Physiological Chemistry.

A New Constituent of Urine. By T. Baumstark (Deut. Chem. Ges. Ber., vi, 883—884).

Urine was evaporated on the water-bath to a syrup, and this was mixed with a considerable quantity of absolute alcohol. The alcoholic filtrate was freed from spirit by distillation, and the residue, after the removal of hippuric acid by ether, was neutralised with ammonia, treated with basic lead acetate, and filtered. On evaporating this filtrate, crystals of urea were obtained, together with crystals which did not dissolve in spirit. These crystals are slightly soluble in cold water or aqueous alcohol, moderately soluble in hot water, insoluble in absolute alcohol or ether. Analysis of the new substance led to the formula, $C_3H_8N_2O$. It forms white prisms resembling hippuric acid and melting above 250°. When strongly heated, it is decomposed, with production of white fumes having a peculiar odour, and a combustible gas which smells like ethylamine and has an alkaline reaction. The new substance forms easily soluble salts with acids, and although it does not combine with bases, its solution is precipitated by mercuric nitrate. Nitric acid converts it into sarcolactic acid, and boiling with baryta-water causes the separation of half the nitrogen in the form of ammonia; the other half is apparently separated as ethylamine, barium carbonate being deposited. These reactions may be explained by representing the formula of the new body as follows: $NH_2—CO—C_2H_4NH_2$, and the action of alkalis on it may be represented by the following equations:—

$$(1)\ NaHO + NH_2.CO.C_2H_4.NH_2 = NH_3 + NaCO_2.C_2H_4.NH_2.$$
$$(2)\ NaCO_2.C_2H_4.NH_2.NaHO = Na_2CO_3 + C_2H_5.NH_2.$$

T. B.

The Cartilage of the Shark. By P. PETERSEN and F. SOXHLET (J. pr. Chem. [2], vii, 179—181).

THE cartilage of a fresh specimen of *Scymnus borealis* formed an elastic mass which was almost transparent when in thin sections, and on drying became covered with crystals of sodium chloride.

Analysis showed it to consist of—

Organic matter resembling chondrin, and containing 15·4 per cent. of nitrogen	8·03
Inorganic matter	17·77
Water	74·20
	100·00

The inorganic matter contained—

Common salt	94·24
Soda	0·79
Potash	1·64
Lime	0·40
Magnesia	0·05
Iron oxide	0·27
Phosphoric acid	1·03
Sulphuric acid	1·88
	100·30

These figures correspond with 16·69 per cent. of common salt in the fresh substance, and 4·80 per cent. of nitrogen in the dried cartilage. As the fresh fish contains only 1·16 per cent. of inorganic matter, it becomes a subject of interest to inquire whether so great an accumulation of salt in the cartilage is due to chemical combination, or to some kind of osmotic attraction exercised by the substance of the cartilage.

T. B.

Brittleness of the Bones in Cattle. By J. NESSLER (Landw. Versuchs-stationen, xvi, 187—192).

A DISEASE in cattle occurs nearly every year in some parts of the Black Forest, during which the bones of the affected animals become very brittle. It most frequently attacks cows in calf and young cattle, and occurs only on particular farms which overlie granite or sandstone; the contiguous farms on which the disease never appears, or only in very dry seasons, are mostly on gneiss. The animals are often cured by change of pasturage. Analysis of various bones of different sound and diseased animals gave the following results:—

Percentage of Dry Matter.

	Pelvis.		Vertebræ.		Forearm.		Tibia.		Joint of tibia.		Os Femoris.
	Sound	Diseased.	Sound	Diseased.	Sound	Diseased.	Sound	Diseased.	Sound	Diseased.	Diseased.
Ash	45·49	36·75	45·50	28·09	64·27	65·96	61·02	66·95	34·82	24·41	63·30
Phosphoric acid	15·93	12·81	18·81	10·59	27·68	29·22	25·92	25·74	14·08	9·36	23·96
Lime	—	18·54	—	—	36·15	35·71	32·81	—	18·21	12·71	35·60
Fat	25·52	36·65	22·65	36·00	1·63	3·96	1·90	1·57	26·70	58·61	2·14
Nitrogen	3·77	4·00	3·41	4·76	4·09	3·84	4·62	4·72	4·15	—	4·47

Percentage of Ash.

