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# 20. Transcaucasus: One of the Most Ancient Regions Using the Earth's Heat

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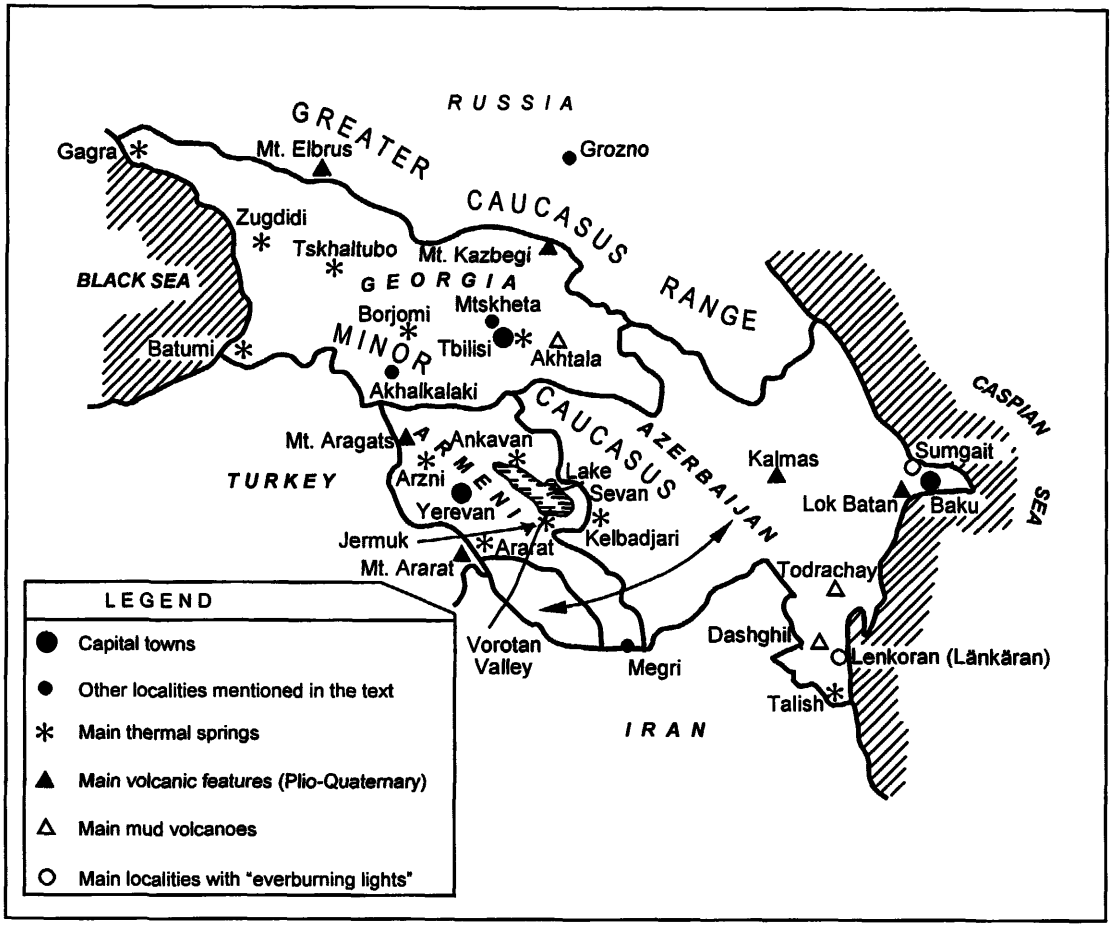
*Abstract*: Archaeological findings from several places in Georgia, Armenia, and Azerbaijan attest to the fact that thermal springs and some by-products of the Earth's energy found south of the Greater Caucasus Range were known and used by peoples since prehistoric times. These uses gradually intensified through the centuries, resulting in a tradition of thermal bathing in many localities with natural manifestations. Among these is Tbilisi, the capital of Georgia, whose etymology relates to the occurrence of thermal springs. Georgian historical events include long-lasting balneological practices. The region also has myths and legends that emerged due to the presence of volcanic features, thermal springs, and mud volcanoes, as well as the unusual manifestations known as "everburning lights."

