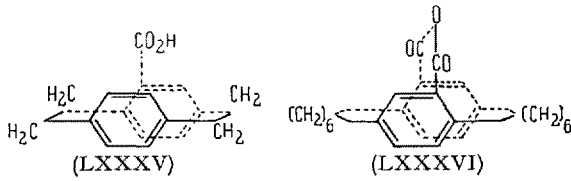the second benzene ring. The forms represented are evidently both *R*.

(LXXXV) (LXXXVI)

(6) *Summary of the Generalized Scheme*

It may be convenient to bring together in note form the explanations and procedures set out and illustrated in the foregoing sections.

Classification of Asymmetry. Atomic covalencies up to four are to be covered. The elements of asymmetry are the centre, in practice identified with the asymmetric atom, the axis, and the plane.

Sequence Rule. In order to classify configuration about an element of asymmetry, we order the groups about it by an application in turn of the following sub-rules:

(0) Near end or side precedes far (inapplicable to the asymmetric atom).
(1) Higher atomic number precedes lower.
(2) *Cis* precedes *trans*.
(3) *R* precedes *S* (for pseudo-asymmetry only).
(4) Higher mass-number precedes lower (among isotopes only).

Conversion Rule. Among the groups of highest priority follow the right- or left-handed pattern of their sequence from the side of the model remote from the group of lowest priority.

Labelling Rule. According as the pattern is right- or left-handed, label the element of asymmetry *R* or *S*, or, in the case of a pseudo-asymmetric element, *r* or *s*.

Zusammenfassung

Ein früherer Vorschlag[4] für die Spezifizierung der asymmetrischen Konfiguration organischer Verbindungen wurde modifiziert und erweitert. In der vorliegenden Abhandlung wird mehr Nachdruck auf Beispiele gelegt, welche das Verfahren erläutern, als auf eine formelle Darlegung der Prinzipien in allgemeiner Form. Die prinzipiellen und praktischen Gründe, welche für ein allgemeines Verfahren zur Spezifizierung der absoluten asymmetrischen Konfigurationen sprechen, werden diskutiert. Da ein solches Verfahren nur auf wenigen eindeutigen Regeln beruhen soll, muss es folgende Bedingungen erfüllen: 1. die Reste, welche die Asymmetrie bedingen, müssen auf Grund einer permanenten, internen Eigenschaft geordnet werden; 2. das dreidimensionale Muster, welches so erhalten wird, muss direkt als Klassifikationsgrundlage dienen.

Ebenso wie in der früheren Mitteilung wird auch in der vorliegenden Abhandlung als ordnende Eigenschaft von Gruppen, welche sich in ihrer chemischen Konstitution unterscheiden, die Atomnummer verwendet. Darüber hinaus wird gezeigt, wie die feineren Unterschiede, welche Asymmetrie verursachen, wie die Atommasse sowie Konfiguration und Position der Gruppen, berücksichtigt werden können.

Das Verfahren wurde soweit ausgebaut, dass man es auf alle bekannten Typen der optischen Isomerie organischer Verbindungen anwenden kann. Zur Spezifizierung der Konfiguration werden neue Symbole vorgeschlagen, welche ausschliesslich die absolute Konfiguration darstellen sollen.

Formation of the Resting Condition in Plants

Environmental Factors Causing the Onset of Rest

By A. VEGIS[1], Uppsala

The question concerning the formation of resting condition, i.e., of quiescence of plants, has not yet been solved in spite of its great theoretical and practical importance. The formation of resting condition before the onset of the season unfavourable for the growth has been known for some time[2]. But, inspite of all efforts made, it has, however, not been possible to achieve any success in establishing the environmental factors which under natural conditions are responsible for the formation of resting state. This circum-

stance has been the cause of considering the rest period as an unalterable peculiarity in plants, which is hereditary and does not come about by the influence of environmental conditions[3]. Such a conception is even now advocated by some investigators[4].

