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Phytotron -C. N. R. S.
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PHYTOTRONIC NEWSLETTER No 8

Summary

I. Editorial

Here is a new issue of our bulletin, the second for this year 1974, which, unfortunately, is appearing with much delay and for which, we hope, our readers will excuse us.

Some of our readers have provided us with benevolent financial aid, either personally or through official or private organizations. We again would like to ask these kind donors to please send their donations to us filling in the cheques or money orders in the name of :

R6gisseur Avances et Recettes, C. N. R. S. Circonscription Gif-Orsay,
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with the endorsement : Participation aux frais de parution du Bulletin "Phytotronic Newsletter".

We are unable to send receipts for the donations due to CNRS policies. However, in the next issue, the third for 1974, we will provide a statement of the amounts received, since the beginning, of the bulletin's publication.

In addition, due to the increased costs of postage it is no longer possible for us to continue sending our bulletin by air-mail, and it is with great reluctance that we must do so as our readers have become-too numerous. Below is a detailed account of expenses for the English edition sent abroad. It is evident that the cost of stamps represents about 60"/0 of expenses, the air-mail postage representing more than half the cost :

English Edition	Number of Copies	Total Expenses	Cost of Stamps
N° 1 . November 1971	915	841, 35 F. F.	503, 25 F.F.
N°2.May 1972	1117	2629, 65	1645- 25
N° 3. October, November 1972	1535	5168, 50	2450. 60
N° s4, 5, 6. November December 1973	1658	6199, 50	3868, 30
N°7.May June 1974	1689	5169, 60	2928, 60

Therefore, as the Phytotron of Gif-sur-Yvette assumes more than *90%* of the expenses, we are obliged to send all issues by boat starting with the present issue.

We would like this opportunity to reproduce below a paragraph from a letter October 11, 1974 from Professor P.J.Kramer (Duke University, USA).

"At the moment, I would be inclined to put emphasis on exchange of information through the Phytotronic Newsletter and other media as less expensive and more practical than a large meeting. After some discussion with Hellmers and Downs, it seems to us that it might be worthwhile to consider converting the Newsletter into a journal for the exchange of information".

We kindly submit this idea, which is identical to the one we held ever since the initial publication of the Phytotronic Newsletter, for our readers' reflection and ask them to give us their opinions, suggestions. questions, answers or remarks. We will publish the' maximum amount of information that we receive.

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The summary of the present Bulletin, as everyone can see, covers a wide ground, because we constantly seek to extend our efforts for informing not only scientists but also industrialists and practitioners.

We analyze an international meeting which was held in Paris and give the list of papers presented at another which was held in Vienna, Austria,

In passing we salute the Ecole d'Horticulture de Versailles which is 100 years old this year.

But all Phytotronists probably will be interested and pleased to see the section Research Strategy enlarged and where we have reproduced extracts from an article by Dr. P. Chouard, published in the Encyclopedia Universalis under the title Phytotronique. In the same section is included the contribution received from Dr.I.Horvath on the small Phytotron in the Botanical Garden in Szeged (Hungary) as well as that of Dr. J. W.O'Leary (USA) on the growth of plants at high humidity.

We are particularly happy to open up our bulletin to Eastern countries and, aside from the paper from Hungary mentioned above, to reproduce a text which comes to us from Ing. B. M. Chetverukhin (USSR) on a system of information and control developed in Kiev. This text as well as information concerning the growth chambers of Warren Sherer (USA) should be added to the list of manufacturers given in issue no.2 (May 1972).

In the section, information, we call attention particularly to the opening of a new Phytotron in the Philippines inaugurated September 24, 1974 and for which we wish a bright future in all areas of rice culture which hopefully will make it possible to solve the problem of the basic food in numerous Asiatic countries.

In closing we urge our kind readers to report information or notices of any meetings or ideas liable to interest our readers.

Thank you in advance.

P.Chouard and N. de Bilderling

II. The Sun at the Service of Mankind

International Congress held at Paris (France)

July 2-6,1973

Sponsered by Unesco, organized by the International Solar Energy Society (ISES), Cooperation Mediterraneenne pour 1'Energie Solaire (COMPLES), Association Francaise pour l'Etude et le Developpement des Applications de 1'Energie Solaire (AFEDES) and Centre Amenagement et Nature, this Congress, held in the Unesco building, brought together some 650 participants from 59 countries to take stock of the "role and effects of solar radiation as directly related to man and his environment • Sun and Life, Sun and Energy, Sun and Housing". It was indeed a multi-disciplinary gathering during which about 300 papers selected by Scientific and Technical committees were discussed.

Any books were published after this Congress and those persons who want to receive documents can contact the Institut Francais des Combustibles et de l'Energie (IFCE) 3 rue Henri Heine , Paris 75016-France.

From all the papers we have chosen only several/from the general Section Sun and Life which is directly linked to plant Biology for which we give a brief analysis below, based on the documents given to those attending the Congress.

B13- Solar radiations and plants.

7 papers are foreseen :

1) PHOTOSYNTHESIS: AN UNFOLDING DISCOVERY. E. RABINOWITCH (USA).

Photosynthesis a discovery on the frontier between biology, chemistry, and physics took 75 years (1770-1845) and involved five outstanding men from all parts of Europe, each contributing one part to the overall formula describing this fundamental process of life on earth (Priestley, Ingenhousz, Senebier, de Saussure and Mayer). Since 1845/three important developments had been : 1) Deciphering of the enzymatic path by which CO is converted to carbohydrate made by Melvin Calvin ; 2) The discovery of the "photosynthetic unit", a physical resonance mechanism, by Emerson and Arnold and 3) The discovery that the primary process involves two successive photochemical steps in two different types of reaction centers and is catalyzed by two different pigment complexes. We are still far from complete understanding of photosynthesis and from being able to control it in the living cell and imitate it outside it.

2) Coefficient of utilization of solar radiation energy by natural and cultivated phytocenoses. A.A.NICHIPOROVICH (USSR).

No summary.

3)Captation of solar energy by maize crop. P. CHARTIER, R. BONHOMME and C.VARLET GRANCHER (France).

Utilization of solar energy by crop depends upon

1)interception of solar radiation by the crop (soil cover, albedo),
2)repartition of absorbed photons between the different leaves,
3) physiological responses of leaves at the given stage of growth.

For maize plants with high photosynthetic productivity (C4 type), the yield at any moment equals at a maximum 6, 6% of the incident radiation. Maximal photosynthetic yield of leaves is lower than 17% for the only visible part of spectrum.

4)Solar irradiation and wind velocity on slopes. The predominant factors for plant life in subalpine habitats. H. T URNER (Switzerland).

No summary.

5)The effect of quality and intensity of light on the weight of dry matter, content of pigment in chloroplasts and N Y K and Ca in maize plants M. R. SARIC and M. J. PETROVIC (Yugoslavia).

The highest weight of dry matter was under yellow-orange and white light, whereas the lowest one was under blue light. When light intensity decreased to 22. 500 lux, the weight of dry matter decreased considerably. The content of pigments in chloroplasts was highest under white light. Under lower light intensities chlorophyll content is higher. The content of N, P, K and Ca was specific in dependence of light of different wave lengths. Special effect of the deficiency of the individual ions and light intensity was not noticed. In most cases the content of ions was higher under lower light intensity.

6)Interaction between photosynthesis and phytochrome action: importance for plant morphogenesis. R. JACQUES (France): Photosynthesis influences photomorphogenic responses in plants (vegetative growth and reproductive development) regulated by the phytochrome. It is impossible to precisely define "critical photoperiods" which depend on the flux density and their spectral distribution in the course of the photoperiod. The exact links between the two principle pigmentary systems (chlorophyll and phytochrome) simultaneously stimulated in natural light, are still unknown.

7)The effects of air ions on plants. A. P. KRUEGER, S. KOTAKA and E. J. REED (USA).

High densities of positive or negative ions elicit the following functional changes: increase integral elongation and dry weight by ca 50%, stimulate production of cytochrome C and other Fe-containing enzymes, augment Fe uptake, alter the active and residual Fe content of the tissues, raise the rate of 02 consumption, affect the swelling and shrinking of isolated chloroplasts, inhibit EDTA-induced bleaching and increase RNAse activity of leaves.Air ion depletion slows the rate of growth and decreases normal turgor. Based on this work, a hypothetical mechanism of air ion action on plants are developed.

B23-Luminous microclimates in Plant Life.

8 papers are foreseen.

1) Soil-Foliage interaction in the solar radiation budget of a cordon vineyard. M. FUCHS and G. STANHILL (Israel).

No summary.

2)A calculation model and descriptive formulas for the extinction and reflection of radiation in leaf canopies. J.GOUDRIAAN (The Netherlands).