## How Geothermal Resources Affected Early Trancaucasian Peoples

The region south of the Greater Caucasus Range between the Black and Caspian Seas is one of the world's oldest centers of civilization. A human lower jaw discovered in a recent archaeological excavation in Georgia indicates that people were already settled in the Transcaucasian region about 1.9 million years ago. It is likely that prehistoric people in this region would have known and used thermal springs, such as those in the Vorotan Valley. They also might have noticed the imposing external manifestations of the Earth's heat: volcanic eruptions, lava flows, ash avalanches, tephra covers, and earthquakes that occurred in several areas of the Greater and Minor Caucasus Ranges during the Paleolithic and Neolithic.

Ancient legends, originating in Neolithic times and handed down from parent to child in early historic times, mentioned the demolition of prehistoric settlements by lava and their burial

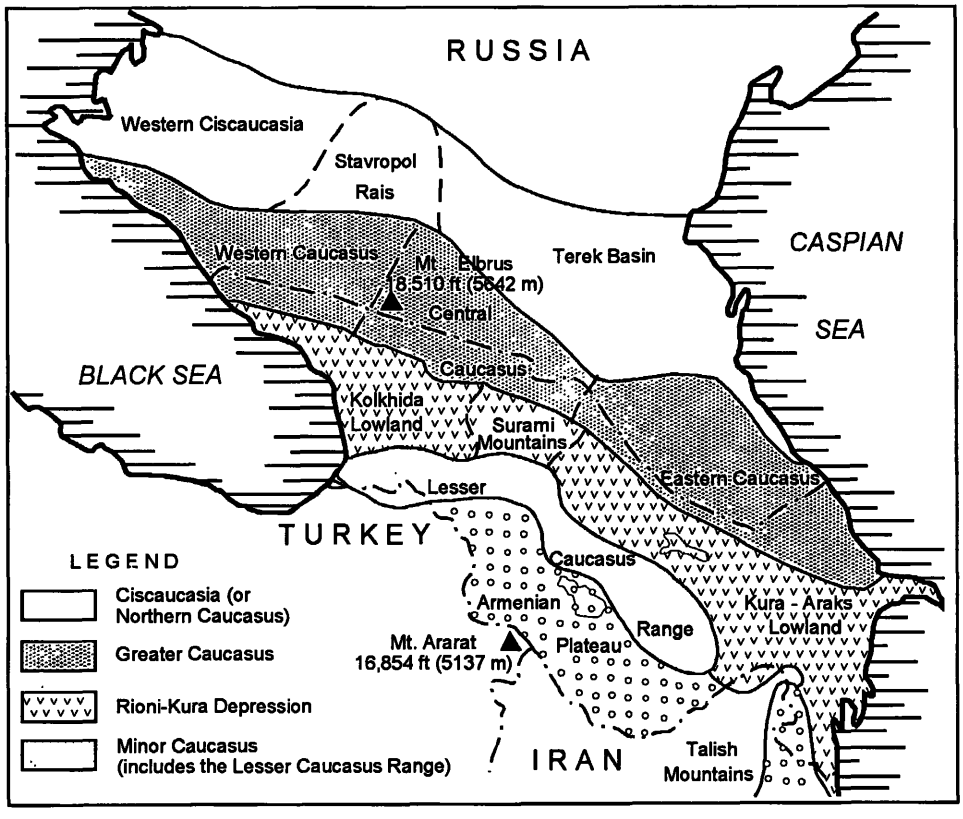



Main thermal manifestations and volcanic features of the Transcaucasus.

under a pyroclastic cover. These legends are not surprising: a Neolithic tomb has been recently discovered in Armenia, completely filled and covered by volcanic agglomerates dating from 6,000-7,000 years ago. As for the myths directly or indirectly related to the occurrence of volcanic features in the Caucasus region, worthy of mention is that of "Amirani," a legendary hero who, because of his conflict with the deities, was chained to the highest peak of the Greater Caucasus Range (Mt. Elbrus) and condemned to suffer the attacks of an eagle devouring his liver during the day, while the liver regenerated during the night. It is similar to the ancient Greek myth of Prometheus, who was condemned to the same punishment by Zeus after his "theft of fire" in disobedience of a divine order. Since the myth of Prometheus is a rather elaborate one, it probably evolved from the older Caucasian myth of "Amirani."

