieces.

Bitter macaroons. Take half bitter and half sweet finely ground almonds, sweeten to suit taste with $^1/_2$ kilogrm saccharine syrup or 2 grms easily soluble or $^5/_4$ grm refined easily soluble saccharine and stir up this mass with the stiff cream of white of eggs (12 of the latter to $^1/_2$ kilogrm of almonds). Little round heaps of this mass are put on a baking-tray or on sliced wafers and baked at a moderate heat. Cocoa, lemon-peel, vanilla or fine spices can be added to the mixture, or hazelnuts, used instead of almonds.

French rolls. Stir up 125 grms of butter to a custard, add 4 yolks and 2 whole eggs, 4 tablespoonfuls of thick yeast, 4 tablespoonfuls of good milk, 1 grm of easily soluble or $^3/_5$ grm of refined easily soluble saccharine, put in a little salt and 125 grms of flour and work up into a loose dough till there are bubbles in it; let it rise, knead it out thick, cut out four-cornered pieces, fill them with hazelnut stuffing and roll them into tubular forms. Rub them over with whipped egg and bake

at moderate heat. The stuffing is made of hazelnuts, an egg. vanilla and saccharine.

Chocolate cream. Put 5 whole eggs and $^1/_7$ grm (5 measure spoonfuls) of easily soluble saccharine into a pot, place the latter in boiling water, stir up the contents continuously with a spoon till they are thick, then let them cool and add $^1/_4$ lb. of cocoa dissolved in a cup of water to the cooled cream. It is then put on saccharine biscuits or used as a filling for tarts.

Blanc-mange. $^2/_3$ litre of cream are mixed with 4 ounces of powdered almonds, $^1/_2$ stick of vanilla and $^5/_6$ grm or 30 measure spoonfuls of easily soluble saccharine, let the whole boil up covered over, remove it from the fire, mix in $^3/_8$ ounce of dissolved gelatin, let the blanc-mange cool, pour it through a cloth into a form washed out with well-water and let the mass stiffen.

Vanilla ice. Boil $^1/_2$ litre cream and $^1/_2$ stick vanilla well covered over, add 4 yolks of eggs and 130 grms saccharine-syrup or $^1/_2$ grm = 18 measure spoonfuls of easily soluble saccharine, beat the whole on a hot plate to a thick cream without letting it boil; when it has cooled, stir it on ice for $^1/_4$ hour, fill it into the ice-box and let it congeal.

All other kinds of fruit-ices can be made in a similar way.

From the Koenigsberg Hartung'sche Zeitung (Gazette) of 22nd October 1887 we extract a report in abridged form on the meeting of the Polytechnic & Trade Association which runs as follows:

> With great interest the members present listened to the accounts of experiments made by Herr Steiner, confectioner, at the suggestion of the Board, and tendered their thanks. Samples of baking products made with saccharine, vanilla cream and cordials sweetened with that substance, were handed round. The yeast-dough cake though containing only $^1/_{250}$ grm saccharine instead of sugar, had fermented easily and was found remarkably nice. In the opinion of the gentleman mentioned, saccharine is peculiarly well adapted for use in many cases, especially for sponge-cake etc.

6. Concluding Remarks on the Utilisation of Saccharine in Industries.

In the preceding chapters we have communicated all our experience, gained in the course of years partly by own experiments, in part through reports from practical men whom we count among our customers. As stated in full in our introductory remarks at the beginning of this section, it is not possible to give everybody suitable and reliable directions for each particular case and for all existent circumstances; nevertheless we believe we have given through our explanatory communications such hints and directions as will serve for the guidance of manufacturers and enable them to discover with ease the best way of using saccharine successfully in each individual case, and to profit by the great advantages involved in its use in all the branches of industry we have mentioned. There are unquestionably still more trades that might reap very definite advantages by using saccharine. Our reason for not including them in the list of branches referred to in this work is because experience is either wanting entirely or has been gained in too small a measure as yet, and because we are guided by the conviction that a new product should be recommended only for purposes in which it has been proved an entire success.

Gratuitous samples for experimental purposes can be had on application by manufacturers at any time. Nevertheless, considering the manifold ways in which saccharine may be employed and the various forms in which it is offered for sale and which are not all suitable for attaining one and the same object, it is **indispensably necessary on applying for samples to state definitely for what purpose they are wanted.**

Furthermore we are ready to help manufacturers with advice and assistance, and do not doubt that we shall be able

to give them many little hints likely to prove of service, and to make experiments in the utilisation of saccharine considerably easier for them. It is, however, imperatively necessary not only to state the purposes it is intended for, but also to give us a detailed account of the method used in each separate case, to describe, in short, the system of working, mixing proportions etc. explicitly, and above all to state in figures the exact proportion of sugar used so far.

