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Photovoltaic Power Supply for Mobile Measuring Stations in Distant Mountainous Regions

By

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With 1 Figure

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Summary

SISSOLAK M. 1985. Photovoltaic power supply for mobile measuring stations in distant mountainous regions. — Phyton (Austria) 25 (1): 39—42, 1 figure. — English with German summary.

The use of solar panels as a power supply to run the instruments of two microclimatic stations does not bring about any problem and has been proving to be a success for three vegetation periods.

Zusammenfassung

SISSOLAK M. 1985. Lichtelektrische Stromversorgung für mobile Meßstationen in abgelegenen Gebirgsgegenden. — Phyton (Austria) 25 (1): 39—42, 1 Abbildung. — Englisch mit deutscher Zusammenfassung.

Der Einsatz von Sonnenbatterien zur Stromversorgung für den Betrieb zweier mikroklimatischer Stationen bereitet keinerlei Schwierigkeiten und hat sich durch drei Vegetationsperioden bewährt.

Introduction

Within the scope of the research project "Heavy Metal Stress on Plants" the responses of plants under heavy metal stress on anthropogen caused copper habitats were to be clarified. The results of such researches on these special habitats should offer the possibility to give evidence about the effects of heavy metal stress on our environment.

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The "Schwarzwand" and the "Tofereralm", copper mines in the district Salzburg, in the valley of the river "Großarl", which were shut down over hundred years ago, both higher than 1600 m above sea level were chosen as habitats. On both localities the maximal concentration of copper in the soil available for plants reached data up to 200 ppm. This high copper stress is resisted only by very few ecotypes of plants ,which often colonize the ground sparsely. All "Copper Plants" but especially *Saxifraga stellaris* L. showed highly changed habitus on both habitats. The point was, whether that was caused only by the concentration of copper or also by other ecological factors. Therefore the microclimate of the copper stocks on the dry habitat Tofereralm and on the wet habitat Schwarzwand was to be measured and registered during the whole vegetation period, in comparison with areas free of copper stress, to be able to study the influence of temperature, precipitation and radiation on the copper tolerance of the plants.

Methods

One could not employ a stabile measuring station for this problem (c. f. also Moser 1973). The different measuring localities on the copper stocks were to be opened up only by a mobile measuring station (c. f. also Cernusca 1973). In addition the registered microclimatic data should be conducive to the fixing of the parameter necessary for a cultivation in a greenhouse. It was necessary to register the data on recorders with low current consumption 5 mA/h) because the mobile measuring stations which were to be set up were very distant and therefore only to be reached by long approaches.

In addition the feed rate of the recording chart was very slow (10 mm/h) and therefore the recording paper had to be changed respectively only after eight weeks. The temperature of soil and air was measured by IC (integrated circuit) which produces an output current proportional to absolute temperature. Even connecting cables up to 100 meters do not cause any major variation. In any way the error was within the evaluation accuracy of 0,5° C. The radiation was registered by the conventional Star-Pyranometer, the balance radiation by the Pyrradiometer. All the instruments were installed into an alpine tent. On the Schwarzwand there were to be operated two 12 V recorders with a total of 10 mA/h, on the Tofereralm three 12 V recorders and one 9 V electric fence with a total of 24 mA/h, the fence to prevent the instruments from being destroyed by the grazing cattles. Even the use of four accumulators, each of them with 6,5 A/h, could hardly bridge the intervals of eight weeks, because the night temperature also being very low during the vegetation period reduces the rate capacity very much. Besides every control of the measuring station was connected with an exhausting transport of the accumulators, which had to be charged during the night. The lengthening of the intervals one needed for taking care of the instruments and the wish to be able to operate with less expenditure of work led to the employment of solar panels.

Results

The used solar panels with 0,45 m² produced the maximal power of 33 W at a temperature of 25° C, a radiation of 1000 W/m² and a starting voltage of 12 V. Thus the efficiency of the solar panel is of the order of 7,3%. There can be registered maximal radiation data up to 750 W/m² on midsummer days as the average of a 16 hours'day. This is proportional to a power of 12,5 kW/m².d. Thus the solar panel produces 400 W/d. The 12 V power pack with 13 A/h needs approximately 200 W/d for a full charge. Under normal conditions a full charge

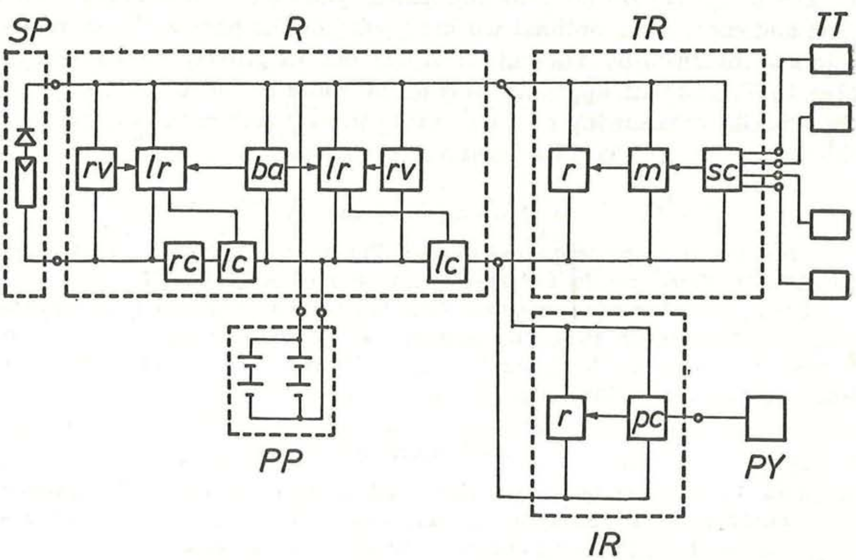

Fig. 1. Block diagram of the mobile mesauring station.
SP = Solar panel (e. g. Philips, BPX 47c/36); R = Regulator (e. g. Siemens, SFH 910); rv = reference voltage, lr = linear regulator, rc = reverse current, lc = load controller, ba = balance adjustment; PP = Power pack (e. g. Sonnenschein, Dryfit A 300); TR = Temperature recorder (e. g. BBC-Goerz, Miniscript K); r = regulator, m = multiplexer, sc = sensor calibration; TT = Temperature transducer (e. g. Norwood, AD 590); IR = Irradiation recorder (e. g. BBC-Goerz, Miniscript K); r = regulator, pc = pyranometer or pyrradiometer calibration; PY = Pyranometer or Pyrradiometer (e. g. Schenck, Type 8101 or 8111

is not necessary, because the measuring stations need a maximum of 6,9 W/d for working. For this reason it is small wonder that the average radiation of 230 W/m² during 14 hours is easily able to supply the power pack with 100 W/d during the summer months. This is proportional to about 15 times the consumption. Even during winter, at a minimum of the radiation intensity of 35 W/m² during 5 hours, there are still 6 W/d available for the charge. Therefore the power supply of the measuring stations by the solar panels did not cause any problem during the vegetation period. The quantity of electricity should be sufficient to charge the accumulators entirely on sunny as well as on cloudy days; therefore the power supply can be guaranteed also during the night as well as during spells of bad weathers. For this reason the solar panel on the Schwarzwand could produce enough current to guarantee the working of the measuring station even in the light shadow.

Unexpected difficulties arose in choosing the suitable charge controlers which should prevent the power pack from inadequate charging and control the optimal working point of the panels. Series regulators or minor output currents with load cut off proved to be a success (Fig. 1.). Panels with approximately 0,1 m² could be sufficient to operate the described measuring stations during the vegetation period, because the power limit of 7 W/d has been never reached.

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