Some legends of the Transcaucasian region refer to Mt. Ararat, a prominent massif with a perpetual snowcap. The Ararat massif is the result of relatively recent (Plio-Quaternary) volcanic activity. Although there has been no eruption, strong earthquakes are known to have

The Great Caucasus Range is a segment of the Alpine-Himalayan chain that, because of its morphological prominence, is considered the southern geographical divide between Europe and Asia. A wide variety of geologic environments exists within and south of the Great Caucasus Range, between the Black and Caspian Seas, and inside the present-day territories of Georgia, Armenia, and Azerbaijan. This variety accounts for the notable differences in the regional heat flow field, whose values display sharp changes from zone to zone, and even within the same zone at relatively short distances.




Mountains and lowland regions of the Caucasus.

Igneous processes that accompanied and followed tectonic activity in the Caucasus region starting from Pre-Cambrian times were rejuvenated during the Alpine orogenesis, resulting in the renewal of the regional heat field and the establishment of favorable conditions for the formation of local and relatively shallow heat flow anomalies in specific geologic sectors. These anomalies provided the basic conditions for active geothermal phenomena such as volcanic eruptions, earthquakes, mud volcanoes, and thermal springs in areas with particular hydrogeological and tectonic features.

The rejuvenation of the natural heat field was particularly strong during the Pliocene and the Quaternary. It involved the whole Transcaucasian region, especially the central sector of the Great Caucasus Range and the Lesser Caucasus, in the areas of Borjomi, Akhalkalaki, Sevan Lake, the Vorotan River, and Megri (Paffengholts, 1948). These areas have many natural manifestations.

The most prominent geomorphological feature of the Great Caucasus Range is Mt. Elbrus, a volcano (5642 m) that started to form in the Pliocene and was completed in the Quaternary. Along its slopes, warm waters (15°-20° C) spring out perennially in permafrost areas above 4000 m, leading to the conclusion that many hydrogeological systems develop actively in these areas and take their temperatures at depth from a broad thermal anomaly beneath Mt. Elbrus. For this reason, some geologists think that Mt. Elbrus is a quiescent, but not yet extinct, volcano.

Comparable situations occur in the other prominent volcanic features of the region considered in this chapter, such as Mt. Ararat, 5137 m, located in Turkey near the convergence of the Turkish, Armenian, and Iranian frontiers.

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occurred in the area in historical times. No nearby mountains detract from the solitary magnificence of this massif, which is formed by two adjoining peaks: Great Ararat and Little Ararat.

The "mountains of Ararat" are mentioned in the Bible (*Genesis* 8:4), but the Ararat massif proper is locally named *Masis* by the Armenians, *Agri-Dagh* by the Turks, and *Koh-i-Nuh* ("Noah's mountain") by the Persians. A Persian legend refers to Ararat as the "cradle of the human race." However, the Great Ararat summit is celebrated and known worldwide because it is believed to be the site upon which Noah's Ark came to rest, waiting for the waters of the universal flood to subside. Armenian legends maintain that the remains of the Ark were long visible on the mountain, not disappearing until 1840, when a tremendous earthquake followed by a huge avalanche affected the mountain's summit and totally destroyed the nearby village of Aghuri. According to tradition, Aghuri is the village where Noah built his altar and made ritual animal sacrifices to God soon after he and his companions could safely leave the Ark and regenerate the human race. The story of Noah's Ark is still a tradition among the Armenians, who believe themselves to represent the world's first human race after the Deluge. This is why Mt. Ararat was in antiquity, and still remains, a sacred mountain for the Armenians, venerated as the "mother of the world."

The Vorotan Valley, Armenia. The thermal springs in this area probably were used by prehistoric peoples.

