Chemistry of Vegetable Physiology and Agriculture.

Alcoholic Fermentation and the Conversion of Alcohol into Aldehyde by the "Champignon du Muguet." By G. LINOSSIER and G. ROUX (*Bull. Soc. Chim.* [3], **4**, 697—706; see also Abstr., 1890, 1179).—Contradictory statements have been made by previous authors as to the character of the fermentation induced by the "Champignon du muguet" (a fungus producing the disease "thrush" in the mouth). Sterilised solutions inoculated with the pure fungus yield alcohol, the maximum amounts obtained being 2·7 per cent. in 43 days, using dextrose solution (*plus* necessary salts); and 5·5 per cent. in 124 days, using wort from dried raisins.

Three stages may be distinguished during the fermentation:—(1) rapid growth of the organism; (2) active fermentation; (3) lessened activity due to the toxic influence of the fermentation products, aldehyde having, it would seem, the greatest effect. "Muguet" can cause the fermentation of dextrose, levulose, and maltose; saccharose is neither inverted nor fermented, but serves as a food material; lactose cannot even be used as food. Substances other than sugars, although unfermentable, can support the growth of this fungus; such food materials, in order of nutritive value, are, dextrin, mannitol, alcohol, sodium lactate, lactic acid, gum, and glycerol; tartaric acid and tartrates barely serve to sustain life; starch, erythrol, acetic acid, acetates, oxalic acid, oxalates, aldehyde, acetone, and aromatic substances are not foods.

The sugar present is never wholly fermented by this organism, neither are the various sugars attacked at the same rate. In a mixture of equal proportions of dextrose and levulose, the ratio dextrose/levulose tends towards a minimum (0·3); hence, it is impossible to use the fungus as a means for obtaining pure levulose.

The growth of the organism is favoured by the alkalinity of the solution employed; more of the sugar is then used up, but the ratio of alcohol produced to sugar used is lowered. In addition to glycerol and succinic acid, considerable quantities of acetic acid and acetaldehyde are produced. The ordinary ferments give for the ratio glucose destroyed/acetic acid produced, a mean value 0·0025; this quantity is 0·09 to 0·14 for muguet. The aldehyde is mainly produced by the oxidation of the alcohol induced in presence of air by the ferment. A small proportion of the acetic acid present is a true excretory product of the organism, but the greater part is undoubtedly produced by the oxidation of the aldehyde without the intervention of the ferment, for muguet does not grow in an aldehyde solution. In the slowness with which fermentation takes place, in the maximum concentration of alcohol produced, and in the ratio of weight of sugar destroyed to weight of organism produced, the "Champignon du muguet" exhibits marked analogies with the *Mucorini*, and differs considerably from the *Saccharomycetes*. The conclusion that the organism does not belong to the latter is borne out by the results of a careful morphological study. W. T.

Assimilation of Nitrogen by Plants. By B. FRANK and R. OTTO (*Chem. Centr.*, 1891, i, 332—333; from *Ber. deut. bot. Gess.*, **8**, 331—342).—The authors have endeavoured to prove experimentally whether the Leguminosæ directly absorb pure nitrogen by means of the leaves or not, and to this end experiments have been made with cut leaves. So far, however, the results obtained are not sufficiently definite.

Experiments on the growth of the rhizobium of the root nodules in the presence of the organism of the nodules in solutions containing (*a*) sugar, (*b*) sugar and asparagine, (*c*) asparagine, show that the growth was most rapid in the presence of both sugar and asparagine, and least rapid when sugar alone was supplied.

Finally, peas were grown in unsterilised earth, in sterilised earth, and in sterilised earth to which a small quantity of the fresh soil was added. All the plants grew perfectly, and assimilation of nitrogen took place in every case. J. W. L.

Simultaneous Evolution of Oxygen and Carbonic Anhydride by Cactæ. By E. AUBERT (*Compt. rend.*, **112**, 674—676).—Cactæ, when exposed to light of moderate intensity at a temperature of 35°, evolve oxygen and carbonic anhydride, their respiration ratios being 0·98 (*Opuntia*) to 0·88 (*Mamillaria*), whilst their assimilation ratios are 2·38 to 2·28. This result is probably due to the fact that the thin superficial chlorophyllian layer is not able to decompose the whole of the carbonic anhydride evolved by respiration from the colourless parenchyma underneath. The intense light of the tropics decomposes the whole of the carbonic anhydride, and in the tropics loss of carbon takes place only during the night. C. H. B.

Influence of Salt on the Formation of Starch in Vegetable Organs containing Chlorophyll. By P. LESAGE (*Compt. rend.*, **112**, 672—673).—The examination of the leaves of plants growing on the sea shore, and experiments made by watering plants with pure water and with salt solutions of various strengths, show that salt has a distinct influence on the formation of starch in the chlorophyllian organs of plants, and in extreme cases prevents it. The necessary result is a decrease in the assimilation of carbon. The author has previously shown that salt reduces the quantity of chlorophyll.

