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## CRENOBALNEOTHERAPY IN RUSSIA

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### History of Russian health resort medicine

Health resort industry in Russia was created during Peter The Great time in the early 18<sup>th</sup> century. Peter The First traveled extensively in Europe ; he visited Spa, Carlsbad and Pyrmont resorts and "took waters". Impressed by visiting these resorts, Tsar issued an order "of finding Russian thermal waters" April 24, 1717.

Russia's first resort was established near St. Petersburg in Karelia. It was called Marcial (Olonets) waters. At the same time Lipetsk and Sergievskie mineral waters were discovered. Newly discovered sources, at the beginning, were not attracted by large number of patients because of long distance from central areas, poor communication, lack of comfort.

Pyatigorsk and Kislovodsk (first resorts in the region of Caucasian Mineral Waters (CMW)) were founded in late 18<sup>th</sup> – early 19<sup>th</sup> century on places of military fortresses, first sources "patients" were soldiers.

At that time several attempts were made to summarize knowledge about discovered mineral waters and sources. Scientific balneology began to develop in the late 19<sup>th</sup> century.

In 1863 the *Caucasus Russian balneological society* was found, which played an important role in the study of mineral waters.

Balneology for the first time began to be studied at Moscow University in 1865, at the same time it had been firmly established in medical practice. A special role in the development of balneology as a science belongs to famous Russian clinicians : Nikolay Pirogov, Gregory Zakhar'in, Sergey Botkin.

The famous Russian physiologist Ivan Pavlov contributed to the development of experimental balneology. Most of the work on effects of mineral waters on the secretion of digestive glands was performed using his methods.

By the early twentieth century in Russia there were 36 resorts. It was a most intensive period of development of CMW region. Almost 100.000 persons visited this resort per year.

After October revolution 1917 all resorts of Russia have been nationalized. In 20-s first "health centers" were created on CMW for treatment of wounded soldiers of Red Army.

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In the first decades after October revolution a lot of resort facilities were built and reconstructed in the region of CMW, Crimea, Sochi, Ural, Siberia, Far East and Central Asia. Availability of resorts for everybody was very important development direction in Soviet Union.

Extensive work was carried out to study distribution, composition and properties of mineral waters. A number of research institutes were founded : in 1921 in the region of CMW, in 1922 in Tomsk, Siberia, in 1926 in Moscow (Central Research Institute of Balneology). Overall in Soviet Union existed 14 institutes of Balneology and Physical Medicine, they were involved in hydrogeological, experimental, clinical and physiological studies with mineral waters.

In the years of World War II (1941-1945) resorts were used for needs of Soviet army as military hospitals. After war reconstruction of resorts was carry out intensively, in parallel education of new hydrogeologists, balneologists was done.

In 1960 all health centers, balneary etc. were handed over to Trade unions (except children centers and tuberculosis sanatorium that were held by Ministry of Healthcare). So 20 % of resorts visits were fully reimbursed, other big part was partially reimbursed. Trade unions often also reimbursed transport expenses.

In 1985 in Soviet Union there were more than 14.000 spa facilities owned by different trade unions, ministries and organizations (2.250.000 beds in total).

In the 90s a difficult period of economic crisis and big changes came. Number of spa facilities decreased, more than half of them have changed ownership that does not always solve the financial problems. Number of visits decreased due to a rise of prices. 3654 spa facilities functioned in 1990, 2700 in 1996 and only 1997 in 2009. Currently it's a positive trend in development of Russian resorts : demand on recreation services is growing, quality of services itself became better. That happened due to fact of appearance of private resorts facilities. However there is a strong belief that recreation must be accessible to most of population of country. Ministry of Healthcare together with government of Russia sees main role of resorts network in disease prophylaxis, rehabilitation as well as in health and wellness support of Russian people.

## **Spa therapy in Russia**

Natural factors used for spa treatment in Russia are :

1. climatic factors,
2. peloids,
3. mineral waters.

Climatic factors play important role, considering huge territory of Russia and large variety of different climatic zones. Dozens of million Russian people live and work in lack of sunlight in areas with a negative average annual air temperature and permafrost, and for 9 month a year wearing warm clothes and heating their houses. Possibility to visit resort is very important for them.