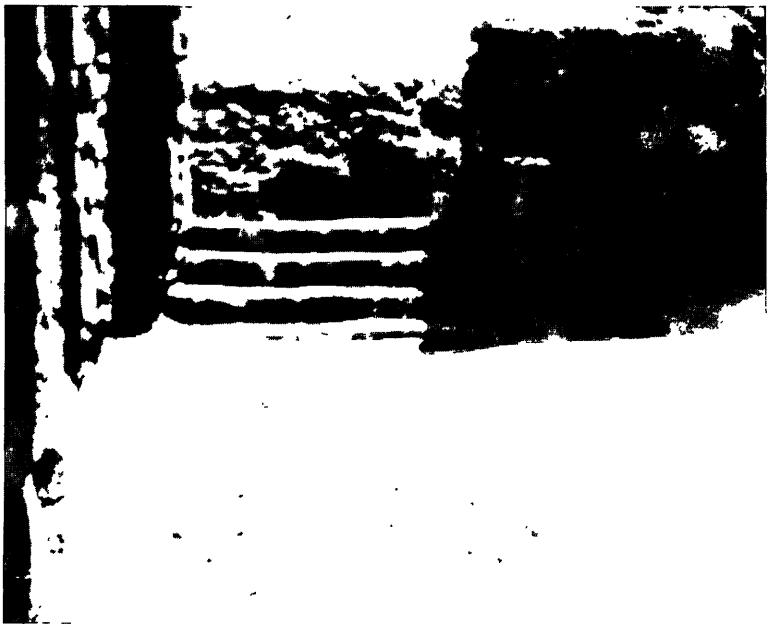
Prehistoric people of the Transcaucasus region were also familiar with some of the by-products of the Earth's heat. This is evidenced by the widespread use of volcanic rocks as building materials and of obsidian for domestic tools (knives, scrapers) and hunting or warfare weaponry (axes, arrowheads). Moreover, due to its abundance in the region, it is likely that obsidian was used to barter for other kinds of materials or products from neighboring lands, starting from early Neolithic times.

## Historical Use of Thermal Springs and Geothermal By-Products

Written accounts, archaeological discoveries, ruins, and ancient monuments prove that the systematic use of thermal waters for healing purposes dates back at least 2,500 years. The most important of these localities are described briefly.

### *Armenia*

Archaeological excavations conducted a few decades ago in Arzni led to the discovery of open-air bathing pools dug in travertine deposits. Many Roman coins dating from 100 B.C. to 200 A.D. have been found inside and near the bathing pools. This indicates that commanders, rulers, soldiers, and common people using the thermal baths left coins as tokens of gratitude to divinities and water nymphs for successful healing (Demekhin, 1940). Construction of the pools dates back to the beginning of the Christian era, but thermal bathing for therapeutic purposes was probably practiced at Arzni since at least the 5th century B.C., well before Armenia came under Roman rule.



Ruins of old baths at Erebuni, Armenia.

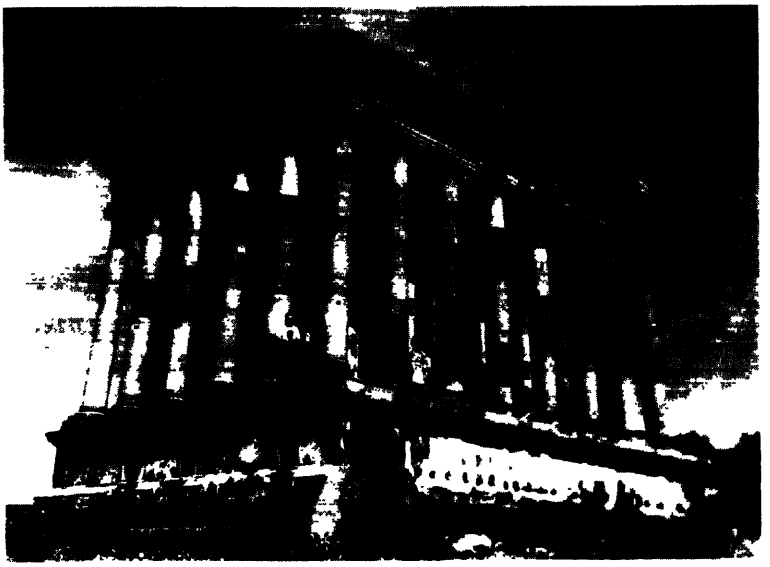
Jermuk also has been frequented since early historic times. Stepanos Orbelyan, an ancient Armenian historian, reported that the *nakhararq*

(barons and other nobles of the 3rd-5th centuries A.D.) used to take baths at Jermuk for healing, for rest and recovery after hunting parties, and for recreation (Yeremin, 1939). This spa has remained in more or less continuous operation since ancient times and is currently one of Armenia's most popular thermal resorts.

