24 SEPTEMBER 1980 (FOUO 9/80) 1 OF 1

JPRS L/9311

24 September 1980

East Europe Report

SCIENTIFIC AFFAIRS

(FOUO 9/80)

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CONTENTS

INTERNATIONAL AFFAIRS

NEW SATELLITE GENERATION FOR INTERSPUTNIK COMMUNICATIONS NETWORK

New Geostationary Satellites

Prague TELEKOMUNIKACE in Czech Jul 80 No 7 p 112

[Article by jb: "Soviet Olympic Satellites]

[Text] A total of 123 objects were launched into space in 1979. The largest share, 103 space objects, accures to the Soviet Union. The United States of America launched 13 satellites (one of them the telecommunications satellite Westar for internal service in the United States), Japan 2, the United States jointly with Great Britain 1, USSR jointly with India 1. Two objects, part of whose scientific and technical equipment was supplied by Czechoslovakia, were launched in the framework of the Interkosmos program. The West European space agency ESA successfully launched the carrier rocket Ariane designed for putting into orbit joint West European space objects (to include telecommunication satellites).

Among the Soviet space objects launched in 1979, fully 79 are a part of the extensive Kosmos program. Three of them were meteorological satellites, the remainder forming a part of the transportation system primarily for the well-known space laboratory Salyut-6 (Soyuz type satellite for transportation of crews and Progress type for transportation of materiel).

A total of 10 telecommunication satellites were launched by the Soviet Union in 1979, 5 of them of the traditional type Molniya-1 and Molniya-3 servicing the Soviet national network Orbita, or the Intersputnik system participated in by socialist countries. The other five telecommunication satellites are of the geostationary type, orbiting along the equatorial path at an altitude of almost 36,000 km above the earth's surface. They all were launched from the Soviet Baykonur space center. The first among them to reach the geostationary orbital path on 21 February 1979 was the satellite Ekran-3; it was positioned at 99 degrees east longitude. It is designed for direct transmission of black-and-white and color television to small collective stations in remote areas of the Soviet Union. Ascensional communication (studio to satellite) takes place at a frequency of 6,200 megahertz, descentional communication (satellite-Earth) at the frequency band of 702-726 megahertz. The next satellite Ekran-4 (international designation Statsionar-T) was launched on 3 October 1979; it is also positioned at 99 degrees east longitude and its mission is identical to that of Ekran-3. The satellite Raduga-4 (international designation Statsionar-1) has been on a geostationary orbital path (at 85 degrees east longitude) since 25 April 1979. It is designed for transmission of black-and-white and color television signals as well as for telegraphic and telephonic transmissions for the needs of Soviet telecommunication services. It operates in the 4 and 6 gigahertz band. All three of these satellites are designed primarily to serve the national needs of the USSR.

Two other geostationary satellites are designed for television, telephone and telegraph communication in the framework of the 22nd International Olympic Games in Moscow (summer of 1980). The first satellite Gorizont-2 (international designation Statsionar-4) was launched on 5 July 1979. It is positioned above the Atlantic at 14 degrees west longitude and will facilitate communication between the Soviet Union and the American continent, or Africa. Experimental operation and transmissions proved its excellent transmission properties. The second satellite of this type, Gorizont-3, was launched on 28 December 1979 and is positioned at 53 degrees east longitude. It will feed the signal also to Cuba, Mongolia, Vietnam, and the socialist countries of Eastern Europe. Western European countries and the Intelsat network will receive the signal via stations on the ground. It is envisioned that these satellites will also accommodate Czechoslovak interests as regards transmissions from the summer Olympics.

New Generation of Satellites

Prague PTT REVUE in Czech May-Jun 80 pp 78-79

[Article by Eng Jiri Valenta, Communications Research Institute, Prague: "New Generation of Satellites for Intersputnik"]

[Text] The close of last year, specifically the month of November, brought about a further qualitative change in the satellite communication network Intersputnik. By way of explanation, let us add that Intersputnik is an international organization enabling its member countries to use satellite technology for their radio communications.

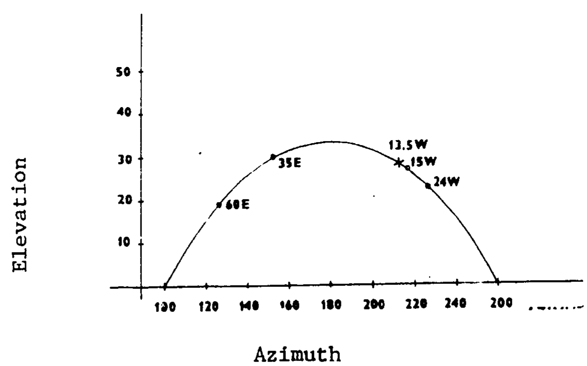
During November 1979, all ground stations of the Intersputnik network, and, thus, also the Czechoslovak ground station, suspended operation with nonstationary satellites of the type Molniya and switched to communication with the geostationary satellite type Statstionar. The USSR plans to gradually launch 10 of such satellites distributing them at internationally approved positions so as to provide radio communication service for the entire surface of the earth, of course with the exception of the polar caps.

The Czechoslovak ground station cooperates with the satellite Statsionar-4 located in the equatorial plane above 13.5 degrees west longitude. A satellite in such a position facilitates continuous communication between ground stations located in Europe, Northern Africa and the east coast of America. This means that the Czechoslovak ground station can communicate via the Statsionar-4 satellite with the Cuban ground station and with all ground stations in socialist countries and the European part of the USSR. The geostationary satellite Statsionar-4 does not allow communication between the Czechoslovak ground station and ground stations in Mongolia, Vietnam and the Asian part of the USSR, as these stations already lie below the horizon in relation to the Statsionar-4 satellite. Eventual communication between the Czechoslovak ground station and ground stations located in Asia would require using another of the geostationary satellites of the type Statsionar located above the Indian Ocean. In this case it would involve the satellite Statsionar-5. It ought to be kept in mind, however, that for stations with a single antenna, during operation Europe-Asia via Statsionar-5 for analogous reasons there can be no operation Europe-America, as the satellite Statsionar-5 lies below the horizon for the ground station in Cuba.

Let us now analyze the differences between communication with the Statsionar and Molniya satellite systems in closer detail. The Molniya system operates with a nonstationary satellite orbiting along an elliptical path around the earth with an orbiting time of 11 hours 58 minutes (12 hours sidereal time). Only 6 hours of this orbital time can be used for communication purposes, when the satellite is in the vicinity of the earth's apogee, i.e., in that part of its elliptical path farthest from the earth. It follows from Kepler's second law (constant areal velocity law) that in the vicinity of its apogee the satellite travels along its path at the slowest speed. Thus, its tracking by ground station antennas becomes technically easier. Thus, providing for continuous 24-hour operation calls for a minimum of four satellites in orbit so that at the instant of planned transfer from one satellite to another there be at least two Molniya satellites above the horizon of each of the cooperating ground stations. It is specifically these technical breaks during transfer (minimum of four in 24 hours), lasting several minutes, that constitute a considerable hindrance to operations. It is further necessary that ground station antennas for nonstationary satellites by equipped with relatively complex devices enabling satellite tracking even during faster changes in azimuth and elevation. On the other hand, the advantage of Molniya satellites is their allowing communication with ground stations located in large geographic latitudes, as for ground stations located approximately above 75 degrees of geographical longitude, the geostationary satellites are already below the horizon.

The Statsionar system operates with a geostationary satellite positioned in the equatorial plane at an altitude of approximately 36,000 kilometers above the surface of the earth. The orbiting time for such a satellite is identical to the earth's rotation, so that such a satellite appears stationary to an observer on earth. The significance of this satellite to operations is provided by its facilitating permanent and uninterrupted 24-hour operation by means of only a single satellite. As the geostationary satellite appears practically stationary in relation to a ground station, there is no need for most of the complex guidance and tracking mechanisms of ground station antennas. However, that does not mean that such mechanisms for ground stations can be completely dispensed with. Even well positionally stabilized geostationary satellites deviate from their nominal position, particularly due to the effects of gravitational and centrifugal forces, and in several-day intervals their position must be corrected.

The Czechoslovak ground station operates with the Statsionar-4 satellite, the nominal position of which is 13.5 degrees W. For a satellite operated in this manner, the Czechoslovak ground station uses a nominal azimuth of 215.0 degrees and a nominal elevation of 27.2 degrees. Orientation of the Czechoslovak ground station's antenna to this satellite is shown in the diagram below.



Orientation of the Czechoslovak Ground Station to the Geostationary Path

It also depicts the type of curve into which the geostationary path transforms itself from the viewpoint of the ground station. A satellite whose position would correspond to the geographical longitude of the position of the Czechoslovak ground station would occupy the top of this curve. All satellites positioned farther to the west than the Czechoslovak ground station would be situated in the right-hand, descending wing of the curve. That is also the nominal position of the Statsionar-4 satellite, i.e., 13.5 degrees W. Comparing the requirements on the guidance systems of a ground station when operating with the Molniya and Statsionar satellites, operation with the Molniya satellite is substantially more difficult from this aspect. The ground station antenna during operation with a nonstationary satellite must constantly track its motion. In actual operation, this means that we have to know the motion of a given nonstationary satellite in relation to the ground station in terms of azimuth and elevation. The motion velocity of a nonstationary satellite is an extremely variable value governed, in the case of the Molniya satellite, by Kepler's laws. At a given interval, the Molniya satellite, according to its position on the elliptical path, can register a change of anywhere from several tenths of a degree to several degrees. This necessarily calls for great reliability and backup for a ground station's guidance system as well as for increased requirements on the crew's training. In addition, during switching from one nonstationary satellite to another the ground station must have at its disposal the orbital parameters of both satellites to cut the switching time to an absolute minimum.

In this respect, operation with a satellite of the Statsionar type, as compared to the Molniya satellite, offers considerable advantages. The originally requisite calculations for azimuth and elevation can be dispensed with, as their values need not be fed into the tracking system of the ground station's antenna. Another great advantage offered by operation with the Statsionar-4 satellite, the undisputable fact remains that--particularly as regards telephonic communications (in automatic or semiautomatic operation)--the elimination of operational breaks represents a distinct improvement, mainly for communications between Prague and Havana.

Statsionar-4 facilitates communications between the European continent, North Africa and the east coast of America. The next geostationary satellite, Statsionar-5, which is expected to be launched in the near future, will facilitate communications between the European continent and Asia. It is envisioned to gradually launch in subsequent stages the remaining satellites of the Statsionar type, which could eventually be used in the Intersputnik communication network. The satellites visible from Czechoslovak territory for the operation of the Czechoslovak ground station will be Statsionar-2, Statsionar-8 and Statsionar-9. According to notification data of the UIT, these satellites can expand and partially even replace operations via satellites Statsionar-4 and Statsionar-5, thereby providing the Czechoslovak communications administration with a new set of possibilities.

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BULGARIA

FORECAST OF MONTHLY PRECIPITATION TOTAL FOR INDIVIDUAL STATIONS

Sofia KHIDROLOGIYA I METEOROLOGIYA in Bulgarian Vol 29, No 3 1980 pp 17-22

[Article by M. Genev and S. Stoyanov: "Forecast of Monthly Precipitation Totals for Individual Stations"]

[Text] The forecasting of geophysical macroprocesses calls for surmounting a number of difficulties related to the multifactorial nature of external influences on the forecasted elements and the fluctuation of such processes, as well as the choice of information and of suitable forecasting model and its investigation. This is manifested particularly strongly in the quantitative forecasting of precipitations.

The purpose of this article is the study of the dynamic-statistical forecasts of the monthly precipitation totals over the territory of an individual station using the method developed by Professor Alekhin (1-3), based on the intraseries laws governing the development of geophysical processes and which makes the implementation of this task possible in principle. Experience based on such studies (4, 5) has proved the possibility to apply this method in complex random phenomena considerably different from one another in terms of the scale of the territory over which they develop. The work studies the May-September intra-annual period which is characterized by the liquid phase of precipitations.

The initial series in this study are formed by the daily sum total of precipitations $Y_{i,j}$ measured at the V. Levski Park in Sofia between 1887 and 1978. We consider that the terms of this series are elements of the set

$$(1) \qquad A=\{Y_{1,1}, Y_{2,1}, \ldots Y_{a,1}, Y_{1,2}, Y_{2,2}, \ldots Y_{a,2}, \ldots Y_{1,v}, Y_{2,v}, \ldots Y_{a,v}\},$$

in which u is a parameter reflecting the calendar days of the month while v is a parameter reflecting the calendar months of the year. Consequently, we may form the set

$$(2) \qquad B=\{\bigcup_{i=1}^{a} Y_{i,1}, \bigcup_{i=1}^{a} Y_{i,2}, \ldots \bigcup_{i=1}^{a} Y_{i,v}\},$$

whose elements are the monthly precipitation totals, i.e.,

$$(3) \qquad \{Y_{i,j}/Y_{i,j} \in A \wedge Y_{i,j} \in B\}.$$

Since the sum total M of the monthly precipitation totals $X_{i,j}$ remains unknown in the general case, we shall use the extract

(4) $$C=\{C_1, C_2, \ldots, C_v\},$$

in which

(5) $$\begin{aligned} C_1&=\{X_{1,1}, X_{1,2}, \ldots, X_{1,s}\},\\ C_2&=\{X_{2,1}, X_{2,2}, \ldots, X_{2,s}\},\\ &\text{— — — — — — — —}\\ C_v&=\{X_{v,1}, X_{v,2}, \ldots, X_{v,s}\}, \end{aligned}$$

in which s is the parameter which reckons the calendar years within the period under consideration. It is obvious that

(6) $$\{A\subset B\subset C\}\cap M,$$

however, we may consider that the volume of the extracts under consideration

(7) $$\mathrm{card}\{C_i\}\sim 90$$

is adequate for the purpose of resolving the forecast problem.

