Physiological Chemistry.

On Conjugated Sulphuric Acids in the Organism.

By E. BAUMANN (Pflüger's Archiv. f. Physiologie, xiii, 285—308).

THE author has previously applied the term "conjugated sulphuric acids" to acids which, on heating with the stronger mineral acids, become split into sulphuric acid and other different bodies (this Journal, 1876, i. 726). He found the salts of these acids in the urine of mammalia. The quantity present in the urine varies in different animals: a vegetable diet appears to increase them.

The Phenol-forming Substance of the Urine.—The author obtained the potash salt of this substance as follows:—If the alcoholic extract of horse-s urine be evaporated to a syrupy consistence, and allowed to stand several days in the winter, crystalline scales then separate. These are drawn through a small linen filter, pressed between paper, and crystallised from water and afterwards repeatedly from strong spirit. They are soluble in about 10 parts of cold water, less so in spirit, almost insoluble in cold, but more soluble in boiling alcohol. Analyses showed the composition of this salt to be aproximately $C_6H_5KSO_4$. The author thinks that the substance first obtained from horse's urine is a mixture of a salt having the above formula, with another perhaps very similar to it, and containing more carbon, which can be only imperfectly separated by crystallisation.

Behaviour of Phenol in the Animal Body.—From the urine of patients treated with carbolic acid, the author obtained, by distillation after acidification, large quantities of phenol. The quantity of conjugated sulphuric acid is also much increased and amounts to 10 or 15 times the normal quantity. The author also obtained crystals of phenol-sulphate of potassium from the urine of patients who were treated externally with carbolic acid.

With regard to the *formation of conjugated sulphuric acids in the animal body* the author finds experimentally that, after the administration of large quantities of phenol, the sulphates present in the body (which had been introduced as sulphate of soda) appear in the urine as phenol-sulphates. Further experiments, the author thinks, show that phenol introduced into the body soon passes over into a combination which, even when small quantities of phenol are administered, is more or less converted into phenol-sulphuric acid; if greater quantities of phenol have entered the body, a larger portion of the first phenol-compound is excreted with the phenol-sulphuric acid in the urine.

The correctness of this conclusion is, he thinks, shown by the experiment of feeding another animal with the first formed phenol-compound, which can be obtained from the liver, when phenol-sulphuric acid appears in the urine. As regards the nature of this first-formed compound, the author can only say that it contains phenol in a manner similar to phenol-sulphuric acid, and gives off the same on heating with strong acids.

The author finds that phenol-sulphate of potassium is a non-poisonous salt, and can be administered to rabbits with impunity. He hence suggests sulphate of soda as a chemical antidote in carbolic acid poisoning.

On Indican.—The author experimented first with extracts of the leaves of *Isatis tinctoria.* He obtained indigo-forming substance from all parts of the plant except the blossom and fruit, and believes that the occurrence of indican is connected in some way with the presence of chlorophyll, as plants which had grown up in darkness and were destitute of chlorophyll, did not contain any.

The author administered indol to a dog, both hypodermically and by the stomach, and found a great increase in the excretion of conjugated sulphuric acid. Indican was also present in very large quantity. He therefore concludes that the indican of the animal body is a conjugated sulphuric acid.

Further investigations showed that oil of turpentine likewise produces conjugated sulphuric acid in the organism.

E. C. B.

Contribution to the Knowledge of Peptones. By ALBRECHT KOSSEL (Pflüger's Archiv. f. Physiologie, xiii, 309—320).

THE author believes, in opposition to Maly, that peptone does not give a precipitate with acetic acid and ferrocyanide of potassium, and that any precipitate occurring on the addition of these reagents would be due to the presence of a small quantity of unchanged albumin.

He confirms the views of previous observers, that the albumin-molecule, during pepsin-digestion, becomes poorer in carbon and nitrogen, that it therefore probably undergoes a hydration on oxidation.

Further, his experiments confirm the statement of Lubavin that the peptones (or at least a part of them) possess properties which are common to the amidic acids. In these respects the process of pepsin-digestion does not differ from the splitting of the albumin-molecule on boiling with water, acids, or alkalis, or when acted on by the ferment of decomposition; it differs, however, in giving rise to products which are not (at least at the commencement of the process) converted by the further action of the ferment into carbonic acid and ammonia. The author could detect no ammonia in digestion of albumin lasting 24 hours.

E. C. B.

On the Excretion of Potash Salts. By AUG. DEHN (Pflüger's Archiv. f. Physiologie, xiii, 353—368).