Peloidotherapy in Russia has big history. Actually there are 53 resorts using peloids for treatment and rehabilitation. Peloids differ in terms of conditions of formation, source

material, chemical composition and physico-chemical properties. In Russia we distinguish 4 classes of peloids : peat, sapropelic, silt sulfide and volcano mud. Unique mud-bath industry was developed in Soviet Union consisting of extraction, processing, transportation, storage, regeneration and heating of muds. Various techniques of peloido-therapy were developed : mud baths, applications, forms for internal use, combined methods (peloido-therapy with current, ultrasound etc.).

## Mineral waters

Mineral waters – natural subterranean water with constant composition having therapeutic properties due to high content of biologically active substances, ionic or gas composition or common ion salt composition (mineralization) as well as its special physical properties (temperature, radioactivity, pH).

The most common types of mineral waters are following :

1. Mineral waters, with action determined by mineralization and ionic composition
2. Carbonic waters
3. Sulphurous waters
4. Ferruginous waters
5. Bromine/ iodine/ iodine-bromine waters
6. Siliceous thermal waters
7. Arsenic waters
8. Radon waters
9. Boron waters
10. Mineral waters, enriched with organic substances

Mineral water	Active substance	Minimal concentration
Carbonic	CO <sub>2</sub>	500 mg/L
Sulphurous	H <sub>2</sub> S	10 mg/L
Iodine	I	5 mg/L
Bromine	Br	25 mg/L
Arsenic	H <sub>3</sub> AsO <sub>3</sub>	0,7 mg/L
Siliceous	H <sub>2</sub> SiO <sub>3</sub>	50 mg/L
Ferruginous	Fe	10 mg/L
Boron	H <sub>3</sub> BO <sub>3</sub>	35 mg/L
Radon	Rn	0,2 kB/L

**Table 1. Minimal concentration of active substances in mineral water**

Mineral waters are classified according to total amount of dissolved substances : total mineralization, ionic composition, gas composition, countenance of microelements and organic substances in water, radioactivity, pH and temperature.

Mineral waters are classified according to mineralization as :

- oligomineral water (1-2 g/L),
- water with low mineralization (2-5 g/L),
- water with medium mineralization (5-15 g/L),
- water with high mineralization (15-30 g/L),
- brin water (35-150 g/L),
- extra brin water (150 g/L and more).

Water for internal use need to contain more than 1 g/l of total mineralization (mostly 2-20 g/L) or less if contain active substances. Brin water can be used for bathes in dilution according to standards.

Mineral waters are classified to ionic composition as : chloride Cl<sup>-</sup>, hydrocarbonate HCO<sub>3</sub><sup>-</sup>, sulfate SO<sub>4</sub><sup>2-</sup>, sodium Na<sup>+</sup>, magnesium Mg<sup>2+</sup>, calcium Ca<sup>2+</sup> in different combination of anions and cations.

Mineral waters are classified to specific elements as iodine I, bromine Br, ferrous Fe, siliceous Si, radon R.

According to the content of gases waters are divided as carbonic-acid, nitrogen, hydrogen sulfide.

According to temperature we define thermal water as 37-42°C temperature, hyper-thermal – more than 42°C temperature.

The following groups are divided according to pH of water : alkaline (pH < 6,8), neutral (pH = 6,8-7,2), saline (pH > 8,5).

Content of organic substances in water is of great importance and may determine their specific properties.

The most often mineral waters used for bathes are sodium chloride, carbon dioxide, hydrogen sulfide, radon, iodine-bromine, arsenic and siliceous.

## Resorts of Russia

Resorts of Russia are divided according to their main factors as climatic, balneo- (with MW for external or internal use) and mud, often combination is possible.

There are 5 main groups of resorts divided for territorial attribute : Siberia, Far East, Caucasus, Central part of Russia, Krasnodar region.

Below are listed most famous resorts of Russia :

**Sochy Mazesta** – balneoclimatic resort in Krasnodar region on Black Sea. Climate there is subtropical. Main factor is thermal sulfurous chloride sodium mineral water with mineralization 6-27g/L, H<sub>2</sub>S concentration 140-400 mg/L.

**Anapa** - seaside piedmont mud climatic resort Mediterranean-type on the Black sea. Specialized for children. It offers silt muds and hydrocarbonate waters.

