Na asparaginate	$+ Pb(NO_3)_2$	: beautiful unmixing
,,	$+ UO_2(NO_3)_2$	: in the heat liquid
Na benzoate	$+ Cd(NO_3)_2$	: in the heat very beautiful
Na salt of p-toluic acid	$+ Pb(NO_3)_2$	: on heating, not beautiful
,, o- ,, ,,	$+ Pb(NO_3)_2$	: ,, ,,
,, phenylacetic ,,	$+ UO_2(NO_3)_2$	: ,, ,,
,, ,, ,,	$+ Cd(NO_3)_2$	: beautiful on heating
,, phenylpropionic ,,	$+ UO_2(NO_3)_2$	: unmixing on heating
,, ,, ,,	$+ Cd(NO_3)_2$	: beautiful on heating

In the 800 examined combinations of the 20 salts of group A with the 40 salts of group B we could only state unmixing with certainty in 29 cases.

The number of cases stated with each of the cations amounted to: $Pb^{\cdot\cdot} = 9$, $UO_2^{\cdot\cdot} = 8$, $Cd^{\cdot\cdot} = 6$, $Ce^{\cdot\cdot\cdot} = 1$, $Co(NH_3)_6^{\cdot\cdot\cdot} = 1$, $Zn^{\cdot\cdot} = 1$, $Mn^{\cdot\cdot} = 1$, $Ni^{\cdot\cdot} = 1$, $Co^{\cdot\cdot} = 1$.

Evidently in particular the Pb, UO_2 and Cd salts with the Sodium salts of carboxylic acids examined here are in a favourite position with regard to an unmixing at the double transmutation.

Botany. — *Concerning the influence of temperature treatment on the carbohydrate metabolism, the respiration and the morphological development of the tulip.* III. By L. ALGERA. (Communicated by Prof. J. C. SCHOUTE.)

(Communicated at the meeting of October 31, 1936).

DISCUSSION OF THE RESULTS.

The respiration and the carbohydrate metabolism.

Table III and figures 6 and 8 of the preceding publication (1) show that the respiration also after being calculated on the basis of 20° C. is dissimilar in the various lots. Is this to be explained by the assumption that the applied temperature influences the forming or activation of the respiratory enzymes or can the differences discovered be attributed to the difference in the sugar percentage. It has been proved that the concentration of the reducing sugars is little changed by the temperature treatment. It is more obvious to ascertain whether there exists a relationship between the non-reducing sugars and the respiration.

If the intensity of the respiration was exclusively controlled by the percentage of these sugars, then there would have to be a strict proportion between them. The quotient:

$$\frac{\text{carbon dioxide emission (oxygen consumption) per K.G. dry weight/hour}}{\text{quantity non-reducing sugars per K.G. dry weight}}$$

should then on the different dates not only be continually equal in the same lot but also in all the lots individually.

Table III (1) and the figures 1 and 2 show how far this is correct. From 26th July till 17th August the value of the quotient declines. After the division the lines of LN 20-20-op, LN 20-13-op and LN 20-9-op at first drop a little and then gradually rise. The deviations of the horizontal line are however slight so that in this period there is a fairly good proportion between the respiration and the non-reducing sugars. With LN 20-5/4-op the value of the quotient continues declining up to planting, and at planting it is then considerably lower. With LN 20-17-op it continually keeps on rising up to planting. A month after the planting the differences have chiefly disappeared again.

With the lots, which were planted at 13° C., the value of the quotient increases rapidly at first after which a slower increase ensues and then drops again. The proportion is not so clear here.

As the non-reducing sugars chiefly consist of sucrose, the respiration was also calculated on the basis of this sugar. A proportion is however hardly perceptible here.