Saccharine and Sugar.

In the preface to this work we informed our readers that after passing through a revolution of opinion as to its merits and defects, saccharine had been the object of a violent attack on the part of men interested in the sugar trade and that from time to time it was still exposed to rebuffs in the same quarter. We think it best not to conclude our statements without making some remarks on the position of saccharine with regard to sugar.

Saccharine is in the same position to sugar as many recent inventions and innovations are to well introduced inventions of an earlier date, and to already existing arrangements. Experience teaches that both what is new and what is old can exist at the same time without one being prejudicial to the other, that there is space enough in this wide world for both and all the more so as colonisation is rapidly opening up new fields for civilisation. Each article may be peculiarly suited for a sphere of its own. Only a radically inferior product can be suppressed and ousted by a wholly superior article, and it is sure to meet that fate no matter how hard the struggle may be. The law of the survival of the fiitest holds good here as elsewhere. Some examples can be added in illustration of these assertions.

Railways and conveyances drawn by animals are both flourishing at present; postal communication can bear the rivalry of both telegraphic and telephonic systems; petroleum has not lost its value by the introduction of gas and electric light; hand-made articles are still in demand though the same things are made by machines; sewing by hand has not been superseded by machine-sewing; and speaking of victuals, beverages etc. Are not both butter and margarine in use? chicory and coffee? vaniline and the vanilla-pod of the tropics etc.?

Statistics of imports, exportats and consumption indicate that our wants, the great lever for the progress of our times, and in particular our pretensions to a certain position in human society, are rapidly increasing, and that consumption is growing beyond proportion from year to year — beyond proportion in respect to the increase in population and especially, of civilisation. Coffee and sugar, for instance, are consumed daily in large quantities even by the poorer classes and are no

longer what they were, a privilege of the wealthy. Railways are made use of by everybody nowadays and people who have never been beyond the narrow boundaries of their native place have become a phenomenon worthy of special exhibition! Railroads are continually on the increase, there are more of them from year to year, and yet steam-tramways and electric lines have cropped up beside them, and in spite of all that, the number of horses kept for purposes of conveyance, steadily increases, private carriages and hackney coaches are becoming more numerous from day to day, new tramways and omnibus companies are daily advertised, and the high dividends they pay are the best proof of their being needed, and finally is not self-locomotion on cycles rapidly gaining ground to a totally unexpected extent?

When the first railways were built there was a general outcry against them among breeders of horses, keepers of post-horses, and on the part of all who subsisted on conveyance by means of horses, and everybody spoke of the ruin of this branch of trade and of all connected with it; and when sewing-machines were first introduced they were looked upon as an invention that would put an end to female labour. Although a sewing-machine is to be found in almost every household of the middle classes, the want of female domestics has never been so much felt as at present, and female labour both in industries and farming has gained the upper hand to such an extent that the governments of various states have been compelled to use legislative measures, and to limit the hours of work for females.

In a similar way we could continue citing examples of parallel cases, if it did not take up too much space in this book. Now the cultivation of madder, a dye-plant that used to be grown on a large scale, had to be given up, because aniline colours proved better *in every respect*, and this formed a clear case of the survival of the fittest, and the total annihilation of the *altogether* unfittest.

After this digression let us return to saccharine and sugar. It must be admitted, after what has just been said, that manufacturers of sugar must have a very poor opinion of the value of their product if they believe they have reason to fear its being supplanted by saccharine and their ruin brought about thereby. Practical experience has shown that these apprehensions on the part of sugar manufacturers are quite unfounded; for since the introduction of saccharine as a marketable article the annual production of sugar has not only found ready buyers year for year but it has even increased rapidly, in the year 1887 to 88 alone by 2 millions of centners. Besides this, higher

prices were obtained, and even the very considerable stocks from preceding years were cleared off.

On the other hand, saccharine has made a path for itself and its consumption is steadily on the increase.