**Staraya Russa** – resort in 100 km from Novgorod. It offers 10 sources of chloride sodium-calcium-magnesium mineral waters for bathes (19-20 mg/L) and drinking (2,8-10 g/L), sulfide silt muds.

**Marcial waters** - balneo- and mud resort in Karelia near St Petersburg. It offers ferruginous hydrocarbonate-sulfate magnesium-calcium oligomineral waters for drinking and bathes (with 20 to 100 mg/L of continece of Fe), silt muds.

**Belokuriha** - piedmont resort of steppe zone in the foothills of Altai Mountains (in Siberia). The resort has 5 wells of siliceous thermal radon oligomineral water, used for bath, inhalation, irrigation and drinking.

**Yangan Tau** - resort situated in 150 km from Ufa. There are places of release of natural vapors (40-50°C) and dry thermal gases (50-70°C) in this area. Vapor bathes and dry baths of 48-70°C temperatures with carbon dioxide and radium emanation are used for therapeutic purposes. Hydrocarbonate radon oligomineral water from source is used for baths and drinking.

**Sergievskie mineral waters** – balneo- mud resort of forest-steppe zone near Samara. It offers sulfurous sulfate-hydrocarbonate calcium-magnesium water (concentration of H<sub>2</sub>S up to 84 mg/L), sulfurous chloride sodium water (concentration of H<sub>2</sub>S up to 260 mg/L). There is a mud lake, fed by sulfurous mineral waters.

**Lipetsk** - balneo-mud resort of forest-steppe zone. Clays, silt mud and sulfate-chloride sodium water (with mineralization 3.8 g/L) are used for treatment.

**Kavminvody** - is a unique resort famous by richness, diversity and quantity of natural therapeutic factors : there are more than 100 sources of mineral water and 13 types of medicinal silt mud of Tambukan lake in this region. Fore main city-resorts were established in this area : Pyatigorsk, Kislovodsk, Yessentuki, Zheleznovodsk form Kavminvody (Caucasian mineral waters).

Resort	Type of mineral water
Pyatigorsk	Thermal sulphurous water, carbonic water, radon water
Kislovodsk	Carbonic sulfate hydrocarbonate magnesium-calcium water (Narzan)
Yessentuki	Carbonic chloride-hydrocarbonate sodium water (Essentuki-4, Essentuki-17) for drinking
Zheleznovodsk	Carbonic sulfate hydrocarbonate calcium-sodium mineral water (Smirnovskaya, Slavyanovskaya ).

**Table 2. Caucasian Mineral Waters Resort**

## Organization of health resort industry in Russia

There are different types of resort facilities : balneary, policlinic, health center (sanatorium) etc. Term "sanatorium" in Russia is generally a combination of resort/re-creational facility and a medical facility. It is used to combine people rest with medical services.

Health center (sanatorium) is main institution at the resort. It used for after hospital care, medical rehabilitation of occupational diseases and accidents at work, rehabilitation and recovery.

Health centers have specialized physicians and medical teams and advanced diagnostic facilities.

Treatment in health center is usually consist of balneotherapy, peloidotherapy, thalassotherapy, physical therapy, physical training, nutritional therapy, acupuncture, etc. Great importance is done to health education and risks factors reduction.

All health centers are of various forms of ownership - state, public associations (including trade unions), private, departmental, etc. 47 of 2.2 thousand of resort facilities of Russia are owned by Ministry of Healthcare, including all tuberculosis sanatoriums.

Each health center (sanatorium) has medical profile (specialization) : for treatment of patients with cardiovascular diseases, neurologic disorders, musculoskeletal system disorders, gastrointestinal disorders, respiratory disorders etc. There are highly specialized sanatoriums for treatment of patients with bronchial asthma, diabetes mellitus, glomerulo-nephritis, etc. There are multi-disciplinary health centers for treatment of patients with multiple diseases of various organs and systems. There are health centers for children and for children with parents.

There is a network of local health centers (out of resorts) for treatment and rehabilitation of patients with more severe disease, for which climate change is not favorable. Some of these centers have care department for patients transferred from a hospital after some operations and after acute period of severe diseases (e.g. myocardial infarction, stroke). For patients after myocardial infarction a special program of physical training and physical therapy has been developed at the state level.