The model describes the interception and reflection of radiation by the components of the canopy. The angular distribution of the incoming and reflected radiation is taken into account. Repeated scattering is executed in wavebands where the leaves have a high scattering coefficient. It appears that in most cases the radiation profile may be approximated by an exponential extinction with leaf area index. Some formulas are given for a rapid calculation for the thus found extinction coefficients and for the reflection coefficients, Generally these formulas are sufficiently accurate, compared with the results of the model.

3)Solar radiation distribution and its effects on photosynthesis in a spruce forest canopy. P. G. JARVIS, R. E. NEILSON and J. M. NORMAN (U. K).

No summary.

4)Plant- community photosynthesis as related to insolation climate. S. KUROIWA (Japan).

Effective foliage architecture for photosynthesis was theoretically analysed in relation to insolation climate variable with latitude.

1.As to the ideal foliage, vertical change of extinction coefficient for isotropic light k was mathematically clarified. On the basis of this k-change, a geometrical architecture of the ideal foliage was modeled; the horizontal leaves clump to make a cluster structure in the upper and middle layers, and disperse at random in the lower and regularly in the bottom layer. 2. From analyses of effective foliage angle for photosynthesis, it was concluded for a wide range of latitudes that a vertical-leaf type is more effective than others in rich foliages but a horizontal-leaf is a little more effective in isolated foliages. 3. Using theoretical formulae it was clarified that daily total photosynthesis is proportional to day length D and increases a little much with D-increment even under a constant amount of daily total insolation.

5)Interception and use of sunlight energy by different types of vegetation of the Mediterranean Region. F.E.EGKARDT, M.METHY and R.SAUVEZON
(France).

The survival of green plants is based on their capacity to secure a positive balance between input and output of energy. This is achieved through a combination of many different structural and functional properties which may vary greatly from species to species.

6)Photosynthesis and growth of plant canopy in relation to solar radiation climate. T. HORIE -(Japan).

A model was developed for simulating plant canopy photosynthesis and growth only by radiation climate as environmental factor. Growth curves of sunflower plants grown under varying radiation climates were simulated using experimentally determined plant parameters. Simulated growth curves showed a good correspondence to the observed curves both in ordinary radiation climate and in drastically changed climate. It was made clear that three important factors are concerning in the plant growth response to radiation climate:photosynthesis, specific leaf area and allocation ratio of photosynthates.

7) Statistics of sunflecks and its application to light flickering problems in plant communities. S. ISOBE(Japan).

The application of Miller and Norman's formulation to the canopy of horizontal elliptic leaves isotropically distributed in azimuth yields the distribution of sunfleck size.

8) Solar radiation estimation in and under forest canopy M.DUCREY (France).

Different methods has been used: measurements with pyranometers and estimations with hemispherical photographs. Data are given for stands of Pinus sylvestris and Fagus sylvatica. Then, emphasis is laid upon the comparison of data obtained with the two methods. Advantages and disadvantages of hemispherical photographs are discussed; this brings out the limits of utilization of this method in forest stands. It allows the appreciation of forest canopy structure and particularly the distribution of leaf areas.

B33-The solar radiations and balance of energy in plant life.

7 papers are foreseen :

1) The sun and the stomatal apparatus. T. A. MANSFIELD, *F. S.* MARTIN and H.MEIDNER (UK).Analysis of importance of endogenous rhythms in stomatal movements and how these interact with diurnal changes in the environment. Results of recent investigations into the role of active ion transport in stomatal physiology are presented and critically considered. The use of antitranspirants is discussed with a view to assessing future possibilities of influencing stomatal movements to promote improved plant growth.

2)Utilization of sun energy for crop production B. 0. BOBROWSKA (Poland).

No summary.

3 Investigations on lowering the energy dissipation and rising the utilization of radiation. Zh. V. STOJANOV and R. J.FLOROV(Bulgaria).

Energy dissipation during photosynthesis/ photo-respiration was determined on the ground of thermodynamics of irreversible processes and efficiency coefficient of gross photosynthesis was calculated. The efficiency coefficient determined in this manner was tested under various environmental conditions (e.g. air humidity, mineral nutrition).

It is possible to lower considerably the energy dissipation and to rise the efficiency coefficient by means of mineral nourishment, e.g. nitrogenous salts.

4)Thermodynamic approach to evaluate utilisation of sun energy by plants. R. J. FLOROV (Bulgaria).

The living systems are thermodynamic oppen systems, which receive free energy, utilise it by different internal processes and accumulate it as biomase, a part is dissipated during the different internal processes irreversibles and is eliminated in the milieu as heat across the control surface. The measure of dissipation is the rate of production of entropy, which

is possible to determinate by the thermodynamic forces and flux between the control surface and milieu. The maximal accumulation of free energy is connected with the minimal production of entropy. The minimal production of entropy is connected by plants with the minimal value of the heat exchange and temperature difference leaf-air and the unhindered transpiration.

5)Influence of stomata regulation on the transformation of sun energy through leaves. S. de PARCEVAUX (France).

Most of the energy absorbed by leaves is used, as latent heat, for the vaporization of the water lost through transpiration. An equation of leaf energy budget has been established for the most general case, in terms of various physical and biological parameters. Besides radiation, the relevant physical parameters are thermic or aerodynamic ones (thickness of the boundary layer). Biological phenomena are only revealed by one parameter, the leaf diffusion length, the variations of which mainly depend on stomata regulation. This regulation plays an essential role in transpiration and photosynthesis. The energy absorbed through photosynthesis is generally unimportant as compared to the other factors of energy exchanges. Approximate values are given for each element of the budget which emphasizes the importance of stomata regulation.

6)Energy balance and evapotranspiration at different levels. R. J. BOUCHET and A. PERRIER (France).

No summary.

7) Photoenergy of plants and the use of concentrated sunlight for raising crop yields,A.A.SHAKHOV (USSR).

The irradiation of non-photosynthesizing organs (seeds, tubers, pollen) by concentrated sunlight pulses gives significant increase of yields. The principal value of pulsed-light irradiation consists in its mutagenic effect. As a result of it a promising new field has emerged in plant breeding, the production of highly efficient forms of farm crops. The primary processes in non-photosynthesizing organs exposed to intensive illumination are probably based on biphoton reactions, formation of free radicals, stimulation of the activity of enzymes.

D13- Optimization technics of solar energy. Utilization in agriculture Greenhouses-Solar driers.

17 papers are foreseen :

1)Solar cabinets for combined crop irrigated culture with aquaculture in water economy concept. H. BOUTIERE and P. COULOMBON (France).

Devices allowing integration in a single installation of vegetable cultivations watered with fresh, or in some cases , brackish water and breeding of fisches or aquatic invertebrates are described. Solar energy is employed for salt water still and photosynthesis. The principe can be applied to light installations as well to heavy structures with several levels.

2)Solar stills for agricultural purposes M. K. SELCUK(USA) and V.V.TRAN (Canada)

A mathematical model describing heat an mass transfer a system combining a Solar Still with a greenhouse, its solution and test results of a small scale unit, built at the Middle East Technical University, Ankara, Turkey , are discussed.

The unit was employed to demonstrate technical feasibility of the system. It has to be developed further and modified for larger scale operations. The basis of an optimization study which is underway at the Brace Research Institute of McGill University in Montreal, Canada, aiming to find the best combination of design and operation parameters it also presented.

3)Solar distillation applied to protected cultivations, J. F. M. RONCHAINE

In hot countries, protected cultivations do not yet exist like those in cold countries. They could be feasible by protecting the crops against the exceeding heat which could be used to desalt sea or brackish water for their irrigation.

Several combinations are to be investigated: winter cultivation alternated with summer desalination by a conversion of the installation ; utilization of the solar energy reflected by the shading system and otherwise lost; interposition of a transparent double acting screen conditioning for plants and distillating for water. This research needs collaboration of the techniques of solar energy, desalination and agronomy.

-r)Role of sun light in the definition of greenhouse climate, J.DAMAGNEZ and all. (France).

No summary.

5)Models as tools in greenhouse climate design, I. SEGINER (USA).

No summary.

6)Sunlight intervention into thermic balance of shleters R. BARTOLI and A.GAC (France).

Certain parameters play an important role, among others: soil thickness and form of the superstructure, on trapping solar radiation and on the regulation of day and night temperatures. During the night use of exterior antiradiative screens prove useful.

7)Qualitative and quantitative modifications of solar radiation in greenhouses linked to the form and material of the covering. A.NISEN (Belgium).

The covering modifies, especially quantitatively, incident radiation; few qualitative modifications of radiation are observed, except in the case of colored materials, normally reserved for shading. The form and orientation of the greenhouse conditioning the energy balance on the plant level, must be calculated bases on the time when the culture envisaged will be used and the type of covering being utilized.

