AIR TEMPERATURE AND HUMIDITY CONDITIONS OF THE BOTTOM OF THE MACOCHA ABYSS AND THE PUSTÝ ŽLEB VALLEY IN THE AREA OF THE PUNKVA RIVER DISCHARGE IN THE MORAVIAN KARST

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SUMMARY

In the period of April - October 1991, the Department of Geography, Faculty of Science, Masaryk University Brno performed microclimatic measurements at the bottom of the Pustý žleb Valley and the bottom of the Macocha Abbys. In the contribution are presented results of measurements analysis of air temperature at both localities, especially with the view to differences in level of mean daily temperatures, daily extreme temperatures and their amplitudes. Similar criterions were used for evaluation of relative humidity.

KEY WORDS

Moravian Karst - air temperature - relative humidity - variations

INTRODUCTION

The foregoing climatological investigations, intent on the territory of Moravian Karst, are oriented especially to its local climate (Quitt, 1971, 1976, 1984) or to the microclimate of similar caves (Quitt, 1982). This article is aimed at the temperature and humidity conditions of the two expressive concave forms of the karst relief.
In the period of 11 Apr. - 22 Oct., 1991, the Department of Geography, Faculty of Science, Masaryk University, Brno carried out microclimatic measurements of air temperature and relative humidity at the bottom of the Pustý žleb Valley near the discharge opening of the submerged river Punkva (station Punkva, height above sea level

352.5 m) and on the bottom of the Macocha Abyss (station at the height above sea level 355 m) in Moravian Karst (Fig. 1, 2). Their objective was to obtain information about the regime of the two meteorological elements in those morphologically different, conspicuous concave forms of the relief, interconnected by a cave system. The measurements were performed by means of thermohygrographs and the August psychrometer (checking instrument) in small meteorological screens at the height of 1.5 m above the ground.

AIR TEMPERATURE

The fundamental objectives of processing the records of air temperature was: finding the differences in the regime of air temperature for the above period at the level of daily mean temperatures and daily temperature extremes, evaluation of daily temperature amplitudes and differences in the daily temperature variation and finding the influences of external weather on the daily temperature regime.

Temporal changes of mean daily temperatures, daily temperature maxima, minima and amplitudes are presented in Figs. 3-6, the frequency of their occurrence in Figs. 6-8. The following facts follow from them:

(1) At the two stations the annual variation of temperature is reflected to a different extent. Despite the cumulation of cold air at the bottom of the abyss, the difference of extreme daily means of spring and summer and summer and autumn represents 58 and 52 %, respectively of the corresponding differences at the station Punkva.

(2) The variability of all four temperature characteristics on the bottom of the valley (station Punkva), in comparison with the bottom of the Macocha Abyss, is substantially higher.

(3) Temperature differences between the two localities increase from the spring season to summer and decrease again towards autumn.

(4) Short-term temporal fluctuations of maximum temperatures correspond to each other in only rough features (Fig. 4), whereas in the case of minimum and mean temperatures (Figs. 3, 5) they correspond with each other quite closely, particularly in spring and autumn. In the case of daily temperature amplitudes the agreement of fluctuations is practically non-existent (Fig. 6). The different closeness of the relation of corresponding pairs of sets can be documented by correlation coefficients whose values are:

for daily mean temperatures 0.90
for daily maximum temperatures 0.74
for daily minimum temperatures 0.92
for daily temperature amplitudes 0.28