The series X (t) have been converted into deviations from the average $\overline{X}_i(t)$ and have been normed. They have been studied for time stability using the generally accepted statistical parameters which proved to be relatively constant. Furthermore, their long-term periodicity was studied. Fig. 1 indicates the change in the dynamic precipitation norm for June represented through sliding averages of each 10 terms in the corresponding series X(t). Fig. 1 clearly shows the periods of increased or decreased precipitation activity. The existence of such long periodical fluctuations in all studied series X(t) confirms the possibility that the problem could be resolved with the help of the dynamic-statistical method for forecasting geophysical processes.

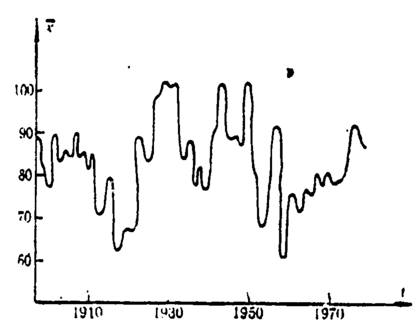

Fig. 1. Course of the dynamic precipitation norm $\overline{X}_{10}$ for June

Table 1. Extremal Values and Average Period t_R of the Correlation Function $R(\tau)$

Description \ Month	V	VI	VII	VIII	IX
$R(\tau)_{max}$	0,21	0,34	0,39	0,68	0,48
$R(\tau)_{min}$	−0,24	−0,42	−0,32	−0,66	−0,37
t_R	9,0	7,2	5,8	5,0	6,4

In this work the study of the influence of each term of the series X(t) on the subsequent terms and their time distribution has been achieved through the correlation functions $R(\tau)$, computed according to the (1, 5) method with a time displacement $\tau=1, 2, \ldots, 30$. Some characteristics of the function $R(\tau)$, as maximum and minimum values and for an average period t_R are shown in Table 1.

The results of Table 1 indicate the possibility to forecast monthly precipitation totals on the territory of an individual station with the help of the dynamic-statistical method, in which the average period of the correlation function for the considered months varies from 5.0 to 9.0. Such computations are illustrated by Fig. 2 which shows the values of the function $R(\tau)$ for the month of July, whose course in time clearly indicates the possibility to forecast the values of the variation series X(t) on the basis of the method we suggest.

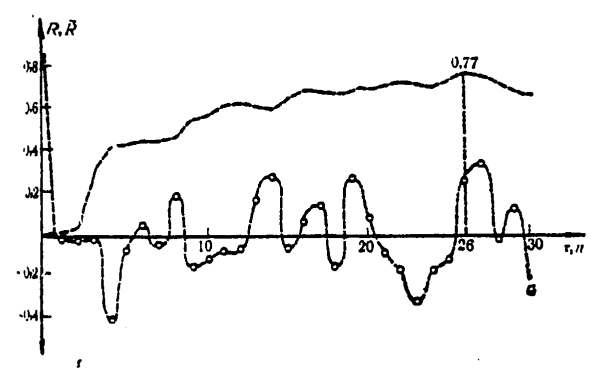

Fig. 2. Correlation function and general correlation function $\bar{R}(n)$ of precipitations for the month of June.

Not only the distribution of the correlation tie between two terms of the series, depending on their reciprocal displacement within time τ, as described by the correlation function of $R(\tau)$, but the integral correlation tie between each term of the series and n preceding terms, described with the general correlation function $\tilde{R}(n)$(3, 5) is of substantial significance in the study of the internal laws governing a time series. The function $\tilde{R}(n)$ enables us to assess the representativeness of the series under study and to determine the optimum period n_{opt} in the prehistory needed for purposes of effective forecasting. The study of the functions $\tilde{R}(n)$ of the series considered in this work indicates, yet once again, the possibility for an effective forecasting of monthly precipitation totals over the territory of the station under consideration. The forecasting itself is achieved through inverse relations functions $K(\tau)$, computed through the minors of the correlation matrix in accordance with the method of (5). The scope of the functions $K(\tau)$, and the optimum period n_{opt} are shown on Table 2.

Table 2. Extreme Values of the Inverse Relations Function $K(\tau)$ and the Optimum Period n_{opt} in the Prehistory of Studied Series X(t)

Description \ Month	V	VI	VII	VIII	IX
$K(\tau)_{max}$	0,28	0,52	0,56	0,29	0,30
$K(\tau)_{min}$	−0,50	−0,55	−0,33	−0,44	−0,36
n_{opt}	30	26	22	20	28

The results of the computation shown in the table indicate that each of the series X(t) has its characteristic volume of prehistory in which the accuracy of the forecasts is the highest. The optimum period n_{opt} for the series under study fluctuates from 20 to 30. These computations are illustrated in Fig. 3 which indicates the course of the inverse ties function $K(\tau)$ for the month of June, for the forecasting of whose monthly precipitation totals requires the prehistory $n_{opt} = 26$.

The computations indicated so far are the base on which, following the method developed in (5) the monthly precipitation totals have been forecast with the help of the dynamic-statistical method (1). Some characteristics of the control forecasts for the studied time series X(t) are given in Table 3.

The table indicates the amplitudes A, the standard σ_f for the factual and σ_{fo} of the forecast values of the series X(t), the correlation coefficients $r_{f\,fo}$ between the factual and forecast values of the monthly precipitation totals, and the frequency P of control forecasts.

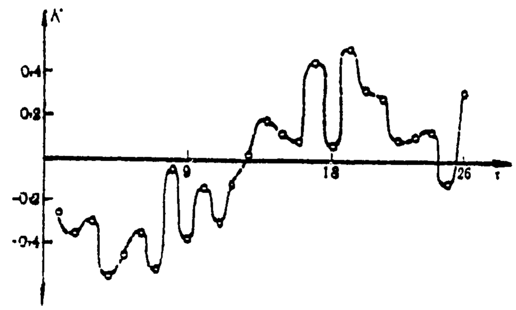

Fig. 3. Function of inverse intraseries ties k(τ) for precipitations in June.

Table 3. Description of Control Forecasts

Description \ Month	V	VI	VII	VIII	IX
A	31,8	42,6	63,4	22,3	26,3
σ_f	35,9	41,4	50,1	29,3	41,4
σ_{fo}	33,7	41,5	40,2	26,1	30,4
$r_{f\,fo}$	0,78	0,77	0,73	0,77	0,74
P	77%	83%	72%	76%	70%

Judging by the results of the computations of Table 3, the correlation coefficients $r_{f\,fo}$ between the factual and forecast values of the monthly precipitation totals in the period under consideration have been relatively high for the type of series $r_{f\,fo}$ = 0.73-0.78, while the frequency of control forecasts P = 70-83 percent. An illustration of the forecast included in this work is found in Fig. 4 which indicates the forecast values for the series X(t) for June and the corresponding factual values of the series.

The results obtained in this work from the forecasting of monthly precipitation totals for the series under study confirm that the control forecasts were successful. This proves, yet once again, the possibility to broaden the applicability of the dynamic-statistical forecasting method (1,5) to a broad range of geophysical processes.

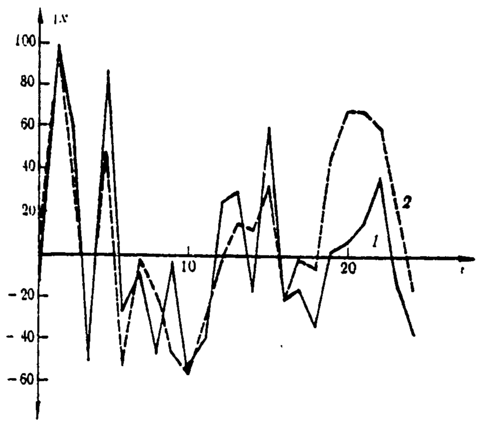

Fig. 4. Course of factual 1 and forecast 2 June precipitation totals

FOOTNOTES

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BULGARIA

METHOD, DROPSONDE TO MEASURE CLOUD WATER CONTENT

Sofia KHIDROLOGIYA I METEOROLOGIYA in Russian Vol 29, No 3, 1980 pp 27-36

[Article by D. E. Gaytandzhiev: "A Method and System for Measuring the Water Content of Clouds With a Dropsonde"]

[Text] Among the familiar methods and instruments for measuring the water content directly in clouds, aiplane water content measuring devices (2, 3, 5, 6, 8, 11) and some instruments for the study of low clouds under mountainous conditions (9) have been most frequently used in meteorological practice. However, not one of the familiar airplane instruments can fully satisfy all requirements concerning such measures as exhaustively formulated in monograph (5) and work (3).

Measurement conditions are difficult in thick convective clouds and such flights are dangerous to the airplane. For this reason, the experimental data published on the water content of such clouds have been scarce. Their accuracy must be carefully considered. They apply primarily to the peripheral cloud areas. Yet, the new requirements regarding the study of the structure, development, and physical characteristics of clouds, including convective clouds, and the need to improve man's influence on hail processes lead to ever stricter requirements governing such measurements. Occasionally they must be made in very turbulent conditions, considerable water content, rather low air temperatures, and changing phases of cloud elements. In the course of such studies frequently it is preferable to be familiar with the continuous verticle structure of the water content in the cloud zone rather than the breakdown of the water content according to the trajectory of the airplane's flight.

We were faced with the task of finding a method for determining the temperature of the cloud environment, the air stream vector and the water content of the cloud without tearing the latter with an airborne laboratory, which would enable us to take operative soundings of a given part of the cloud based on data provided by the ground meteorological radar and thus obtain data, synchronized with the radar information on the cloud area on direct cloud measurements. It is self evident that the sonde should be able to operate at all air temperatures and phases of cloud particles.

We selected among the small number of methods which basically enable us to determine the water content of clouds under such circumstances the method based on the degree of cooling a heated body depending on the quantity of evaporated cloud water falling on its surface as the sonde moves within the studied area.

A dropsonde could be placed at a given point of the cloud with the help of a modified Oblako antihail rocket or through other methods (airplane, balloon). A parachute opens at the stipulated point on which the sonde is dropped. A specially designed parachute is opened in the agitated area of the cloud as a result of which the sonde drops with a minimum roll and at the necessary velocity in terms of the environment. The water content along the trajectory of the sonde is determined on the basis of the temperature differential between two bodies (collectors) electrically heated. The first--the "open"--is in the undisturbed flow and moves at the speed of the sonde. As a result of the evaporation of cloud elements falling on the surface of the collector and the heat exchange with the environment, its temperature reaches the value t_k. A second collector, identical to the first, is placed, under the same heat exchange conditions, in the same environment but is exposed to an air flow cleared from cloud elements. For this reason the temperature t'_k of this "screened" collector is higher than that of the "open" collector in the existence of a water or ice phase. Data on the t'_k-t_k temperature difference and the location of the sonde are transmitted through a radiotelemetry system.

We shall consider the heat exchange between the collectors and the cloud, on which the water content definition method is based. The equation of the heat balance of the open collector includes the following components considered for a unit of time under stationary conditions:

The joule heat Q_1, released by the heating current in the collective equals

$$Q_1 = A \cdot I^2 R,$$

in which A is the thermal equivalent of the work;
I is the electric current heating the collector;
R is the resistance of the collector's heating element.

The amount of heat Q_2 released on surface S' of the collector, exposed to the flow, as a result of the conversion of the kinetic energy of the flow into thermal energy, equals

$$Q_2 = \alpha S'_r \frac{Av^2}{2C_p},$$

in which α is the heat transfer coefficient;
r is the restoration coefficient;
C_p is the specific heat of the air at constant pressure;
v is the velocity of the sonde relative to the environment.

In the air flow the heated collector releases the convective heat in the course of the heat exchange

in which $\bar{\alpha}$ is the heat coefficient;
S is the surface of the collector;
t_k is the temperature of the heated collector;
t is the air temperature.

It is possible to prove that the heated collector (whose simplified appearance is that of a thin plate) spends the amount of heat Q_4 for the transfer of heat to the carriers (supports) under the condition of a heat exchange between the latter and the air flow:

$$Q_4 = 2\frac{t_k - t + \frac{Q_1}{\bar{\alpha} P_k l}(ch\, m_k l/2 - 1)}{\frac{sh\, m_k l/2}{\lambda_k S_k m_k} - \frac{ch\, m_k l/2}{\lambda_\partial S_\partial m_\partial}},$$

in which l is the length of the plate (collector);
P_k is the perimeter of the cross section of the plate (collector);
λ_k is the collector's heat conductivity coefficient;
P_∂ is the perimeter of the cross section of the carriers;
λ_∂ is the carriers' heat conductivity coefficient;
S_k is the area of the collector's cross section;
S_∂ is the surface of the carrier's cross section;

$$m_k^2 = \frac{\bar{\alpha} P_k}{\lambda_k S_k}; \quad m_\partial^2 = \frac{\bar{\alpha} P_\partial}{\lambda_\partial S_\partial}.$$

The quantity of heat dispersed by the collector through radiant heat transfer equals

$$Q_5 = \varepsilon_k c_0 S\left[\left(\frac{t_k}{100}\right)^4 - \left(\frac{t'}{100}\right)^4\right],$$

in which ε_k is the degree of blackness of the heated collector;
c_o is the radiation coefficient of an absolutely black body;
t' is the temperature of the structure surrounding the collector $(t' \simeq t)$.