Ruins of very old baths, probably dating from pre-Christian times, have been discovered in Erebuni. The walls are made of juxtaposed, uncemented volcanic blocks. Bathing has continued here from ancient through recent times.

Thermal springs in Ankavan and Ararat have been in use since early historic times. Near one, a cultic structure cut from volcanic rock was built in pre-Christian times. The old structure was modified and later became a Christian temple. Near Ankavan and Ararat, imposing travertine formations up to 50 m thick outcrop over large areas. The travertine, made of almost pure $CaCO_3$, has a crystalline structure and is snow-white. The use of the travertine from these localities dates from prehistoric times, when early Armenians excavated this rock for carvings. In historic times, travertine quarries provided blocks and facing slabs for monuments and other buildings. This peculiar by-product of geothermal

Ancient sanctuary cut in volcanic rock, Armenia. Christian symbols of a later period are seen at the top.



Temple-palace of the sun's and Earth's heat at Garni, Armenia.

activity has been an important and long-lasting resource for Armenia: travertine from Ankavan and Ararat is still used by the Armenian building industry for facing material that is comparable to precious white marbles (Ananyan, 1959).

In Garni, the use of thermal water for bathing dates back to ancient times and has continued through the present. The importance that ancient Armenians attached to such natural geothermal resources is confirmed by their construction of votive temples.

### *Azerbaijan*

The two most important thermal resorts of Azerbaijan are Kelbadjari and Talish. Each has a cluster of thermal springs, with temperatures of up to 72° C at Kelbadjari and up to 64° C at Talish. Written records on the use of these springs date back to the early Middle Ages. These thermal springs are described in ancient books, listed under the name of the main disease that was usually treated. For instance, *gotursu* (or *goturlu*) referred to thermal springs used for treating diseases of the skin, especially eczema; *elisu* was the spa for rheumatism treatment; and *khaltan* was the thermal spring used for treating liver diseases.

### *Georgia*

Georgia has many thermal localities, each of which is formed by a cluster of springs (Buachidze, 1980). The most important of these localities are Tskhaltubo, Mtskheta, Borjomi, Gagra, Zugdidi, Batumi, and Tbilisi.

At Tskhaltubo, the hydrothermal water has a total flow rate of hundreds of liters per second. In this area of Karst topography, prehistoric peoples settled in caverns near the spring outlets, undoubtedly bathing in the thermal waters.

Around Mtskheta, the ancient capital of Georgia, are ruins of very old baths. The floors of some bathing rooms are paved with mosaics resembling the Roman style. Most likely these baths were already in use at the beginning of the Christian era, if not earlier.

Borjomi is a renowned thermal locality now, but its bathing tradition is very old. A few decades ago, during the excavation of the catch basin for the Yekaterina spring (located in the center of Borjomi), the ruins of six ancient baths were discovered at a depth of 7 m. The floor and walls

of these ancient baths are slabs and blocks of volcanic rocks, respectively. Archaeologists estimate that the bath buildings date from the 1st century A.D., although thermal bathing by early Georgians at Borjomi is probably much older.

## Thermal Balneology at Tbilisi

Tbilisi is the present capital of Georgia, but because of the importance given to thermal practices, it can be considered the historical capital of hot springs in the whole Transcaucasus region.

From its first days, the town was known as *Tphilisi* or *Thbilisi*. Some historians maintain that this name derives from *Thubali*, proto-historic Georgian tribes that are considered the fore-fathers of the Georgian nation (Djavakhischvili, 1983). However, a more reasonable and the most accepted etymology of Tbilisi is now that of *Thbili (*which means "warm" in Georgian), with a clear connection to the warm springs that exist in the suburbs and outskirts of the town. One of these springs still flows and can be seen in the center of the old town.

In historical times, these springs spawned legends related to the founding of Tbilisi. One of them tells of King Vakhtang Gorgasali (late 5th century), who lost his falcon while hunting in the woodlands south of Mtskheta, the capital of the Iberian Kingdom. He later found it in the pool of a nearby hot spring, together with a pheasant. Both birds were scalded, and the king interpreted this event as a divine sign and decided to establish the new capital of Iberia in Tbilisi.

Geothermal bath at the Dedotsikhe fortress at Tbilisi, Georgia.

