UNDERGROUND WATERS ARE SOURCE OF HEAT ENERGY

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UNDERGROUND waters are a cheap source of heat. The waters at such depths of the Earth's crust, that are quite accessible for present-day boring techniques, get considerably heated and form major artesian basins and fissure systems with great reserves that are continuously replenished by natural means. This kind of heat energy of the Earth's entrails is practically inexhaustible: many natural thermal springs function uninterruptedly throughout a geological period.

Heat from underground waters has been used by man since the most ancient times. Excavations of Neolithic, and probably of Paleolithic, man have been found near now-functioning thermæ. Ancient baths, cave settlements, remains of the culture of the bronze and early iron age have been found in the area of Mineral Waters in the Caucasus and in Armenia.

However, there were quite few natural outlets of thermal springs and very rarely were they situated in places that were convenient for settlements. Most frequently they were used for medicinal purposes. It is only with the development of scientific knowledge of underground and thermal waters, with the introduction of deep-hole boring, mainly in the last two decades, that the problem of large-scale economic utilization of the heat of underground waters started to attract universal attention.

Thermal underground waters which even recently were considered to be "specific" and "rare", beginning at certain depths and increasing in temperature as they become deeper, may be considered as continuous zones of underground waters. On the other hand, underground "cold" waters which are considered to be the usual thing are characteristic of a comparatively small top zone that forms only a thin covering film, if compared with the many-kilometre-deep layer of hot and superheated waters of the entrails of the Earth!

Being under pressure and having thermal capacity higher than the surrounding rock, the underground water accumulates heat generated underground and by force of its own dynamic energy conveys it in great quantities up to the surface. The excess pressure of drilling waters, which attains tens of atmospheres, ensures the transfer of heat to the sites of consumption on the surface and creates considerable hydraulic energy.

In recent years thermal springs are finding ever greater application for heating and power production purposes. High temperature underground waters and vapours are utilized for producing electric energy, for central heating of towns, for warm water-supply, in agriculture for heating hotframes and hothouses, in public baths, bathing pools, and in shower installations. They have also found extensive application for medicinal purposes. These, however, are but the first steps in their versatile application.

In the Soviet Union underground water heat is mostly employed at the site, at the thermal spring outlets—in the various spas (Kuldur, Goryachevodsk, Braguny, Chukotka territory, Kamchatka, Magadan region, the Kuril Islands, Hoji-Obigarm, Transcaucasia) and in many oil-field districts.

Lately the work conducted by Soviet geologists, hydrogeologists, and geophysicists, has resulted in vast basins of bedded and fissure waters being found in the Caucasus, Transcaucasia, Central Asia, in the European part of the USSR, in various areas of Siberia and in Kamchatka. It is reported that there are hot bedded and fissure waters in the permafrost areas in the North and North-East of the Soviet Union under the strata of frozen rock: major thermal springs break through the layer of frozen rock there and appear at the surface with a temperature of up to 90-100° C. and with an immense yield (Chukotka territory, Okhotsk Sea coast, some areas of the Northern Urals, etc.). Many hot artesian water basins cover territories of tens and hundreds of hectares, while some of them, as for example the West Siberian artesian thermal water basin, cover a territory of millions of square kilometers.

The exceptional abundance of thermal waters in the USSR has been convincingly shown in a number of papers read at the first USSR Geothermal Conference held in 1956.

In the Caucasus which is better investigated in geothermal respect than other territories of the USSR a number of foothill and inter-hill underground water basins have been discovered, that possess great pressures, valuable chemical

composition, and considerable water yields in the boreholes, the water temperature in the geosyncline flexures of many aquifers being 100-150° C. and up to 270° C. and over. Their resources are practically unlimited. Many hot waters possess an excess pressure of tens of atmospheres under the hole mouth, contain valuable salts and rare elements (iodine, bromine, boron, sulphur, etc.) in industrial quantities. The boreholes usually have quite a large yield—up to 50 litres per second and sometimes even as high as 100 litres per second and over.

Not so long ago the existence of hot waters on the territory of the European part of the USSR had not even been suspected. But this area turned out to be a territory of thermal and high-thermal water development at considerable depths—1,500 m and deeper (Second Baku District, Dniepropetrovsk—Donets syncline, North Caspian area, Moscow synclase, and others).

At a number of extremely large artesian basins in Turkmenia (Kopet-Dag flexure, West Turkmenia's basins, etc.), in the Uzbek SSR (Tashkent, North-Tashkent, Ferghana basins, etc.), in the Tajik SSR, in the foothills of the Tyan-Shan mountains within the boundaries of Kirghiz SSR the deep underground waters with zonal variations of mineralization and chemical composition are characterized by still higher temperatures.

Thermal springs are no less developed in the central and eastern parts of Siberia, within the Chukotka territory, and in the areas of the Pacific coasts of the USSR. There are hundreds of natural outlets in the Transhaikal region alone, characterized by very high temperatures and great yields, making it possible to provide a multitude of towns and villages with central heating and to set up local health resorts, as well as, major hothouse and hotframe vegetable establishments.

Well-known are the countless thermal springs, geysers, and hot vapour and gas fumaroles in the present-day volcanic areas of the Kamchatka and Kurile volcanic islands arc. The heat from the depths of these areas may be used for creating major geothermal power plants, while many of the natural thermal springs on Kamchatka and the Kurile islands may serve as bases for large-scale hothouse vegetable and fruit growing establishments that are so important for the population of the Far East.

Thus, the hydrothermal resources of the Soviet Union are practically boundless. They may be brought on to the surface by boring to greater or smaller depths in many regions of the country.

The Laboratory of Hydrogeological Problems of the USSR Academy of Sciences together with other institutions has recently compiled the first general summary of the prospected sources of underground water and vapour heat in the USSR, to be utilized for heating and power production purposes. This summary recommends that over 60 towns be suplied with central heating and suggests more than 100 districts where hot underground waters should be regionally used for agriculture, residential house heating, communal, technical, and sanitary-hygienic purposes.

Preliminary calculations show that for organizing the central heating of a town with 100 thousand inhabitants it is sufficient to utilize two or three high-yield holes with hot water, which, according to the data furnished by the Daghestan Branch of the USSR Academy of Sciences, will give a saving of no less than 10 million rubles.

The utilisation of the heat of underground waters for commercial purposes will not only provide a great saving but this energy of the Earth will save the national economy millions of tons of wood fuel, coal, and oil and will considerably relieve pressure on transport.

Many medicinal and oil-bearing thermal springs in the Caucasus bring to the surface great quantities of sulphur, boracic acid, bromine, iodine, carbon dioxide, helium, lithium, and other elements. The yield in drilled and natural thermal springs of some scarce salts and elements comes to tens, hundreds, and even thousands of tons a year.