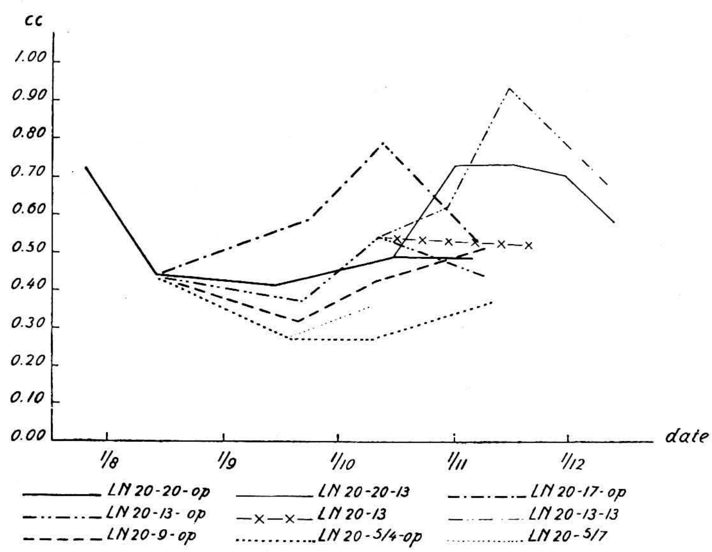

Fig. 1. Le Nôtre. Season 1934—1935. Carbon dioxide liberation (calculated on the basis of 20° C.) divided by the non-reducing sugars.

From the proportion found between the intensity of the respiration and the concentration of the non-reducing sugars, we can deduce something concerning the way in which the sugars discussed are formed.

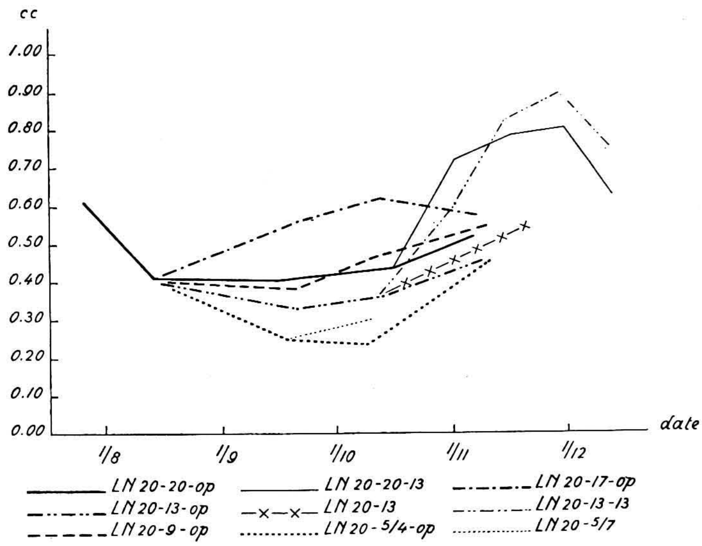

Fig. 2. Le Nôtre. Season 1934—1935. Oxygen consumption (calculated on the basis of 20° C.) divided by the non-reducing sugars.

Three views are possible with regard to their way of formation:

1°. The starch-decomposition takes place according to the scheme: starch → non-reducing sugars → reducing sugars.

2°. The reducing sugars are formed in another way than as indicated in 1°.; the non-reducing sugars are secondarily formed out of the reducing sugars.

3°. Both possibilities are combined.

As the concentration of the reducing sugars is very small up to some time after the planting and decreases rather than increases, the supposition expressed in 2°. leads to the presumption that the reducing sugars, which arise through unknown intermediate reactions are partly respired, and for the rest are converted into non-reducing sugars. According to this view, a proportion between the non-reducing sugars and the respiration is not very explicable. A proportion with the reducing sugars would then be more conceivable.

It is therefore more probable that the reducing sugars are formed via the non-reducing sugars. The greater the concentration of the latter sugars, the quicker the reducing sugars will be formed from them under otherwise equal conditions. Notwithstanding this fact, their concentration between 20° and 9° C. is however the same and at 5 (4)° C. only a little higher. A simple explanation for this equality is the assumption, that the reaction: non-reducing sugars → reducing sugars is so tardy that the reducing sugars formed are immediately respired. In these circumstances the respiratory process is thus limited by the quantity of respirable sugars available and its rate depends on the intensity with which these sugars are formed. As the rate of this formation calculated on the basis of equal temperature depends on the concentration of the non-reducing sugars, it is clear why the respiration, calculated on the basis of 20° C., in such a great measure is proportionate to this concentration. The low value of the quotient at 5 (4)° C. perhaps shows that the concentration is so high here that it no longer acts as a limiting factor for the respiration. Through this the percentage of reducing sugars too, may be somewhat higher. It is not yet explicable why the quotient with LN 20-17-op before the planting is so high.