Let us assume initially that the only thing present in the cloud is the liquid phase with a water content w_1. In this case the amount of heat spent for the evaporation of the water settling from the cloud on the collector will equal

$$Q_6 = w_1 \cdot E \cdot v \cdot S^* \cdot [c_w(t'' - t) + L_w],$$

in which E is the integral coefficient of the spread of cloud drops;
S^* is the exponential area of the collector normal in terms of the air flow;
c_w is the specific heat of the water;
t'' is the temperature of boiling water at the given pressure;
L_w is the heat of the water conversion into steam.

No strictly stationary heat transfer could exist when a sonde drops through the cloud mainly as a result of the disparate water content in the various parts of the cloud and, to a lesser extent, because of changes in the air temperature. However, at sonde dropping velocities of 10-15 meters per second, when the evaporation of the cloud elements takes place within the time during which the water content remains virtually unchanged and no water collects on the surface of the collector, the heat transfer may be considered stationary. In that case the equation of the heat transfer of the open collector will be

(1) $$Q_1 + Q_2 = Q_3 + Q_4 + Q_5 + Q_6.$$

Missing in equation (1) is a term which considers the kinetic energy of the drops hitting the surface of the collector because of the smallness of their effect (4), and the quantity of heat transmitted along the fine leads of the temperature meter (microthermoresistor, thermocouple), attached to the collector.

Similarly, the same components as of (1) are participating in the equation for the heat balance of the screened collector, with the exception of term Q_6, for no cloud drops evaporate from the surface of this collector

(2) $$Q_1' + Q_2' = Q_3' + Q_4' + Q_5'.$$

Since both collectors are heated from the same source (connected to it sequentially--Fig. 3b) and since they have virtually identical resistance of the heat elements (made of tantalum), $Q_1 = Q_1'$. Similarly, $Q_2 = Q_2'$ because of identical flow velocities. Therefore, comparing (1) with (2) we could write

(3) $$Q_3 + Q_4 + Q_5 + Q_6 = Q_3' + Q_4' + Q_5'.$$

Replacing the terms in (3) with corresponding expressions, we shall obtain the equation for the water content of the liquid phase in a cloud medium:

(4) $$w_1 = \frac{\bar{a} S (t'_k - t_k) + \dfrac{2(t'_k - t_k)}{\dfrac{sh\, m_k l/2}{\lambda_k S_k m_k} - \dfrac{ch\, m_k l/2}{\lambda_\partial S_\partial m_\partial}} + \varepsilon_k c_0 S \left[\left(\dfrac{t'_k}{100} \right)^4 - \left(\dfrac{t_k}{100} \right)^4 \right]}{E \cdot v \cdot S^* [c_w (t'' - t) + L_w]}.$$

The estimation of the terms on the right side of (4) shows that the $Q_5'-Q_5$ difference is lower than $Q_3'-Q_3$ by an order of two. Thus, under average measurement conditions of 3-9 kilometers atmospheric altitude range the relation $\frac{Q_3'-Q_3}{Q'_5-Q_5}=85\div475$ for the value $t'_k-t_k=0{\cdot}5\div30°C$ increases with the growth of t'_k-t_k. The Q'_4-Q_4 becomes even smaller in terms of Q'_3-Q_3. In such a case equation (4) could be written with an accuracy of up to 1 percent in terms of w_1 as

$$(5)\qquad w_1=\frac{\bar{a}\,.\,S(t'_k-t_k)}{E\,.\,v\,.\,S^*[c_w(t''-t)+L_w]}.$$

Bearing in mind that the steam heat changes with the altitude together with $t'': L_s=L_0-0.57\,t''$ and expressing the temperature in absolute degrees (^{o}K), we shall have

$$(6)\qquad w_1=\frac{S}{ES^*}A_H(T'_k-T_k),$$

in which

$$(7)\qquad A_H=\frac{\bar{a}}{v\,[c_w(T''-T)+L_0-0{\cdot}57\,(T''-273{\cdot}15)]}.$$

Equation (6) was obtained by assuming the existence of nothing but the liquid water phase in the cloud. Conversely, should the cloud contain nothing but the ice phase with a W_1 water content for the cloud, equation (6) is retained as

$$(8)\qquad A_H=\frac{\bar{a}}{v\,.\,[c_i(T'''-T)+L_i+c_w(T''-T''')+L_0-0{\cdot}57(T''-273{\cdot}15)]}.$$

in which $c_i=c_i\,(T)$ is the statistic ice heat;

$T'''\simeq273{\cdot}15\,°K$ is the ice melting point;

L_i is the ice melting heat.

The coefficients A_H (7) and (8) are the complex functions of the temperature of the medium and the atmospheric pressure at a given level-- $A_H=A_H(T,P)$ and, depending on measurement conditions, may change within a wide range. The essential characteristic in defining w on the basis of (6) based on the dropping sonde method, when the velocity of the dropsonde in terms of the environment is also determined by T and P, is the fact that the A_H coefficients change their values within a small range at each atmospheric level.

In the liquid water phase as in the ice phase the variations of the A_H coefficients in terms of the corresponding average values for A_H at a given level are usually within the range of the tenths of a percent to $2\div3$ percent. With a probability of $95\%\ \Delta A_H=\frac{|A_H-\bar{A}_H|}{\bar{A}_H}$ will not exceed 6 percent and it is only in extreme atmospheric conditions, noted in the case of aerological soundings with a probability lesser than 0.02 percent that ΔA_H reaches 7 percent.

Fig. 2 shows the variations of A_H at each level of the 3-9 kilometer atmospheric stratum for the summer period (May-September) based on aerial soundings over Bulgaria (Sofia). The mean values of A_H for both water phases were obtained under average temperature and pressure values for the period at a given level. The extreme coefficients A_{Hmin} and A_{Hmax}, located on the left and right sides of the mean value for A_H were computed in cases of coincidence of extreme unfavorable values of T and P at a given level (showing the extreme deviation from the average A_H, such as, for example, T_{max} and P_{min}, or vice versa), each of which may occur once every 10 years. The chart figures show the temperature of the environment at the altitude for which the value of A_H was computed. One can easily see that most of the minimum values of A_H for the ice phase and, particularly, the maximum values of A_H for the liquid phase have no practical physical meaning at the given temperatures. The remaining two extreme values of A_H are considerably more probable under factual conditions. Also, differences between them are lesser. This makes it possible in a real atmosphere, and in the existence of both the liquid and ice phases, as well as in the conversion from one phase to another, to adopt a single common mean value for A_H for each altitude.

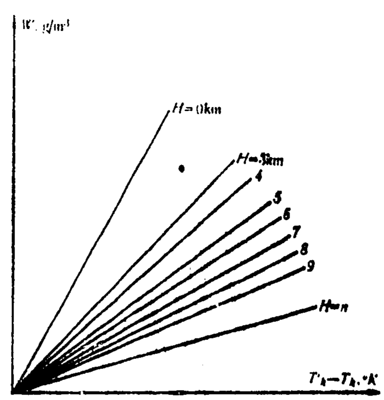

Fig. 1. Approximate diagram of the relation $w = w(A_H, T'_k - T_k)$

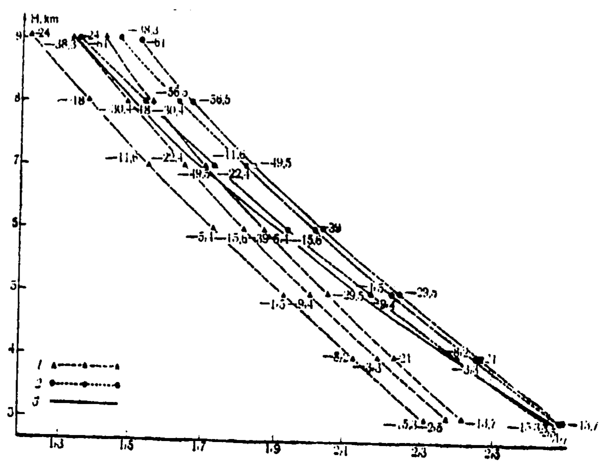

Fig. 2. Relative changes of the A_H coefficient according to the altitude of the measurement, temperature of the environment, and phase of the cloud water. The figures indicate the temperature of the environment at a given altitude for which A_H has been computed. The divisions on the abscissa scale are indicated in relative units.

1. ice phase; 2. water phase; 3. mean value - $\overline{A}_H$

The continuous line on Fig. 2. indicates the rough correlation between the mean value of A_H at a given atmospheric level and the altitude. The curve was computed for average summer conditions over Bulgaria, based on the assumption that the liquid phase would predominate at temperatures higher than -13 -- $-15^{\circ}C$, while the ice phase will predominate at temperatures from -25 to $-30^{\circ}C$. Despite the fact that this assumption does not cover cases of evaporation of bigger ice elements on the surface of the collector in the lower area of the considered range or the evaporation of liquid drops at its upper segment, which could occur in convective clouds, evaluations indicate that it is possible to draw up a mean value curve for A_H (H), in which deviations from this value under factual conditions would not exceed 6-7 percent in the case of more general measurement conditions as well. At the same time, the measurement of the cloud temperature provides the possibility for a more precise determination of A_H in a specific measurement case. However, this question exceeds the limits of this article.

Considering A_H as a permanent value for a given atmospheric level, it is possible to define the water content of a cloud, in principle, with the indicated accuracy, as a simple linear function (6) of the temperature difference between the collectors, not obviously dependent on the parameter H--the altitude of the point of measurement above sea level. Fig. 1 shows a rough diagram of this relation. The grade of the lines in terms of the abscissa, determining the sensitivity of the sonde, depends on the design of the system and the altitude.

The relative changes of A_H with the altitude could be obtained by considering the variations of the values included in A_H within a given atmospheric range. The established velocity of the parachuted dropsonde depends on atmospheric density ϱ_H on the corresponding altitude H:

(9) $$v_H=\sqrt{\frac{2m_3 g}{\varrho_H c_z \sigma}}=\frac{\text{const}_1}{\sqrt{\varrho_H}},$$

where M_3 is the mass of the parachuted sonde;
g is the gravity accelerations;
c_z is the coefficient of aerodynamic resistance of the dropsonde;
σ is the area of the parachute midsection.

Crossing the cloud, the sonde goes into different atmospheric strata where the average S heat coefficient $\bar{\alpha}$ acquires different values. Under the conditions of a laminar border "collector-medium" stratum, i.e., for $Re \leq 5.10^5$, with a longitudinal air flow on the collector (flat plate) the coefficient $\bar{\alpha}$ is determined according to formula (7)

(10) $$\bar{Nu}=0{,}67\,Re^{0{,}5}\,Pr^{0{,}33},$$

in which $\bar{Nu}=\frac{\bar{a}\,d}{\lambda_b}$; $Re=\frac{v\,.\,d}{\nu_b}$; $Pr=\frac{\nu_b}{a}$

and in which d is the usual collector size;
λ_b is the coefficient of the heat conductivity of the air;
ν_b is the coefficient of kinematic air viscosity;
a is the coefficient of air temperature conductivity.

Substituting the expression for v_H (9) in the criterial equation (10) we obtain the correlation between the coefficient $\bar{\alpha}$ of the collector and the altitude

(11) $$\bar{a}_H=0.57\,\frac{\lambda_b}{\sqrt{d}}\sqrt{\frac{v_H}{\nu_b}}=\text{const}_2\,\frac{\lambda_b}{\sqrt{\nu_b}\,\sqrt[4]{\varrho H}}\cdot$$

Introducing (9) and (11) in (7) and (8) and also taking into consideration, along with T and P, the changes in all other parameters of (7) and and (8) occurring in accordance with the altitude, we could determine in advance the changes in the coefficient A_H with the altitude changes in terms of the value of A_{H_0} for a determined altitude (for example with $H_0 = 0$). Table 1 shows the relation A_H/A_0 for the 3-9 kilometer atmospheric stratum. Similarly we can compute the relation A_H/A_0 for any altitude in terms of the corresponding coefficient A_{H_0} for any random point on the suface or above it.

Table 1.

Altitude over Sea Level H [km]	3	4	5	6	7	8	9
A_H/A_0	0,754	0,677	0,603	0,536	0,474	0,423	0,377

The data in Table 1 correspond to approximate mean values of the coefficient A_H on Fig. 2 and are obtained under average summer conditions (May-September) over Bulgaria, coinciding with the corresponding atmospheric parameters according to (1) and (10).