Another legend, dating from early medieval times, is related to the healing properties of Tbilisi's thermal springs.

The legend recounts that a wounded bird fell into the pool of a thermal spring but was immediately healed by the warm water and could fly away at once.

Legends aside, recent archaeological excavations within the urban area indicate that people had already settled Tbilisi during Aeneolithic times, the end of the 4th millennium B.C. (Early Metal Age); therefore, it is hard to imagine that they did not know how to use the waters from the thermal springs nearby. Later archaeological evidence reveals the progressive development of the town, from the Bronze Age (3rd millennium B.C.) to the first centuries of the Christian era (Meskhi, 1958).

By the 4th century A.D., Tbilisi had already developed into a fortress-town and the stronghold of Mtskheta. A large thermal spa was built within the fortress. The spa was modernized in the late 5th century, when Tbilisi became the new capital of Iberia.

The Kingdom of Iberia began forming in the 2nd century B.C. Its territory grew to include modern Karthli and Kakheti and adjoining regions of Southwestern Georgia. Iberian statehood lasted until the Sasanidian King Khosrau I conquered the region and abolished the Iberian monarchy in the mid-6th century A.D.

During the whole period of the Iberian Kingdom, and for subsequent centuries until 1450, the practice of thermal bathing at Tbilisi was unaffected by historical events and political changes. The baths were frequented by an increasing number of persons, including people from Tbilisi and other Georgian localities, patients from neighboring Transcaucasian regions, and visitors or travelers from faraway lands. This is confirmed by reports and works of national and foreign writers, who stressed the effectiveness of balneotherapeutic treatments for a number of diseases, as well as the architectural beauty of some thermal establishments. Ibn-Haukali, a 9th century Arabic traveler, wrote: "there are some thermal baths in Tbilisi, which are not heated by any fires.... Some baths here are as nice as the Tiberian baths...." The author apparently was aware that some thermal baths in Europe and the Middle East were heated by wood fires. It is also likely that the author was making a comparison with the baths of Hammei Tiberias in Galilee, which were established in 20 A.D. by Herod Antipas and named after the Roman Emperor Tiberias (see Chapter 4, this volume).

Other references to the Tbilisi spas are found in accounts by Arabic merchants and traders living in Georgia during the 11th and 12th centuries. Al-Farik and Ibn al-Jauzi, for example, reported

that "the entrance to the baths is free..."; however, it is not clear whether "free entrance" meant that the admission to the baths was free of charge, or if the baths were public.

Bath complex at Tbilisi, 17th century.

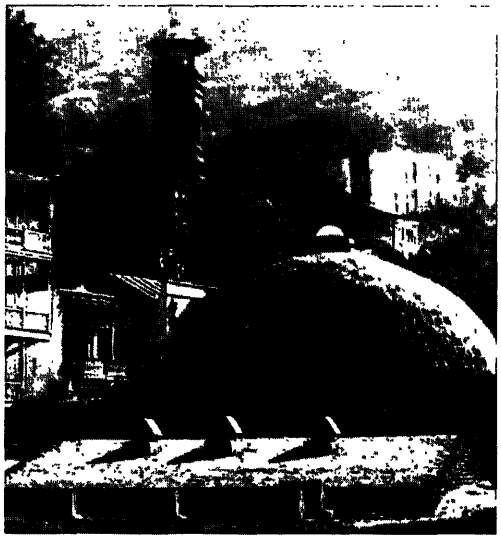
Balneotherapy continued at Tbilisi even after the Georgian territories fell under the rule of the Ottoman Turks in 1453 and expanded, with new bathing complexes added for the next five centuries. This custom included all classes of people, regardless of gender or religion. The Russian traveler Vassilis Gagara, for instance, wrote in 1640 that "both Christians and Muslims used to attend the baths...." Moreover, the famous French traveler Jean Chardin (later Sir John), when passing through Tbilisi in 1672 during his last visit to the Middle East, noted the widespread use of the town baths. He also wrote in his travel journals about the existence of a special pipeline that conveyed hot water from a natural spring to the palace of the Viceroys of the House of Mukhran, who governed at Tbilisi under the aegis of the Iranian shahs from 1658 until 1723.