C. H. B.

Presence and Function of Diastase in Plants. By J. WORTMANN (*Ann. Agron.*, **17**, 84—89; from *Bot. Zeit.*, 1890, Nos. 37—41).—After a variety of experiments, the author concludes that diastase in plants has not the importance which has been ascribed to it, and that starch is transformed into soluble products by other means, probably by the agency of living protoplasm. Diastase is formed in small quantities, certainly, in leaves which contain no starch; the quantity of diastase present is in no case proportional to the amount of starch; from some starch-containing leaves, it is quite absent, and yet these leaves are the seat of very active starch-transformation. It is in special cases only, such as the germination of seeds, tubercles, and rhizomes containing starch that the solution of the starch is accomplished by diastase. The author points out that in testing for the disappearance of starch under the action of diastase the result is conclusive only when the liquid gives no blue colour with iodine after being boiled and cooled. J. M. H. M.

Formation of Nitrogenous Organic Bases by the Decomposition of Proteïds in the Vegetable Organism. By E. SCHULZE (*Ber.*, **24**, 1098—1101).—When the seeds of *Lupinus luteus*, *Soja hispida*, and *Cucurbita pepo* are allowed to vegetate in the dark for 12—14 days and the shoots extracted with water, a solution is obtained which, after removing proteïds as completely as possible, yields a precipitate with phosphotungstic acid. This contains considerable quantities of nitrogen, and, on treatment with milk of lime, yields nitrogenous organic bases. From *Lupinus luteus* and *Cucurbita pepo*, the author has been able to isolate the arginine described by Schultz and Steiger (Abstr., 1886, 725), whilst *Soja hispida* yields a base which is either identical with or very closely allied to arginine. The quantity of arginine obtained from *Cucurbita pepo* is small, but *Lupinus luteus* yields it in such quantities that the author has been able to show by quantitative experiments that it must have been formed at the cost of the proteïds present as reserve substance in the cotyledon.

Arginine only differs from the lysatine described by Dreschsel, inasmuch as it contains an additional atom of nitrogen and of hydrogen in the molecule. Experiments are in progress to determine, if possible, the relation existing between them. H. G. C.

Physiological Importance of Calcium Oxalate in Plants. By KOHL (*Ann. Agron.*, **17**, 90—91).—The author adds some observations to his previous work on this subject (Abstr., 1890, 191). He shares with Palladin the theory that this salt is eliminated as an accessory during the synthesis of proteïds from amides and carbohydrates. If this be true, oxalates should be found in all plants. The author shows that in many cases amongst algæ and fungi, even where little or no calcium oxalate is found, oxalic acid or soluble oxalates are still present, and diffuse rapidly out of the plant, so that a calcium salt gives a precipitate in the vicinity of many fungi, and the hyphæ of some of them are encrusted on the outside by crystals of calcium oxalate formed from the lime in the soil. Amongst fungi forming oxalic acid in large quantities the author notes *Saccharomyces Hansenii*, the *oxalic ferment* recently discovered by Kopf. But if the formation of oxalic acid by this and other fungi, and that of acetic acid by the schizophytæ, are regarded as fermentations, why should not the idea be enlarged to cover the formation of tartaric and malic acids, &c., in the higher plants? The author expands this idea, and suggests that the lower plants give by preference molecular fermentations resulting in the production of alcohol, lactic and butyric acids, &c., whilst fermentations of oxidation resulting in carbonic, oxalic, malic, and tartaric acids prevail amongst the higher plants. The migration of calcium oxalate in the tissues, maintained by Schimper, is now admitted by the author, who supports also Schimper's idea that the calcium oxalate is rendered soluble for this migration, whether by free oxalic acid (Wahrlich) or some other substance. He has recognised the presence of calcium oxalate in the expressed and filtered juice of many plants, as many as four crystalline forms of this salt being deposited on allowing these liquids to evaporate. J. M. H. M.

Calcium and Magnesium Oxalates in Plants. By MONTEVERDE (*Ann. Agron.*, **17**, 92—94).—This abstract, from a long memoir in Russian, sums up the principal conclusions arrived at by the author. He shows the presence of these salts in a great number of Gramineæ not hitherto examined. He denies the statement of Schimper that oxalates migrate in the plant tissues, and that of Aé that they disappear gradually in organs etiolated by darkness. The formation of oxalates is greatly promoted by light, both directly and as a consequence of increased assimilation. Blue light is better than darkness, but vastly inferior to orange. The quantity of lime in the soil or nutritive medium has an influence up to a certain point; apparently the normal quantity of oxalic acid formed by the plant combines wholly with lime, if enough is present, and in default with magnesia and other bases. After taking exception to Schimper's classification of the oxalate deposits into primary, secondary, and tertiary, the author remarks that the primary deposits of oxalate are accessory to the transformation of albuminoïds, and not to respiration or to the formation of cellulose. The secondary oxalate appearing in the leaves as the nitrates absorbed by the plant are destroyed is accessory to the synthesis of albuminoïds. J. M. H. M.