	Pelvis.		Vertebræ.		Forearm.		Tibia.		Joint of tibia.		Os Femoris.
	Sound	Diseased.	Sound	Diseased.	Sound	Diseased.	Sound	Diseased.	Sound	Diseased.	Diseased.
Phosphoric acid	35 02	34·88	41·34	37·69	43·08	44·29	43·92	38·45	42·89	38·33	37·86
Tricalcic phosphate calculated from ditto	76·34	77·04	90·24	82·16	94·04	96·68	95·86	83·94	93·63	83·67	82·53
Total lime	—	50·45	—	—	55·86	54·13	55·59	—	55·48	52·06	56·25
Lime not combined with phosphoric acid	—	9·19	—	—	4·90	1·74	3·63	—	4·74	6·72	11·47
Magnesia	—	·76	—	—	—	—	—	—	—	—	1·24
Potash	—	1·52	—	—	·29	·27	·20	—	·33	·44	·25
Soda	—	1·64	—	—	1·01	1·12	1·22	—	1·31	2·69	·30

Of the hollow bones only the walls were taken for analysis, without the joints or marrow. It is seen that in the spongy bones there is more fat and less ash and phosphoric acid in the diseased specimens than in the sound; in the long bones no such difference is seen. With the exception of the bones of the forearm, there is a smaller percentage of phosphoric acid in the ash of the diseased bones.

The bones of diseased animals appear to be less in weight than the bones of a healthy animal of the same size. In many cases the disease is in all probability due to an insufficiency of lime and phosphoric acid in the food.

E. K.

Estimation of Hæmoglobin in Blood. By M. QUINQUAUD (Compt. rend., lxxvi, 1489).

THE author finds that there is an exact relation between the quantity of oxygen which blood can absorb and the amount of hæmoglobin it contains, so that the latter can be determined by ascertaining the former. The quantity of oxygen absorbed by 100 cubic centimeters of human blood is 260 c.c., of ox-blood 240 c.c., and of duck's blood 170 c.c. The quantities of iron in 1000 grams of these kinds of blood are 0·53, 0·48, and 0.34 grm. respectively. According to Hoppe-Seyler's computation, that 0·43 grm. of iron corresponds with 100 grams of hæmoglobin, the quantities of this substance in 1000 grams of these kinds of blood are 125, 120, and 82 grams respectively. The numbers obtained by Preyer from observations with the spectroscope are a little higher, but bear the same proportions. The amount of hæmoglobin in the blood of the fowl is nearly the same as in that of the duck.

T. L. B.

Variations in Hæmoglobin in the Zoological Series. By QUINQUAUD (Compt. rend., lxxvii, 487—489).

BY the method of estimating the amount of hæmoglobin, depending on the action of a hyposulphite, the author has been enabled to draw up a table showing the variations in the weight of hæmoglobin contained in the blood in various animals and under different physiological conditions.

His researches lead him to the following results :—

1st. The progressive diminution in the amount of hæmoglobin contained in equal volumes of the blood follows, as a rule, the steps of the animal scale.

2ndly. The blood of young animals contains less hæmoglobin than that of adults. A line representing the amount of hæmoglobin takes the following course. It falls slightly during the first few days of extra-uterine life, rises during childhood, remains horizontal during adult life, and finally falls slowly during old age.

3rdly. The blood of birds is much less rich in hæmoglobin than that of mammals, but the weight of the globules is rather greater in the former than in the latter, though the mammalian globules contain only a third of the quantity of albuminous material present in those of birds.

4thly. As a rule, the females have less hæmoglobin than the males.

5thly. The lymph of crustaceans contains 4 to 5 cubic centimeters of oxygen in 100, whereas ordinary water in the middle of winter, when completely saturated, contains only 1 cubic centimeter in 100.