8)Optimal shape of greenhouse roofs deduced from the solar shape of tree crowns and other plant surfaces. M. BITTERMAN and D.DYKYJOVA (Czechoslovakia)

A new type of solar greenhouse deduced from the heliotropic growth curvature of tree crowns and plants sown in clumps in described. The shape and windows differs, on the global scale, according to latitude and the corresponding declination of the sun. The asymetric roofs intercept a large proportions of perpendicularly incident solar radiation in the early spring and late autumn months. As a result of the better irradiation and microclimate the plant yields are increased and the flowering and ripening of fruits is enhanced.

9)Role of sunlight energy in the heat of the greenhouses at Quebec T.A. LAWAND and all (Canada).

Conventional greenhouses in Quebec are studied with a view to redesigning the structure in order to optimize the amount of luminous radiation incident on the plant canopy while minimizing the thermal losses. Although, at the moment, the final optimized shape of the proposed greenhouse is not known, one potential new structural design is proposed which reduces the exposed surface area without significantly affecting the input of direct solar radiation. Experiments are continuing on the measurement of parameters needed in the extension of these optimizations. The uses of reflective screens during the night and new structural greenhouses design should reduce thermal losses by 54 to 67% in Quebec. High prices of fuel pose an opportunity to solve these problems.

10) Covered cultures in Chili. B. LEPE and G. FRICK(Chili).

No summary.

11) Thermodynamics of sun-drying .Mrs.W.SZULMAYER (Australia)

The process of sun-drying of sultanas as practised by farmers in Australia has been investigated, and the results show a correlation of drying rates with temperature and relative humidity of the air as well as with exposure to sun. By incorporating sorption isotherms of sultanas into the Mollier i-x diagram, (or psychrometric chart) the changing vapour pressure gradients between the drying surface and ambient air can be determined, as drying progresses. The method is suitable for predicting whether a product can be dried to the required low moisture level in prevailing weather conditions, when the limit of drying is reached, and when water re-sorption by the product will occur.

12)Heat transfer characteristics of a solar drier. M.A.S.MALIK (Canada) and F.H.BUELOW (USA).

As low as 6°C rise in outside air temperature is sufficient to speed up the drying of farm crops to moisture contents safe for storage. This can be accomplished by using a simple solar collector which can be readily incorporated into the design of a conventional roof. Heat transfer characteristics of such a collector are investigated in this paper. Two types of roofs, namely a flat and a corrugated one, can be used on the collector. Solar collector with a corrugated roof shows improved heat transfer but also results in a higher pressure drop. Satisfactory correlation between theory and experiments is seen to exist.

13) A natural convection solar crop drier. 0. St. C. HEADLEY and B . G . F. SPRINGER (Trinidad).

A new tune of Solar drier consisting of a flat elate collector a drying cabinet and a dehumidifier has been developed for various types of crop drying. A sloped flat plate collector heats the air and passes it by natural convection into a drying cabinet where it removes water from the fresh crop. The cooled moist air then falls to the bottom of the drying cabinet and is pulled through the dehumidifier and back into the base of the flat plate collector by the upward convection draught generated by the collector. Water is removed from the system as a liquid and the system operates without any mechanical aid.

14) A crop drier Utilising A Two Pass Solar Air Heater. S,SATCUNNANATHAN (Trinidad).

A crop drier was built based on the two pass solar air heater with the drier section placed below the collector. This design eliminates insulation of the bottom of the collector and provides for a compact unitary construction. Air is heated by being drawn through the collector and is then passed through the drier. Several types of crops were experimented with and the results proved quite satisfactory.

15) A Solar timber Kiln. W. R. W. READ, A. CHODA and P. I. COOPER (Australia).

An experimental installation consisting of a prefabricated kiln, a solar energy collector and a rockpile thermal storage unit to be used for timber drying is described. The mode of operation and the overall performance of the system, including the quality of the dried timber and various observations made during the drying runs are discussed. An economic assessment is made of the process and comparisons made with conventional drying procedures.

The results to this stage have shown that timber can be dried successfully. However further operating experience is required to improve the system and to obtain design criteria for future installations. Initial cost estimates indicate that the economics are slightly in favour of conventional drying. However, future work will be aimed at improving the performance of the system in an attempt to make the process economically viable.

16)Solar dryers for Indian Conditions. S. G.KAPOOR and H.C.AGRAWAL (India).

Design of solar dryers, suited to Indian weather and economic conditions, easy to handle and allowing minimum heat losses, is described. The optimum tilt of the dryer is based on a simplified and sophisticated theoretical analysis. Experimental results on few representative fruits and vegetables of summer and winter seasons, are given. Comparison is made of drying rates and final product quality with those obtained for drying outside in the sun. It is found that solar types dryer serves as a very efficient device to dehydrate products hygenically. The estimated fabrication and annual maintenance cost of the proposed unit is considerably low.

17) A New glass-roof solar dryer for cocoa beans and other crops.
B. N. GHOSH(Brazil) .

A new type of sun drying plaftorm for cocoa has been designed and developed at the Cocoa Research Centre of Brazil (CEPEC)which is light in construction and is covered by a fixed glass-roof like a greenhouse. Its cost is much cheaper than a barcarra while the drying efficiency is high, mainly due to a better utilization of the available solar energy. The drying house is also equipped with infra-red heaters located under the platform and use low-cost commercially available gas as fuel, so that the same unit can double as an artificial dryer during rains or at night, thus increasing its effectiveness even further. The disadvantages associated with the other types of artificial dryers do not exist in the new system. In the present paper, the design and construction of the glass-roof solar dryer is discussed, which can also be used for drying practically any other crop on the farm.

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In closing we note that on the occasion of this International Conference several meetings or study days were held, including one on Research methods for the biometeorological environment of man organized by the Office Francais de Recherche de Bioclimatologie (OFRB) and the Soci€te M6tereologique de France (SMF).

Study Session "Sun and Biology"

held on January 17, 1974 in Paris

This study session organized by the Association F rancaise pour le developpement des applications de 1'6nergie solaire (AFEDES) and the Socidte Francaise des Thermiciens (SFT) at the Institut Francais des Combustibles et de l'Energie (IFCE-3 rue Henri Heine, 75016-Paris) had as its objective to summarize the work of the conference "The Sun at the Service of Man" in its relation to biology.

From this gathering we have only reported on the part which relates to plant biology for our readers, from the morning session presided by Professor M.Moyse.

4 papers either summarized the work of the conference or illuminated the current state of research and possible or desired orientations.

a) Photosynthesi s M. Moyse (Orsay).Of the 700 watts per square meter of energy that the sun pubs at the disposition of the plant 50% is lost (infra-red). The photosynthetic process produces glucosides which place themselves at a mid-point between carbon and hydrocarbons. For agriculture the study of photosynthetic yield is important because the autocatalytic processes consume a part of the energy stocked by photosynthesis and relttilized for the growth and formation of plant material (foliar, in particular). If one draws up a balance sheet of the initial energy transmitted one has on an average:

10% directly reflected

20% crosses without absorption and feeds the second foliar stratum
20% re-emitted in thermic from in the ambient air

49.4% used in the form of heat (transpiration, absorption and translocation of mineral salts, maintenance of temperature, able to go up to 10% above ambiance, and all enzymatic and catalytic transformations).

0.5% to 0.6% the rest, finds itself in the glucidic synthesis. In the laboratory the maximum yield of light energy obtained for algae was 30%.

Types of research done or to be undertaken : 1) Choice of plants-plants in C_4 of desert areas (sorghum, corn) fixed CO_2 better than the plants of our countries as a result of their better adapted enzymatic systems. Types to hybridize or else for more interesting end products for man.

2)Amelioration of light absorption by increased use of foliage in diverse strata. Decrease of too high, photorespiration, causing a loss of up to 20% of unused energy.

b)Photosynthesis at the plant canopy. P. CHARTIER (INRA).

In the cycle for fixing carbon by plant cover the maximum yield observed is of 2.6% for a period of 10 minutes. The principle loss in CO_2 occurs either at the time the culture is installed or else after cutting. In a normal culture the water cycle must be considered to avoid exaggerated evapotranspiration.

c)Use of solar radiation in agriculture: Greenhouses-Solar driers . J. DAMAGNEZ (INRA).

The cost of fuel has laid to rest the problem of profit in certain greenhouse vegetable production, particularly lettuce. In France the power installed in greenhouses is from 250 to 300 Kcal/Hour/sq.meter with a maximum of 350 for the East. Possible and necessary research includes :

l)role of the double wall on the interior temperature

2)kind of heating energy support: covering, radiative by air or heating by ground or by walls.

3)agronomic study of the kind of management for flat culture or else vertical for tomato or cucumber, for example.

4)greenhouse conceptions to limit heating costs. It should be noted that there are about 1000 Has of greenhouses of light plastic in the Mediterranean area. Use of heating pumps; aspersion of warm water on the walls in the winter and cold water in the summer,

5)Optic cleanliness of walls in order to ameliorate and distribute light while limiting solar infra-red radiations in the summer. Study of diffusing mate rials permitting a better penetration of the plant cover.