[3] M. TREUB, Bull. Soc. roy. Bot. Belgique 26, 182 (1877). – G. HABERLANDT, *Eine botanische Tropenreise* (Engelmann, Leipzig 1893). – A. F. W. SCHIMPER, *Pflanzengeographie auf physiologischer Grundlage* (Fischer, Jena 1898). – G. VOLKENS, *Laubfall und Lauberneuerung in den Tropen* (Gebr. Borntraeger, Berlin 1912). – S. SIMON, Jb. wiss. Bot. 54, 71 (1914).

[4] E. BÜNNING, Naturwissenschaften 31, 493 (1943); *Entwicklungs- und Bewegungsphysiologie der Pflanzen* (Springer, Berlin, Göttingen und Heidelberg, 1948).

[1] Institute of Physiological Botany, University of Uppsala.
[2] E. ASKENASY, Bot. Ztg. 35, 793 (1877).

However, already GASSNER's[5] experiments with *Chloris ciliata* have shown that at high temperatures the non-resting caryopses do not germinate when placed on moistened filter paper under germinating conditions in darkness. This "loss" of capability to germinate caused by a long stay at high temperature under germinating conditions in darkness, could not be neutralized later either by illumination of the germinating seeds or by removal of the seed coats. Seeds recently freed from their seed husks and placed under germinating conditions at high temperature did not show any "loss" of readiness to germinate and germinated as well in darkness as in the light. During the germination in darkness, treatment with oxygen at high temperatures had the same favourable result on germination as the removal of the seed coats. When the seeds were freed from their husks and treated with oxygen the percentage of germination did not increase. Therefore it was concluded that ordinary partial oxygen pressure is sufficient for germination. In contrast to this the seeds with husks showed full percentage of germination only in an atmosphere strongly enriched with oxygen. Thus in case of seeds covered with husks the latter render some difficulty for the access of oxygen to the inside of the grain and consequently the partial oxygen pressure in the air is not enough to induce the germination. The promotive effect of light on the germination could be observed also in the seeds freed from husks when the supply of oxygen was experimentally reduced. Thus, light influences germination by affecting the seed, i.e., the embryo.

GASSNER was convinced that the caryopses have permanently lost their ability to germinate since they did not germinate later at optimum conditions. Therefore he did not consider this phenomenon in connection with the formation of resting condition in the seed embryo. This connection was proved significantly later by the investigations of DAVIS[6] with experimental objects more suitable for this purpose. When fruits of *Ambrosia trifida* L. were placed in moist medium at high temperature, a number of fruits did not germinate. The germination of fruits depends upon the degree of after-ripening, the temperature, and oxygen available to the embryo within the fruits. The oxygen supply is controlled by the membranes encasing the embryo and also by temperature. At high temperature an adequate oxygen supply corresponding to the demands of the embryos not after-ripened cannot be maintained. As a result of such limited oxygen intake, embryos that are not thoroughly after-ripened are often prevented from germination. The fruits or seeds that do not germinate at high temperatures do not die, but after a time revert to a resting condition and must again be returned to the cold and go through another

after-ripening process before germination can take place. The cause of secondary dormancy in embryos appears to be due to restricted aerobic respiration at high temperatures.

The embryos of *Xanthium* seeds at maturity do not exhibit any tendency to resting when placed under germinating conditions. The resting state, however, may be induced in the embryos of intact seeds at temperatures at which germination ordinarily takes place, provided that the oxygen supply to the embryos supplemented by means of clay or agar is restricted to the extent where no germination takes place[7]. Although a restriction of the oxygen pressure by the seed membranes was found to be necessary for the formation of resting condition, yet it did not develop in the absence of oxygen. An oxygen supply to the seeds just below that necessary to cause germination at a rather high temperature appears best for the formation of resting state. When seeds, the embryos of which have been rendered resting, were kept moist and at low temperature, the resting condition disappeared from the embryos after some time. There are known to be other cases, pointing to the decisive importance of the restriction of the oxygen supply in inducing the resting stage in the seed embryos[8].

APPLEMAN[9], who thoroughly studied the resting state of potato tubers, also came to the conclusion that the primary reason for the formation of resting state is due to low permeability of the periderm to the gases. Consequently, the buds cannot be supplied with enough oxygen for the continuance of growth. It should also be noted that the buds of lily bulbs, like the seed embryos mentioned above, readily become resting if the supply of oxygen is limited[10].