IN the following experiments the author, like previous observers, made use of the chloride of platinum test. Chlorine he estimated by nitrate of silver, with addition of some neutral chromate of potash, and urea according to Liebig's method with nitrate of mercury. His chief results are as follows :—

I. *Normal Urine.*—Experimenting on himself, the author found (from an examination of the urine on seven days) that, on a mixed diet, the average excretion of potassium chloride *per diem* is 4·5 grams, and that of dipotassic oxide 2·9 grams. The variations observed he considers due to the different food ingested. He shows for instance that Liebig's extract of meat contains in 100 grms., 15·74 grms. of potassium chloride, 10 grms. of potash, and 8·3018 grms. of potassium. A cup of good coffee he reckons contains ·1 grm. of potassium chloride, and beer sometimes as much as ·4729 grm. of the same salt per litre. The author observes that increased ingestion of water, and consequent excessive secretion of urine, gives rise to an increased excretion of potassium. He finds further, that under ordinary conditions, the proportion of potassium chloride to sodium chloride excreted is on an average as 1 to 1·35, but that change of nourishment produces variations of this proportion in either direction. After alluding to the powerful affinity existing between chlorine and potassium, and mentioning that potassium does not occur in the urine in sufficient quantity to combine with all the chlorine, the author lays down the rule that: In normal urine, all the potassium occurs in the form of chloride. If an excess of potassium (*e.g.*, in the form of phosphate) be introduced into the system, the plasma of the blood has to give up so much chlorine that all the phosphate may become converted into chloride of potassium. The consequent defect of sodium chloride produces a desire for common salt, on the introduction of which the blood regains its normal composition.

II. *Excessive Introduction of Potassium Chloride.*—The author describes an experiment on himself in which he took 2 grams of potassium chloride dissolved in 1,000 c.c. of water. The result was that not only were the 2 grams of chloride excreted, but also a considerable quantity of the same salt was withdrawn from the body. The elimination of the salt commences from 3 to 4 hours after its introduction, and may extend over more than one day. The greater part of the water in the above experiment (955 c.c.) was thrown off in a short time, almost unused, as its content of the chloride was less than normal. The author also finds that the introduction of potassium chloride causes the withdrawal of common salt from the system.

From experiments in which potassium chloride was administered, without any increase of water, the author finds that if there is an excess of potassium chloride in the blood, it does not immediately attract water, but a considerable part is soon excreted (the urine becoming more highly loaded with this salt), whereas the rest remains stored up in the blood, to be excreted at the next convenient opportunity.

With regard to the influence of potassium chloride on the excretion of urea, the author found that the introduction of this salt into the system increased the metamorphosis of tissue, and he concludes that nourishment rich in potassium has the same effect.

The introduction of potassium always gave rise to violent headache, in the case of the author, and he considers that the headache which in many persons is produced by taking very strong coffee, is due to the amount of potassium chloride contained therein.

E. C. B.

Milk-globules, and a New Theory of Churning. By F. SOXHLET (Landw. Versuchs. Stat., xix, 118—155).

IT is generally supposed that the fat-globules of milk are contained within a thin membrane, which it is necessary to destroy, before the fat itself can be separated and extracted from the liquid in which the globules are suspended. The destruction of this membrane can be accomplished, it is said, in two ways; either mechanically, by the operation of churning, or chemically, by the solvent action of some reagent, such as potash or acetic acid. Now if it be true, that, as in the latter case, the action of acetic acid upon milk is really due to a solution of this globule-membrane, then it is clear that more acetic acid must be used than would be required for the mere coagulation of the milk. Experiments, however, show that this is not the case. Again, if some milk be mixed with just enough very dilute acetic acid, to convert nearly the whole of its sodium phosphate into acid phosphate, but not sufficient to cause the separation of the casein, and a current of carbonic acid gas be passed through the liquid, perfect coagulation ensues, and the fat may then be extracted by shaking with ether.

These experiments seem, on the one hand, to indicate that the action of the acetic acid is to rob the milk of its emulsive condition, but, on the other hand, to refute the idea that it accomplishes this by the destruction of an enveloping membrane. In the precipitation of the casein by carbonic acid, the membrane-theory is inadmissible, because carbonic acid will not dissolve any single albuminous body.

The fact that the milk-globule, in its natural state, cannot be dissolved by ether, may be explained upon the assumption of a peculiar property of adhesion possessed by it, and this view is supported by the following experiment: if milk be dried in a vacuum over sulphuric acid, the fat can be easily extracted from the residue by ether; but if the residue be dissolved in water, the solution resists the action of the ether, just as milk does in its natural state.