6)As concerns drying, reminders about several installations presented and which are of particular interest to African or South American countries.

d)Solar radiation measurements of interest to biologists. C.PERRIN de BRICHAMBAUT (M6teorologie Nationale).

Solar radiation covers a very large spectrum of which only a small part is of interest to plant biology. Measurements must be done in energetic units watts/si .meter, for example, instead of luminous measurements in lux. In solar radiation two light components: direct and diffuse. Terrestrial long wave-

length radiation (5 to 50 microns) should not be neglected when calculating the radiative balance of a surface. Importance of near ultra-violet: 280 to 400 nrn, The methods and measurement apparatus must be standardized.

In a general conclusion for this very important and necessary conference we are glad to say that it satisfied perfectly the desire of its organizers to provide a unique occasion for looking at work being done and to provide an exceptional amount of documentation to participants. For our part we only regret the absence of a written compilation of all the lectures that were given.

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[III. - JOINT MEETING-IIR-ORE-Commission El I

(International Institut of Refrigeration-Office for Research and Experiments of the International Union of Railways) Vienna (Austria) September 3-7,1973.

The objects of this meeting are: Air conditioning of rooms and vehicles: tests, comfort, criteria, noise and vibration; load analysis; overall economies in installations

As several conferences might interest our readers we give below titles of papers presented :

Section I. -Controlled environment testing.

Chairman: M. TOEGEL (The Netherlands) -8 papers :

1) N. de BILDERLING (France)-Technology of a phytotron: the installation at Gif-sur-Yvette.

2)F.H.FOCKENS et R.KOPPE (The Netherlands),Investigation into the performance of phytotrons.

3)H. GRATEPANCHE et P. PRET (France)-Vehicle testing climatic chambers.

4)S. A , SAPOZHNIKOV, V. M. TCHERKEZ, A .A . CHOUSTER (USSR)- A method of investigating the processes of heat transfer and infiltration in insulated transport vehicles.

5)P.NUSGENS(Belgium).Measurement techniques applicable to testing chambers.

6)R.GASSER (Switzerland)-Measuring of small air velocities in air conditioned rooms.

7)L. BATTAREL (France) -The application of direct expansion refrigerating machines to large size climatic testing chambers,

8)H.MICHEL (France)-Electrical heating of premises: some studies and test facilities.

Section 2- Criteria concerning environmental conditions and comfort.

Chairman : H.G.BURNAY (Belgium) - 8 papers

1) R,G.NEVINS (USA) - Evaluation of criteria for the thermal environment for health, comfort and acceptability.

2) P.O.FANGER (Denmark) - The influence of age, sex, adaptation, season and circadian rhythm on thermal comfort criteria for man.

3) B,DELAVAL (Belgium) -A mathematical model for the study of climatic comfort.

4) V.KORSGAARD et T.LUND MADSEN (Denmark)-New instruments for measuring thermal comfort.

5) P.SUTER et CH.CHOULAT (Switzerland)- Strict similarity tests on a reduced model concerning the dynamics of a heated room.

6) T.TROJANOWSKI (Poland)- The localisation of outside air intakes into a contaminated environment.

7) P.E.McNALL Jr. (USA)- Proposed new ASHRAE comfort standard,

8) R.E.J.SHAVE (United Kingdom)- Assessing the acceptability of thermal environmental conditions occurring in industrial buildings.

Section 3- Noise and vibration problems

Chairman : A. B, NEWTON (USA) - 4 papers

1)J. ROBERT (France) - Problems of noise and vibration with air conditioning equipment for railway vehicles. Generalities ; results of measurements carried out on modern railway vehicles.

2) J. ROBERT (France)- Methods used to reduce noise and vibration emitted by air conditioning equipment in modern rail coaches.

3) W.C.MODRE (USA) - Reducing noise and vibration in automative air conditioning compressors.

4) Y.N.CHEN (Switzerland)- Noise generated by multi-jets of acoustic tiles,

Section 4. Load analysis

Chairman : Dr.MEFFERT (The Netherlands) - 11 papers

1)F.STEIMLE et H.SPEGELE (Germany, Fed.Rep.)- The behaviour of flap controlled induction units.

2) 13.TODOROVIC et B.KORENIC (Yugoslavia) -Actual cooling loads from solar radiation through windows in the corner room of a building.

3) M.E.HOFFMAN (Israel) - The evaluation of external surface temperature by the thermal-time -constant method.

4)K. H. SCHEUNEMANN (Germany, Dem,Rep.)- Contribution to the calculation of room temperature under long term load changes (transient behaviour).

5)B.HACHEM (Belgium)- A variational formulation of the problem of the influence of heat capacity, heat sources and ventilation on temperature distribution.

6) O.A.ARNAS et J. J.PORTIER (Belgium)- A study, under non-steady state conditions, of conductive transfer in composite structures.

7) O.A.ARNAS (Belgium)- On radiant energy exchange in enclosures with diffuse-specular surface.

8) J. J. P ORTIER et A . PREUMONT (Belgium)- Integral analysis of an anis otherm wall jet.

9) R.GILLES (France)-Air conditioning load calculations: how to differentiate between thermal structures.

10) R.GILLES et A .GAIGNOU (France)-Commercial glazing in the calculation of air conditioning loads.

11) B.GRAFF (Germany Fed. Rep.)-Possibilities and limits in predicting the air flow in air conditioned rooms.

Section 5- Overall economies in installations .

Chairman : J.TIREL (France) -5 papers

1) H.G.KERSCHBAUMER (USA)- A new approach to improve the efficiency of heat reclaim systems using centrifugal compressors.

Z) A.B.NEWTON (USA)- The economies of subway air conditioning systems using hermetic compressors and solid state inverter drives.

3) U.KNAU (Germany, Fed. Rep.) -The overall economic efficiency of refrigeration systems and air conditioning units for railway coaches, and the significance of energy supply with respect to their design.

4) P.NOVAK (Yugoslavia)- A further analysis of the economical index for heating and air conditioning rating systems.

5) J.TOUS SAINT (The Netherlands)- Load probability versus A .C. systems ability.

Editor's note- All papers with discussions are published under the following title : Air conditioning of rooms and vehicles. Annexe 1973 2- to the Bulletin of the International Institute of Refrigeration .Issued by: Institut International du Froid,177, Bld Male sherbes -75017-Paris-France, Price:118 - 356 pages.

IV.THE SCHOOL OF HORTICULTURE IN VERSAILLES CELEBRATES ITS FOUNDING 100 YEARS AGO

As was noted in our last issue (N° 7) an "open house" was organized in Versailles on June 15,1974 by the Board of Directors of the School and the Alumnae Association. Besides having a reception and exhibit, a very beautiful booklet was published for the occasion entitled: 100 ans d'Horticulture 1874-1974.

This booklet for the school's centenary celebration includes a first chapter written by the alumni and professors which retraces the school's history, noting that the building known as the Directors' Pavillion is the original house built in the 17th cent•:.ry, by Jean Baptiste de la Quintinie. The various ways of educating those planning to work in horticulture and the work done by engineers in France and throughout the world were thus reviewed.

The second chapter is devoted to various aspects of horticulture:ornamental and nurseries, fruits and vegetables, marketing and production studies in different areas. It closes with remarks about equipment.

Research and its evolution are taken up in chapter Three, with particular emphasis on the latest developments in genetics and rapid amelioration of varieties and on progress in the struggle against parasites.

Finally, the last chapter is about the art and technique of landscaping, recalling that with the evolution of gardens came ideas about environment and green spaces. It closes by citing horticultural exhibits.

Throughout this publication there is evidence of the many efforts made by horticultural engineers to safeguard and broaden their speciality, horticulture. In reading or merely glancing through the booklet one realizes how right Olivier de Serres was when as early as 1600 he called a gardener "a goldsmith of the earth because he surpasses the simple farm-laborer as much as the goldsmith surpasses the common blacksmith".

V-PHYTOTRONICS - A NEW STRATEGY FOR FUNDAMENTAL RESEARCH. APPLIED RESEARCH AND APPLICATIONS

For readers of the Phytotronic Newsletter and by way of research strategy at the Phytotron in Gif-sur-Yvette we will be taking up below some portions, and summarizing others from Dr.P.Chouard's article published in the volume "Organum" (20th and last volume) of the Encyclopedia Universalis (Paris, 1973-74, pp.499-505) under the heading "Phytotronics".

In the "art of warfare""strategy" is the movements of armies placed so as to win a battle; in other words, it is the plan of action conceived of by the strategist. In the same way, "tactics" is the art of combining all the means at hand for executing plans of strategy and "logistics" (which differs only slightly from "management") is the supplying of arms as well as food to men. It is this sense of the word strategy that we use when referring to the kind of combat called scientific research and whose aim is to unravel elements of truth which make it possible to interpret nature, or more exactly, relationships between the elements which make it up.