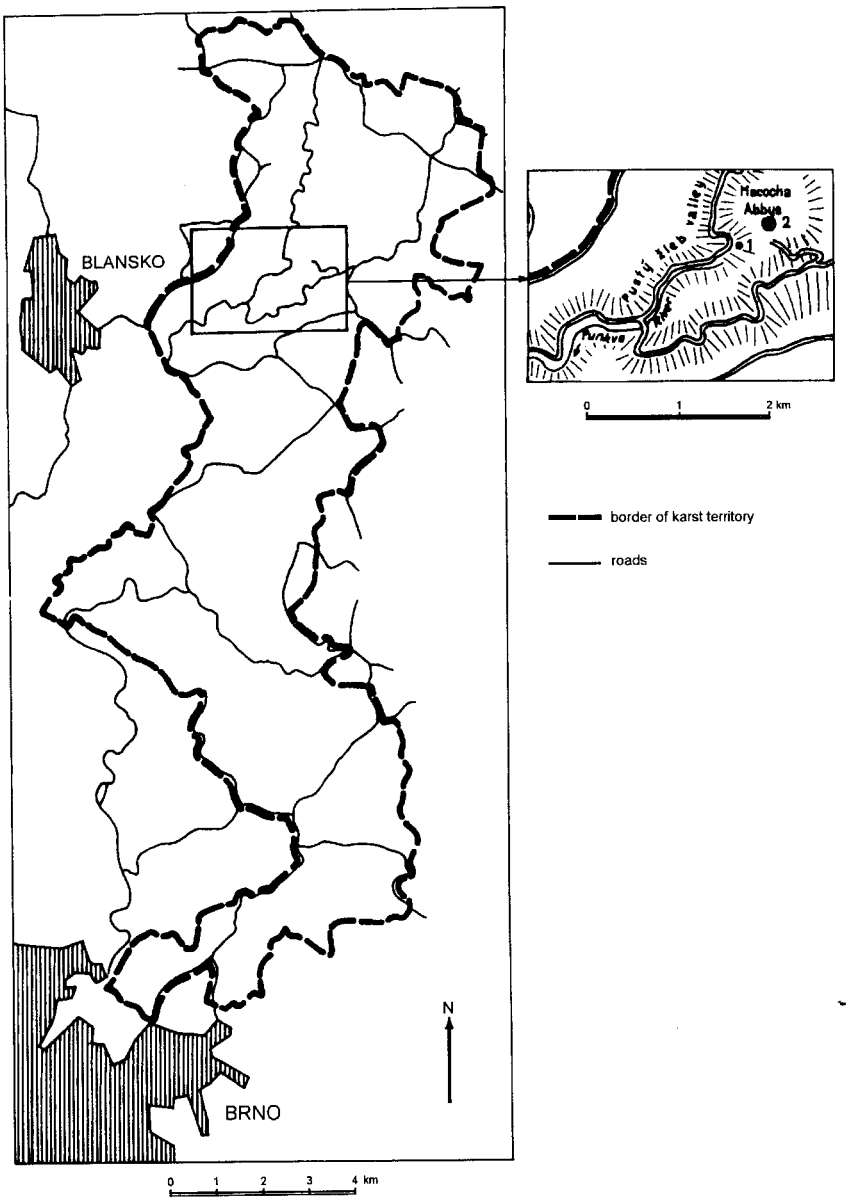

Fig. 1. The schematic map of Moravian Karst with the location of the stations Punkva and Macocha Abbys