As a matter of fact the proportion discovered is not absolute; just before and after planting especially at 13° C., the respiration increases more rapidly than in accordance with the concentration of the non-reducing sugars. This can be attributed to an acceleration of the reaction: non-reducing sugars→reducing sugars, e.g. by an increase or activating of the enzymes which control the rate of this process. There however exists a possibility too, that as the season advances, continually more reducing sugars are being formed by another way than via the non-reducing sugars. In other words the case put in 3° is becoming more and more actual. When in this way reducing sugars are formed faster and faster a point of time comes after which the respiratory enzymes are no longer able to utilize all of these sugars and from now on the percentage of reducing sugars begins to increase.

After the intensity of the respiration has been largely deduced from the quantity of the non-reducing sugars and the small percentage of reducing sugars has been attributed to respiration, the question is raised to what factors the increase of the non-reducing sugars in the cooled bulbs are due.

The temperature treatment and the non-reducing sugars.

Also on discussing the relationship between temperature treatment and the amount of non-reducing sugars, the respiration has to be considered. The increase of these sugars at a lower temperature can be explained in two ways. It can be a result of a quicker starch decomposition but also of a slower sugar utilization, so in our case of a slower respiration.

According to MÜLLER—THURGAU (3) the latter possibility has been realized with the potato.

The quantity of starch which at a certain date since 26th July has been converted into sugars, is equal to the increase of the sugars existing, increased with the quantity which till that time has been respired.

In table III (1) and fig. 3 the result of this calculation is summed up on a basis of 1 K.G. dry weight. The starch decomposition is quicker in proportion to the temperature being lower, except that it is slower at 9° than at 13° C. In the period from 17th August till 9th October, at 5 (4)° C. about twice as much starch is converted than at 20° C.

SNELL (4) also arrives at a similar conclusion with the potato. At the same time he refers to HOPKINS and SCHANDER, who also combat the view of MÜLLER—THURGAU.

The differences largely disappear after the planting. The bulbs which have received a warmer treatment overtake the more cooled bulbs through a more rapid starch decomposition.

Shortly after the planting too, the lowering of temperature promotes the sugar formation. This is evident if LN 20—13—op is compared with LN 20—13—13 and LN 20—20—op with LN 20—20—13. In both the

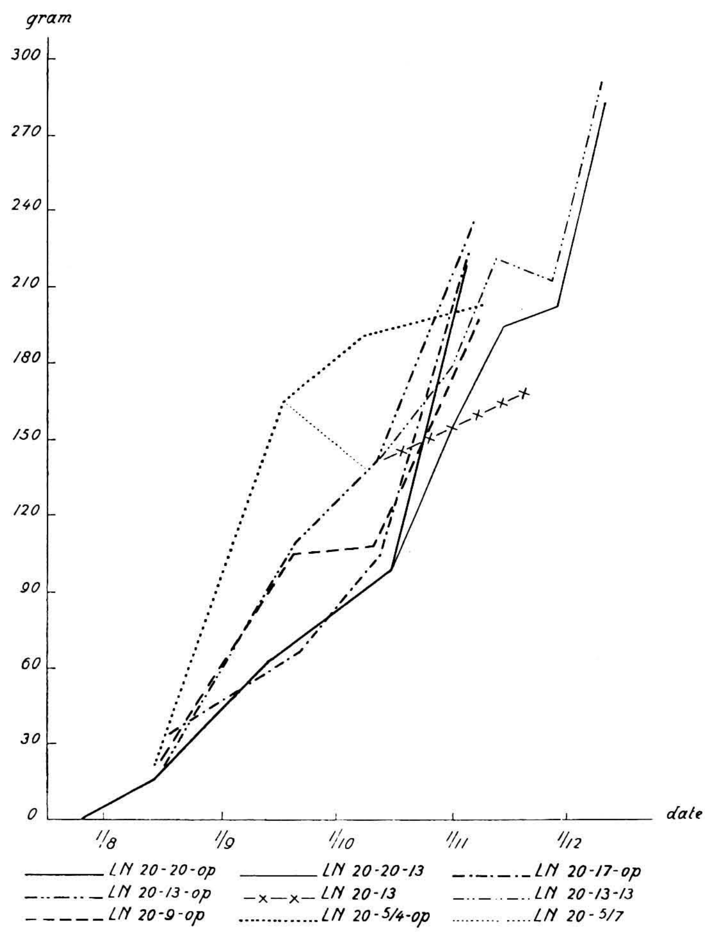

Fig. 3. Le Nôtre. Season 1934—1935. Sugar increase since 26th July + respired food per K.G. dry weight (in gr.).

cases the sugar formation at 13° C. is less rapid than in the open, although the average temperature here was 9° C. The difference between

LN 20—13—13 and LN 20—13 shows that the planting is also of influence.