E. C. B.

The Saccharifying Ferment of the Blood. By P. PLOSZ and E. TIEGEL (Pflüger's Archiv für Physiologie, vii, 391—398).

THE authors investigate the nature of the saccharifying action which the blood shows at the moment in which its blood-cells become dissolved, described by Tiegel in his treatise "On the fermentation of the blood" (*Pflüger's Archiv f. Phys.*, vi, p. 249).

Experiment.—10—12 volumes of $\frac{1}{2}$—$\frac{3}{4}$ p.c. NaCl solution are added to a suitable quantity of whipped blood. The mixture is poured into a shallow vessel and left for 24 hours at a temperature below 50°. By this time the blood-cells have settled to the bottom, sharply separated from the liquid above, which the authors name the "wash-liquid." Albumin is separated from the liquid by coagulation. If, after a time, traces of sugar or considerable quantities of peptone are found in the liquid, it is considered unfit for experiment. If this be not the case, the following experiments are made with it:—

(i.) 25 c.c. of the "wash-liquid" are mixed with starch and digested in the hatch-oven for an hour, then tested for sugar; it is found in greater or less quantity.

(ii.) 25 c.c. of the liquid, rich in blood-cells, are removed from the bottom of the vessel and mixed with starch paste until it becomes lac coloured. If, after an hour, saccharification has taken place, the wash-liquid is separated as well as possible, and replaced by a similar quantity of NaCl-solution cooled to 5°. After 24 hours the fermentation will have disappeared entirely or will be perceptible only after a longer time, or after adding more of the liquid containing blood-cells.

(iii.) The rest of the blood-cells, together with the supernatant wash-liquid, are allowed to stand at 20°—30° for 24 hours. Gradually the blood-cells dissolve and impart colour to the liquid. It may be shown by testing that a destruction of the ferment takes place, proportional to the solution of the blood cells, and is complete at the end of 24 hours.

The above phenomena are thus explained. According to Expts. i and ii, together with i and ii given in Tiegel's treatise (quoted above), a ferment exists in the blood, which is generally so combined that it is hindered from acting. By the treatment described above, the combination is dissolved, and the ferment sets to work. Possibly the ferment exists in combination with a globulin substance; for by the action of a solution of sodium chloride, a globulin substance which contained a saccharifying ferment was extracted from fibrin, after the fibrin had been thoroughly washed with water. It may be that the ferment of the blood is combined in the blood-cells, and that this combination is dissolved in a similar manner. Whether the cause which brings about the solution of the blood-cells is the same as that which destroys the ferment, cannot at present be determined.

The destruction appears to set to work in full measure only after solution of the cells, as shown in the following experiments: 3 c.c. of active pancreas-glycerin are mixed with 15 c.c. of washed blood-cells, digested for 24 hours at a temperature below 5°, then for one hour with NaCl-paste in the oven: saccharification has clearly taken place. The rest of the mixture is digested for 24 hours: saccharification still evident. The blood-cells are dissolved with ether, and the mixture again digested for 24 hours: saccharification is quite destroyed.

Moreover, a saccharification artificially set up in starch and albumin is destroyed by addition of the blood-cell solution. In order to see whether a ferment is combined in blood-cells of living-blood in a similar way, Bock and Hoffmann's experiments were repeated, and with success. The authors explain the results by supposing that the solution of sodium chloride washes out ferment from the blood and glycogen from the liver. A ferment was obtained from the urine of an animal experimented on, and also from human diabetic urine; Béchamp has obtained a similar ferment from normal urine. The authors conclude that the fermentation takes place not in the kidneys or urine, but in the liver or blood, but contend against von Wittich's supposition that the saccharification in the liver is caused by a ferment contained in the liver-cells.

C. C.

The Blood in Apnœa. By AUGUST EWALD (Pflüger's Archiv f. Physiologie, vii, 575—581).

MAINLY of interest to the physiologist. The author finds that in apnœa, produced by inflating the lungs with a pair of bellows, the quantity of oxygen in arterial blood is increased until this becomes almost saturated, whilst the amount of oxygen in the venous blood is diminished. He also states that it appears from some unpublished experiments of Pflüger's, that in apnœa the consumption of oxygen is neither increased above, nor diminished below, the normal.