Assuming now that at a given point with altitude H_0 the water content of the medium is w_{H_0}, which we determine through a given method (such as, for example, the absolute weight method) and, at the same time, we determine the temperature differential $T_k' - T_k$ of the collectors of the system moving at a specific velocity v_{H_0}, in terms of this environment, we could compute A_{H_0} according to (6). Subsequently, on the basis of the existing A_H A_{H_0} relation we could determine for any atmospheric level the corresponding coefficient for A_H which will also correspond to the given design of the system. The coefficients would coincide for systems of identical design. Consequently, a single calibration measurement would enable us to build a family of linear graphs $w = w(T_k' - T_k, H)$ of the type shown on Fig. 1 for a given design of a dropsonde. The same results could be obtained with a greater number of calibration points similarly obtained for different altitudes with a subsequent determination of the remaining coefficients of A_H through interpolation and extrapolation in accordance with the law of changes in the A_H A_{H_0} correlation with the altitude.

On the basis of $w = w(T_k' - T_k, H)$ in cloud sounding, the water content of the clouds is determined in accordance with the measurements of the temperature differential between the collectors and the position of the sonde.

Summing up all parts of this method the following could be singled out: The method enables us, in principle, to take measurements in clouds without the use of airplanes. The water content of the clouds is determined on the basis of two measurable parameters, which is considerably simpler compared with methods involving the use of aircraft.

This calibration of the system is based on the factual heat transfer between the collectors and the flow, for which reason it should provide more reliable results than the computation method of calibration involving similar instruments mounted on aircraft (2), (3), (6). At the same time, the use of the A_H/A_{H_0} relation replacing the specific value of A_H largely eliminates inaccuracies in determining A_H caused by the incomplete coincidence between the conditions under which the given criterial equation (10) was obtained and the factual heat transfer conditions.

If the power of the heat source of the collectors is able to insure a sufficiently fast evaporation of cloud elements from the surface of the open collector along the entire trajectory of the sonde, the method used to determine the water content becomes independent of variations in the tension (power) of the source. This insures the identical calibration of a series of identical instruments.

No restrictions in terms of the temperature of the medium studied or the phase of the cloud water exists in the course of measurements within the indicated error thresholds.

One of the shortcomings of the method is the fact that the velocity of the dropsonde is limited by the power of the collectors' heat source. In drop velocities of 10-15 meters per second, corresponding to the 3-9 kilometer atmospheric stratum, at altitudes in excess of 6 kilometers, the speed of the sonde reaches values corresponding to the speed of precipitation of the biggest cloud drops and their equivalent ice elements. This reduces the probability of the latter's settling on the collector, despite the fact that, in itself, the "encounter" between such elements and the collector is unlikely in a usual cloud water content.

Finally, let us add that there is also a maximum value for the maximum water content measured by this system, corresponding to the power of the source and the design of the sonde.

Fig. 3 shows a diagram of a sonde drop. The system contains two identical collectors--Fig 3a. In their simplified version, each of them represents a fine plate 1, covered with a net which prevents the splashing and blowing away by the air flow of relatively big cloud elements. The layers are located symetrically within the bodies 2 made of a water repellent material. Their front sections contain openings with an area of S*. Both layers are identically heated by source 12--Fig 3b, to which they are connected sequentially. Each plate has an attached collector temperature meter 3.

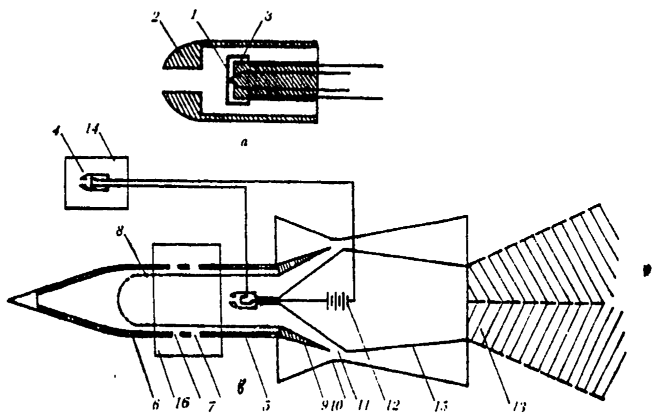

Fig. 3. Basic diagram of a dropsonde.

a. design of the integral water content collector;
b. general sonde diagram.

An undisturbed air stream flows on the open collector 4, while the screened collector 5 is in the inner area of screen 6. As a result of the inertia of cloud elements flowing together with the screen, the purified air which blows collector 5, goes through the draining slits 7 and perforated inner wall 8. The rear end of the screen shown as diffuser 9 ends at the narrowest part of the Ventura pipe (10) where openings 11 are located through which the air entering the screen is drawn out. The instrument compartment 15 is located inside the Ventura pipe. It contains the source 12 and the telemetry system (not indicated in the drawing) for transmitting the data readings and determining the sonde coordinates. The parachute system 13 (some of which indicated with a dotted line) is affixed to the rear section of the system. The body of the screen and the parachute are made of water repellent materials.

As a result of the simultaneous effect of parachute 13, which determines the dropsonde velocity, depending on atmospheric density, and the Ventura pipe 10, the speed of the flows for both collectors is identical throughout the sonde trajectory. Thus the temperature of the open collector is lower than that of the screened collector only in the presence of a liquid or ice phase in the medium.

The advantages of the system include the possibility for its operative delivery through a rocket to the studied part of the cloud.

A continuous record of the water content values is possible with a steady transmission of the temperature differences in the collectors and through the radar tracing of the position of the sonde.

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CZECHOSLOVAKIA

WORKING ENVIRONMENT IN NUCLEAR POWER PLANTS

Prague PRACOVNI LEKARSTVI in Czech No 4, Apr 80 pp 147-153

[Article by Jozef Carach, Regional Health Service; in Slovak: "The Working Environment in Nuclear Power Plants"]

[Text] The CSSR embarked on the industrial utilization of nuclear energy only within the last few years, later than other industrially developed countries. An important milestone here was the erection of the V-1 nuclear power station at the end of 1978. In view of its designed output and operating parameters, the A-1 nuclear power plant has to be considered only an experimental and pilot facility in terms of current criteria, and without greater economic or industrial importance.

The number of employees at the two atomic power plants, including those at the scientific research base at the Jaslovske Bohunice site, who are exposed to particular risks, amounts at present to approximately 1,600 persons. Information relating to radiologic safeguards within the atomic power plant has been published in the specialized literature both here and abroad.

The structural design of the nuclear reactors, which was based on Soviet concepts, has some characteristic features that are reflected in the problems of radiological protection. For containing the fission process the system of multiple barriers is generally used. This consists of high-grade fuel element cladding, a primary loop and the mounting of all the apparatus of the reactor primary loop within gas-tight containers. No "safety jacket," a container that as a whole seals off the reactor and the associated equipment, is used. A complex purification system reduces the quantity of radioactive substances in the primary loop to the lowest possible level compatible with economic considerations.

In connection with safeguarding the personnel, the areas of the nuclear plants are divided into a number of zones. In the clean area there is no risk of internal contamination by radioactive substances or of external radiation. Such areas, where staff can remain for an entire shift, include the reactor operation room, the control room of the purification station, some of the radiological laboratories, the machine room, and the like. There are other areas where short stays are the rule and where it is unlikely that the workers will receive dosages exceeding 30 percent of the maximum permissible dosage. The remaining areas fall into what is called the controlled zone, where conditions are such that exposures can be 30 percent of the maximum permissible dosage and higher. The controlled zone includes linking and service passages, the reactor room, the area where fuel elements are loaded and some others. This zone also includes some areas where the dosage levels are such that they are not usually accessible and are entered only under exceptional circumstances and when taking exceptional measures. These are the hermetic boxes of the steam generators and the ion-exchange filters and some other areas. A condition under which these areas are entered is interruption of coolant circulation, leakage of water from the relevant section of the primary loop of the light-water reactors and the carrying out of deactivization of the apparatus contained.

The hermetic apparatus that prevents the escape of radioactive substances into the working environment throughout the entire lifetime of the power plant, as well as the screening, requires a number of design and structural elements involving significant financial outlays that amount to several percent of the entire cost.

From the point of view of the reliability of the operational nuclear equipment it is extremely important to select materials with a high degree of resistance to corrosion by the coolant used. For light-water reactors of the VVER type this is austenitic stainless steel, which is used for the steam generators, for the primary tubing and for structural elements of the purification station for radioactive water. An important construction material in the active zone of the reactor is zircon with 1 percent niobium which is used for cladding the fuel elements, and zircon with 2.5 percent niobium for the pressure tube. For the reactor vessels, heat-resistant perlitic steel is used; for the driving mechanisms of the regulating and emergency systems, stainless chrome steels; for the vessels of the volume compensators, a special carbon steel; and as a sealing material in the systems of the primary loop, copper and nickel alloys.

Although there is adherence to the general rule that exposure to ionizing radiation should be as low as compatible with the practical aspects of operation, we encounter the natural tendency to create working conditions and a method of organizing work where individual dosages frequently approach the maximum permissible dosage. This trend can be substantiated by the summary chart of average quarterly dosages per person, at the A-1 power plant for different years, in particular for certain occupational groups. (Cf. Figure 1.)

The major health risk to plant personnel is external irradiation from gamma and beta sources, and to a negligible degree, neutron radiation and internal contamination by radioactive substances.

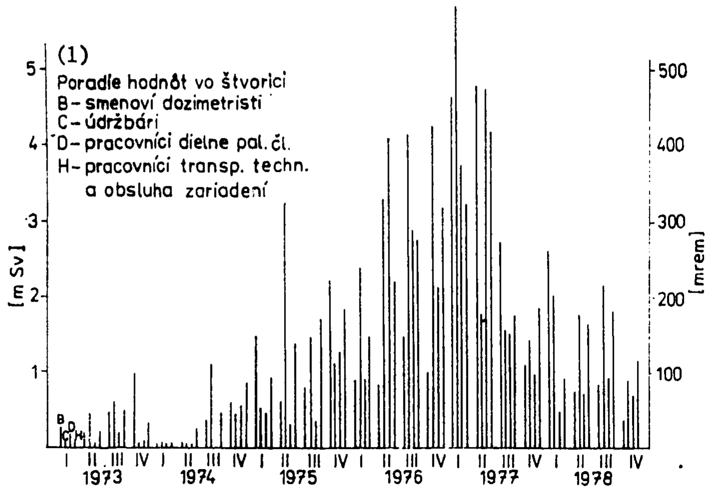

Figure 1. Summary of Average Quarterly Dosages per Person from Operations at the A-1 Power Plant

Key:

1. Order of values within each quarter
B. Shift dosimetric workers
C. Maintenance workers
D. Workers in the fuel-element loading area
H. Transport and technological equipment operators and equipment operators

From many years of experience in monitoring nuclear reactors we know that it is primarily exposure to external radiation that accounts for the total dose, up to 95 percent and above, while the amount contributed by internal sources contamination usually amounts to only a few percent. External radiation is the result of gamma radiation of fission products. Under operating conditions it is ^{16}N. That is an important component of the radiation. In areas far from the reactor core there are active corrosion products. Depending on the construction materials corrosion products are formed that migrate throughout the entire primary loop, being activated by the thermal neutrons in the active zone of the reactor and transported by the coolant to the surfaces of the primary loop. It is primarily the following radioactive corrosion products that are responsible for contaminating the reactor, the primary loop, the surfaces of the control and safety systems, the steam generators, the circulation pumps, the fuel element jackets, and other pieces of equipment: ^{51}Cr, ^{54}Cr, ^{59}Fe, ^{60}Co, ^{95}Zr and ^{141}Ce. The most important radionuclide, the one that determines the radiation situation in the loops, is however ^{60}Co.

When the coolant medium and the moderator circulate through the active zone of the reactor, the elements in these substances are activated, and the above-mentioned ^{16}N as well as ^{19}O, ^{18}F, ^{14}C, ^{42}K, ^{24}Na and ^{3}H are formed.

The neutron field represents a negligible contribution to the overall risk from external irradiation when the biological shield is functioning properly.

In accordance with Announcement No 65/72 of the Law Code on health protection measures with respect to ionizing radiation (in the CSR, Announcement No 59/72) all workers who could possibly be exposed in the course of a year to more than 30 percent of the maximum permissible dosage must be provided with personal film badges and the necessary protective clothing when entering the controlled zone, and then only through the hygiene trap. Workers engaged in especially high-risk work also receive KID 2 pencil dosimeters, TLD dosimeters, and dosimeters equipped with automatic warning devices. In case of accident the film badge is evaluated immediately, the film holder also containing a film dosimeter exhibiting a linear response over a broad range of dosages.

We have seen, as have others at other nuclear plants, that, as time goes on, both the individual and the collective dosages of the plant personnel are increasing with the length of time a plant has been in operation. The breakdown rate of equipment and the need for maintenance work increases with time. Almost three-quarters of irradiation stems from exposure to radioactive corrosion products received during maintenance work. Table 1 presents a summary of dosages from external irradiation for workers at the A-1 power plant between 1973 and 1978.

The group receiving the greatest exposure is that of the maintenance workers, especially those working on steam generator repairs. The source of the radiation is the corrosion products deposited in the piping and tubing. Other occupational groups that suffered higher than average doses of external gamma radiation include the transport and technological workers exposed during replacement of spent fuel elements, during repairs on the loading machinery, and while working in the long-term storage area for spent fuel, as well as chemists who conduct sampling and analysis of radioactive media at the operations.

It appears that the level of irradiation of plant personnel at nuclear power plants is rising throughout the world. The situation can be improved by optimalizing designs and improving work organization, especially for equipment repairs.