Recent respiratory investigations have shown that also in the young intact resting buds of woody species the oxygen uptake is limited by the rate of oxygen diffusion[11]. In this case, too, the supply of oxygen to the inner part of the bud corresponding to the demands of the aerobic respiration cannot be secured.

It must be emphasized, however, that for the formation of resting condition oxygen supply is necessary to some extent. It was proved by the above mentioned experiments of DAVIS that by stronger limitation of oxygen supply to the seed embryos, the germination can be prevented without the onset of the resting condition. Such seeds, however, germinate very easily when transferred to an atmosphere with sufficient oxygen. If the oxygen pressure in the inside of seeds or buds is below the level necessary for the formation of the resting state, while the oxygen content of the atmosphere is usual, a slight rise of partial

[5] G. GASSNER, Ber. dtsch. bot. Ges. *26*, 350, 504 (1910); *29*, 708 (1911); Jb. Hamb. wiss. Anst. *29*, 1 (1911).
[6] W. E. DAVIS, Amer. J. Bot. *17*, 58 (1930).

[7] W. E. DAVIS, Amer. J. Bot. *17*, 77 (1930).
[8] N. C. THORNTON, Contrib. Boyce Thompson Inst. *13*, 487 (1945).
[9] C. O. APPLEMAN, Bot. Gaz. *61*, 265 (1916).
[10] N. C. THORNTON, Contrib. Boyce Thompson Inst. *10*, 381 (1939).
[11] B. M. POLLOCK, Physiol. Plant. *6*, 47 (1953).

oxygen pressure can obviously cause the formation of resting condition[12]. On the other hand, a strong reduction of the partial oxygen pressure causes accumulation of products of anaerobic respiration, i.e., acetaldehyde and ethanol, as for example at high temperature in hot water. A continuance of the latter can cause injuries or death to the plant organ concerned. A temporary, short lasting, strong restriction of oxygen supply can, however, break the quiescence, which had developed earlier[13]. Especially striking is this phenomenon in the resting buds of *Stratiotes aloides*, which are brought too closely together in a limited amount of water[14].

A number of investigators have shown with many plants that for the formation of resting condition in the buds, the length of day may be of considerable importance[15]. On the other hand, it has been proven that not in all cases can the onset of resting conditions be traced back to the effect of the length of the day[16]. Moshkov (1935) has observed that a sufficiently short day period can bring about cessation of growth in the terminal shoots of woody species only when the temperature is high enough. This incidental observation of Moshkov was regarded lightly. It was also known that *Allium cepa* shapes the bulbs only above the temperature level of $10°$ to $15°C$[17], but also this finding did not consider temperature, which had exceeded certain level, as the cause of formation of resting buds in general.

It was shown in a range of experiments with *Stratiotes aloides*[18] that, when the temperature is raised above a certain level, a further deepening of quiescence in the already resting buds can be brought about and the length of the resting state can be extended. Even the buds, which are in the state of after-rest and can be induced to germination in a narrow temperature range, will be induced to rest again by surpassing for a certain time the upper temperature limit. The extremes of temperature intervals at which the buds are capable of opening extend more and more during after-resting at low temperatures. Simultaneously the buds become more strongly stabilized against the inactivating influence of high temperatures. Under natural conditions the buds are completely stabilized against the in-

activating influence of high temperatures when they begin to open in the spring. A similar phenomenon is observed also during the state of after-ripening of the seed embryos[19]. If the seeds are not after-ripened and are placed for germination at high temperatures, they do not show readiness to germinate and gradually become resting. However, if they are placed for germination at a sufficiently low temperature, but otherwise at equal experimental conditions, they are ready to germinate. In this connection the viviparous germination in cold and rainy weather may also be mentioned, when the seeds have already germinated in the ears of cereals[20]. This applies also to such species of cereals which at higher temperature may be more or less resistant to germination[21]. Likewise the bulbs of *Tulipa*, *Hyacinthus* and *Narcissus* do not show any interruption of development when placed at the right time at low temperature after the differentiation of organs primordia is completed[22]. This low temperature must correspond to the demands of the plants at the beginning of extension growth. In such case the plants mentioned can conclude their cycle of development and growth in nine months instead of twelve.