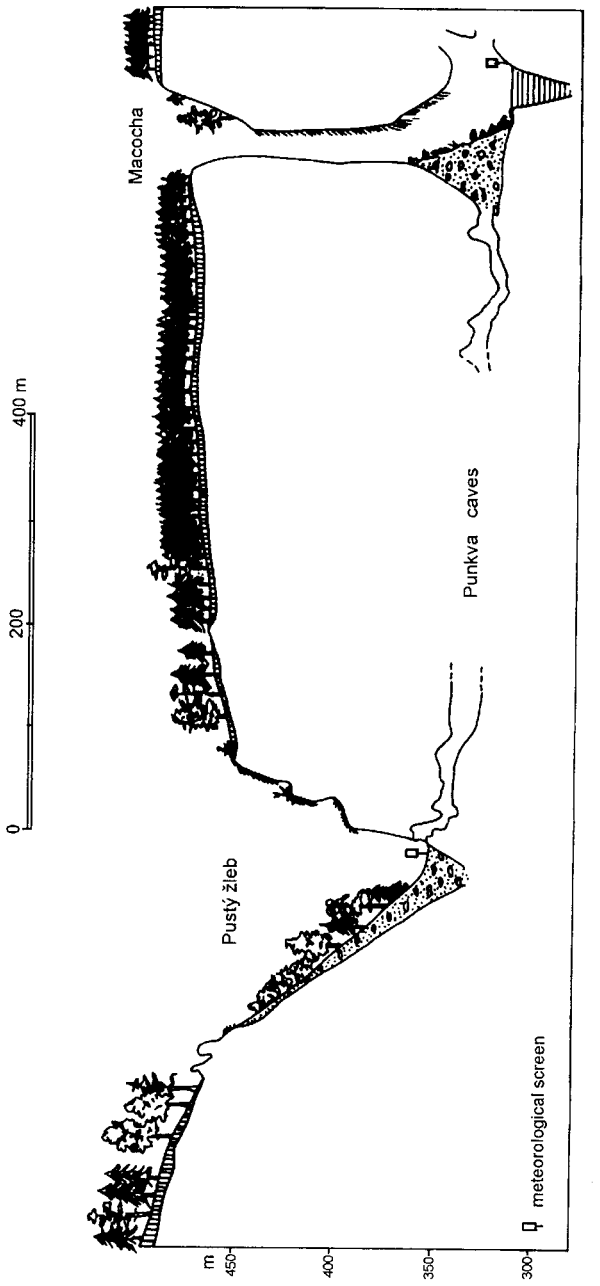

Fig. 2. A schematic section of the Punkva caves between Pustý žleb Valley and Macocha Abyss

(5) Typical of the frequency distribution of daily temperature means, maxima and minima (Figs. 7-9) are, besides the logically greater concentrations of sets at the bottom of Macocha and the shift of the most frequent intervals at station Punkva towards higher values (with the exception of minimum temperatures) smaller differences between the leftsided limitations of the respective polygons than between the rightsided limitations.

(6) The preceding statements are also confirmed by the mean daily temperature variations at the two stations (Fig. 10). Besides differences in the level of daily temperature extremes and in the intensity of the temperature rise and drop in the period of the day significant differences in the duration of the ascending and the descending parts of the curve of the daily temperature variation are evident from them (the duration of the temperature rise at the stations Punkva and Macocha are 10 and 7 hours, respectively, the duration of the drop 14 and 10 h, respectively), as well as a relatively long interval of the duration of temperatures near the extremes on the bottom of Macocha. The described differences of the daily temperature variation are also confirmed by the distribution of sets of deviations of the hourly values of temperature from the daily means (Fig. 11).

On the basis of the above facts it is possible to state that at a generally lower air temperature level (i.e. in spring and in autumn) the temperature differences between the two localities diminish, and *vice versa*. In both concave forms of the relief in those seasons there is an evident cumulation of cold air, particularly under the stabilisation of the temperature stratification during the night hours. This fact is confirmed by relatively small differences of temperature minima in the transitory seasons, justifying the assumption that the air cooled at night due to radiation causes flows from the highest, flat levels of the karst relief katabatically to the bottom of the abyss and the valley where, thanks to its original autochthonous cooling, it conditions the small differences of the temperature minima. These differences are the smaller, the greater is the autochthonous cooling of the air. This mechanism, conditioned by the radiation regime of weather, is impaired by the advection during which the process of night radiation cooling is attenuated. The result of it in such cases is a significant rise in minimum temperatures in a better aerated valley in comparison with the abyss where, thanks to the cooling effects of the day and the rock walls, the temperature minima are maintained at a conspicuously lower level (marked particularly in summer, episodically also in spring and in autumn - Fig. 5). The described processes then affect to a considerable extent also the agreement of the level of temperature means. On the other hand, in the case of maximum temperatures it is possible to state on the basis of their marked differences under different systems of local streamings (anabatic streamings) and also under a different deformation of the advection streaming across the terrain and a general labilisation of the temperature stratification during the day quite different mechanisms conditioning them (better exchange and warming of air in the space of the valley in comparison with the abyss).