Another system for controlling risks in the working environment from external radiation is the system of installed and portable dosimetric instruments. The installed system monitors the magnitude of exposure to gamma radiation in the different areas of the nuclear plant, it registers any

Table 1. Annual Dosage Burden From External Gamma and Beta Radiation for Workers at the A-1 Atomic Power Plant Between 1973 and 1978.

Rok (1)	Integrálna dávka všetkých pracovníkov (2)		Priemerná dávka na jedného pracovníka (3)		Maximálna dávka na jednotlivca (4)	
	gama mSv (5)	beta mSv (6)	gama msV (5)	beta mSv (6)	gama mSv (5)	beta mSv (6)
1973	384	162	0,69	0,28	9,05	50,08
1974	706	447	1,18	0,74	27,29	95,70
1975	3629	790	5,62	1,22	57,66	27,63
1976	6418	6648	9,59	10,01	97,22	174,00
1977	7244	5139	9,36	6,70	100,17	409,66
1978	4087	4085	4,86	4,96	199,27	662,83

Key:

1. Year
2. Aggregated dosage of all workers
3. Average dosage per worker
4. Maximum dosage per worker
5. Gamma, millisieverts
6. Beta, millisieverts

increase and gives warning of this on the central evaluating equipment. This system also provides information on the state of technological equipment, especially on any change in activity in the loops or any escape of radioactivity.

The portable equipment is used when repairs are being made, when the hermetic boxes have to be entered and in the course of various operational procedures when there is expected to be a risk of radiation. It is used to provide more precise information when the permanently installed dosimeters have signalled a rise in the gamma field in a certain area.

The activity of the radionuclides in the reactor core itself is created by the activity of the fission products. There are numerous computer programs that make it possible to estimate the inventory of fission-product poisons in the reactor on the basis of a knowledge of the operating conditions. As an illustration, for one megawatt of thermal output, the average activity of ^{131}I in the reactor is between 888 and 1036 GBq.

Thus in the course of normal operations, but also especially under emergency conditions, radionuclides in the active zone of the reactor and in the primary loop can escape into the working environment through gaps in a large number of pieces of equipment. One of the most important factors affecting the escape of fission products into the coolant and the moderator, and subsequently to the areas of the nuclear power plant, is the condition of the cladding of the fuel elements. Damaged fuel elements are a major source of radioactivity in a nuclear power plant. The quality of the zircon sheathing on the fuel elements determines the hermeticity and the life of the elements and thus, consequently, the radioactivity of the coolant. The radioactivity of the coolant is the second most important source of radioactivity in the entire power plant. In the cooling water of the primary loop the following radionuclides are the major ones formed by the fission process: ^{133}Xe, ^{135}Xe, ^{131}I, ^{132}I, ^{91}Sr, ^{92}Sr, ^{139}Ba and ^{138}Cs. The total activity in the water of the primary loop can reach 3.7×10^6 to 3.7×10^7 Bq/l.

Under normal operating conditions activating and active corrosion products predominate in the circulating medium; when the fuel element coating is damaged, fission products predominate. From the standpoint of physical chemistry, leakage to the working environment can occur in the form of gaseous substances, aerosols, radioactive steam or contaminated solutions.

For safeguarding workers at a nuclear power plant from the danger of internal contamination by radioactive substances a complex system of organizational measures has been worked out and is being put into practice. Just as external radiation is monitored by permanently installed dosimetric systems, the concentration of radioactive gases and aerosols is continuously evaluated in corridors, in serviced areas and in areas that are usually unserviced. Many portable instruments are also used where atmospheric samples are taken and analyzed in the laboratory.

Valuable information about deposited sources of radioactivity that were previously in the form of dust or a radioactive aerosol in the atmosphere is provided by scraping tests. Finally, the last link in controlling the internal contamination of the power plant personnel is the activity of the health center, whether in the form of direct measurements of the radiation emitted by radionuclides deposited in the organism made with a whole-body counter, or by excretion analysis.

Internal contamination by tritium presents an especially great risk. There are a number of ways for tritium to be formed in the course of operation both in the heavy-water moderator used at the A-1 power plant, and in the light-water moderator at the V-1 power plant. In regards to the low-energy beta radiation emitted by tritium, monitoring of the radionuclides is carried out by a program based on liquid scintillation spectrometry, both for evaluating the activity of steam and humidity in the atmosphere, or within the different areas of the power plant, for evaluating the activity in the liquid media of the reactor, as well as in biological samples processed and evaluated in the health center.

A not insignificant share in reducing the risk of internal contamination, even when there is ample ventilation and radioactive areas and equipment are sealed, is played by individual protective devices. Very effective respirators are used. They contain a filter material based on synthetic fibers that is highly efficient, while offering little resistance to airflow. The wearing of work clothes is mandatory. Putting on pressurized suits for work in contaminated areas is often justified during the operation of a nuclear power plant.

Movement between zones that differ in the degree of radiation risk is possible only through hygienic locks or traps that provide for hygienic purification and dosimetric control. If decontamination cannot be achieved using the usual means--e.g. soap, shampoo, and scrub brushes--then the health center intervenes. When necessary it has more aggressive means available for decontamination. First aid for internal decontamination at the center can include the use of medications to prevent cellular deposition of the contaminant radionuclides, nonradioactive iodine, activated barium sulphate, and Berlin blue, or to accelerate the elimination of already deposited radionuclides by means of complexing agents.

Precise records of the dosages from sources of external and internal radiation are kept for every worker. Computers are used in this and of course the relevant programs are drawn up so that they answer a number of questions such as the evaluation of a collective dose, dosages per worker, dosage per megawatt of electric output and information on the possibility of distributing the dosage so as to stay within the limit of each individual. This last item is very important in scheduling maintenance work that has a high radiation risk associated with it.

The airborne dosages of external gamma radiation in micro-Gy/hour are given in Table 2 for some selected areas at the A-1 power plant. The same areas as in Table 2 are evaluated in Table 3 with respect to surface contamination. As can be seen, the greatest surface contamination was observed in the reactor room and in the long-term storage area for spent fuel elements.

The third parameter characterizing the radiation situation in these areas in the concentration of radioactive aerosols, Table 4. The greatest radiation risk from aerosols is concentrated in the reactor room.

In order to determine and compare the occupational risks of work sites where there are sources of ionizing radiation and where different types of work are done, these are divided into groups, as shown below in Table 5. The health care workers use sources of x-ray radiation primarily; workers at technical work sites use sealed gamma radiators and x-ray devices for flaw detection. The group "other workers" includes personnel at the research institute, colleges and veterinary facilities.

Table 2. Airborne Dosage Magnitudes of External Gamma Radiation and Changes in Them in the Course of 1978 at Selected Areas at the A-1 Atomic Power Plant, in Micro-Gy/hour.

Objekt (1)	Pracovisko (2)	1977 december	1978 máj	1978 december
Objekt č. 30 reaktorovňa (3)	miestnosť č. 229 chodba obsluhy (4)	2—7	1,5—40	2—4
	miestnosť č. 501 (5) chodba ovládania sekčných armatúr	1—70	2,5—30	1—3
	miestnosť č. 516 dlhodobý sklad (6)	1000—5000	500—5250	750—6000
	miestnosť č. 700 reaktorová sála (7)	30—200	25—300	5—300
Objekt č. 29 medzistrojovňa (8)	miestnosť č. 114 parogenerátory 3, 4 (9)	—	500—1500	100—1500
	miestnosť č. 54 priestor motorov TK (10)	3—15	2—8	2—5
Objekt č. 29 (11) medzistrojovňa; neaktívna časť	pri napájacej nádrži bloku I (12)	300—600	300—350	—
Objekt č. 41 (13) čistiaca stanica aktívnych vód	miestnosť č. 1 chodba obsluhy (14)	—	70—150	100—200
	miestnosť č. 17 montážna hala (15)	—	200	200
	miestnosť č. 35 miestnosť odparky (16)	—	10—100	30—120

[Key on following page]

[Key to Table 2]

1. Building
2. Work site
3. Building 30, reactor
4. Site 229, service passage
5. Site 501, passage for controlling section fittings
6. Site 516, long-term storage
7. Site 700, reactor room
8. Building 29, intermediary machine shop
9. Site 114, steam generators 3 and 4
10. Site 54, TK engine area
11. Building 29, intermediary machine shop; nonreactive part
12. At the feeding tank of power block I
13. Building 41, radioactive water purification station
14. Site 1, service passage
15. Site 17, loading room
16. Site 35, evaporating unit

Table 3. Surface Contamination at Selected Areas in the A-1 Power Plant, in Bq/cm^2

Objekt (1)	Pracovisko (2)	1977 december	1978 máj	1978 december
Objekt č. 30 reaktorovňa (3)	miestnosť č. 229 chodba obsluhy (4)	0,2	0,2	0,2
	miestnosť č. 501 chodba ovládania sekčných armatúr (5)	0,4—1,0	0,4—2,5	6,5
	miestnosť č. 516 dlhodobý sklad (6)	11,1—37,0	16,5	7,5
	miestnosť č. 700 reaktorová sála (7)	9,6—46,6	3,7—38	3,7—10
Objekt č. 29 medzistrojovňa (8)	miestnosť č. 115 parogenerátory 5,6 (9)	0,2	1,9	-
	miestnosť č. 54 priestor motorov TK (10)	0,4—5,3	1,5—8,5	0,5
Objekt č. 29 medzistrojovňa neaktívna časť (11)	vo vchode do priestoru napájacích nádrží (12)	0,1	0,2	—
Objekt č. 41 čistiaca stanica aktívnych vôd (13)	miestnosť č. 1 chodba obsluhy (14)	—	9,5	10,0
	miestnosť č. 17 montážna hala (15)	—	1,4	0,75
	miestnosť č. 35 miestnosť odparky (16)	—	1,7	1,7

[Key on following page]

[Key to Table 3]

1. Building
2. Work site
3. Building 30, reactor
4. Site 229, service passage
5. Site 501, passage for controlling section fittings
6. Site 516, long-term storage
7. Site 700, reactor room
8. Building 29, intermediary machine shop
9. Site 114, steam generators 3 and 4
10. Site 54, TK engine area
11. Building 29, intermediary machine shop; nonreactive part
12. In the entry into the area of the feeding tanks.
13. Building 41, radioactive water purification station
14. Site 1, service passage
15. Site 17, loading room
16. Site 35, evaporating unit

Table 4. Concentration of Radioactive Aerosols in Selected Areas of the A-1 Power Plant in the Years 1977 and 1978, in mBq/1

Building	Work Site	1977 December	1978	
			May	December
Building No 30, reactor	Site 229, service passage	12	under 5	under 5
	Site 501, passage for controlling section fittings	under 5	under 5	under 5
	Site 516, long-term storage	10	11	5
	Site 700, reactor room	5-55	7.5	i5-14

In the fourth and final section of Table 5 are the personnel at the atomic power plant in Jaslovske Bohunice. From the table it is easy to see that under the conditions obtaining in this country, contrary to the common assumption of the greatest occupational risk being associated with health care, it is the nuclear power plants that are the most significant source of occupational radiation burden. The table does not include the contribution from internal contamination sources.

Table 5. Annual Occupational Radiation Burden From X-Ray and Gamma Radiation at Various Types of Work Places Having Sources of Ionizing Radiation

Typ pracoviska (1)	Počet pracovníkov v rôznych dávkových intervaloch (6)							
	0—5 mSv	5—10 mSv	10—20 mSv	20—30 mSv	30—40 mSv	40—50 mSv	50—60 mSv	nad 60 mSv
Zdravotníctvo (2)	372	3	1	—	—	—	—	—
Technické pracoviská (3)	45	4	2	—	—	—	—	—
Ostatné (4)	160	—	—	—	—	—	—	—
Atómová elektráreň Jaslovské Bohunice (5)	951	94	81	29	18	4	1	1

Key:

1. Type of work place
2. Health care
3. Technical work places
4. Other
5. Atomic Power Plant, Jaslovske Bohunice
6. Number of workers in the different dose ranges

In Table 6 on following page, the workers at the power plant are divided into 11 occupational groups. The occupational groups receiving the highest exposures were maintenance workers, equipment operators and workers in the transport and technological section. The summary of the changes in the aggregate dosage for the years 1970 to 1978 given in Table 7 is interesting. The aggregate dosage shows a strongly rising trend interrupted by the shutdown of the power plant for technical reasons.

From the standpoint of radiation risk we recognize three important temporal stages at a nuclear power plant. The first stage is when the power plant is being put into operation, and this has two subdivisions: the physical and the energy-producing start-ups. They can be characterized by, on the one hand, a low level of fission-product poisons in the reactor and an insignificant amount of radioactive corrosion products, and on the other hand by the still unknown operational peculiarities of the facility, with the necessity of working out solutions to unique situations as they arise, and the presence of unaligned and uncompleted operational elements. The second stage, which encompasses the periods of trial operation and the beginning of permanent operation, is usually marked by a low level of radiation risk. Hygiene problems usually begin at the next stage when corrosion, wear and leaks in the equipment, as well as deterioration in the human factor, begin to become serious. Both worldwide and domestic experience testifies to this.

In view of the current interest in the recent start-up of the V-1 power plant, the radiation situation in the areas at the plant after it was brought up to 100 percent of nominal output on 23 March 1979 is presented in some detail below.