Peculiar Odour of Soil. By BERTHELOT and G. ANDRÉ (*Compt. rend.*, **112**, 598—599).—With a view to ascertain the cause of the peculiar smell observed when soil is moistened, a quantity of soil, free from all visible vegetable *débris*, &c., was extracted with water at 60°, and the liquid distilled. The distillate has the peculiar odour of the moistened soil, and its intensity increases if the first distillate is redistilled and only the first portion collected. The odour, however, is still perceptible in the residual liquid.

The substance is neither an acid nor an alkali, nor a normal aldehyde; its concentrated aqueous solutions are precipitated by potassium carbonate with production of a resinous ring. When heated with potassium hydroxide, an acrid odour like that of aldehyde resin is developed. It does not reduce ammoniacal silver nitrate, and with alcohol and iodine it gives the iodoform reaction. C. H. B.

Analysis of Fodders, with special reference to the Proteïds. By A. STUTZER (*Landw. Versuchs-Stat.*, **38**, 469—477).—Tables of the analysis of 58 feeding stuffs, showing percentage of non-proteïds, albumin, and indigestible proteïds. E. W. P.

The Climatic Conditions for the Development of Nicotine in Tobacco Plants. By A. MAYER (*Landw. Versuchs-Stat.*, **38**, 453—467).—In a previous communication, the author showed that by the use of a rich and easily assimilable nitrogenous manure, the percentage of nicotine in tobacco plants was increased; in the series of experiments now described, the influence of heat, water, light, and the moisture in the air have been inquired into. Plants grown under glass contained in some cases double the percentage of alkaloïd found in those plants grown in the open and consequently at a lower temperature, and in those plants growing under shelter, a higher temperature corresponded with a higher percentage of nicotine. Full lighting also was accompanied by increase of alkaloïd, even up to 100 per cent. of that contained in plants from which the light was in a measure cut off. A small supply of water seemed to be most beneficial to the full development, an excess being inimical. Increase of the moisture of the atmosphere surrounding the plant, whereby transpiration was diminished, led to an increase in the amount of alkaloïd. E. W. P.

Drainage Waters from Bare and Cultivated Soils. By P. P. DEHÉRAIN (*Ann. Agron.*, **17**, 49—82).—The mode of experiment and the first results obtained have been described in a previous memoir (Abstr., 1890, 1459). The results of a second season's observations are given in this memoir. Soils of different natures, obtained from different localities, showed a great difference in retentive power, the ratio of total rainfall (March 1 to November 7) to drainage water being in four cases 3·7, 2·9, 2·9, and 2·3 respectively; the most retentive were the strong clays. The nitrates found in the drainage waters from the same four soils, reckoned into kilos. nitric nitrogen per hectare, were respectively 152·4, 128·1, 62·5, and 45·2; so that the nitrate lost was far from being proportional to the quantity of water percolating; neither had it any connection with the richness in nitrogen of the soils. Ammonium sulphate was added to some pots of bare soil, in order to ascertain whether autumn or spring applications of this salt are preferable, having regard to the nitrogen lost as nitrate in drainage. The results are exhibited in the following table, the sulphate having been added to the soil in November:—

	Drainage water.		Nitric nitrogen.	
	Soil alone.	Soil with ammonium sulphate.	Soil alone.	Soil with ammonium sulphate.
	c.c.	c.c.	mgrm.	mgrm.
Jan. 6 to Jan. 24	2900	1910	52	112
Jan. 24 to Feb. 3	1840	3150	27	178
Feb. 3 to May 4	1960	1950	68	129
May 4 to May 31	3330	2680	124	153
June 3 to July 15......	7850	6820	375	2039
Total	17880	16710	646	2611

In this particular season, no considerable nitrification of the ammonium salt occurred until the hot and wet month of July, and the quantity washed through during the winter was certainly less than the roots of the wheat crop could have assimilated.