Phytotronics is a new "plan of action" for research in plant biology of which phytotrons and phytotronic devices are logistic means. One might say that phytotronics is not only a technique but a method of approach for a large number of problems of plant biology....lf three of the most important factors in plan development were discovered before 1950, that is before phytotrons, it was by comparing diverse natural conditions, preceding the phytotronic method, which brought about the first experimental knowledge of such functions:

- removal dormancy by the cold (Johannsen 1890-1900);
- vernalization, that is the role of the cold as preparation for flowering (Klippart, 1857; Gas sner, 1918); Gregory and Purvis, 1936-1948; Melchers and Lang 1939-1959);
- photoperiodism regulating flowering by length of day and night (Tournois 1912; Garner and Allard 1920).

These three functions owe their current development to means which have become progressively phytotronic (K.Hamner) and by the use of greenhouses in the form of simplified phytotrons (Borthwick and coll.; Wareing, among others) . The GINIRS Phytotron in Gif-sur-Yvette and other phytotrons throughout the world or the large and numerous phytotronic devices at universities or research centers, are the origin of many publications on these three functions....

Life, in all its forms (and in plant form in particular) is recognizable by the growth of germs which multiply, reproduce, and evolve from youth to an adult stage and to death, Ontogenesis develops necessarily in one or several ambient environments provided that they are compatible with the expression and maintenance of life. As concerns plants, the phytotronic method accomplishes an analysis of modes of intervention by each one of the parameters of the environment and their various combinations ..A description of possible forms of ontogenesis in relation to characteristic circumstances of the environment which preside over their expression is a direct aim of phytotronic strategy.

Ontogenesis is also associated with the so called "molecular" system of expression of genetic information and with the consequences of spatio-temporal structures (cytoplasmic heredity and others analogous) which also are other initial factors of the egg or "germ of life" in their relation to other environmental factors.

The triaeGenetic information - Initial cellular structure-Environment" is the foundation of all life, but the cellular structure represents an anti-chance, a neguentropic production, which all structural development of organized bodies beings show by its increasing complexity. The physical environment modifies the expression of genetic information as well as biologic structure and is modified by the biological environment thus created, so that the resulting basic triad expresses itself in neguentropic language open systems and cybernetics. And it is conceivable that the phytotronic method which analyzes the action of the composition of the environment be a privileged way to approach the plant world, for its beginnings as for its expression and for what it will become.

It therefore remains to give at least a short-term prospective review of types of phytotronic intervention in different branches of plant biology, and particularly of plant physiology.

Experimental ontogenesis of the entire plant is the full time preoccupation of phytotrons and phytotronics devices. The entire arsenal of combinations of factors of the environment can and must be employed as much as possible.

The entire plant is cultivated phytotronically from germination. One can immediately recognize how general conditions for germination (water, oxygen, temperature) are determined and those which hinder it. Classical data in this subject has not yet been systematically taken up in phytotronics.

At the next stage it is the plantlet, then the young plant becoming adult which aria above all put to the test in their juvenile stages. An analysis of conditions for the differentiation of anatomical and morphological structures during this stage of ontogenesis, or stage of vegetative life which makes it possible to interpret manifestations of ontogenesis: Wearing of the plant, ramification process of amphiblastic (emission of special small branches such as stolons, suckers); kind of intervention of the environment on the phenomenon of "topophysics" (foliar forms and structures successively different with advancement in age); length of plastochrones (intervals of time between successive emissions of leaves); variations in the number of foliar helixes and eventual fasciates; speed of growth (in length or expressed in mass)and its modifications;autonomous or aitonomous dormancies.

One is thus able to determine a number of functions which direct the plant' s total productivity and to measure them: total productivity of each sort of organ, productivity in varied sorts of substances (glucosides, proteins, alkaloids, etc.).

When maturity of flowering is reached (once determined, the circumstances and variations in length that it requires), the phytotronic method makes it possible to determine the conditions necessary for flowering or floral turning : passing from the reproductive state, its diverse stages (primary induction, secondary.....) to the final expression of flowering; as well as those conditions which allow for or which regulate the generalization of flowering or its strict localization and diverse factors of the final senescence or protection against this senescence.

At the same time the existence and relative degrees of importance of the major functions or physiological processes of morphogenesis and ontogenesis can be known ; photoperiodism; thermoperiodism; vernalization; various steps leading to dormancy and lifting of dormancy conditions requiring forced rests. Determining the existence of such functions, their relative importance, quantitive values and their interventions as a function of various levels of environmental factors provides a physiological and ontogenetic portrait of each species and eack stock, as well as an essential diagnosis for their behavior in a natural or cultural environment, in other words, for their autoecology.

The phytotronic method implies also the intervention, in the course of different steps of development, of numerous conditions; by successive approximations one can determine the surrounding factors which modify in one way or another, the sequence of events of ontogenesis, of morphogenesis, or in other words, their cultural and physiological program. Thus, one sees phenomena appear, more or less easily depending on the materials used, such as acceleration of senescence in the form of neoteny, phenomena of antisenescence, that is to say of rejuvenation of new abnormal structures so-called

teratological, which open up an as yet barely explored area of experimental teratogenesis, the counterpart of experimental morphogenesis. The exploration of ecophysiologic behavior must be undertaken, that is to say the establishment of "ecophysiological portraits" of all the species in a section or a type, and within numerous families, orders and classes of plants, or in the framework of species and stocks making up units of vegetation or phytosociological units.

Ecology, botanical geography and mycology in particular can benefit from phytotronic methods. Only a knowledge of behavior vis-a-vis surrounding factors for all species and stocks in a limited and well defined territory (e.g. the Alpine stage of the Pyrenees) can lead to interesting conclusions as to the origin of stocking of a certain territory. And this is done by confrontation with the area of dispersion the same species, rare species or near forms, and by phytotronic experimentation of several of these taxons dispersed throughout the world. In plant morphology and plant teratology, morphological concepts could become more consistent due to physiological experiments of a phytotronic nature. It would be the same for anatomy. In the phytotronic method one must also consider genetic information data but with environmental effects and the condition, in space and time, of cellular and pluricellular structures, considered as data facts (axiomatic) while awaiting a better interpretation in terms of energetics of open systems and cybernetics, enriched by phytotronic analysis, Morphogenesis, tested by the strategy of phytotronics, can reconcile the most diverse tenants of plant biology. The correlations of growth and inhibition penetrating into the area of morphogenesis and organogenesis take on a character of correlations and of regulation s of development. The phenomena, simpler than in the case of entire plants, suggest the intervention of substances (auxins, cytokinins, gibberellins, etc .) alone or together, or associated with varied doses of metabolite....

In the larger physiological area of budding, normal or adventitious relative to the organogenesis of roots, stems, flowers, leaves, we know about the role of auxin-cytokinin balance determined by R.Skoog. One discovers there a multitude of new facts which go as far as being able to produce at will roots, stems or flowers from the same types of cells, whether they be epidermic, under epidermic, or others, and separated from all other tissue. Controlling the growth of mother plants, phytotronic conditions making possible budding, combinations regulating growth and metabolites, contribute to this mastery of directed organogenesis. A quantity of hypothesis and problems which, at the highest level, interest the idea of sequences or development programs result from this.

Applying the phytotronic method to more or less isolated tissues, especially to calluses and tissues from calluses, has made it possible mainly to define different types of attraction gradients of propensity for flowering and has given rise to new problems of organogenesis and morphogenesis. The discovery of androgenesis, that is the transformation of male cells, precursor of pollen, or pollinic cells themselves into whole plants remaining haploid, benefit from the phytotronic method which determines the most appropriate conditions for the process to take place or be inhibited. The same goes for the aptitude of isolated cells, called for furnishing photoplasts and for arswering more or less easily the vegetative incorporation of elements.

The use of phytotronic techniques on whole plants as well as on plant fragments under cultivation make it possible to situate the quantitative production of diverse substances, such as glucosides, amino acids, alkaloids, and opens up new perspectives for biogenesis as well as answers for the best conditions for the production of various substances.

The method of climate conditioning can also be applied in vitro to biochemical models which only contain enzymes and some substratum, exposed to conditions of temperature or lighting (particularly to rhythms of lighting and more so in a monochromatic light) which make it possible to corroborate the first conclusions obtained in vivo,

Finally, the same phytotronic methods are applicable to biophysical processes, such as those which concern a search for forms of intervention of the phytochrome in a large number of biological actions and which are at the same time of biophysical and biochemical origin like endogenous rhythms.

There is also the application of phytotronics for the service of man.

The initial stage of technical innovations differs little from fundamental research. In fact, they are the same kinds of research, done for scientific curiosity alone, but where one becomes aware, while looking at them in their diverse aspects, that their results can be transformed into useful techniques either by direct transfer to the art of engineering or because they give rise to complementary research. Here are some examples of such applications :

-Problems of forcing and the work of Blaauw on the ecophysiology of bulbous plants, mainly the tulip and hyacinth.