The reason why these two products find a willing market and why these two industries manage to prosper side by side and to continue developing, is to be discovered in the fact that the demand for sweet things has risen enormously. The wise men from the East brought our Saviour, as the Bible tells us, incense, myrrh and honey. At those times these articles were the most delicious and precious spices known and worth their weight in gold and precious stones. For a long time after that honey was still one of choicest presents of oriental embassies to mighty monarchs. In our age a sweetening substance, whether in the shape of honey or sugar, is to be found in the humblest household, and nevertheless the demand for sweet things is not satisfied by any means, as we have just stated. The consumption of sugar in this century has risen enormously; at the beginning of the last century it did not amount in all Europe to more than half a million of centners, in 1730 the importation to Europe went up to $1^1/_2$ millions of centners, in 1867 there were consumed on the whole 14 millions of centners, in 1885 the entire consumption exceeded 25 millions of centners, of which 23 millions of centners were beet-sugar, and at present it amounts to more than 30 millions of centners.

In 1870 the consumption of sugar per head of the population in Germany was 5 kilogrammes, in England 20 kilogrammes.

According to the latest statistics (1883) the consumption per head of population was as follows:

Belgium	4 kilogrms	Switzerland	9 kilogrms
Denmark	12 -	United States of North America	25 -
Germany	8,5 -	Brazil	10,5 -
England	32,5 -	Argentine Republic	20,5 -
France	13,5 -	Cuba	21,5 -
Italy	3 -	South Australia	32 -
Holland	13 -	New South Wales	46 -
Norway	6 -	Victoria	44 -
Austro-Hungary	6 -	New Zealand	42 -
Russia	3,5 -	Queensland	40 -
Sweden	8 -		

From these tables it may be seen that with the exception of England, the largest sugar consuming country in Europe, most of this product is consumed in countries with the smallest populations, and further, that even if we accept as a fact the supposition that consumption has reached its utmost limits in the latter, the production of sugar would have to be ten times, nay, even a hundred times larger than it is, if the consumption of

the article in densely populated countries should reach the same level.

It is beyond the bounds of possibility for the sugar industry to supply such demands, for the cultivation both of the beet-root and of the sugar-cane makes great demands upon both soil and climate, and with respect to area there is a limit to the growth of both; it may be taken for granted that as far as Europe is concerned, almost all suitable land is already utilised for the cultivation of the beet-root.

Nor is it proved as yet by any means that our great agriculturist, Albrecht Thaer, called the Father of Agriculture, was wrong in his opinion on the cultivation of the beet conveyed in the words: »rich fathers — poor sons«. The state of affairs has certainly changed materially since then by the almost universal adoption of artificial manuring, but whether in spite of that the physical condition of the soil will not necessitate a restriction in the growing of the beet-root is a question left for the future. Then, it is true, we could exclaim with Albrecht Thaer »poor sons« or grandsons, if we had not saccharine, which enables farmers to give up growing the beet and to cultivate fruits rich in starch-flour, for the latter can be worked up by manufacturers into starch-sugar and therefore the cultivation of them would still be profitable.

At any rate neither manufacturers of sugar nor agriculturists have any reason to regard saccharine as a rival to be driven from the field by any means at their command. The seven years in which it has been a trade article have shown that a way has been paved for it both steadily and successfully, and in this case also the old saying: »the more enemies the more honour«, has proved once more, true.

Literature on Saccharine.

Seldom has so much been written on a new article in a proportionally short space of time as on saccharine. In attempting to compile the publications on this subject, we must confess at once that only the large works and essays of the Press are given in the following list. Articles on saccharine are, however, to be found in all handbooks of medicine, pharmacy and other scientific branches connected with them; furthermore the organs of the Press throughout the world have repeatedly published articles treating on this substance. We have made a collection of excerpts from the latter; at present it fills up no less than 6 quarto volumes.

List of Publications.

C. Fahlberg: American Chemical Journal. Vol. I. p. 170 und Vol. II p. 181. 1879|80.

C. Fahlberg u. J. Remsen: American Chemical Journal. Vol. I. p. 426 und Vol. II. p. 135. 1880|81.

Remsen u. Hall: American Chemical Journal. Vol. II. p. 135. 1880|81.

Fahlberg u. List: Saccharin. Leipzig 1885.

A. Stutzer: Saccharin. Prüfung seines chemisch-physiologischen Verhaltens. Deutsch-amerik. Apothekerzeitung. No. 14. New-York 1885.

Fischer u. Rabow: Therapeutische Monatsberichte. No. 10. p. 395. Berlin 1885.

A. Mosso, J. Aducco u. U. Mosso: Esperienze fisiologiche intorno allazione Vella Sulfinide benzoica. Archivio per le scienze mediche. Vol. IX. No. 22. pag. 415. Torino 1885.