A previous experiment of the author's having suggested that for some crops (sugar-beet, for example) the presence of humus is as essential to a proper development as a due supply of nitrogen, phosphates, and potash in mineral forms, or at any rate that the latter do not suffice to produce a full development of the crop in the absence of the former, further experiments were undertaken to elucidate this most important point. The mode of pot culture was adopted; several different plants were tried, and the quantity of drainage water in each case, and of nitrate contained therein, were ascertained. The humic matter added to the soil for the purpose of the experiments was obtained by percolation of condensed steam through farmyard manure; such an extract contains, in addition to the nitrogenous organic matter, manurial ingredients in the form of a little phosphate and a considerable quantity of potash. The comparisons were between five pots in each series (1) good soil; (2) exhausted soil; (3) ditto with mineral manures (sodium nitrate, superphosphate, and potassium chloride); (4) the same soil as No. 2, with 1 litre of humic extract; (5) the same soil as No. 2, with 1 litre of humic extract and mineral manures. The plants tried were oats, hemp, peas, rye-grass, and clover; wheat and sugar-beet were included, but failed from accidental causes. The results are, perhaps, comparable amongst themselves, but in no case was as good a crop obtained as would be the case in field culture. The most important results may be thus summarised:—

Oats.—The mineral manures produced full effect; no special influence could be traced to the humus, and the nitrate found in the drainage water was inconsiderable in every case save that of the good soil unmanured, which produced a poor crop.

Hemp.—The worst crops were obtained in the exhausted soil, and in the same with addition of the three saline manures only, and from these two occurred by far the greatest loss of nitrate by drainage, as the following table shows:—

	Pot 1.	Pot 2.	Pot 3.	Pot 4.	Pot 5.
Weight of crop....	35·8	15·5	22·8	25·7	38·4 grms.
N as nitrate in drainage	61	632	1222	40	36 mgrms.

It is true that pot 5 received more total nitrogen, phosphate, and potash than pot 4, but it seems fairly inferable from the poor crop in pot 2, and the loss of nitrate therefrom, that these ingredients, when presented in the purely saline form, could not be fully utilised by this crop.

Rye-grass.—Two cuts were made, and the produce weighed as hay:—

	Pot 1.	Pot 2.	Pot 3.	Pot 4.	Pot 5.
Total produce	66	37	53	51	63 grms.
N as nitrate in drainage water..	33	149	196	140	45 mgrms.

Here also there seems some reason to attribute specific favourable action to the humic matter.

Peas.—In this case the good soil of pot No. 1 (manured year after year) yielded a better crop than any of the rest:—

	Pot 1.	Pot 2.	Pot 3.	Pot 4.	Pot 5.
Total dry produce .	121	66	69	70	83 grms.
N as nitrate in drainage	220	118	132	247	285 mgrms.

Special conditions, and not the mere supply of manurial ingredients, whether as salts or in humus, are necessary to the successful growth of this and probably other leguminous crops; and their indifference, now well established, to the artificial supply of nitrogen is well shown in the large amount of nitrate lost in the drainage water from all the pots.

Clover.—The results are similar to those given by the peas.

	Pot 1.	Pot 2.	Pot 3.	Pot 4.	Pot 5.
Total dry produce .	130	82	85	80	92 grms.
N as nitrate in drainage	269	159	164	196	216 mgrms.

The following interesting table is compiled from the results of these pot experiments :—

Milligrams per Litre of Nitric Nitrogen in the Drainage Water from different Soils under different Crops.

	No. crop.	Oats.	Rye-grass.	Peas.	Clover.	Hemp.
1. Rich soil	38	7·3	1·7	42	31	3·5
2. Exhausted soil	29	0·2	6·0	15	19	22·0
3. No. 2 with chemical manures	—	0·2	10·2	21	21	45·0
4. No. 2 with humic extract	—	2·3	5·0	40	29	2·0
5. No. 2 with chemical manures and humic extract	—	0·9	2·0	31	32	2·0

Experiments were also made on the best crops for growing during the autumn as green manures, to prevent the great loss of nitrates by drainage which occurs in a wet season after the removal of the summer crop. The autumn of 1890 was, however, very unfavourable for these trials, being very dry, and the long frost which set in about the middle of November, and lasted into January, effectually stopped loss of nitrate, and put an end to the growth of all the autumn green crops.

The following table, nevertheless, is of interest, showing the quantity of nitric nitrogen per hectare lost during the November rains under the different circumstances :—

Summer Crop.	Green manure.	Nitric nitrogen in November drainage.
Sugar beet.................	none	7·5 kilos.
Maize (forage)	none	14·5 ,,
Oats	rape	0·37 ,,
Hemp	none	10·5 ,,
Peas	turnips	0·51 ,,
Rye grass continued in	rye grass	0·38 ,,
Clover ,, ...	clover	1·10 ,,

In dry autumns, it is probable the cost of cultivating and sowing a crop for green manure would exceed the advantage to be gained in preservation of nitrates in the soil; in wet autumns, the green manuring should be very advantageous. The author suggests for this purpose a mixture of rape and vetches, the former to prevent washing out of nitrates, the latter to accumulate nitrogen from the atmosphere.

J. M. H. M.