-Technique for producing chrysanthemums of the most varied sort at any season of the year.

- Acceleration of ontogenesis, e.g. wild plants used as a plant guinea pig.

- Acclimatization of plants, e.g. Veratrurn Viride by Went,

- Ecophysiological research which furnishes criteria for early selection e.g. fodder plants, particularly Graminaceous ones.

- Knowledge of physiological mechanisms of resistance to unfavorable climatic circumstances, particularly drought, cold, salinity or excess heat.

- Study of physiological mechanisms of the pollution of the atmosphere, the earth and the water , e.g.by ozone, smog, or SO_2sometimes lead to modifications in enzymatic systems.

- Problems of organogenesis and plant multiplication, particularly with the meristem culture without virus.

- Problems of specialized productivity: alkaloids, glucosides , starches, lipids, or proteins.

-Problems of global production and optimization of physiological mechanisms of productivity, establishing mathematical models and determining diverse environmental parameters.

In closing, we felt it would be interesting and useful to reproduce M.P.Chouard's conclusions :

. . . Phytotronics appears to be at the same time a technique and a research method. It is notable that in 20 years time phytotrons and varied phytotronic devices have shown that they are important instruments for discovery in the areas of botany and plant physiology. In turn, these discoveries, have given rise to applications which have far-reaching effects on the quantity and quality of agricultural and horticultural production in developed countries as well as in developing countries. These effects are already considerable and will become

more so. Although the phytotronic technique is already very developed, it is necessary to continue to make progress in the technique and its adaptions. In particular, it must be adapted to the requirements of ecologists and bio-climatologists aiming to rapidly transpose their knowledge into natural and agricultural biotypes.

On these grounds phytotronics must constantly seek technical progress which requires expensive equipment-justifiable, however, by its growing importance-and cooperation between researchers, users, production and planning designers on the national as well as international level.

VI.PHYTOTRON IN THE BOTANICAL GARDEN OF ATTILA J6ZSEF I UNIVERSITY, SZEGED, FOR THE STUDY OF THE ECOLOGICAL ROLE OF LIGHT

received from Dr. I. Horvath, Department of Botany,
Attila Jozsef University, Szeged (Hungary)

Based on experience gained in the course of the construction and operation of conditioning apparatuses/photothermostat, small phytotron/, the author is convinced that a phytotron can be constructed more simply if only one of the environmental factors is made to change over a wide spectrum, while the other factors are regulated only in a more restricted interval. The factor adjusted in the wide spectrum is determined by the objective of the research work. In our case this factor is the light.

Setting out from this principle, the plan of a "block phytotron" was prepared /Horvath Block phytotron. Acta Bot. Ac .Sci. Hung. 12/3-4/285-291. 1965/, on the basis of which our phytotron was successfully put into operation in the Botanical Garden of Attila Jozsef University, Szeged, in 1971.

The Phytotron was installed in a house specially built for this purpose, which is surrounded by laboratories. The advantage of this central arrangement is that in this way the effects of the temperature of the environment and of radiation are decreases considerably, /It would have been even more favourable to instal it in a subground floor, but because of the high subsoil water level this would have been a much more expensive solution. /

Four climatic chambers are available for tile growth of the plants in the phytotron, the volume of each chamber being 8 m /2 x 2 x 2 m/. The climatic chambers are separated from the lamps by glass ceilings, and so the lamps barely affect the temperature. This is also ensured by a constant stream of low temperature air above the glass ceiling. Thanks to this, in illumination with phototubes the vertical temperature gradient is very small.

The average values of the temperatures measured at 10-minute intervals for 6 hours at various distances from the glass ceiling in the four climatic chambers are presented in the Table below.

Table

The light, temperature, humidity and air-movement in the phytotron can all be regulated by programme. The gas-composition of the air is constant,

and corresponds to the natural gas-composition of the free atmosphere. This latter is ensured by the fact that the air in the climatic chambers is exchanged at least 20 times an hour. The air supply is provided via a 10-metre high chimney rising above the building.

Chamber	Distance from the glass ceiling/cm/						Average
	10	20	30	40	50	120	temp. /C/
1	23.8	23.8	23.9	24.2	23.9	23.9	23.9
2	24.0	24.0	24.2	24.0	23.9	23.8	24.0
3	24.0	24.2	24.0	24.0	24.0	23.8	24.0
4	24.2	24.1	24.0	24.0	23.9	23.8	24.0

Light conditions

The illumination is primarily achieved with 40 and 80 W phototubes. With the latter it is possible to provide an intensity of illumination of at most 20.000 lux, The use of other lamp types, e.g. halogen lamps, is also being tried, with the help of which intensities of illumination of 40,000-50,000 lux can be attained. The application of different types of phototubes and filters permits the variation of the spectral energy distribution.

Temperature

With the present cooling and heating capacity, the temperature can be regulated in a programmed daily rhythm between 15 and 30°C, independently of the external temperature. The temperature is regulated by an ether-membrane control of our own design, The accuracy of the regulation is + 0.5°C.

Humidity

In the interest of the regulation of the humidity, the air drawn in through the chimney, frequently having a humidity higher than required, is dried by cooling. Independently of the external temperature, this cooling is to + 5°C. The relative humidity of this air at 5°C is 100%, but this falls to 40% on heating to 20°C. Thus, at 20°C or higher temperatures, the control of the humidity of the air in the range 40-90% is possible, varying in a programmed daily rhythm. A hair hygrometer modified by ourselves is used for the regulation. The humidification is carried out with a VISZEK L 5 type/Hungarian manufacture/humidifier mushroom, which sprays water droplets about 20 p in size. The accuracy of the regulation of the humidity is -F 2%

Apart from the regulation of the humidity, the cooling of the air also plays a role in cooling the light sources, for this cooled air is led away above the glass ceiling where the lamps are situated.

The air in the phytotron is at a slight overpressure, which decreases contamination from the adjacent rooms.

Depending on the conditions established, the energy requirements of the phytotron are 10-30 Kw/hr.

Research plan of the Phytotron

In the phytotron first of all the effect of light factors upon the utilization of energy by photosynthesis is studied.

In connection with the light factor special attention is paid to studying the effect of the daily rhythm; besides an overnight rhythm those lasting for three, six, and twelve hours, respectively, are also studied, according to enlig-tening corresponding to "long part of days". This means that in the case of a daily rhythm lasting for three hours two hours will be light and one hour will be the dark phase.

Moreover the effect of strength of light in different daily rhythms/also differing from the natural one/and also of spectral energy distribution is investigated.

Further studies comprise the photosynthetic pigment system as well as studying leaves by light microscope and chloroplasts by electron microscopy.

For the investigations first of all cultivated plants are used: mustard, bean, pea, cucumber, tomato and different species are compared.

VII. USE OF THE PHYTOTRONIC METHOD TO STUDY PLANT GROWTH AT HIGH HUMIDITY

received from Professor J. W.O'Leary -University of Arizona-Environmental Research Laboratory -TUCSON -International Airport- TUCSON-Arizona 85706 USA.

At the Environmental Research Laboratory of the University of Arizona we are convinced that closed-controlled environment agriculture is going to be a significant part of the total agricultural endeavours in desert areas and certain other situations, for many reasons. In order to meet the engineering and economic criteria for feasibility, such closed environment structures pose a unique environment for plant growth -- the high radiation load of desert areas coupled with extremely high humidity more characteristic of wet tropics. In addition, the carbon dioxide level of the enclosed atmosphere must be controlled.

The plant physiology section has the task of investigating the physiological implications of plant growth in this type of environment. Since such a combination of environmental factors rarely has been met in the past, there is virtually no literature available upon which to draw for help. Thus, we have developed phytotronic type facilities to directly answer the pertinent questions ourselves. We have two types of facilities. The first consists of three controlled environment chambers manufactured by ISCO, Inc .of Lincoln, Nebraska which we modified considerably to give us a multi-chamber system in which we can obtain solar intensity of radiation (Sylvania Metal-arc Lamps), relative humidities from low to 95-100%, and carbon dioxide concentrations at any desired level, as well as the normally controlled variables such as photoperiod and air temperature. The second type of facility is a group of four naturally

lighted polyethylene covered chambers which were designed and built entirely by our staff. These units are called Phytocells.In addition to being able to control air temperature and carbon dioxide concentration as well as maintaining 95-100% relative humidity, we can vary air velocity through the 3 meter by 3 meter growing area from 50 to 600 ft min $^{-1}$.

The two most important nneRtions we asked when first confronted with the possibility of growing mesophytic type plants in an environment with radiation loads of 1.0 cal cm $^{-2}$ min^{-1} and higher and a continuous relative humidity of 95-100% were:

(1) When plants are grown in air with continuous 95-100% relative humidity, will the reduction in transpiration be sufficient to significantly reduce the delivery of mineral ions to the leaves?