Zeitschrift für die Rübenzuckerindustrie. 1885: p. 1112. 1886: p. 543, 852, 949. 1887: p. 949. 1888: p. 73, 256.

American Chemical Review. Vol. V. No. 4. p. 89. Chicago 1885.

E. Salkowsky: Über das Verhalten des sogen. Saccharin im Organismus. Virchow's Archiv für patholog. Anatomie und Physiologie und für klinische Medizin. Vol. 105. p. 46. Berlin 1886.

V. Aducco u. U. Mosso: Untersuchungen über das physiologische Verhalten des Benzoësäure-Sulfinid. Leipzig 1886.

V. Aducco u. U. Mosso: Über die therapeutische Wirkung des Saccharin. Archives italiennes de Biologie. Tom. VII. Fasc. II. Rome 1886.

E. Leyden: Über Saccharin. Deutsche medizinische Wochenschrift. Berlin 1886.

Denkschriften des Vereins für die Rübenzuckerindustrie des Deutschen Reiches an den Reichskanzler Fürsten von Bismarck vom 15. November 1886, 8. Juni und 20. Dezember 1887, 22. August 1888, 12. Januar 1889.

Sir Henry Roscoe: Royal Institution Lecture. April. London 1886.

A. Mosso: Applicazione terapeutiche della Sulfinide Benzoica. Gazetta della chimiche. Torino 1886.

Beilstein: Organische Chemie. 1. Aufl. p. 631.
Rundschau für Pharmacie. II. Sem. XI. Jahrg. No. 39. 1886.
Pharmaceutische Zentralhalle. No. 51. Jahrg. VI. Dresden 1886.
Chemiker-Zeitung. No. 17. Jahrg. X. Köthen 1886.
Pharmaceutische Post. No. 14. Jahrg. XIX. Wien 1886.
American Analyst. New-York. 1. May und 1. July 1886.
Uhland's Versuchsstationen. No. 5. Leipzig 1886.
British Medical Journal. London. 18. Febr. 1886.
Wettendorfers Spiritus-Industrie. No. 87. Jahrg. IV. Leipzig 1886.
Scientific American. 7. Aug. 1886.
Rundschau für die Interessen der Pharmacie. XII. Jahrgang. Prag 1886.
Tellus, Medizinische Zeitschrift. No. 4. Warschau 1886.
Protokoll des Vereins für innere Medizin. April. Berlin 1886.
Berichte der deutschen Zuckerindustrie. IX. 24. Berlin 1886.
Fahlberg, List & Co.: Saccharin (Benzoësäure Sulfinid). Salbke a|E. 1887.
Fahlberg, List & Co.: Saccharin u. Saccharinpräparate. Salbke a|E. 1887.
H. Van Heurck: Nieuw Tijdschr. voor de Pharmac. in Nederl. XX. p. 328. Amsterdam 1887.
E. Stadelmann: Mitteilungen aus der Heidelberger medizinischen Klinik. Heidelberg 1887.
Kohlschlütter u. Elsasser: Therapeutische Monatshefte. p. 356. Berlin 1887.
Schmiedberg: Grundriss der Arzneimittellehre. p. 187. 2. Aufl. 1887.
F. Lutze: Pharmaceutische Saccharinpräparate. Berlin 1887.
Hager: Pharmaceutische Zentralhalle. XXVIII. No. 29. 1887.
Limbeck: Medizinische Wochenschrift. XII. 23. Prag 1887.
C. Schmidt: Repertor. der analytisch. Chemie. 438. 1887.
M. Abeles: Wiener medizinische Wochenschrift. No. 24. Wien 1887.
Barron Harvey's & Co.: Soluble sweet coated Pills. London 1887.
Pollatscheck: Zeitschrift für Therapie. No. 9. 1887.
B. Fischer: Pharmaceutische Zeitung. p. 71. 1887.
Th. Clemens: Allgemeine medizin. Zentralzeitung. p. 75. 1881.
Liebreich u. Langaard: Kompendium d. Arzneiverordnung. Berlin 1887.
Th. Nevinny: Saccharin. Zeitschrift des allgem. österr. Apotheker-Vereins. No. 31—36. Wien 1887.
Noyes: American Chemical Journal. VIII. p. 176. 1887.
Remsen u. Palmer: American Chemical Journal. VIII. p. 223. 1887.
Fahlberg u. List: Berichte der deutschen chemischen Gesellschaft. XX. p. 1596. Berlin.
Remsen: Berichte der deutsch. chem. Gesellschaft. XX. p. 2274. Berlin.
C. Fahlberg: The new sweet product from Coal-tar. London 1887.
Wilson, Salamon & Co.: Saccharin. 300 times the sweetening power of cane sugar. London 1887.
H. Eckenroth: Pharmaceutische Zeitung. XXXII. No. 84. p. 599. 1887.
Allgemeine Wiener medizinische Zeitung. XXXII. Jahrg. No. 5. Wien 1887.
Wiener medizinische Wochenschrift. No. 24. Wien 1887.
British Medical Journal. London 15. October 1887: p. 296. 1888: 1223.
Medical Press. London 1887 (in verschiedenen Leitartikeln).
Medical Circulair and Press London 1887.
The Provincial Medical Journal. London-Leicester. 1. Nov. 1887.
Therapeutische Monatshefte. Oktober. Berlin 1887.
Deutsches Archiv für klinische Medizin. Band 41 p. 178. 1887.
Journal de Pharmac. et Chimie. p. 216, 1887: p. 292, 515, 1888.
Pharmaceutische Zeitschrift für Russland. No. 26. Riga 1887.
Chemisches Zentralblatt. p. 568. 1887.
J. Worms: Journal des Fabricants de sucre. Paris, 18 Avril 1888.
J. Worms: Bulletins de l'Acad. de Médecine. p. 139 u. 219. Paris 1888.
Fahlberg, List & Co.: Zur Frage der Unschädlichkeit des Saccharin. Salbke a|E. I. u. II. Teil 1888, III. Teil 1889, IV. Teil 1890.
Mercier: Bullet. et Mem. de la Société de Méd. prat. Paris 1888.
Bruylants: Journal de Pharmacie et de Chimie. XVIII. p. 292. 1888.
Ogier: Journal de Pharm. et de Chim. XVIII. p. 81.