In general a chemical conversion takes place quicker at a higher than at a lower temperature. This gives rise to the assumption that through the effect of the temperature something changes in the bulb, through which just the reverse is brought about.

So in this way cooling would for instance be able to effect an increase or activation of the enzymes which control the reaction starch→sugars. By greater enzyme activity the retarding effect of a lower temperature would be more than compensated.

This explanation does not seem to me to be correct, for if this were the case, then the bulbs at planting would have to contain more enzyme in proportion to the cooling having been cooler. As all the lots planted in the open have been subjected here to the same temperature conditions, then the cooled bulbs should form sugar at the greatest rate. The reverse is however the case.

At planting LN 20—13—13 will contain just as many enzymes as LN 20—13—op and LN 20—20—13 as many as LN 20—20—op. The warmest planted bulbs should then form sugar quickest. Likewise LN 20—13—13 should be more rapid than LN 20—20—13. It is rather tardier, although the difference is not very great.

LN 20—5/7 in the period from 24th September till 9th October should also be quicker than LN 20—5/4—op. Instead of increasing, a part of the sugars is even re-formed into starch.

According to my point of view, the following explanation, is at least provisionally, more satisfactory. This explanation makes use of the principle of the moving equilibrium. This principle says, as far as it applies to the temperature, that with a process which takes place under evolution of heat, the entire quantity of substance formed increases by a lowering of the temperature. In other words the process only comes to an equilibrium at a higher concentration of the substance formed.

The analyses indeed show an influence of the temperature on the equilibrium concentration of the non-reducing sugars (Table II and fig. 1 of the preceding publication).

The bulbs of the season of 1934—1935 were lifted on 20th July 1934. Round about this date the outside temperature was about 20° C. From 20th July till 24th July the bulbs were in an unwarmed bulb house, where the temperature will also have been in the neighbourhood of 20° C. On the 24th of July the bulbs were transferred to a room where the temperature was regulated exactly at 20° C. On 26th July they had therefore been exposed to 20° C. for some time. The fact that on 17th August the percentage of non-reducing sugars is equal to that on 26th July indicates that an equilibrium has been reached. Only such a quantity of sugar is formed as is absorbed by the respiration. If the parcel is divided on 17th August and the bulbs transferred to 5, 9, 13 and 17° C. resp. remain at 20° C., the latter will be near to their equilibrium. The others are further removed from it, in proportion to their having been put in a lower temperature and as a reaction passes quicker in proportion to its being removed further from its equilibrium, the sugar formation, for this reason will take place more rapidly as the temperature is lower. This tendency is apparently stronger than the retarding effect of the fall of temperature.

It is not known whether the concentrations at planting on 9th October are equilibrium concentrations. The differences would perhaps have been still greater on the treatment being prolonged further.

The fact that all lots after having been planted in the open a month contain about the same amount of non-reducing sugars, proves that under the influence of the equal temperature, average 9° C., they tend to reaching the same equilibrium concentration. This equilibrium concentration according to the principle of the moving equilibrium is clearly lower than the concentration attained at 4° C. on 9th October.

Both the lots too planted at 13° C., notwithstanding their differences at the time of planting, tend to attain the same equilibrium concentration which, as was to be expected, is lower than with the bulbs planted in the open.

Finally, the behaviour of LN 20—5/7 can still be mentioned. Its concentration is lower on 9th October than on 24th September, apparently because the concentration at 5° C. had then already become greater than corresponded to the equilibrium at 7° C.

The question arises whether the principle of the moving equilibrium can really explain everything here. The hydrolytical splitting of starch into sugars is a process which is attended with a very small evolution of heat and therefore only a slight equilibrium shifting can be expected.

BĚLEHRÁDEK (2) however points out that the position of an equilibrium is also shifted a.o. by viscosity- and chemical changes of the medium.