(2) Will the reduction in latent heat transfer due to the decreased transpiration lead to intolerably high leaf temperatures under the intense radiation in these enclosures?

These types of questions could be answered and possible remedial measures tested only with the phytotronic approach. We found that the transpiration decrease did not lead to significant reduction in mineral transport to leaves. In fact, even when we reduce transpiration further by combining elevated CO2 with the high humidity, it does not seem to seriously reduce mineral delivery to leaves.

The reduced transpiration does increase leaf temperature, but we have found that we can compensate for this by increasing the air velocity through the growing area, thereby increasing the sensible heat transfer from the leaf to the air. The maximum permissible air velocity through the plant growing zone in controlled environment enclosures always has been taken to be about 100-150 ft min^{-1}. However, we have demonstrated that velocities as high as 450 ft/min^{-1} can be used with no harmful physiological effects as long as the relative humidty of the air is very high.

Thus, not only have we managed to answer the specific questions we asked, but we also have provided some beneficial information for application in many other controlled environment situations. These and other problems associated with plant growth at high humidity constitute the major emphasis of the plant physiology group at the Environmental Research Laboratory, University of Arizona.

Note from the Editors.- Since not many places have the capability of doing this type of research, professor J.W.O'LEARY has proposed to sent reprints of papers describing their results to anyone requesting them.

VIII. INFORMATION AND CONTROL SYSTEM FOR FARM CROP CULTIVATION FOR ARTIFICIAL CLIMATE STATIONS (Phytotrons)

We reproduce with great pleasure text received from the Institut of Automatization - 22 Nagozny str. KIEV 252655 USSR -Trig. B.M.CHETVERUKHIN

The phytotron information and control system is designed for automatic central control, digital recording and regulation (adjustment) in accordance with a pre-set program of microclimate parameters of artificial climate stations.

The characteristic features of the system are as follows :

Communication with the object is carried out through a dispersive distributor (commutator) with a main communication channel containing 15 wires irrespective of the number and type of connected pickups.

Use is made of the compensation method of measurements which ensures a high accuracy of central control and for all practical purposes rules out the effect of impedance of the connecting wires, of transient resistances of the contacts and their variations on the measurement results,

Provision is made for an automatic correction of the individual characteristics of the pickups, which enables the magnitudes of systematic errors to be substantially reduced.

A new communication system is used which makes it possible to easily match the high operating speed of the central control machine with the relatively low operating speed of the actuating mechanisms of the adjusting controls.

SPECIFICATIONS

Number of controlled and regulated (adjusted }points..... 496
Ranges of measured and regulated values:
- by relative humidity of air within temperature range of 5 to 50°C , % 30 to 98
- by temperature , °C ..... minus 50 to plus 50
- by illumination, thou lux..... 10 to 100

Basic measurement error :
- of temperature, °C .....+ 0, 3
- of relative air humidity, % + 2

Discreteness of assignment of programmed values of controlled parameters :
- by temperature, °C 1
- by relative air humidity, % 1
- by illumination, lux. ..... 1 x 10
- by time, hr..... 1

Operating speed time required to measure, record and to give out the control action in one point), s 0, 8
Number of independent programs (schedules) of changes of parameters with time 83

System operating conditions;
automatic with periodic startings....
in pre-set time intervals, min 10, 20, 30, 60
measurements upon operator's
request..... in any controlled point
Laws of control run through .....positional and pulse-proportional
Programmed durations of photoperiod
phases "day" and "night" , hr..... 0 to 29
Programmed transistions from "day"
to "night" and vice versa, hr ..... 0 to 9
Pickups:
of temperature ..... platinum, resistance thermometers gr .22
of relative air humidity ..... De, -IK
of illumination.....special design
Power supply (from a--c three-phase mains):
voltage, V 380/220
frequency, H z 50
Power consumption, kV.A. 6

NB. If anyone wants more information please write directly to this Institute.

IX. GROWTH CABINETS MANUFACTURED BY Warren SHERER (USA)

Address: Warren Sherer-West, Industrial Road, Marchall, Michigan, 49068, USA.

This company sent us a prospectus pointing out that the Soviet government bought more than 30 cabinets. The following two models are recommended:

Model CEL 36-10 with 10 sq. feet of /usable surface (0, 9 m2) with 12 fluorescent lamps F 48-T1 2/CW/wHO and 8/25W incandescent lamps.

Model CEL 38-15 with 15 sq. feet of usable surface (1, 4m2) with 16 fluorescent lamps F 73,-T 12/CW/VHO and 12-50 W. incandescent lamps.

In these two models the lighting would be 5000 FC at 6 inches(0, 20m) under the lamps. Limits of temperature control: 10 to 44°C with all lamps lighted; 7, 2 to 44°C with half the lamps on and 4, 4 to 44°C in darkness.

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X. THE PHYTOTRON IN THE PHILLIPINES

On September 24,1974 a new Phytotron at the International Rice Research Institute was inaugurated according to information received from L. T. Evans of Canberra on the occasion of the symposium "Climate and Rice".

This phytotron was financed by several countries including Australia and has a total of 275 m2 of usable surface comprising :

1) 6 greenhouses of 40m2 each able to hold 4 Koito cabinets of 1,20 m2 surface with exact temperature control
2) 4 large Koito cabinets of 4,50 m2 usable surface, divisible into 3 parts with individual temperature regulation placed outside the building, completing the greenhouses with natural lighting.
3) 10 Koito cabinets with artificial lighting of 1,40 m2.

The ensemble is under the direction of Dr. Shouichi Yoshida, specialist of rice problems.

Address: IRRI, P.O. Box 583, Manilla, Philippines.
17-IF

XI. FRENCH TECHNICAL AND SCIENTIFIC WEEK IN TORONTO, CANADA (October 3-4, 1974).

During this week many speakers talked about the field of biology but the following were worth noting :

Dr. R. Jacques - Light and plant morphogenesis

Dr.F.Trombe - Complete perspective on thermal utilization of solar energy and terrestrial energy

Dr.C.Loriux -Ice-caps, witnesses of the environment.

Many films were also presented including one on the Phytotron in Gif- sur-Yvette filmed in 1969 in co-production with CNRS-Sciencefilm.

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XII. INFORMATION FOR PHYTOTRONISTS

a-New Books

-Irkoutsk Phytotron -Project and Realization -V. K. KURETZ Ed.Nauka -Novosibirsk 1974 -96 pp.price 62 Kopeek (in Russian)
- Air conditioning of rooms and vehicles -Annexe 1973-2-to Bulletin of Institut International du Froid -177 Bd Malesherbes 75017 Paris-France, 356 pp. -
European Horticulture Statistics -Ed. Mr. Luitse Gen. Secretary AIPH -Stadhoudersplantsen 12-18 Postbus 361 Gravenhage-The Netherlands.
- Third International Symposium on Virus Diseases of Ornamental Plants-Technical Communication of ISHS N°36- May 1974- Editor: ISHS'-le Van den Boschstraat 4-The Hagne-The Netherlands.
-Activite du Service d'Ecophysiologie (Biog6ographie et Ecologie du Developpement) pour 1972 et 1973 .Ed.UER de Sciences Fondamentales et Appliquees de l'Universite" de Poitiers France-Mimeo - 160 pp.

-Technical Communication of the ISHS;

N°35 symposium on "Water Supply under Glass and Plastics".
Geisenheim-September, 1972
N°39 symposium on "Basic Problems of Protected Vegetable Production".
Hannover, September, 1972.

b)New Reviews and Publications

I) Ornamental Horticulture

This publication intends to meet the information needs for scientists dealing with ornamentals, horticulturists, nurserymen, students and gardeners. Each monthly issue will contain about 100 summaries of articles from the 1200 different serial publications from all over the world. Publication is expected to start in January 1975. Order to: Commonwealth Agricultural Bureaux, Central Sales Brancia, Farnham Royal, Slough, SL 2 3BN-UK.

2)Fruit Science Reports

The Research Institute of Pomology in Poland (Pomologiczna St. N°18 -96-100 Skierniewice) in 1974 started publication of this report in English, in order to make the results of their research work accessible to wider circles of readers. This journal publishes also research work done at the Agricultural Academies, other institutions and accepts papers from other countries if they are concerned with pomological research in a moderate climate zone. This journal is available by subscription or in exchange for a similar publication.

Vol.1-N°1 -1974 was distributed during the Horticultural Congress.

3)Publications from Sweden, Department of Reforestation

The Department of Reforestation will sent to all who are interested their publications in exchange, without charge.

The proceedings of IUFRO International Seed Symposium held in Bergen 1973 must be purchased at the following prices separetely: Vol.I -35 SKr- Vol. II- 45 SKr- Vol. III -25 SKr or together - 100 Skr including mailing.