The above view is confirmed by their agreement of the leftsided limitation the polygons of frequencies (Figs. 7, 8, 9) and a different level of similarity of temperature

maxima and minima also follows from the mean daily variation of air temperature at both stations (Fig. 10).

The minimum agreement of daily temperature amplitudes proves the difference in causes influencing them at the two localities. Whereas at the station Punkva the conspicuousness of the daily variation of temperature is conditioned by both the processes of the atmosphere during the day and by the night cooling (the daily variation of temperature has the shape of a more or less simple wave - Fig. 12 A), at the station Macocha the size of the daily temperature amplitude is conditioned practically only by the night cooling (Fig. 12 B) which, in the course of the day is balanced by the temperature rise to the level of the preceding night and/or the preceding day without a conspicuous daily variation. Also in this case it is possible to consider the specific daily temperature regime to be the consequence of the nightly katabatic flux of cold air directed from the flat relief of the abyss edge to the bottom via its less sheer northern limitation and the fact that this air becomes temperature balanced during the day (i.e. warmed) with the rock walls.

Mentioned causes of the peculiarities of temperature conditions on the bottom of the Macocha Abbys is possible to reason about principial. Other influences, for example the dynamical connection with the system of the Punkva caves are not substantiated. Among others therefore, that the main cave system is separated from the abbys by the man-made wickets. They are open only briefly for the visitor groups.

AIR HUMIDITY

The evaluation of relative air humidity was carried out with respect to the extremity of the daily variation and the degree of duration of the saturation of the atmosphere in the period of the day and from the point of view of the regime of daily means of relative humidity.

The first step of this processing was based on evaluating of the daily registrations of the hydrographs in point of view of marginal values of relative humidity after 5 %, since 95 % as far as to the lowest one exceeded by the time 24 h. Fig. 13 present the results of elaboration of linear regression dependence of mean exceeding time on the value of relative humidity on either stations. This dependence is comprehensible typical with high values of correlation coefficients (on the station Punkva = 0.97, on the station Machocha = 0.98). Objective of described method is determination of two characteristics of diurnal course of relative humidity. Both are determined by regression equations (Fig. 13):

1. characteristic time interval of the high degree of air saturation [h] (marked by b in Fig. 13),
2. value of relative humidity [%], exceeded 24 h - criterion of the mean extermity of diurnal course (marked by a in Fig. 13).