In absence of natural factors in local health centers imported muds, naftalan, artificially prepared baths are widely used for spa treatment.

There were 2148 resort facilities in Russia in 2006 : out of this 741 health center for adults, 431 for children, 58 for children accompanied by parents, 91 health camps, 807 preventive clinics, 20 polyclinics and balneary. The largest number of them is situated in the Krasnodar and Stavropol Krai, the Moscow region.

Aftercare for working peoples is for free (reimbursed by Obligatory Medical Insurance) for following diseases : unstable angina, myocardial infarction, stroke, heart and vessels surgery, gall bladder removal surgery, diabetes, joints plastic. Medical rehabilitation in health centers is free for disabled persons, veterans of wars, for persons who have suffered from industrial accidents and occupational diseases.

## **Society of Restorative Medicine**

Activities of scientists and physician balneologist were supported by scientific societies, which were created in large cities (Moscow, St. Petersburg, Yekaterinburg, etc.) and incorporated into Russian and All-Union societies (in Soviet times). Currently, there is a Society of Restorative Medicine.

## **Journal Issues in balneology, physiotherapy and exercise**

The oldest journal covering use of natural therapeutic factors, *Issues in balneology, physiotherapy and exercise*, was established in 1923. Journal reflects fundamental theoretical problems of physical methods of treatment, latest achievements of national and foreign researchers, and applied its use in clinical practice. Journal publishes results of research and reviews, historical articles and articles on organization of health resort industry.

Authors of the journal are leading scientists of Russia and foreign countries, as well as clinicians - physical therapists and balneologists.

Journal regularly publishes reviews on physiotherapy and balneology new books, reports about congresses and conferences, information on scientific meetings.

## **Education of balneotherapy**

Balneotherapy together with physical therapy are taught in medical schools, primary specialization is done in specialized departments of balneology and physiotherapy of medical and scientific research institutions with a regular (every 5 years) educational qualifications (144 hours).

## **History and research activity of Russian Research Centre for Restorative Medicine and Balneology**

Central Research Institute of Balneology was founded in Moscow in July 1921. Its first goals were to study diseases to be treated at resorts, to study therapeutic effects of physical factors, organization of health resort industry and education. Significant attention was paid to exploration and development of deposits of mineral waters and peloids. In 1958 Central Research Institute of Balneology was merged with Central Research Institute of Physiotherapy ; Central Research Institute of Balneology and Physiotherapy was formed. It has become a leader among other scientific institution through USSR in these medical areas. Institute had a lot of departments, among which are department of physical therapy, clinical department, experimental department and department of study of resorts having two branches : Resort Resources and Medical Balneology and Climatology. Below we discuss more detailed description of the Department of Medical Balneology.

There were balneary, swimming pool, contrast baths, drinking gallery, inhalatorium, mud baths, pools for mud storage and regeneration, chemical laboratory for preparation of artificial baths, radon laboratory.

Imported silt sulfide mud of Tambukan lake and mineral water from 2 wells (chloride sodium-bromine water of 120 g/L mineralization in dilution for bathes and sulfate sodium-magnesium-calcium water of 4 g/L mineralization for drinking) were used.

One of important areas for research was development of artificial mineral waters for external use (artificial hydrogen sulfide, carbon dioxide, radon, iodine-bromine bathes),

that made it possible to apply them in health facilities out of resorts. Special devices allowed use of dry carbonic bathes, dry-air radon bathes, underwater spinal traction. Hydrotherapy was widely used : contrast baths, underwater massage, various types of showers, aromatherapy.

Research activities were aimed to increase the effectiveness of treatment of natural factors in patients with various diseases. To achieve these goals studies of mechanism of physiological and therapeutic action of hydrobalneoprocedures were conducted.

It concerned central regulatory mechanisms, biochemical processes, microcirculation changes and permeability of membranes, immune reactions, etc. Skin penetration and distribution of active substances of mineral waters and peloids have been studied.

Studies of specificity of reactions depending on physico-chemical composition of mineral water, study of minimal effective concentration of active ingredients were conducted.

Optimal parameters (temperature, concentration, duration of procedure, amount of procedures per treatment) for various diseases were identified. Methods of treatment of different diseases, indications and contra-indications for their use have been developed and published.