T. S.

The Part played by Gases in the Coagulation of Albumin. By E. MATHIEU and V. URBAIN (Compt. rend., lxxvii, 706—709).

PROCEEDING from the observations that the serum of blood, when deprived of its gases is not coagulable by heat, even at a temperature of 100°, and that egg-albumin exhibits the same anomaly, the authors have investigated the causes of the coagulation of albumin, and the relations of this substance to globulin. They state that the pneumatic mercury pump enables them to deprive albumin not only of gases, but also of volatile salts. Deprivation of gases renders albumin incoagulable by heat; and the disappearance of volatile salts converts it into a substance analogous to globulin. They find that—

1. Carbonic acid is the agent which determines the coagulation of albumin by heat. Egg-albumin, which abounds in carbonic acid, is not coagulable at a temperature of 100° when deprived of this gas, but is still precipitable by alcohol acids and metallic salts. Re-addition of carbonic acid renders the albumin again coagulable by heat alone. Albumin coagulated by heat contains carbonic acid and gives it up when treated with acids *in vacuo*.

2. Albumin when deprived of its volatile salts is converted in globulin. These volatile salts consist of ammonium carbonate, with traces of the sulphate and sulphide. The addition of a trace of ammonium carbonate to a solution of globulin, converts it into albumin. The solution is no longer coagulable by carbonic acid in the cold, but coagulates at a temperature of 70°.

A solution of globulin treated with 1–200th of an alkaline phosphate, acquires the properties of casein, and is coagulated by acetic acid. If, on the other hand, albumin, casein, and fibrin be dissolved by the aid of ammonia, and submitted to evaporation at ordinary temperatures, a substance is produced which appears to be globulin. From these facts the authors conclude that globulin is comparable with Mulder's protein, in that it is a substance from which all other albuminoids are derived.

T. S.

Variations in the amount of Urea excreted under the Influence of Caffeine, Coffee, and Tea. By L. RABUTEAU (Compt. rend, lxxvii, 489—491).

THIS paper, as the author states, was called forth by a previous one by M. Roux, on the same subject. Roux's results were at variance with those of the author, inasmuch as they showed that tea and coffee increased the amount of urea.

The author describes two sets of experiments, one made by Eustriades, of Smyrna, and the other by himself.

In the experiments of Eustriades, which were made on his own person, 15 centigrams of caffeine produced a diminution in the urea of 11 p. c., and 30 centigrams of the same diminished it by 28 2 p. c. Slowness of the circulation was also noticed. In another experiment, 60 grams of roasted coffee, taken in infusion, diminished the urea by 15·18 p. c., the circulation also being retarded.

Here the author remarks that in every case where a hot liquid, or even hot "eau sucrée" is taken, the circulation undergoes a temporary acceleration, which may possibly lead to errors.

The author's own experiments were made on himself, and the average results obtained are seen in the following table:—

	Urine in 24 hours.	Urea in 24 hours.	Pulse.
First Period. Ordinary Diet.			
April 4th to April 9th, 1870	1126 gr.	24·98 gr.	74
Second Period. 15 *grams of Tea daily.*			
April 9th to April 14th	1145 gr.	23·64 gr.	64
Third Period. Ordinary Diet.			
April 14th to April 19th..........	1046 gr.	25·00 gr.	68
Fourth Period. 15 *grams of Green Coffee.*			
April 19th to April 24th..........	1259 gr.	21·8 gr.	62
Fifth Period. Ordinary Diet.			
April 24th to April 29th..........	1242 gr.	26·18 gr.	69

Hence in the author's case, 15 grams of tea diminished the urea by

6·85 p. c., whereas the same quantity of green coffee diminished it by 14·11 p. c.

The fact of the augmentation in the urea in Roux's experiments being only transient, leads the author to expect that Roux will, in future experiments, arrive at results similar to his own. He proposes to make further experiments on this subject, in which he intends estimating not only the urea, but also the carbonic acid.