Exposure levels for gamma radiation in serviced areas fluctuated between 0.2 and 20 micro-Gy/hour. An insignificantly low concentration of radioactive gases (object activity) was measured at 3.7 to 20 Bq/1 and a concentration of radioactive aerosols (object activity) at 0.5 to 20 mBq/1. Contamination of surfaces and equipment occurred only in isolated instances and was immediately eliminated. In the hermetic boxes exposure levels of gamma radiation were on the order of gray/hour.

In the boxes of the steam generators and the main circulation pumps moisture from the atmosphere was frozen in order to determine the concentration of tritium. A value of 143.5 Bq/m^3 was obtained. The volume activities of the aerosols in the boxes are also very low, testifying to the satisfactory tightness of the equipment and the pipelines of the primary loop. Damage to the cladding of the fuel elements has not yet been observed, and the only source of fission products is their surface contamination by U-235.

Table 6. Annual Radiation Burden in Various Occupational Groups

Skupina (1)	Počet pracovníkov (2)	(3) Počet pracovníkov v rôznych dávkových skupinách							
		0—5 mSv	5—10 mSv	10—20 mSv	20—30 mSv	30—40 mSv	40—50 mSv	50—60 mSv	nad 60 mSv
A	67	56	3	5	1	2	—	—	—
B	31	26	4	—	—	—	1	—	—
C	423	295	49	46	17	11	3	1	1
D	25	22	1	1	1	—	—	—	—
E	34	34	—	—	—	—	—	—	—
F	103	99	3	—	1	—	—	—	—
G	5	5	—	—	—	—	—	—	—
H	319	242	34	29	9	5	—	—	—
I	8	8	—	—	—	—	—	—	—
J	88	88	—	—	—	—	—	—	—
K	76	76	—	—	—	—	—	—	—
Σ	1179	951	94	81	29	18	4	1	1

Key:
1. Group
2. Number of workers
3. Number of workers in the various dose ranges

A. Chemists
B. Shift dosimetrists
C. Maintenance group
D. Workers in the fuel element shop
E. Auxilliary workers
F. Supervisors
G. Workers in the hot cell
H. Equipment operators and workers in the transport and technological section
I. Reactor physicists
J. Personnel from other organizations (experts and control agencies)
K. Personnel from the scientific-research base

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Table 7. Overview of Aggregated Dosage Received in Individual Years During Which A-1 Jaslovske Bohunice Power Plant Has Been in Operation.

Year	Number of persons followed	Annual integrated dosage in man/sieverts
1970	80	0.07
1971	146	0.07
1972	476	0.15
1973	502	0.38
1974	654	0.71
1975	737	3.63
1976	781	6.42
1977	897	7.24
1978	1,241	4.09

The health care of the personnel at the A-1 and the V-1 power plants is concentrated in the plant health care center. The purpose of the entrance and periodic medical checkups, in particular those of the section for hematological and biochemical tests, is not so much a search for signs of damage as it is a search for pathological changes in workers resulting from another, nonradiation, etiology, for which they would have to be excluded from being exposed to ionizing radiation. The current maximum permissible dosages reflect many years of experience with the exposure of people to ionizing radiation, and when the international recommendations embodied in our legislation are adhered to, no somatic damage from ionizing radiation can occur.

Another important function of the plant health care center is evaluating internal contamination. Information on the body burden of every worker is compiled on the basis of the data from personal dosimetry provided by the plant's dosimetric service and data on internal contamination provided by the plant health care center.

A plan for dealing with the injuries caused by any possible radiation accident has been drawn up. Under this plan workers exposed are classified into one of the following groups on the basis of their estimated exposure: workers having exposures up to 0.25 sieverts are treated in the plant health center and at the District Public Health Institute in Trnava; from 0.25 to 1 sievert at the department of nuclear medicine of the Institute of Clinical Oncology in cooperation with the First Internal Clinic of the Faculty Hospital in Bratislava. For exposures of above 1 sievert, regardless of the degree of contamination, hospitalization in the Second Internal Clinic of the Faculty Hospital in Hradec Kralove is provided for.

The program for building socialism in the countries of the socialist camp is unthinkable without the development of nuclear energy. Great attention is being devoted to the study of the effects of ionizing radiation on biological systems and on the human body, the safety of nuclear devices and radioecology; and the further development of nuclear power is compatible with maintaining the healthfulness of the working and living environment.

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CSR MEDICAL RESEARCH ACHIEVEMENTS IN 1979

Prague CASOPIS LEKARU CESKYCH in Czech 9 May 80 No 19

[Article by Academician J. Houstek and L. Pelech, M.D., doctor of science: "The Most Important Results of the Sectoral Research Plan of the Ministry of Health of the Czech Socialist Republic in 1979"]

[Text] The report presented here contains an overview of the most important results announced by individual fundamental problem commissions in their bulletins. In choosing these results, emphasis has been placed on those findings which may be utilized immediately in medical practice. Therefore this brief summary does not include all of the fields contained in the research plan. The results are presented in the order in which the individual fundamental problem commissions, and the research projects which they have completed, have been incorporated into the sectoral research and development plan in the medical and pharmaceutical sciences and medical technology.

In the area of morphology and pathology, it was discovered during a study of the morphology of changes in the lungs during fibrosing alveolitis that the seriousness of the change in lung tissue has significance for the determination of a prognosis for the disease; diagnosis by means of a lung biopsy and timely therapy can inhibit the rapid progression of this disease.

In the area of medical genetics the empirical risk of luxatio coxae congenita was determined for our population. The system for identifying families genetically at risk was checked and improved on the basis of sectional supplemented by clinical genetic analyses, which made possible the study of the role of congenital developmental defects and diseases on perinatal, early childhood, and child mortality. The empirical risk of manic-depressive syndromes in our population was estimated and their relationship to additional anthropogenetic and immunogenic signs was critically analyzed.

In the field of pharmacology 248 articles were completed for the new edition of the pharmacopoeia, the dissolving properties of cardiac glycosides were worked on for the purpose of testing the quality of drugs containing these active ingredients, and the methodology established for determining pH in combined hydrodimethylformamide environments. A proposal was also submitted for a new method for the adaptive regulation of the quality of powder mixtures which will make possible the more convenient optimalization of the quality of powdered medicinal materials, and data were determined concerning the constituent materials of Radix ononis which will simplify the preparation of medicinal materials from this drug. An important result was the proposal for setting up the initial medicinal materials for the production of infusion and injection preparations of sodium hydrogen carbonate.

In pediatrics, an analysis of the health of 528 school-age children and of the influence of the social position of their families on their health showed that severe sickness, and respiratory and contagious illnesses appeared most often in grades one through three, with an average number of two to three serious illnesses per child per year, whereas accidents were more prevalent in the higher grades, particularly among the boys. A large percentage of significant neurotic symptoms are connected with the social situation of the family, with the degree of care shown by the parents for the health of their child. Among the parents of children with low grades, of which there were 78 in this sample, there was a statistically significant lower number with a college education, a larger number of children from broken marriages, more frequent disruptions in parental behavior, alcoholism, family conditions which threatened the healthy development of the child, and complicated living situations than in the control group, that is a group of 110 pupils with excellent grades. Health matters were not decisive in determining their success in school. In addition, a graphic representation was worked out of the body type typical of pituitary nanism which can serve as a screening aid for disruptions in growth. It was discovered that in patients with pituitary nanism the somatomedin level in the plasma takes on individually specific values after administration of a growth hormone, and at varying intervals after administration, which may have significance for the treatment of this condition. Additional results permit the diagnosis of a disruption in the function of the family and its severity, thereby making possible the provision of dispensary aid to the threatened child on the basis of objective indicators. These also serve as a measure by which to judge the effectiveness of assistance by society in child development.

In the area of sports medicine important findings were gained concerning the physiological differences in reactions at the onset of physical exertion. The initial rate of increase of oxygen in preadolescent boys is higher than that for trained adults, which points to a rapid beginning of aerobic metabolism in children. This may be placed in relationship with the atypical spontaneous movement activity of children. It is possible to consider a further contribution to be the wide utilization of noninvasive technology--impedance transthoracic plethysmography--during physical exertion of various kinds which facilitates the analysis of the phases of the heartbeat with great sensitivity as well as the study of the changes in hemodynamic parameters (the systolic and per minute heart volume).

In hepatology, the transformation was demonstrated of chenodeoxycholic acid to usodeoxycholic acid in the human intestine and, given the production of chenodeoxycholic acid from poultry bile, a modification was introduced which partially epimerizes this acid into the litholytically more effective ursodeoxycholic acid. The outcomes of the surgical treatment of bleeding from esophageal varices are an additional contribution, as is the founding of several blood vessel anastomoses which statistically significantly prolong the life of the sick. Likewise a contribution was the detailed elaboration of the methodology for the establishment of circulating immunizing complexes such as the sign of the HBsAg medium, because it was determined that HBsAg bound in the form of a dissolved complex has not been verified by normal immunoelectrophoretic methods.

In the field of endocrinology an original micromethod was developed for determining the essential amino acids in biological material brought from other workplaces. A system designed for the screening of sportsmen for doping with anabolic steroids was brought into practical application. A method was worked out for the determination of the spectrum of steroidal hormones, especially in cases of mineralocorticoid disruptions and virilization syndromes. A number of methods were worked out for the determination of somatomedin, somatostatin, gastrin, and other peptide hormones. A method was developed for treating obesity by controlled hunger and several mechanisms or organismic adaptation to limited food intake were explained, particularly in relation to thyroid hormones. The detection of hormonally active tumors was worked out using infrared rays.

In the field of hematology new findings were obtained in the study of the absorption activity of various particles, especially of colloidal iron, and during the utilization of the NBT test. The interaction of colloidal iron with leukemia cells and with follicled cells may serve as a simple test in the laboratory diagnosis of this disease.

In dermatology and venereology a proposal of measures was developed which led to a change in production technology, and by which a serious problem of our automobile industry was resolved--the mass appearance of contact allergic eczema from Terocal. In addition a new, more specific and economically favorable means for a serological examination for syphilis was proposed.

In the field of allergy and clinical immunology it was discovered that it is possible to count on the occurrence in 13 percent of our population of allergic conditions, and that the number of these conditions significantly increases especially during childhood. An increase in allergic coids was demonstrated, and it emphasized that these conditions are in a preasthmatic stage. New methods and examination approaches were discovered for the evaluation of immunity levels against infectious, inflammatory, and tumor-forming processes. A methodological chart of an approach to immunological therapy for respiratory allergies, particularly asthma, was designed.

In the field of rheumatology the first data were collected on the prevalence of juvenile progressive polyarthritis in the CSSR, and the more frequent occurrence of this illness among families was confirmed. X-ray criteria were worked out for the evaluation of the advancement of the rheumatic process in all elements of the cervical vertebrae, making possible rapid orientation. The methodology for determining the level of antistreptolysin "O" in human plasma was modified in the sense that titration came to be used instead of dilution. A new method was developed on the principle used to establish antibodies against streptolysin "O" in human blood serum by means of precipitation on agar. A more frequent occurrence of latent diabetes was found in persons suffering from gout. It was shown that Scheuermann's disease, or rather, vertebral dysosteogenesis, need not always occur in its fully developed form; that on the contrary, many more abortive forms exist which can be the cause in later years of the development of additional pathological changes of the spine. It is possible to call these changes those of a stigmatized spine. The cytological examination of the joints in those ill with rheumatic diseases has crucial significance not only for the diagnosis and evaluation of the activity of the rheumatic process, but also for the evaluation of medicinal effect. A new, color atlas published by our authors abroad is an important contribution to the diagnosis and cure of rheumatic illnesses on a world scale. Corticoids applied to the joint have a significant overall effect and it has been shown that they act as a retardant of the functioning of the surface of the adrenal glands for a period of up to 7 days. Treatment by cytostatic drugs, namely cyclophosphamide, proved successful in 76 percent of the cases of collagenosis with damaged kidneys after unsuccessful cortisone treatment. The treatment of progressive polyarthritis with 6 grams of cyclophosphamide daily is safe, and it is possible to use it as a temporary medication to suppress activity.

In pneumology it was shown that the best method for the basic examination of breathing is the flow-volume curve, which makes possible, as well, a rough judgment of gas distribution in the lungs and resistance in the breathing passages. For its broad practical utilization it is essential that the Chirana national enterprise finish the development of the open circuit spirograph as soon as possible. In addition it was discovered that in prescribing drugs which ease expectoration by individuals with symptoms of expirational stenosis, priority should be given to drugs which do not lessen the tone of the bronchial muscle group, and that inhaled mucolytics should not be applied to the sick who retain bronchial secretions with heightened viscosity.

In the area of the fight against tuberculosis it was shown that isoniazid, administered prophylactically over a period of 3 months to individuals with fibrous lung lesions lowered the occurrence of bacterial tuberculosis by about 30 percent, administered over a period of 6 months the figure became 70 percent, and when administered over 12 months, frequency of occurrence declined by about 80 percent. The occurrence of serious complications, particularly of the liver, tempers the implications for the mass use of isoniazid as a chemical prophylactic against tuberculosis. It was further shown that for those undergoing the first treatment of tuberculosis of the lungs, if there are no associated illnesses, the first phase of treatment can be shortened to 6 weeks with a combination of isoniazid, rifampicin, and ethambutol, at the same time that it is possible to administer these drugs intermittently from the very beginning.