Dujardin-Beaumetz: Journal de Pharm. et de Chim. XVIII. p. 81.
J. Hedley: Therapeutische Monatshefte. p. 144. Berlin 1888.
Const. Paul: Bulletins de l'Académie de méd. Paris, 10 Juillet 1888.
Fragner u. Schreiber: Pharmaceutische Post. No. 46. Wien 1888.
Rapport du Comité d' hygiène et de salubrité de la Seine. Paris, Juin 1888.
Rüger: Reclam's Zeitschr. für öffentl. und priv. Hygiene „Gesundheit". No. 16. XIII. Jahrg. 1888.
Degoix: Petit médecin des familles. p. 887. Paris 1888.
de Pietra-Santa: Journal d'Hygiène. No. 615, 617. Paris 1888.
Bulletins de l'Académie de médecine en Belgique. Bruxelles 1888.
F. W. Pavy: Saccharine. A vindication. Lancet 3. Nov. London 1888.
Stevenson and Wooldridge: Saccharin. Lancet. p. 958. London 1888.
James Little: Über die Fähigkeit des Saccharin bezügl. Verhütung ammoniakalischer Gährungen im Urin bei chronischer Cystitis. London 1888.
T. Lauder-Brunton: Pharmacology Therapeutics and Materia medica. London 1888.
Attfield: Pharmacopoëa Britannica. London 1888.
Macnaughton Jones: Medical Press. London 1888.
Hurry Fenwick: Über den Wert der neueren Mittel in der Geschlechts- und Harn-Pharmacopoëa. London 1888.
John Dougall: Saccharin. London 1888.
H. Haike: Zur Verwertung des Saccharin. Deutsch. med. Wochenschrift No. 45. Berlin 1888.
Girard: Référat de la séance de la Société de Médecine et d'Hygiène. Genf 1888.
Michaelis: Die neueren Arzneimittel. p. 138—141. Waldenburg 1888.
Compte-rendu des décisions du Conseil supérieur d'Hygiène de la Hollande. Amsterdam, 20. Dez. 1888.
Riche: Journal de Pharmacie et de Chimie. XIV. p. 205, 376 Paris 1888.
Wolf: Schm. Journ. B. 213. p. 28. — Therap. Gazette. 3. Ser. II. Heft. p. 443. 1888.
Baron v. Lühdorf: Winke für Zuckerkranke. Hamburg 1888.
Kohlschlütter und Elsasser: Deutsch. Archiv für klin. Medizin. Band 46. 1888.
Wilson, Salamon & Co.: A Vindication of Saccharin. London 1888.
Ch. Kügler: Sur la Saccharine. Bulletins de la Soc. de Thérapeutie. Paris, 11 Janv. 1888.
M. Gerard: La Saccharine ou sucre de houille. Revue scientifique. No. 1. Paris 1888.
de Thierry: La Saccharine. Revue des sciences. p. 97. Paris 1888.
Av. Pollacsek: A Saccharin alkalmazása Diabetes mellitusnál. Orvosi Hetilap. Budapest 1888.
H. van Heurck: La Saccharine de Fahlberg. Anvers 1888.
Wiener Medizinische Presse. No. 43 und 18. Nov. Wien 1888.
Breslauer Ärztliche Zeitschrift. No. 3. Breslau 1888.
The Lancet. June 9. 16. 1888; 6. June 1889.
Progrès Médical. 24 Juillet. Paris 1888.
Wekbl. von het Neerl. Tijdschr. v. Genesk. No. 25. Rotterdam 1888.
Chemisches Zentralblatt. p. 236, p. 1401. 1888.
Bulletin assoc. chim. Paris. 5. Nov. 1888.
Farmaceutisk Tidskrift. No. 1. Stockholm 1888.
A. Stift: Über einige Eigenschaften des Saccharin und dessen Einfluss auf verschiedene Fermente. Österr. ungar. Zeitschr. für Zuckerindustrie und Landwirtschaft. Heft I—IV. Wien 1889.
B. Fischer: Die neueren Arzneimittel. 3. Aufl. p. 110. 1889.
P. Mercier: Studie über Saccharin, dessen antiseptisch. Eigenschaften und über das lösliche Saccharin als Süssstoff. Paris 1889.
E. Gans: Untersuchungen über den Einfluss des Saccharin auf die Magen- und Darmverdauung. Berl. Klinische Wochenschrift. No. 13. Berlin 1889.