All the above mentioned observations, as well as the fact that the buds and seed embryos become resting in summer, have convinced the author[23], that *under natural conditions the cause of the formation of resting condition is a temperature too high for growth of the young, recently formed cells, which are surrounded by structures limiting oxygen diffusion.*

The formation of resting in seed embryos and buds may be thought of as an adjustment of the plant to its changing environment. This adjustment helps to ensure the germination of seeds, the sprouting of the buds and the growth of the shoots only under environmental circumstances suitable for the growth. All resting mechanisms tend to restrict periods of active growth to favourable seasons and to limit or suppress growth under less favourable circumstances[24].

Lowering of activity increases resistance against extreme unfavourable environmental conditions. Obviously this response towards high temperatures originated in warm-temperate climate where it serves even now to increase the resistance of plant to heat and drought during certain periods of the year. The utilizing of the resting state, which was caused by high

[12] N. C. Thornton, Contrib. Boyce Thompson Inst. *10*, 339 (1939).

[13] K. Boresch, Biochem. Z. *153*, 313 (1924); *170*, 466 (1926); *202*, 180 (1928). – T. Morinaga, Amer. J. Bot. *13*, 159 (1926).

[14] A. Vegis, Svensk Bot. Tidskr. *43*, 671 (1949).

[15] W. W. Garner and H. A. Allard, J. agric. Res. *23*, 871 (1923). – B. S. Moshkov, Bull. appl. Bot. Genetics and Plant-Breeding *23/2*, 479 (1930); Planta *23*, 774 (1935). – P. L. Bogdanov, Mitt. Staatsinst. wiss. Forschg. Forstwirtsch. u. Holzindustrie *10*, 21 (1931). – P. Kramer, Plant. Physiol. *11*, 127 (1936).

[16] P. Kramer, Plant. Physiol. *11*, 127 (1936); *18*, 239 (1943). – J. R. Jesper and P. Kramer, Forestry *37*, 796 (1939). – P. F. Wareing, Physiol. Plant. *3*, 258, 300 (1950). – C. E. Olmsted, Bot. Gaz. *112*, 365 (1951).

[17] H. C. Thompson and O. Smith, Cornell Univ. Agric. Exp. Sta. Bull. No. *708* (1938). – O. V. S. Heath, Ann. appl. Biol. *30*, 208, 308 (1943).

[18] A. Vegis, Symb. Bot. Ups. *10*, No. 2 (1948); Physiol. Plant. *1*, 116 (1948); *2*, 117 (1949); Svensk Bot. Tidskr. *43*, 671 (1949).

[19] H. Borriss, Jb. wiss. Bot. *89*, 254 (1940).

[20] A. Atterberg, Landw. Vers.-Stat. *67*, 127 (1907).

[21] I. A. Kostjučenko and T. J. Zarubajlo, Bull. appl. Bot. Genetics and Plant Breeding. Plant Industry in USSR. *17*, 17 (1936).

[22] A. H. Blaauw, Proc. Kon. Akad. Wetensch. Amsterdam *29*, 1843 (1926). – A. H. Blaauw, I. Luyten, and A. M. Hartsema, Verh. Kon. Akad. Wetensch. Amsterdam, afd. Natuurk. 2de Sect. *26*, No. 7 (1930). A. H. Blaauw, A. M. Hartsema, and E. Huisman, Proc. Kon. Akad. Wetensch. Amsterdam *35*, 803 (1932). – E. van Slogteren, R. H. S. Daffodil Yearbook *1935*, 48.

[23] A. Vegis, Svensk Bot. Tidskr. *43*, 671 (1949); Symb. Bot. Ups. *14*, No. 1 (1955).

[24] J. Bonner and A. W. Galston, *Principles of plant physiology* (Freeman & Co., San Francisco 1952).

temperatures, for the overcoming of the cold period of the year is evidently a phenomenon of secondary nature. This was proved to be possible in cases where the resting state had not ended when the cold period of the year had started. In cold climates the resting state ends in many cases only after the influence of low temperatures of long duration. Already KLEBS[25] has defended to his death the view that the formation of resting condition must be comprehended as a reaction of the plant to unfavourable environmental conditions.