Comparative analysis of efficiency, development of rational treatment complexes were carried out.

A large amount of research were devoted to peloids : determination of optimal temperature and duration of procedure, role of different chemical composition of different types of peloids, development of optimal dosage and best practices of peloidotherapy.

In 70-th and 80-th of twentieth century effectiveness of radon water treatment (baths, irrigations, inhalations, drinking of radon water) was evaluated in studies in different fields of medicine (cardiology, neurology, rheumatology, gynecology, gastroenterology), and was backed up by experimental studies.

It expanded understanding of impact of radon water on body and allowed to develop methods of treatment for most common diseases.

It was a time of active search for new non-pharmacological therapies :

- methods of recovery of astronauts after spaceflight were developed in collaboration with Institute of Biomedical Problems of Medical Sciences,
- methods of hydrobalneo- and physiotherapy of obesity and hypothyroidism were created in collaboration with Department of Endocrinology of post Graduate Medical Institute,
- use of hydrobalneo- and mud procedures in vascular pathology in patients with impaired cerebral circulation, peripheral vascular insufficiency of lower extremities was studied,
- technique of horizontal underwater traction in various mineral waters in treatment of dorsalgia was created,
- problem of prevention and treatment of occupational diseases, particularly, vibrational disease was studied.

Rehabilitation has always been the leading branch of resort medicine. Hospital-resort (sanatorium)-policlinic system as stage rehabilitation was developed. Various methods



of rehabilitation using resort factors in patients with myocardial infarction, CABG, stroke, vessel surgery, gastric ulcer surgery etc. were developed. Aspects of health and economic benefits of rehabilitation were investigated.

In 90-th researches were conducted in the following areas :

- study of correlation between concentration of active components of mineral water and effects of procedure,

- role of temperature factor for mud therapy,

- influence of balneotherapy on comorbidity (osteoarthritis and ischemic heart disease, hypertension and dorsalgia, etc...),

- rationale for wider application of balneotherapy methods in patients with more severe disease (cardiovascular disease, CHF, diabetes mellitus) was studied. Prolonged balneotherapy in patients with ischemic heart disease and postinfarction cardiosclerosis made it possible to reduce mortality in this patients. Efficiency of treatment with naftalan for chronic obstructive bronchitis, psoriatic arthritis, seronegative spondylarthritis was assessed,

- methods of treatment with naftalan in patients with chronic obstructive bronchitis, psoriatic arthritis, seronegative spondylarthritis were established,

- balneotherapy began to be used in pneumology : radon baths, carbonic baths, sodium chloride mineral water baths in patients with obstructive and non-obstructive bronchitis, peloidotherapy after lung operation,

- attention was given to methods of hydrotherapy (use of tap water). Effectiveness of use of contrast baths, underwater shower-massage in patients with myocardial infarction, coronary artery disease with stable angina, hypertension, chronic bronchitis, obesity, metabolic syndrome, endocrine dysfunction and infertility in women was proven in studies,

- use of aromatherapy (turpentine baths and bath of a mixture of essential oils) in dorsopathy and gynecological disorder was evaluated,

- special method of determining types of weather was developed by Medical Climatology Department. Climate monitoring is carried out constantly in Moscow and special medical weather forecast is created. Meteosensitivity was evaluated and its correction and prophylaxis by methods of balneotherapy was developed.

For the moment there are several scientific directions of research in Institute :

- use of galvanic baths in rehabilitation of patients with angiopathy,

- use of aromatherapy and thalassotherapy with brown algae in patients with dorsopathy,

- classification of drinking mineral water,

- development of methodological approaches and definition of terms "medical spas", definition of indications and contra-indications for spa therapy,

- study of effectiveness of phototherapy and naftalan in patients with psoriasis.

During its existence, Institute changed official names (Central Institute of Balneology and Physiotherapy, Russian Scientific Center of Rehabilitation and Physiotherapy, Russian Research Centre for Restorative Medicine and Balneology). Currently main building of Institute is under reconstruction.

Famous Russian scientists balneologists : Aleksandrov VA, Danishevsky GM, Nevraev GA, Brosov AN, Olefirenko VT, Davydova OB worked in the Institute. Their researches made valuable contribution to development of balneology.

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