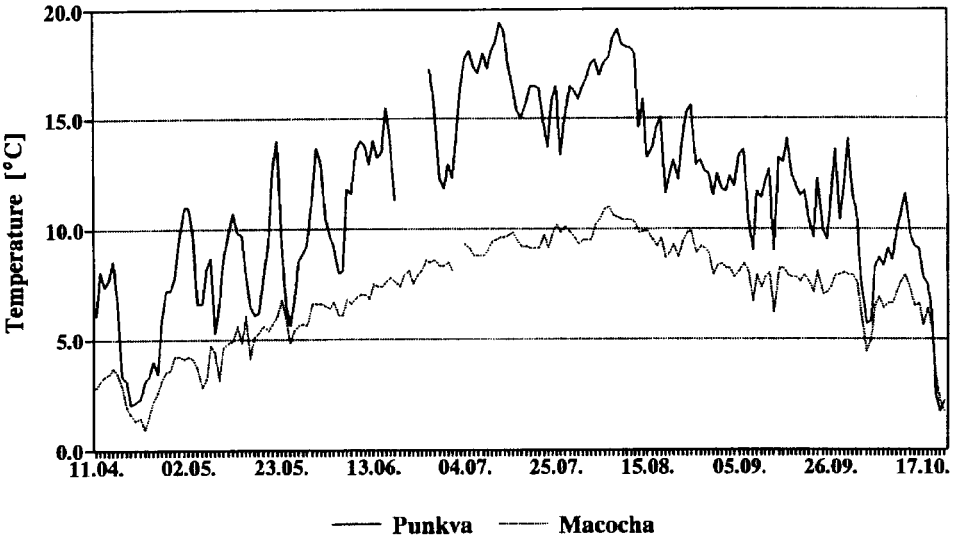

Fig. 3. The regime of mean daily air temperatures at stations Punkva and Macocha

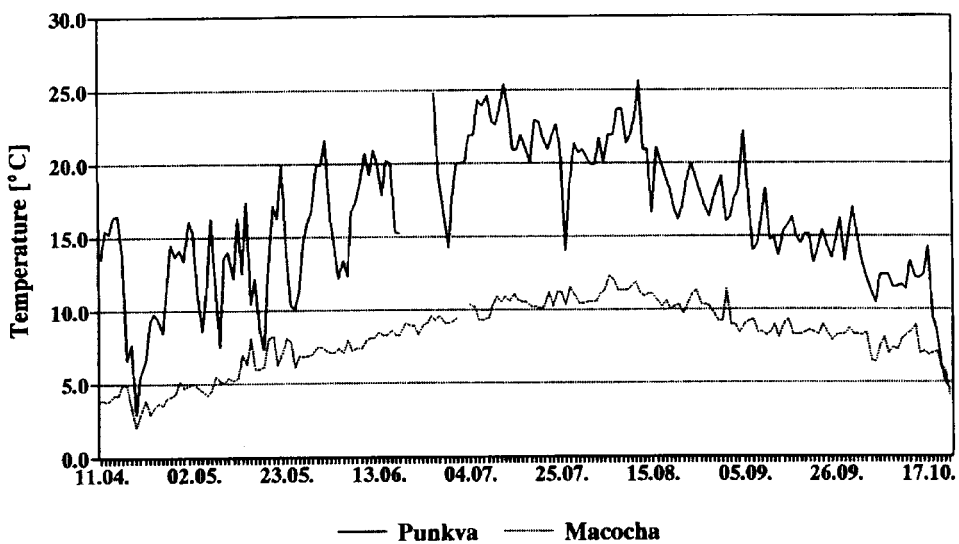

Fig. 4. The regime of daily maximum air temperatures at stations Punkva and Macocha

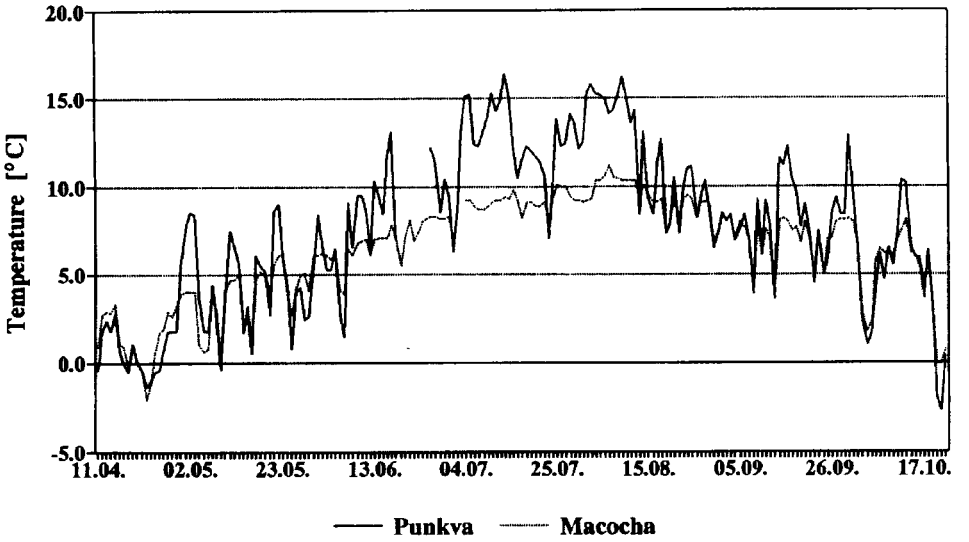

Fig. 5. The regime of daily minimum air temperatures at stations Punkva and Macocha