In the fields of balneology and physiatrics a method of liver rheography was developed, with the aid of which it is possible to elucidate even relatively discrete functional as well as anatomical changes which take place in the course of spa treatments. The objective possibility of predicting the effect of spa treatment was demonstrated.

In the field of gerontology and geriatrics, a comparison of office visits to doctors in districts where the position of geriatric nurse has been introduced, with districts where geriatric nurses had not yet begun to work showed a general increase in the number of visits from the older population to district doctors from 1970. At the same time the number of older people who did not seek out a district doctor at least once a year declined. The increase in visits to district doctors was greater in those districts without geriatric nurses. It was furthermore shown that mortality from the bleeding of undiscovered peptic ulcers increases linearly with age. Older women have the least hope for a timely discovery of a peptic ulcer. Pain is the main reason for seeking out a doctor for more than 60 percent of those ill with peptic ulcers in the under-59 age group. Anacidity due to caffeine in older people does not preclude the presence of a peptic ulcer. In the under-59 age group three times as many males as females become ill with peptic ulcers. In the next age group (60-74 years) the same number of males and females are effected. In the oldest group (over 75 years) four times as many women as men are effected.

In the area of clinical pharmacology it was shown that the standard doses of acetylsalicylic acid result in a majority of children in gastroscopically visible changes in the stomach lining in the course of only 3 days of administration. Furthermore, methods were developed and introduced for the rapid determination of serum concentrations of aminoglycosidic antibiotics in such a way that it is possible to gain data concerning their levels on the same day, after the morning taking of blood. New methods were worked out and verified for the determination of the serum concentrations of azlocilin, mezlocilin, penamecilin, and oxolinic acids. The effectiveness of the new oral antimycotic drug Ketokonazol was confirmed for systemic mycosis in humans. In studying the effectiveness of the new antibiotic cefoxitin, it was shown to have excellent therapeutic effect on peritoneal infections, especially during childhood. Contrary to foreign data, it was less effective against staphylococcal infections. In studying the potential use of chloramphenicol in the treatment of typhus-bearing bacilli with extraordinarily large doses in the form of injections (100-177 milligrams/kilogram) in the course of 1 to 3 hours a bacteriocidal concentration was found in the bile only 1 to 4 hours after the administration of the medicine. Given the fact that a permanent cure presumes the creation of a bacteriocidal concentration for at least 24 hours, chloramphenicol is not suitable for the treatment of typhus-bearing bacilli at this level of dosage and given this form of administration. In a study of the dynamics of the betalytic effect of Trimepranol, administered by intravenous injections, it was discovered that this method of administration caused the effect to last a good 3 hours. Therefore, for clinical practice a sufficient dosage is 1 to 2 milligrams administered intravenously in single dosages. A comparative study was completed by Alnagon and a new analgesic, Fenalgin Spof, on those sick with algesic rheumatic syndromes. The tolearance for and therapeutic effect of both preparations was practically identical. The rapid therapeutic effect of a new localized corticoid, Cobetazol propionate, on chronic torpid psoriasis was demonstrated. For 73 percent of those suffering from superficial mycotic conditions, a reliable medicinal effect was demonstrated for Griseofulvin, applied locally in the form of a paste. In a comparison of new, retarded forms of lithium with unretarded forms, insufficient data was obtained concerning the desirability of administering the retarded preparation (lithemia was low and undesirable reactions appeared), while from the viewpoint of therapeutic effect there was no fundamental difference between the preparations. In a clinical comparison of the effectiveness of the domestically developed preparation Triamcinilon-S with the foreign preparation Locasalen, greater effectiveness and better tolerance was discovered for the preparation Triamcinolon-S in the basic indicators.

In clinical biochemistry models were developed showing the way to an increase in the quality and efficiency of laboratory testing at the National Health Institute. Efforts devoted to the development of new, standardized biochemical procedures have led to several discoveries, which have been confirmed by the authors, and which raises the quality of several routine procedures used in the National Health Institute. A kinetic procedure for establishing the activity of cholinesterase was patented, which has great practical significance and is the subject of interest abroad for possible licensing. Xenobiochemical research and the development of toxicological testing procedures also have great practical significance for the National Health Institute laboratories. This is especially true in the case of projects in which the procedures of liquid chromatography are used. In the field of radiodiagnosis a significant improvement was achieved in the technology and interpretation of angiographic examinations, an expansion and improvement of catheter therapy in preoperation preparation, in the stoppage of bleeding, in the treatment of blood vessel malformation, and in the cytostatic and palliative treatment of tumors. Work on endangeitis obliterans of the veins in the region of the kidneys and pelvis received international recognition. There is significant practical significance in the finding that the primary method for the diagnosis of osseous metastases is isotopic examination and biochemical testing. Other findings are significant for the organization of diagnostic procedures for breast cancer.

In the field of nuclear medicine, the conduct of in-vitro thyroid tests with the aid of radionuclides led to the definition of the discriminatory powers of these tests for thyroid dysfunction, and to conclusions regarding the conduct of these examinations in routine clinical practice, from which follows the progressive introduction of individual tests according to the principles of step-by-step diagnostic procedure. Practical conclusions were formulated for the conduct of radiocardiographic examinations at workplaces of nuclear medicine where the costly picture tube technology with computer data processing is not available. The problem of data transmission duing functional radionuclide studies was successfully resolved by means of a new main frame with dynamic memory which has great prospective significance for the work at nuclear medicine facilities, particularly with a view to the limited possibilities for the import of instrumentation technology. A number of technical and dosimetric problems were resolved, which is contributing to the expansion of examination procedures using radioactive Xenon ^{133}Xe.

In the field of neurosurgery an active neurosurgical approach, making possible the avoidance of a number of serious complications and an improvement of practical treatment results, was suggested for the resolution of a serious societywide problem, i.e. fracture of the base of the frontal sinus and its complications. The study of the postural mechanisms related to neurosurgical illnesses led to greater precision in several practical treatment approaches, especially in stereotactical treatment. A study of the dynamics of human cerebral edema confirmed experimental data that vasogenic edema arises in the tumor itself and only from there spreads to the surroundings. The amount of swelling is in correlation with the degree of demonstrated tissue hydration.

In the field of accident surgery a replacement was designed and clinically verified for the crisscross bindings of the knee joint by means of a graft from the tendon of the thigh muscle with a bone graft from the proximal region of the patella. The method, which was designed, was verified and led to improved clinical results in comparison with other surgical methods in use. In the resolution of the problems of maxillofacial injuries accompanying other wounds, constant cooperation was shown to be essential along with the flexible attainment of the stomatosurgeon in the treatment of multiple trauma conditions. It is desirable to combine an operation on the maxillofacial bone structure with other surgical procedures. A definitive treatment of the skeletal structure of the mid-facial parts is necessary within 10 days, and for fractures of the lower jaw within 14. Designs were worked out for rational therapeutic approaches to severe chest traumas, and treatment directives established. Appropriate X-ray examination procedures were also established. In cooperation with Chirana national enterprise at Nove Mesto in Moravia instrumentation was developed for meniscectomies which is already in production. The problems of postoperative care were worked out (rehabilitation, pharmacological effects, etc.) and a procedure designed for evaluating postoperative results. A new concept was developed for the treatment of infected tumors of the joints and a new classification of pseudojoints was worked out which serves also as a therapeutic directive. A significant finding for medical practice is that it is possible to influence the chemical phenomena accompanying fat emboli by administering calcium chloride. The demonstration of two types of heparin action is also important: the positive influence of small dosages of heparin without an anticoagulant effect, and a negative influence following the administration of a large dosage with anticoagulant effect.

In the field of pediatric surgery, conservative procedures were emphasized for the treatment of child fractures, but at the same time strict indications of osteosynthesis were limited. In the epiphyseolysis of adolescents, especially in the region of the ankle, the Salter-Harris procedure was adopted. The practical significance of this work lies in the radically decreased incidence of hemorrhaging in children.

In the field of obstetrics and gynecology, work has contributed to an alteration of the intrauterine environment for intrauterine devices, which can contribute to an increase in reliability and a decrease in the side effects of intrauterine contraception. Additional practical significance lies in the successful verification of the cryosurgical removal of benign cervical lesions, as well as in all the results relating to the comprehensive study of the efficiency of prebiopsy procedures for tracing precancerosis of the uterus. The results of work tracing the effectiveness of the vacuumaspiration of the uterine cavity is also significant for medical practice. This procedure, which can be performed without anaesthesia and therefore without hospitalization, can in a majority of cases take the place of the classical curettage of the uterine cavity.

In the field of orthopedics the syndrome of bodily asymmetry, and its occurrence and relationship to the formation of the spine in school-age children was studied, and new findings gained in the problematics of child spinal formation. The symptoms of pelvic disorders were worked out, as well as the relationship between plagiopelvia and sacroiliac shift, and a clarification of the relation of plagiopelvia to scoliosis. Good organic tolerance was shown for new hydrogel as well as the potential for using gel in the rebuilding of damaged joints. New splints were introduced into operational practice for the joining of small bones along with a new type of cervicle vertebrae prosthesis, the POLDI.

In the field of opthamology new modifications of microsurgical and antiglaucoma operations, trabeculactomies and the cauterizations of the sclera, were made more precise and evaluated. There was even pushing of the scleral line to the forward chamber, and an original explanation proposed of the mechanism of the functioning of these operations. An ultrasound method was developed for the localization of orbital tumors.

In the field of stomatology, significant practical findings were gained on the basis of a study of damaged permanent teeth of children treated with tetracyclin antibiotics (TA), because changes in teeth following the administration of TA are one of the most pressing problems of pedostomatology and adolescent stomatology.

In the areas of microbiology, epidemiology, and the clinic for infectious diseases, the results of serological examinations confirmed the correctness and successfulness of the so-called second vaccination against measles, and thereby as well the quality of Czechoslovak vaccination materials. It was further shown that staphylococcus which causes mass epidemics within large scale poultry operations produce for the most part Type D enterotoxin. It is an important discovery that human infections with staphylococcus enterotoxin are caused above all by animal staphylococcus groups. Salmonella agona and salmonella typhimurium were most frequently isolated as the cause of adult salmonelosis. The therapeutic effect of large dosages of cortisones in the treatment of parotiditic meningoencephalitises were demonstrated. The cause of fetal malformation was shown to be a form of congenital toxoplasmosis. It was discovered that the bacteriocidal effectiveness of washing substances with a disinfectant effect based on the release of oxygen from sodium perborate is relatively low. An evaluation of the effectiveness of Orthosan BF 12 pointed to significant differences in the quality of individual batches of this product.

In the area of hygiene, new findings (mainly of a methodological character) were gained during a study of the questions of nonhealth-related usage of tetracyclin antibiotics, findings which have created a basis for the development of a standard methodology which can be applied in the hygiene service to the field observation of tetracyclin antibiotics, particularly in agriculture and the food industry.

In the area of occupational medicine significant findings were gained regarding the genesis, development, and importance of the trinitrotoluene cataract. Furthermore, preventive measures and concrete treatment procedures were designed for elbow nerve stress experiences by glass cutters. These results have been included in the methodological guidelines for the performance of preventive examinations of workers at risky workplaces. On the basis of an evaluation of the occupational stresses experienced by stomatologists and anaesthesiologists it has been necessary to alter several long-standing norms related to toxicology, noise exposure, bacterial contamination, and stress on the locomotional apparatus due to necessary body positions during work. The results constitute a framework for the modification of workplaces from an ergonomic, toxicological, and bacteriological viewpoint.

In the field of social medicine, the third decennial revision of "The International Classification of Diseases" was issued for extensive utilization in health practice.

In the field of evaluative medicine, activity was concentrated primarily on the reedition of the Compendium of Evaluative Medical Activity; a methodology was developed for the comparison of occupational potential and the demands of a profession; and the influence of employment on chronic, nonspecific lung and respiratory tract illnesses was evaluated. Criteria were established for the determination of fitness for work or invalidity for cases recovering from strokes and for those afflicted with degenerative diseases of the motor organs, and possibilities were evaluated for occupational participation of those treated for tuberculosis of the lungs.

In the area of the economics of individual health institutions, proposals were worked out for newly differentiated standards for the professional outfitting of out-patient and in-patient facilities which should contribute to an improvement in the delivery of health care services to the population.

In the field of medical history a work was prepared and presented to the public entitled "Charles IV and the Beginnings of the Prague Medical Faculty."

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CZECHOSLOVAKIA

AVAILABILITY OF HYPERBARIC CHAMBERS IN NATION DISCUSSED

Prague CASOPIS LEKARU CESKYCH in Czech No 12-13, 28 Mar 80 pp 383-386

[Article by M. Emmerova, R. Barcal, V. Dolezal, M. Hadravsky, and P. Katz; Czechoslovak Bioclimatological Association of the CSAV (Czechoslovak Academy of Sciences), Prague; president, Prof E. Hadac, doctor of natural sciences, doctor of science, corresponding member of the CSAV: "Hyperbaric Chamber," professional team chief, V. Dolezal, M.D., candidate for doctor of science]

[Text] Summary: A review is presented giving the number, location and availability of hyperbaric chambers in the territory of the CSSR. At present they number 25. In addition to public health service hyperbaric chambers, other-purpose chambers are also listed. A separate table provides data concerning the location, names of directors and some technical features of the hyperbaric chambers.