Through further investigations with *Hydrocharis*-plants it is experimentally proven that the formation of "winter buds" occurs only above the 10°C level[26]. There is no doubt that the circumstances in this respect are similar also in other plants. However, within certain temperature limits and at least with plants forming the resting buds according to the short-day pattern (*Allium cepa* is the only one positively established case where the hypotrophic resting buds, the bulbs, are formed according to the long-day pattern[17]) the formation of resting buds can be prevented by means of sufficiently long daily light periods, the growth, on the contrary, will be continued.

In *Hydrocharis*, and to all appearances in other plants of the same group, among them also most of the woody species investigated, the actions of temperature on the above mentioned level, and of light, have proved to be antagonistic to each other. Higher temperatures aim at the formation of resting buds and the initiating of the resting condition; the light, however, counteracts that and promotes the continuance of growth[27]. As long as the temperature does not exceed a certain limit, the light, acting a minimum number of hours per day, is able to prevent the formation of resting buds and the onset of quiescence.

Thus, it can be considered as proven, that under natural conditions the environmental temperature is of decisive importance in inducing the formation of the resting condition as well as in the commencement of the development of resting buds. The low permeability of the enveloping structures is apparently a presupposition for the formation of the resting condition under the influence of high temperature both in fruits, seeds and in the resting buds; the enveloping structures separate the growing points of these forms from surrounding air and restrict the oxygen diffusion. A limitation of oxygen access at high temperature causes a diminished capacity of aerobic respiration and setting in action certain anaerobic processes, which lead to interruption of growth and

to onset of rest. The temperature effect on the buds can appear only if by short day response the daily light periods are not too long. Likewise, at high temperatures the promotive effect of light upon the germination of seeds not after-ripened, requiring light, apparently comes about on account of the light neutralizing the growth inhibiting effect of this temperature.

It should be emphasized that by means of high temperature only such growing points can be brought into a state of quiescence as are not stabilized against the influence of high temperatures at a limited oxygen supply and as show the ability to grow only within narrow, relatively low temperature limits. Fully after-ripened embryos germinate or after-rested buds shoot even better at high temperatures than at low ones, and such buds when shooting have become independent of the day length[28]. With such buds no inhibition of growth appears from the influence of high temperatures, which might be compensated by the influence of sufficiently long daily light-effect. In similar way the after-ripened seeds, which in immature state require light, are ready to germinate also in darkness. On such seeds the light no longer promotes, but not seldom inhibits. Obviously, the light can exert a double effect on the germination of seeds not after-ripened, whereas the promotive effect prevails over the inhibitory. In the fully after-ripened seeds no inhibition comes into being as a result of temperature influence, which might have been suspended by light. Therefore only one inhibitory effect of light on germination appears here.

Stabilisation against the inactivating action of high temperatures can obviously be explained by certain changes in the respiratory chains, perhaps by their oxidases being replaced by others. In aerobic respiration, which is necessary for extension growth, the hydrogen, i.e., electrons, removed by dehydrogenation from metabolites must be transfered from pyridine nucleotides (DPNH and TPNH) or dehydrogenases to its ultimate acceptor, the molecular oxygen, by carrier systems. Apparently in the embryonal cells of young growing points this transport proceeds comparatively slowly[29]. The limited oxygen availability reduces this already low rate of transfer still more. At high temperatures these carrier systems in young embryonal cells cannot reoxidize the pyridine nucleotides, i.e., dehydrogenases with appreciable velocity. Under such conditions the oxidative breakdown of the intermediates of aerobic glycolysis cannot keep pace with their formation. The latter becomes much more accelerated than oxidative breakdown[27]. In these circumstances lipids, which still more limit the rate of oxygen

[25] G. KLEBS, *Willkürliche Entwicklungsänderungen bei Pflanzen* (Fischer, Jena 1903); Sitzungsber. Akad. Wiss. Heidelberg, math.-naturw. Kl. *2 B*, 23. Abh. (1911); *4 B*, 5. Abh. (1913); Biol. Zbl. *32*, 257 (1912); *37*, 373 (1917); Abh. Akad. Wiss. Heidelberg, math.-naturw. Kl. *3*. Abh. (1914); Jb. wiss. Bot. *56*, 734 (1915).
[26] A. VEGIS, Exper. *9*, 462 (1953).
[27] A. VEGIS, Symb. Bot. Ups. *14*, No. 1 (1955).