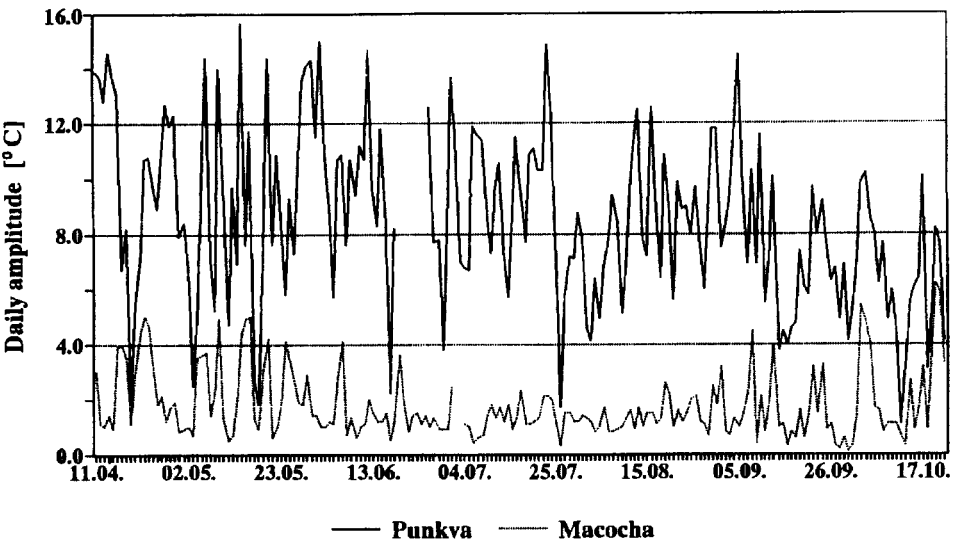

Fig. 6. The regime of daily air temperature amplitudes at stations Punkva and Macocha

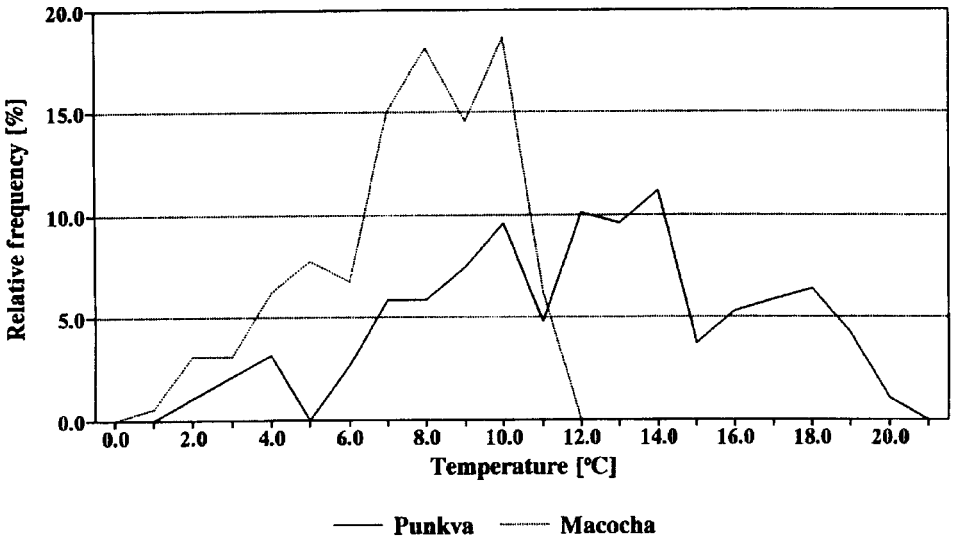

Fig. 7. The distribution of relative frequencies of mean daily air temperatures at stations Punkva and Macocha