Remarkable development of a special form of intensive therapy of patients--hyperbaric oxygen therapy, also called briefly hyperbaroxia, or therapeutic inhalation of oxygen in an overpressurized environment--has occurred worldwide in the past 20 years. The growth of this truly new medical field is evident both from the increasing number of therapeutic hyperbaric units throughout the world, and from the increasing number of therapeutic indications in many branches of medicine: for example, in anesthesiology and resuscitation, neurology, pediatrics, radiology, ophthalmology, dermatology, internal medicine and surgery (1, 3, 4, 6, 7). Hyperbaroxia is already recognized worldwide as the proper treatment for carbon monoxide and cyanide poisonings, decompression sickness, air embolism and cystoid intestinal pneumatosis. We can hardly do without in in the treatment of gas gangrene, acute myocardial infarct complicated by cardiogenic pulmonary edema and shock, and in some cases of hemorrhagic shock (3, 6). Of the many relative indications let us mention its usefulness, for example, in treatment of burns, polytraumatic conditions, refractory osteomyelitis, leg ulcers and perception hearing defects (1, 7). Favorable results have also been reported from the centers treating certain malignant tumors with a combination of radiotherapy and hyperbaroxia.

Hyperbaric oxygen therapy is carried out in overpressurized chambers, which differ either in their content or their size; for example, the chamber may be filled with gas--air or therapeutic oxygen--or with liquid. As to the size, we differentiate between single—space chambers, where only a single patient can be treated without an attendant being present, and multispace chambers which also may have an antechamber permitting entry and exist during the treatment procedure; the presence of attending personnel is a rule there.

The current stage of development of hyperbaric medicine, or "medicine of superpressures" if we use the term of the Academician B. V. Petrovsky, is marked by improvements of organizational and methodological measures: publications of catalogues of hyperbaric centers to keep the medical public informed and thus insure quick availability of the treatment; reviews listing the number and locations of the chambers in individual countries, and a standardization of indication plans and safety provisions for this special kind of treatment. For example, the review published in the British Medical Journal (4) noted that Spain had 44 and Great Britain 49 treatment chambers, the USSR 69 hyperbaric centers, and Japan and the United States a total of 200 chambers.

Because the medical field in this respect is not yet familiar with the situation in our country, at the suggestion of the Third National Conference on Hyperbaroxia, which took place in 1977 in Plzen, we collected information on the network of hyperbaric chambers in the entire CSSR. In contrast to the foreign reviews, we also included information on hyperbaric chambers for professional and sport divers, because under certain circumstances and conditions these facilities could also be used for treatment of urgent cases, for at least whatever time is absolutely necessary. Preliminary information on hyperbaric chambers was recently published by P. Katz (5), primarily for the use of divers.

On the basis of a questionnaire-type survey carried out in 1978 we established that the total number of hyperbaric chambers in our country is 25; 11 of them are for medical use, and 14 for professional and sport divers. Fig. 1 shows their distribution throughout the territory of the whole state. The map shows a relatively equal distribution of the hyperbaric chambers in the individual regions of the CSSR, without specifying their basic funtions. It must be noted, however, that currently we have a relatively equal dispersion which was not centrally coordinated from the viewpoint, for example, of easy access to hyperbaric chambers for acute therapeutic indications. The situation is worst in the northern and eastern Bohemian regions and the central Slovak region. At the present time they have none of the listed types of chambers. As to the number of chambers, Prague and the central Bohemian region, Brno, Bratislava and the western Slovak region and Kosice are in the best position. If we consider the strictly medical applications, the situation is somewhat different. From this aspect it is best in Kosice, Ostrava, Prague, Kladno and Plzen.

Ostrava has available a multispace large-scale hyperbaric chamber, the only one of this type in the CSSR. All the other 24 chambers are either singlespace, with an internal volume of about 1 cubic meter, or multispace, with the maximum internal volume of about 10 cubic meters. Because hyperbaroxia can practically be carried out only in chambers filled with oxygen, or in air-filled chambers in which simultaneous oxygen inhalation is possible, the number of chambers that can be used for treatment drops from 25 to 18; the remaining 7 may serve only in treatment of decompression sickness.

The limited operation of these facilities in the medical centers themselves is a restrictive factor in possible immediate realization of hyperbaroxia. At present, continuous availability of every treatment chamber, or continuous service of the trained personnel, is not a rule. The best situations in all respects exist at the Clinic of Internal Medicine of FNsP [expansion unknown-university hospital with polyclinic?] of the Regional Public Health Institute in Plzen (chief: Docent V. Cepelak, M.D., candidate for doctor of science); at ARO [expansion unknown] Hospital with Polýclinic in Kladno (chief: V. Lemon, M.D.); at the 2nd Clinic of Internal Medicine FNsP I - Regional Public Health Institute in Prague (chief: Prof A. Ripka, M.D., doctor of science); at ARO Municipal Hospital with Polyclinic in Ostrava (chief: J. Dostal, M.D., candidate for doctor of science) and ARO FNsP [expansion unknown] of the Regional Public Health Institute in Kosice (chief: K. Kunayova, M.D., candidate for doctor of science). For quick reference and facilitation of contact with all centers equipped with chambers we attached Table 1 listing them alphabetically according to the cities. In addition to the address of the location of the chamber, we also included the name and address of the person in charge of the individual chamber.

The table also shows characteristic technical data on the type of chamber, its operational pressure--whether equipped with antechamber--the method for filling it and the availability of an oxygen inhalator. Two types of chambers are essentially differentiated in the review--stationary, i.e., permanently installed or mobile only in the operational space; or mobile, i.e., transportable by automobile or suitable for transport by other means.

Our system of socialist public health service with an established firm organizational structure provides the best conditions for making hyperbaric oxygen therapy very soon an accessible treatment method for all indicated acute conditions at any time and in the whole territory of our state. It is therefore advisable that hyperbaric units also be built in the northern and eastern Bohemian and central Slovak regions; all existing hyperbaric facilities should be maintained at a good technical level and, if needed, the personnel augmented. Because of their mobility divers' chambers could be used in emergency cases and in preventive therapy, for example, on a regional scale. Under these conditions we could then start defining the exact areas to be covered by the individual hyperbaric chambers in the CSSR. This is one of the reasons for our work (2).

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Table 1: Data on Hyperbaric Chambers in CSSR

1) Místo	2) Adresa stanoviště	3) Vedoucí	4) Typ komory	5) Provozní tlak	6) Před-komora	7) Způsob plnění	8) Kyslíkový inhalační přístroj
Bratislava	Chirurgické oddělení Vojenská nemocnice tel. č. 3304-51 (47203, 47212) a)	MUDr. S. Seman	stabilní a) vícemístná	0,2 MPa	ne	kyslík a)	ne
	Potápěčská skupina závod Dunaj Martanovičova 16 tel. č. 38453/124 b)	P. Kučera	mobilní b) jednomístná	0,59 MPa	ne	vzduch b) + kyslík a)	ano
Brno	Potápěčská stanice Povodí Moravy závod Dyje Šmahova 113 Brno tel. č. 635037 c)	M. Král	mobilní c) vícemístná	1,1 MPa	ano	vzduch b)	ano
			mobilní c) vícemístná	0,6 MPa	ne	vzduch b)	ne
			mobilní b) jednomístná	0,6 MPa	ne	vzduch b)	ne
České Budějovice	II. chirurgické oddělení Krajská NsP ul. B. Němcové 44 tel. č. 808 d)	MUDr. O. Schacherl	stabilní d) jednomístná	0,15 MPa	ne	vzduch b)	ano
Kladno	ARO NsP Vančurova 1548 tel. č. 3487 e)	Prim. MUDr. V. Lemon tel. č. domů 3463	stabilní d) jednomístná	0,2 MPa	ne	kyslík a)	ne
Košice	ZÚNZ-VSŽ Odd. pre liečbu popalenín Košice-Šaca tel. č. 24700/281 f)	Prim. MUDr. Š. Šimko, CSc. tel. č. domů 23928	stabilní d) jednomístná	0,4 MPa	ne	vzduch b) + kyslík a)	ne
	ARO Vojenská nemocnice Ždanovova ul. 3 tel. č. 31314-5 g)	MUDr. I. Čerkala tel. č. domů 21397	stabilní d) jednomístná	0,3 MPa	ne	kyslík a)	ne
	ARO FNsP Rostislavova 53 tel. č. 23117 h)	Prim. MUDr. C. Kunayová tel. č. domů 53416	stabilní d) jednomístná	0,3 MPa	ne	kyslík a)	ne
Ostrava	Hyperbarická komora MěNsP Nemocniční 20 tel. č. 214527, 234568 i)	MUDr. Z. Tulachová	stabilní a) vícemístná	0,3 MPa	ano	vzduch b)	ano
	Hlavní báňská záchranná stanice Ostrava-Radvanice tel. č. 227-3444/217 j)	J. Daněk	mobilní b) jednomístná	0,8 MPa	ne	kyslík a)	ano
Plzeň	Interní klinika FNsP-KÚNZ Marxova 13 tel. č. 2162/274 k)	MUDr. M. Emmerová tel. č. domů 34776	stabilní d) jednomístná	0,25 MPa	ne	vzduch b)	ano
	ARO Vojenská nemocnice Marxova 9 tel. č. 274026 l)	MUDr. M. Kugler tel. č. domů 41751	stabilní a) vícemístná	0,9 MPa	ano	vzduch b)	ano

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Table 1. (Continued)

Místo 1)	Adresa stanoviště 2)		Vedoucí 3)	Typ komory 4)	Provozní tlak 5)	Před-komora 6)	Způsob plnění 7)	Kyslíkový inhalační přístroj 8)
Praha	ÚLZ Kovpakova 1 Praha 6 tel. č. 33045/694	m)	MUDr. M. Zeman, CSc.	stabilní a) vícemístná	1,0 MPa	ano	vzduch b)	ano
	II. interní klinika KÚNZ-FNsP I U nemocnice 2 Praha 2 tel. č. 290048	n)	Prof. MUDr. O. Ripka, DrSc.	stabilní d) jednomístná	0,3 MPa	ne	kyslík a)	ne
	Aquacentrum Radlická nouz. 7 Praha 5 tel. č. 534261	o)	M. Jihlavec	mobilní b) jednomístná	0,6 MPa	ne	vzduch b)	ne
Praha	Státní zkušobna 212 Dělostřelecká 30 Praha 6 tel. č. 33046/268	p)	Ing. S. Batysta	mobilní c) vícemístná	1,0 MPa	ano	vzduch b)	ne
				mobilní b) jednomístná	0,6 MPa	ne	vzduch b)	ne
				mobilní b) jednomístná	0,6 MPa	ne	vzduch b)	ne
	Potápěčská stanice závod Dolní Vltava Libeňský ostrov 11 Praha 8 tel. č. 832681 830041/5	q)	F. Černý tel č. domů 4339567	mobilní b) jednomístná	0,8 MPa	ne	vzduch b)	ano
	Vodní dílo Orlík tel. č. Příbram 94254	r)		stabilní vícemístná	1,1 MPa	ano	vzduch b)	ano
				stabilní vícemístná	1,1 MPa	ne	vzduch b)	ano
Trenčín	Vodné elektrárne Hurbanova 52 tel. č. 51813/272	s)	I. Haneo	mobilní jednomístná	0,6 MPa	ne	vzduch b)	ne
	Lodenica „Fatima" Na ostrove tel. č. 6008	t)	E. Zápeca	mobilní jednomístná	0,74 MPa	ne	vzduch b)	ne

Key: Column 1: Location
Column 2: Address and telephone
(a) Department of Surgery, Military Hospital
(b) Divers' Group, Danube Plant
(c) Divers' Station, Morava river basin, Dyje Plant
(d) 2nd Department of Surgery, Regional Hospital with Polyclinic
(e) ARO Hospital and Polyclinic
(f) Factory Public Health Institute-VSZ, Burn treatment department
(g) ARO Military Hospital
(h) ARO FNsP [expansion unknown]
(i) Hyperbaric chamber, Municipal Hospital with Polyclinic

Key for table 1 continued

- (j) Main Mine Emergency Station
- (k) Clinic of Internal Medicine, FNsP--Regional Public Health Institute
- (l) ARO Military Hospital
- (m) Airforce Medical Institute
- (n) 2nd Clinic of Internal Medicine, Regional Public Health Institute--FNsP I
- (o) Aquacentrum
- (p) National Testing Station 212
- (q) Divers' Station Dolni Vltava Plant
- (r) Waterworks Orlik
- (s) Hydroelectric plant
- (t) Shipbuilding Yard "Fatima"

Column 3: Chief. Name and home telephone.

Column 4: Type of Chamber (a) stationary multispace
(b) mobile singlespace
(c) mobile multispace
(d) stationary singlespace

Column 5: Operational Pressure. MPa [expansion unknown]

Column 6: Antechamber. ne = no; ano = yes

Column 7: Filled with (a) oxygen (b) air

Column 8: Oxygen inhalation equipment. ne = no; ano = yes

Fig. 1 - Distribution of hyperbaric chambers in CSSR.
Type of chamber: black square - for medical treatment
black triangle - for divers

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