[28] P. KRAMER, Plant Physiol. *11*, 127 (1936). – S. P. BULGAKOVA, J. Bot. de l'URSS. *22*, 413 (1937). – A. VEGIS, Exper. *9*, 462 (1953); Symb. Bot. Ups. *14*, No. 1 (1955). – P. F. WAREING, Physiol. Plant. *6*, 692 (1953).
[29] G. W. TODD, Physiol. Plant. *6*, 169 (1953).

diffusion into the cells, accumulate in the boundary layers of cytoplasm[30]. Under conditions, which bring about the termination of resting state, for example at a low temperature, the lipids, whose accumulation at the cytoplasm surfaces characterizes the onset of resting state gradually become dissolved[30,31]. Simultaneously the transfer of hydrogen, i.e., the electrons, to molecular oxygen is more and more brought about by another route, namely *via* carriers of high effectiveness, with great turnover numbers. Moreover, it seems that these transferring systems of the embryonal cells, which have passed through a rest period, are more protected against inhibitions. The more rapid hydrogen transfer to molecular oxygen obviously accelerates also the rate of oxygen diffusion. Even at high temperatures oxygen is brought fast enough into the cells to reoxidize the reduced pyridine nucleotides, i.e., dehydrogenases, as rapidly as they are formed. Therefore the carbohydrate breakdown products become completely oxidized and few or no lipids, which cause the development of resting condition, are produced[27].

The arresting effect of high temperature on growth can be connected with the formation of lipids[30] and growth inhibiting substances[32]. The presence of lipids and growth inhibiting substances is proven, for instance, in resting buds and seeds. The influence of daily light periods, which promotes the growth, apparently comes about due to production, activation or larger accessibility of the growth promoting substances such as indoleacetic acid and possibly also of other substances. As is known, auxin stimulates oxygen uptake[33], to all appearances it is able to promote the transfer of hydrogen, i.e., electrons, to molecular oxygen in the embryonal cells. It has been repeatedly shown that the resting state of the buds can be terminated by the supply of auxins in proper concentrations[34]. It should be mentioned that the shoots of "witches brooms", which are obviously richly provided with growth promoting substances by means of the corresponding fungus, apparently do not possess a clear resting stage[35] and are able to shoot forth at any time without any treatment when the environmental conditions are favourable.

It is clear that even at long daily illumination at high temperature the young growing points of many plants, especially perennial plants, can be supplied with nutritive mineral salts, auxins and other active substances necessary for the overcoming of inhibition and maintenance of growth, only at a restricted rate[36]. In a composed system of growing points, as for example in a shoot of a tree, at high temperatures, even during a long day, only the terminal growing points can be supplied with the missing substances which are necessary for the growth and removal of inhibition. In addition to that this supply of some active substances can obviously be provided only for a limited time. Most of the growing points in the system, especially those in the axils of the leaves, are formed as resting buds very soon and are left for inhibition. On the other hand, the shooting of newly formed axile buds is a common phenomenon in the woody species, especially in young plants, which shoot early in spring when the temperature is relatively low. Moreover, these axile buds shoot without previous formation of bud scales and without temporary suspension of growth[37]. The formation of such sylleptic shoots from the young axile buds without a preceding resting state can be observed also in the proliferous stumps of the felled trees[38]. In spring, when the resting buds are fully rested and stabilized against the influence of high temperatures, not only the terminal, but also most of the lateral buds are ready to shoot. The primary reason of the correlative inhibition of the axile buds is not the inhibitive influence of the terminal bud, but of too high a temperature. Against the latter, the terminal growing points can be protected longest.