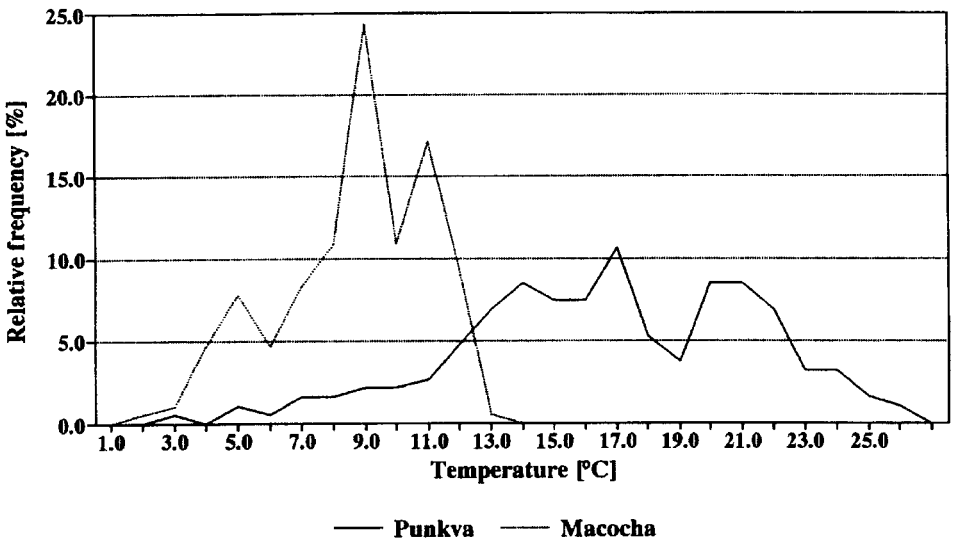

Fig. 8. The distribution of relative frequencies of daily maximum temperatures at stations Punkva and Macocha

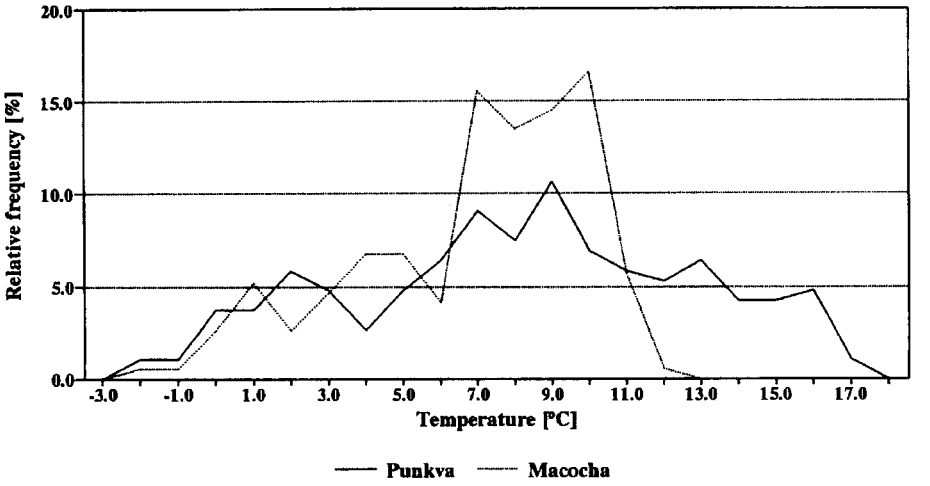

Fig. 9. The distribution of relative frequencies of daily minimum temperatures at stations Punkva and Macocha