Mail to: Dr.S.K.KAMRA
Royal College of Forestry-Department of Reforestation
S-104-05 STOCKHOLM 50 Sweden

c)Climate Laboratory News N° 3

Issue N°3 of July 1974, of the New Zealand news has just come out and has some interesting information :

1)A new revised and reprinted version of the climate Laboratory Guide of Palmerston North Phytotron accompanies issue N°3.

2) Description of International Rice Research Institute Phytotron in the Phillipines. We have summarized this description several pages earlier.

3) Climate room use (rooms x weeks) over a period from Dec.22,1973, December 29,1974 was :

Department Scientific and Industrial Research	22%
Ministry of Agriculture and Fisheries	18
Forestry	35
Universities	25

4)Description of 4 new research projects.

5) Completed experiments: R.S.SOTT-Climate phosphate and the nitrogen fixing activity of Legumes.

A,G.SINCLAIR -"Nitrogen-fixing activity of seven pasture legumes as affected by day temperature, stage of growth, defoliation frequency, water supply and nitrogen fertilizer.

M.LMENZIES -"Seasonal variation in the frost tolerance of radiata pine seedlings",

J.B.HACKER, B. J. FORDE and J.M.GOW. -"Simulated frosting of tropical grasses" -abstracted from Aust. J.Agric.Res.1974, 25 pp.45-57.

d)Japanese Society of Environment Control in Biology welcomes these living abroad to become members of their Society, This Society publishes a quarterly journal entitled : Environment Control in Biology since 1963. Foreign members of this Society may submit their papers for publication in this journal. Papers should be sent to the Editorial Office of the Society. Members have the right to apply for an opportunity to lecture on their research work at the annual academic meeting held by the Society in the autumn at some place in Japan, Annual dues for foreign members including cost for the quarterly journal are US $/ 15. Address: Japanese Society of Environment Control in Biology, c% Biotron Institute, Kyushu University , Fukuoka, Japan.

e) Events Meetings and Exhibitions

1975 - April - Melle, Belgium
Azalea Symposium

Inquiries : Dr .1. van ONSEM Inst. of Ornarn • Plant Growing, Caristasstraat 21, 9 230 Melle, Belgium.

1975 -April 1-4 Vienna, Austria
5th Symposium fur industriallen Pflanzenbau

Inquiries : Dr,. E. Bancher, Institut fur Botanik der T.H.Wien, Getreide-markt 9,1060 Vienna, Austria.

1975-April 13-16 -Long Ashton -UK.
Fifth Long Ashton Symposium : Environmental Effects on Crop Physiology
Inaugural lecture : Professor J. P. HUDSON

Session I, Weather and Microclimate
Session II. Weather and Crop Productivity
Session III. Physiological Processes: Assimilate production
Session IV. Physiological Processes: Respiration and translocation
Session V. Critical stages of Plant Development
Session VI. Modelling and Synthesis of Results,

Inquiries : Dr J. J. LANDSBERG, Microclimatology Section, Long Ashton Research Station, Bristol, BS 18-9 AF -UK.

1975- April 21 to November 4- Roma-Italia

International Horticultural Exhibition

1975- April 25 to May 5- Gand, Belgium

Floralies gantoises- 27th International Horticultural Exhibition

Inquiries : Floralies Gantoises, 265 Burg Charles de Kerchovelaan, GAND, Belgium.

1975- May 13-16 , Scheveningen The Netherlands

Symposium on protected cultivation in the Netherlands

Topics: 1) Control of cultural conditions in greenhouses. -2) Control of growth conditions into the soil - 3) Climate needs for vegetable crops -4) Climate needs for floral crops -5) Other specific aspects of protected cultivation.

Inquiries : Ir.Y. van KOOT. Commission on Protected cultivation ISHS, Proefstation voor de Groenten under glass, Zuidweg 38, Naaldwijk, The Netherlands.

1975-July 3-10 Leningrad, USSR

12th International Botanical Congress. - Includes 18th section: 1) Nomenclature -2) Systematic and Evolutionary Botany -3) Phycology -4)Mycology and Lichenology -5) Bryology - 6) Vascular Plants -7) Floristics and Phytogeography -8) Ecological Botany -9) Structural Botany -10) Growth and Development 11) Metabolism and its Regulation -12) Photosynthesis -13) Mineral Nutrition - 14) Water Relations and Resistance to Extreme Environmental Conditions -15) Immunity -16) Cultivated Plant,' and Natural Plant Ressources -17)History of Botany and Botanical Bibliography -18) Conservation of the Plant World.

In section 10 there is symposium N°7 - Phytotronics organizers : A .F.KLESHNIN (USSR) , V .M. LE/MAN (USSR)- Chairman F. W. WENT (USA) The Phytotronic Secretariat hopes to be able to publish in English and French all conferences and papers presented at this symposium in a book titled "Phytotronique 4".

Registration fees for the Congress- 45 roubles. Congress participants who wish to publish their abstracts must send them not later that November 15,1974.

Inquiries : Organizing Committee of 12th International Botanical Congress, Komarov Botanical Institute, 2 Prof. Popov Street Leningrad 197022, USSR.

1975- August 12-17 -Kumasi, Ghana

4th African Horticultural Symposium -Current research on horticultural crops in West Africa

Final date of application June 1 st 1975.

Inquiries: Mr. J.C.NORMAN -Dept. of Horticulture University of Science and Technology -Kumasi -GHANA.

1975-August 21-27-Moscow -USSR.

VIII International Congress of plant Protection

Topics: 1) Plant protection in USSR -2) Plant protection and environment 3) Economics in plant protection -4) Chemical control -5) The role of meteorology in forecasting -6) Biological control -7) Integrated control,

Information: Secretariat of the Organizing Committee
1/11 - Orlikov per. -107139 Moscow B-I39, USSR.

1975-October 6-11- Budapest, Hungary

7th International Conference on Rural Electrification,Section IV-
Rural Electrification.

Themes :I) Development, prediction and economic problems of power and energy needs of specialized concentrated agricultural. plants. 2- Rational energy-needs of agricultural production and working processes with a special view to automation and control techniques. -3- Role of electric power in the thermal power supply- Possibilities of refrigeration and heat recovery -4- Research problems of electrification in various countries.

Information: Dr. Ing Zoltan Sibalszky, President Organizing Committee, Hungarian Electrotechnical Association , 1055- Budapest , Kossuth Lajas ter 6-8 , Hungar y,

Final date of application : March 31,1975.

1975- October 19-22 -Sofia, Bulgaria

II. Symposium on plant Growth regulators

Organized by M. Popov Institute of Plant Physiology, Academy of Sciences, Academy of Agricultural Sciences, Ministry of Agriculture and Food Industry and the Scientific-technical Union of Agriculturists

Topics: 1-Regulation of plant growth and development-general problems - 2- Natural regulators- 3-Synthetic regulators-4-Application of growth regulators.

A special symposium review is envisaged for publishing in Russian and English -Inscription not later than November 30,1974.

Inquiries: 2nd Symposium on Plant Growth Regulators-M. Popov Institute of Plant Physiology , 36 Street, block 6-SOFIA,I3, Bulgaria.

1976- Switzerland

Symposium on Labour and labour management

Information: Dr.A . Wirth, Swiss Federal Res.Station for Arboriculture, Viticulture and Horticulture, 8820 Wadenswill, Switzerland.

1976- Peru

Symposium on Tropical Fruits

Information: Dr. M. HOLLE -Dept. of Horticulture -Univ. Nac A graria Apt 456 LAMOLINA-LIMA, PERU.

1976 -Spring -Pont de In Morge, Switzerland

Cucumbercae under protection

Inquiries: Dr. G. Perraudin, Station F4derale de recherches agronorniques, 1962 Pont de la Morge, Switzerland.

1976- Spring -Copenhagen, Denmark

Symposium on Propagation problems in Arboriculture

Information: Prof .A .KLOUGART- Dept of Horticulture-Royal Veterinay and Agricultural University -1958 Rollighedsvej 23, KOBNHAVN -5-Denmark.

1976- August -Vollebekk, Norway

Symposium on Floriculture: environment and growth

Information: Prof. E. Stromme Dept. of Floriculture, Agric . College of Norway, Aas-NLH Box 13, 1432 VOLLEBEKK, Norway.

1978- Sydney, Australia

20e Congres International d'Horticulture

Renseignements: Mr.G.R. GREGORY, Chief Division of Horticulture of the N.S. W., Dept. of Agriculture, Sydney, Australia.

1982- Hambourg, Germany FRG

21e Congres International d'Horticulture

Renseignements: Prof.D.FRITZ -Institut fur Gemusebau 8050 Weihenstephan - Freising/OBB .Germany FRG.

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We did not speak about phytotronics at the Horticultural Congress in Warsaw but plan to do so in the next issue. Also, we have not received any information from the Committee for Standardization of Dr. P. Gaastra.

We thank, in advance, all those who will be sending us documents for reproduction in coming issues.

P.Chouard and N. de Bilderling