The possibility exists, that the bulb, at a lower temperature has a different percentage of water than at a higher temperature. Table II of the preceding publication (1) shows that LN 20—5/4—op indeed contains a little more water than e.g. LN 20—20—op. But LN 20—9—op contains as much as LN 20—20—op, although at 9° C. there are far more sugars. In spite of the slight differences in the entire amount of water, yet at a lower temperature a greater part of the water can be "free", be available to dissolve the sugars in it and in this way to dilute the concentration through which the sugar formation takes place more easily.

It is not inconceivable that the temperature influences one or more of the mentioned factors and in this way indirectly affects the rate of the sugar formation.

Although it has clearly appeared that before and shortly after the planting the non-reducing sugars are formed more rapidly at a lower than at a higher temperature, the behaviour of M 3 w 17—9—9/17 shows with respect to M 3 w 17—9—9 that some time after the planting the sugar formation is on the other hand promoted by a higher temperature. Should this observation be correct, then this contrast is difficult to explain. Apparently during the course of the development an exchange of limiting factors takes place. At first the conversion is controlled by a process, which at a low temperature takes place quickest; after that by a process the rate of which increases by a rise of temperature.

Morphological development and carbohydrate metabolism.

Finally some remarks about the question which relationship there exists between the morphological development and the carbohydrate metabolism.

The quickest extension of the young plant is at about 13° C. in the period from 17th August until planting on 9th October. This low optimum can be explained by two factors:

1⁰. The direct temperature influence through which in the range of 5 to 20° C. the growth is quicker in proportion to the bulbs being in a warmer place.

2⁰. Through the greater store of non-reducing sugars at a lower temperature, the plant will have a tendency to grow more rapidly at a lower temperature. Presumably the reducing sugars here too are the direct source of food, but their forming is accelerated by a higher concentration of the non-reducing sugars.

Through the co-operation of both these factors, a curve is formed, the optimum of which is evidently at about 13° C.

In the introduction it has also been discussed, that the optimum shifts to higher temperatures in the course of the season. On the ground of the above, this is possible if the forming of the sugars is promoted by a higher temperature than is the case earlier in the season.

With the Murillo's of 1929—1930 the amount of reducing sugars during the first period after planting at 9° C. and in the open, is greater than at 17° C. (M 17—17—17). This may be partly due to the smaller concentration of the non-reducing sugars, and presumably partly to a stronger respiration at 17° C. After 1st January the reducing sugars of M 17—17—17 increase; even much faster than in the open with M 17—17—op. Round about this time there exists a possibility that the optimum is at a higher temperature.

The fact too, that previous cooling shifts the optimum quicker, can be connected with the carbohydrate metabolism. This already appears from the often discussed behaviour of M 3 w 17—9—9/17 with respect to M 17—17—17. The former lot can at 17° C. increase its percentage of reducing and non-reducing sugars quicker and is therefore already at an earlier date capable of growing faster at a higher temperature.

From this it appears that the "after-effect" of the cooling applied in summer exists in an increase of the capacity so as to form a sufficient amount of sugars from the stored starch at a higher temperature.

If the lots of 1929—1930, which in the middle of December contain about equal amounts of reducing and non-reducing sugars were to be forced into bloom at 20° C. or higher in about that period, it would appear that the rate of extension of the plants is very different. Judging from their equal concentration of sugars this was not to be expected. The differences in the rate of stretching are however understandable, when we think, that as a result of their dissimilar summer treatment they have an unequally strong capacity to form useful sugars sufficiently fast at a high temperature.

This however does not mean that the "after effect" exclusively exists in the possibility of a more rapid sugar production. No more than the whole developing process can only be explained by the carbohydrate metabolism. We only intended to show that certain quantitative differences in the carbohydrate metabolism can be connected with quantitative differences in the rate of the morphological development.

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Botany. — *Occurrence and transport of a substance causing flowering in the Soya bean (Glycine Max L.).* By J. KUIJPER and L. K. WIERSUM. (Communicated by Prof. J. C. SCHOUTE.)

(Communicated at the meeting of October 31, 1936).

The question whether a substance causing flowering in plants exists, is still unanswered. In a recently issued publication KNODEL [1]) once more puts the question quite clearly; there are two principal views on the matter: one, indicated by KNODEL as the conception of KLEBS, to the effect that

[1]) H. KNODEL. Lässt sich die KLEBS'sche Ansicht über die Abhängigkeit der Blütenbildung von der chemischen Zusammensetzung der Pflanze aufrechterhalten? Z. f. Botanik **29**, 449 (1936).