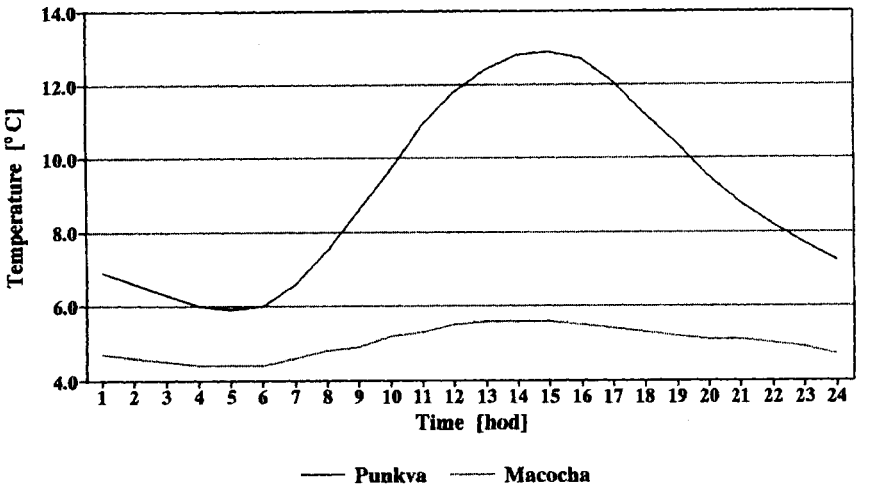

Fig. 10. The mean daily air temperature variation at stations Punkva and Macocha

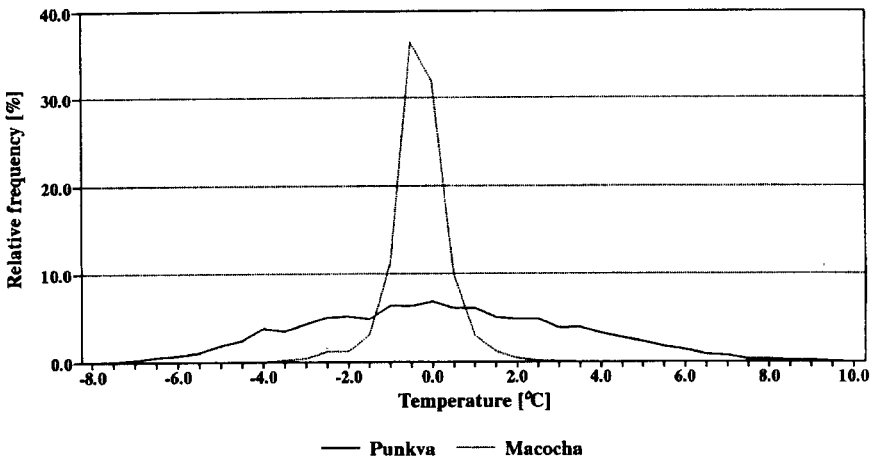

Fig. 11. The distribution of relative frequencies of deviations of hourly values of air temperature from the daily mean at stations Punkva and Macocha

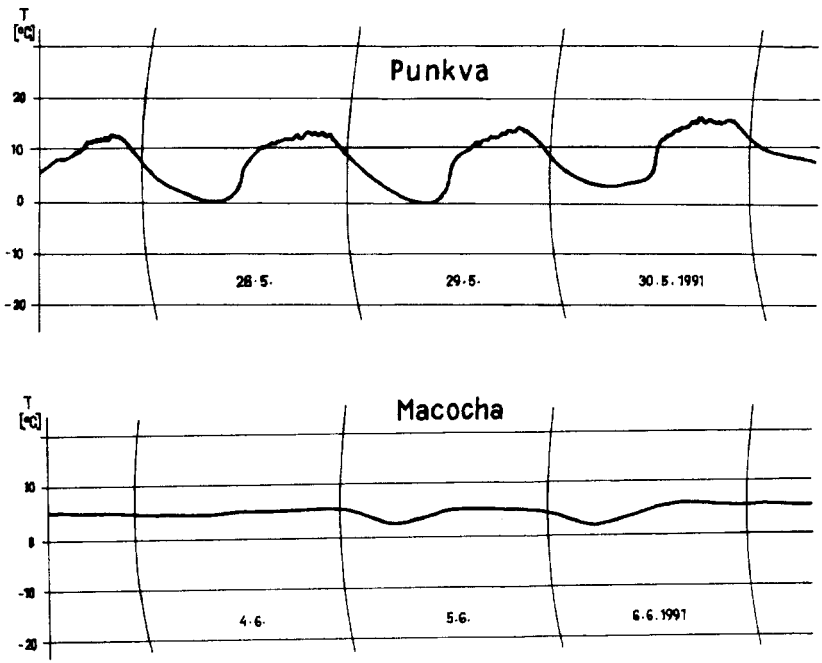

Fig. 12. Examples of thermograph records with a typical daily variation of air temperature at stations Punkva and Macocha

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