Zusammenfassung

Die Einstellung des Wachstums und die Entstehung des Starre- bzw. Ruhezustandes, sowohl in den Ruheknospen als auch in den Samenembryonen, kann unter natürlichen Verhältnissen durch die Wirkung der Temperaturen hervorgerufen werden, die oberhalb des Bereiches liegen, in welchem die betreffenden jungen Vegetationspunkte zur Zeit mit dem Streckungswachstum anzufangen imstande sind. Bei den jungen, noch nicht hinreichend ausgeruhten bzw. nachgereiften Vegetationspunkten ist dieser Temperaturbezirk eng und liegt verhältnismässig niedrig. Während der Nachreife bzw. Nachruhe steigt aber sowohl die maximale als auch die optimale Wachstumstemperatur immer höher. Oberhalb der jeweiligen maximalen Wachstumstemperatur kann in den jungen meristematischen Zellen der Vegetationspunkte, bei denen die Sauerstoffdiffusion durch die Knospenschuppen bzw. Frucht- und Samenschalen be-

[30] A. Vegis, Symb. Bot. Ups. *14*, No. 1 (1955).

[31] N. A. Satarova, Doklady Akad. Nauk SSSR *62*, 713 (1948); Trudy Inst. Fiziol. Rast. im. Timirjazeva *7(1)*, 67 (1950). – P. A. Henckel, Proc. 6th Internat. Bot. Congr. (Stockholm, 1953), p. 789.

[32] T. Hemberg, Arkiv Bot. *33B*, No. 2 (1946); Acta Horti Bergiani *14*, *133* (1947); Physiol. Plant. *2*, 24, 37 (1949); *4*, 437 (1951); *5*, 115 (1952); *7*, 312 (1954).

[33] B. Commoner and K. V. Thimann, J. gen. Physiol. *24*, 279 (1941). – J. Berger, P. Smith and G. S. Avery, Amer. J. Bot. *33*, 601 (1946). – J. Bonner, Amer. J. Bot. *36*, 429 (1949). – L. Anker, Proc. Kon. Nederl. Akad. Wetensch. Amsterdam *54*, 525 (1951); Acta bot. Neerl. *2*, 22 (1953.)

[34] A. Vegis, Acta Soc. Biol. Latviae *7*, 87 (1937). – H. U. Amlong and G. Naundorf, Gartenbauwiss. *12*, 116 (1938). – J. P. Bennett and F. Skoog, Plant Physiol. *13*, 219 (1938). – G. Borgström, *The transverse reactions of plants*, Thesis Lund 1939.

[35] H. C. Schellenberg, Ber. dtsch. bot. Ges. *33*, 118 (1915).

[36] K. Goebel, *Einleitung in die experimentelle Morphologie der Pflanzen* (Teubner, Leipzig/Berlin 1908).

[37] K. Goebel, Bot. Z. *38*, No. 45–50 (1880). – H. L. Späth, *Der Johannistrieb*, Diss. Berlin 1912.

[38] K. Goebel, *Organographie der Pflanzen*, I. T. 2.Aufl. (Fischer, Jena 1913).