Fr. Sarcey: Lá Saccharine jugée par Francisque Sarcey. XIXme Siècle. Paris 1889.
A. Petschek u. Zerner: Über Saccharin. Zentralblatt f. d. gesamte Therapie. Heft VI. Wien 1889.
Fournès: Die Behandlung der Diabetes. Journal d'Hygiène. No. 661. p. 278. Paris 1889.
Const. Paul: Journal officiel. Paris, 5 Août 1889.
W. Jaworski u. J. Rosenzweig: Klinische Untersuchungen und Erfahrungen über das Saccharinnatrium. Przeglad Lekarski. No. 40—43. Krakau 1889.
Dante Torsellini: La saccarina nella alimentazione. Milano 1889.
A. J. Caro: Revue internat. scientif. et populaire des falsifications. 15 Mars 1889.
Das Saccharin, seine Eigenschaften und Bedeutung. Pharmaceutische Zeitung. No. 10. Berlin 1889.
Journal de Médecine de Paris. No. 6, 7 und 9. Paris 1889.
R. Stutzer: Das Fahlberg'sche Saccharin. Braunschweig 1890.
L. Morgenstern: Saccharin im Haushalte und für den Krankentisch. Eine Studie nebst 100 Koch-, Back- und Konserve-Rezepten. Magdeburg 1890.
Das österreichische Sanitätswesen. Organ für die Publikationen des K. K. Obersten Sanitätsrates. No. 9, 10 und 11. Jahrg. XI. Wien 1890.
Fr. Jessen: Zur Wirkung des Saccharin. Archiv für Hygieine. p. 64—80. München 1890.
K. B. Lehmann: Zur Saccharinfrage. Archiv für Hygieine. Band X. Heft I. München-Leipzig 1890.
H. Paschkis: Beiträge zur Kenntnis von der Wirksamkeit des Saccharin. Wiener medizinische Wochenschrift. 40. Jahrg. No. 9 und 10. Wien 1890.
Fr. Strohmer: Österr.-Ungar. Zeitschr. für Rübenzuckerindustrie. Heft 150. Wien 1890.
René Vermandère: Histoire populaire de la Saccharine. Anvers 1890.
C. Kornauth: Studien über das Saccharin. Die landw. Versuchs-Stationen. Bd. 38. Berlin 1890.
O. Wolf: Kontra Karlsbad. Heidelberg 1891.
S. Hirschfeld: Ein Beitrag zur Saccharinfrage. Inaugural-Dissertation. Erlangen 1891.
Wilson Salamon & Co. Lim.: The advantages of Saccharin in the manufacture of Aerated Waters, Cordials etc. London 1891.