E. C. B.

Determination of the Mechanical Co-efficient of Aliments.

By A. SAUSEN (Compt. rend., lxxvi, 1490—1493).

FROM data furnished by the General Omnibus Company of Paris, and also from those contained in General Morin's "Aide-Mémoire de Mécanique," the author concludes that in round numbers 1,600,000 kilogrammeters are the equivalent or practical co-efficient of 1 kilogram of protein, in a well-regulated diet. The omnibus horses of Paris weigh on an average 500 kilograms. Each one draws an average weight of 1,590 kilograms, at the rate of 2·20 meters per second, for four hours daily, and starts this weight 60 or 70 times. It thus performs daily work equal in round numbers to 2,000,000 kilogrammeters. At the rate of 1,600 per gram of alimentary protein, it would require 1,250 grams for its daily ration. It actually receives 1,402 grams, 960 of which are furnished by oats, 135 by bran, and 307 by hay. The difference of 152 grams goes to support the body supposed to be at rest at the rate of 30 grams per kilogram of weight, the quantity shown by experience to be necessary. The same co-efficient holds for the post-horses. They draw on an average 1,300 kilograms each, at the same rate as the omnibus horses, and receive 400 grams of oats for every kilometer traversed.

When the quantity of food necessary for the performance of internal physiological work, or, in other words, for the support of the body at rest, has been ascertained, the additional amount required for the performance of external work in ploughing, &c., may be calculated by the formula, $P = \frac{W}{C}$, P standing for alimentary protein, W for the work, and C for the mechanical co-efficient of the nutritive unit. To determine the work which may be obtained from a given quantity of food, the equation is $W = P \times C$. To express the ratio of food to work, in terms of oats, for example, one would have $\frac{P}{120} = \frac{W}{C}$, the kilogram of oats containing on an average 120 grams of alimentary protein, and *vice versâ*, if we designate by n the number of kilograms of oats. $N + 120 \times 1600$, will give the value of W.

T. L. B.

Influence of Barometric Pressure on the Phenomena of Life.

By PAUL BERT (Compt. rend., lxxvi, pp. 1276—1280).

M. BERT finds the following phenomena in cases of death from poisoning by carbonic acid without want of oxygen, as in animals which repeatedly respire a limited quantity of super-oxygenated air, or of compressed air. 1. The arterial blood remains rich in oxygen till death occurs, and at this moment it still contains 10 to 12 volumes of oxygen in 100 volumes of blood. The carbonic acid accumulates with decreasing rapidity, and a few seconds before respiration ceases, it attains the proportion of 110 to 120 volumes, or almost complete saturation, which seems to take place at 130 to 140 volumes. 2. The respirations become slower and slower, without proportionally increasing in amplitude, and at last they sometimes occur only every two or three minutes. 3. The pulls falls still more rapidly, but the heart continues to beat for several minutes after respiration has ceased. The arterial tension remains high throughout. 4. The temperature decreases with extraordinary rapidity, although oxygen is being absorbed. This shows that the oxidation processes which furnish heat diminish as the blood and tissues become saturated with carbonic acid, despite the entrance of much oxygen into the blood. At death the temperature is only 24° to 28° in the rectum, that of the surrounding medium being 15° to 18°. 5. When the carbonic acid in the arterial blood reaches about 80 volumes, all parts of the animal become completely insensible, with the exception of the eye, which does so only when the carbonic acid reaches 100 volumes. The animal remains perfectly quiet, without the least convulsion during the whole experiment. It is even difficult to say when death occurs. Convulsions occurring in suffocation, after hæmorrhage, or from ligature of the cerebral vessels, are due to deprivation of the nerve centres of oxygen, and not to the presence of carbonic acid. 6. After death, the motor nerves and muscles retain their properties as usual. 7. The tissues are charged with carbonic acid. The muscles contain 60 volumes of it, instead of 15 to 20, and it may reach 100 in the urine.

M. Bert draws particular attention to the fact that sensibility is destroyed long before the heart is affected, and thinks that carbonic acid deserves trial as an anæsthetic.

T. L. B.