Raspail (*Schmidt's Jahrb.*, vol. 24) cites in proof of the existence of a pellicle investing each globule, that the globules do not flow together. This may be answered by the parallel case of an emulsion of sugar-syrup and oil, in which the oil-drops no more tend to coalesce than the fat-globules in milk; and, similarly, by the case of the oil-drops in the *emulsio oleosa* of the German pharmacopœia, which differ from the fat-drops of milk only in being more transparent.

If quicksilver be shaken up with water, it separates into single globules, which cannot without trouble be re-united, the adhesion of the water to the surface of the globules preventing their flowing together.

It has frequently been asserted that a globule-membrane can be detected by the microscope, and Henle (*Froriep's Notizen*, 1839, 223) stated that a casein-membrane was visible after treatment with dilute acetic acid. The author believes these opinions to be quite erroneous, and asserts that no membrane can be observed by the microscope, even with the aid of the highest powers.

There is another argument which has been advanced in proof of the existence of globule-membranes. Brücke (*Müller's Archiv.* 1847, 409) first called attention to the remarkable difference in specific gravity between butter-fat and the liquid in which it is suspended—a difference which, he observed, is sufficient to cause the fat to rise to the surface much more rapidly than it actually does. Brücke explained this difficulty by supposing each fat-globule to be enclosed within an envelope specifically heavier than the liquid, a deduction reasonable enough if milk-liquid could be compared to a solution of salt of the same specific gravity; but he had overlooked the fact that, like all albumin solutions, it is slightly gelatinous, a circumstance extremely likely to interfere with the rising of the globules to the surface.

The power of a gelatinous liquid to retain in suspension finely divided substances of a greater specific gravity than itself, was proved very clearly by Scheibler (Zeitschr. d. Vereins f. *Rübenzucker-Industrie in der österr.-ungar. Monarchie*, xi Jahrg., p. 435), who precipitated the baryta from a solution of barium arabate by sulphuric acid, and found that, after standing for four years, the fluid had remained just as milk-white as it was on the day on which the barium sulphate was thrown down.

From such considerations as these, the author believes the membrane theory to stand in direct opposition to our present chemical and physical knowledge, and he therefore abandons it. With regard to the condition in which the fat-globules exist, he believes that in new milk they are undoubtedly fluid drops, because, at the animal heat, the milk is at a higher temperature than the melting point of butter (34°—37°), and this view seems to be supported by their appearance when viewed under the microscope. But if milk be frozen at a temperature of three or four degrees below zero, the globules lose their fluidity, and become solid, and remain also in this state after the milk has been thawed. It was found that milk which had been thus treated could be churned into butter in 2 minutes, whereas to produce the same result with milk in its natural state required 11 minutes, showing that the low temperature had produced the same effect as 7—8 minutes churning.

The author concludes from this, that in the operation of churning, the liquid fat-globules are brought into the solid condition, but that this change can also be effected by subjecting the milk to a temperature of $-3°$ or $-4°$.

H. H. B. S.

On the Poisonous Action of Alcohols. By DUJARDIN, BEAUMETZ, and AUDIGÉ (Compt. rend., lxxxiii, 80—82).

THIS paper gives the results of experiments on the poisonous action of alcohols on dogs. The authors find that, of the alcohols produced by fermentation, the amount required to cause death within 24 hours varies with the atomic composition. The fatal dose per kilogram of weight of the animal, administered by the stomach (I), and by hypodermic injection (II), was found to be—

	I.	II.	
Of ethyl alcohol....	7·75	8·00	grams.
,, propyl ,, ...	3·13	4·02	,,
,, butyl ,, ...	1·74	2·15	,,
,, amyl ,, ...	1·48	2·02	,,

Experiments with other monatomic alcohols led to the following results:—

Methyl alcohol is more poisonous than ethyl alcohol, the fatal dose being 5 grams per kilogram of weight of the dog.

Heptyl and octyl alcohols vary in their action according as they are administered in the pure state or diluted with ethyl alcohol. The fatal dose of the pure substances is about the same as that of ethyl alcohol; but when diluted to ten times their bulk with absolute alcohol, the doses of 2·3—2·5 grams of heptyl alcohol, and 2—2·2 grams of octyl alcohol per kilogram of weight were found sufficient to cause death.

Cetyl alcohol, being insoluble, is not poisonous.

J. R.