grenzt ist, ein den Forderungen der aeroben Atmung entsprechender Sauerstoffzustrom nicht gesichert werden, was zur Einschränkung der aeroben Atmung führt, die eine Voraussetzung für das Streckungswachstum ist. Im Zusammenhang damit entstehen im Stoffwechselverlauf Änderungen, die in der Bildung der Hemmstoffe und in Lipoidanhäufung in den Grenzschichten des Plasmas resultieren, wodurch Wachstumseinstellung und Ruheeintritt verursacht werden. Solche Änderungen des Stoffwechselverlaufes können aber nicht bei ausgeruhten Vegetationspunkten hervorgerufen werden, obgleich sie dieselben Sauerstoffdiffusion begrenzenden, einhüllenden Strukturen besitzen. Gewisse Beobachtungen lassen vermuten, dass die Leistungsfähigkeit der enzymatischen Systeme, der sogenannten Atmungsketten, welche die Übertragung des Wasserstoffes bzw. der Elektronen von den reduzierten Pyridinnukleotiden (DPNH, TPNH) und Dehydrasen auf den molekularen Sauerstoff vermitteln, bei jungen meristematischen Zellen merklich geringer ist als bei den ausgeruhten. Die oben erwähnten Stoffbildungen können bei hohen Temperaturen offenbar nur durch Zusammenwirken beider Umstände zustande kommen. Allem Anschein nach be-grenzen die bei hohen Temperaturen entstehenden Hemmstoffe die Wasserstoffübertragung in jungen meristematischen Zellen noch mehr. Allerdings kann die Leistungsfähigkeit der erwähnten Übertragungssysteme bei hohen Temperaturen, so lange sie nicht zu hoch liegen, auch in jungen meristematischen Zellen, zum Beispiel denen vieler Knospen, durch eine hinreichend lange tägliche Lichtperiode mehr oder weniger lange auf einem Niveau erhalten werden, bei welchem das Streckungswachstum fortdauern kann und Ruheeintritt unmöglich ist. Es .scheint möglich zu sein, dass dabei Wuchsstoffwirkung von Bedeutung ist. Im Laufe der Nachruhe werden die oberflächlichen Lipoidanhäufungen des Plasmas aufgelöst, und die Wasserstoffübertragung auf molekularen Sauerstoff wird immer mehr durch viel effektivere Systeme übernommen. Eine Zunahme des Sauerstoffverbrauches steigert offenbar auch die Geschwindigkeit der Sauerstoffdiffusion. Völlig ausgeruhte Vegetationspunkte sind in viel weiteren Temperaturgrenzen wachstumsfähig und können durch die Wirkung hoher Temperaturen nicht mehr in Ruhe versetzt werden. Das Streckungswachstum tritt bei ihnen unabhängig von der Tageslänge ein.

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Inhibition par le phényléthylacétate et le phényléthylproprionate de la formation des radicaux acétyles actifs

Dans l'étude thérapeutique de l'action hypocholestérolémiante de l'acide phényléthylacétique Cottet, Mathivat et Redel[1] suggèrent que ce médicament agit en bloquant le coenzyme A nécessaire aux réactions d'acétylations qui aboutissent à la formation du cholestérol.

Nous avons étudié l'action des acides phényléthylacétique (PEA) et phényléthylpropionique (PEP) sur la formation de l'acétyl-coenzyme A, qui est un intermédiaire important dans la synthèse du cholestérol.

Dans les organismes supérieurs, on connaît deux réactions principales formatrices d'acétyl-coenzyme A, selon que le substrat est l'acétate ou le pyruvate. La réaction utilisant l'acétate a été trouvée par Lipmann et Kaplan[2] dans le foie de pigeon, celle utilisant le pyruvate par Green et coll.[3] dans le muscle pectoral de pigeon. Notre étude a porté sur l'une et l'autre réaction.

I. *Cas de l'acétate*. L'enzyme de foie de pigeon forme de l'acétyl-coenzyme A à partir du mélange acétate ATP coenzyme A; son activité est déterminée en mesurant l'acétylation du p-aminophenylsulfamide[2]. Le phényléthyl-
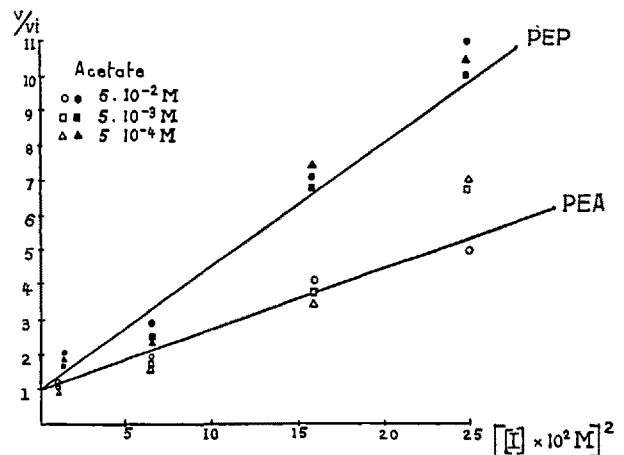

Fig. 1.

acétate[4] et le phényléthylpropionate sont des inhibiteurs de cette réaction.

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[2] N. O. Kaplan et F. Lipmann, J. biol. Chem. *174*, 37 (1948).
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[4] S. Garattini, C. Morpurgo et N. Passerini, Giorn. ital. chem. Ter. *2*, 60 (1955).