Official documents of the 17th century also describe the Tbilisi spas (Dumbadze, 1990). One of these documents is a certificate establishing rules regarding the use of thermal waters. At that time, the owners and operators of all baths were private entrepreneurs, and each spa took the name of its owner. Another official document of that period declared that the baths could be used by people of any social class and religion; however, men and women had to visit the spas on different days. In 1701, Turnephor classified the thermal springs according to temperatures at the natural outlets and systematically described the healing properties of each type of thermal water (Meskhi, 1958).

It is worth mentioning the case of an extraordinary spa whose water was considered suitable for treating urinary diseases and related disorders. Agha Mahmad Khan Kajar, commander of the Persian army and a eunuch, knew of this spa and ordered his soldiers not to sack the city's thermal complexes after conquering Tbilisi in 1795. He then tried to reverse his physiological

condition by bathing at the spa. When a number of baths resulted in no change, he was overtaken by a fierce anger and ordered his hordes to raze and burn all bathing establishments in Tbilisi. At that time, Tbilisi had six thermal complexes, each of which covered a whole city block. Two similar complexes were located inside the fortress for use by dignitaries, elite socialites, and selected people close to the governor of Georgia.

In his delightful work of poems, "A Voyage to Arzrum," Russian poet Alexander Pushkin eulogized the Tbilisi baths in a panegyric written around 1836. In particular, he described the ritual of the massage, required of all spa visitors before bathing, as well as the "sacredness" of the ablution ceremony.



Bathing complex at Tbilisi, 19th century.

From 1806 on, after Georgia was incorporated into the Russian Empire, the spas were transformed by new, larger buildings and fully modernized. The lower levels included marble-faced basins and comfortable couches for bathing, whereas the halls, meeting rooms, and restaurants were located on the ground floor and upper levels. The spas thus became more than curing centers; they functioned as public clubs, business meeting areas, and social centers. After most business meetings, especially after the successful ones, a party was held with tasty meals and joyful toasts.

Until the end of the Russian Empire, the spas were multifunctional. Baths gradually became a social "must" for ladies, who succeeded in having one day per week, usually Tuesday, reserved for women only. Georgians visited the spas not only to treat diseases, but also for beauty treatments, exchanging the latest city gossip, chatting among themselves, and thoroughly evaluating the attractiveness and economic positions of marriageable young ladies.

In 1925, as a result of the new political situation arising from the formation of the Union of Soviet Socialist Republics, the spa buildings were collectivized and began deteriorating. Balneotherapy continued at a modest level. During the 1960s, however, with the founding of the Georgian Institute of Health Resorts and Balneotherapeutics, the Tbilisi spas lost their original health emphasis and assumed different public functions.

## Use of Other Manifestations

In addition to volcanic features and thermal springs, other geothermal manifestations that have had an important impact on Trancaucasian populations are mud volcanoes and "everburning lights." These manifestations formed because of particular hydrogeologic conditions affecting underground structures bearing organic gas.

### *Mud Volcanoes*

Although they are seen frequently in several inland places of the Transcaucasus tectonic depression, mud volcanoes are concentrated in several sites on the shores and the shallow submarine platform of the Caspian Sea in Azerbaijan. The Transcaucasus region contains 400 mud volcanoes; about 200 land and 100 submarine are located in Azerbaijan. Altogether, the 400 account for 40 percent of the world's mud volcanoes (Aliev and Mekhtiev, 1968). The most important among them are indicated on the map.

Prehistoric Transcaucasian peoples undoubtedly noticed the birth and growth of the mud volcanoes, particularly the tribes who settled on the western shores of the Caspian Sea. Surely these peoples were amazed to see spectacular eruptions, such as those occurring at Todrachay, Kyanizadag, and Kalmas—which rose more than 500 m above ground level—or at Lok Batan, which is considered the "world champion" in number of eruptions. It has been estimated that during peak activity, Lok Batan emits some 500 million cubic meters of gas and 20 million cubic meters of thermal water per year, in addition to large quantities of mud. The last eruption took place in 1990, and it was huge: one eruption produced 300 million cubic meters of gas (organic gas, $CO_2$), together with 150,000 cubic meters of muddy material and breccia.

The curative use of volcanic mud in Georgia and Azerbaijan can be traced back to medieval times, but it probably began much earlier. The most important locality in Eastern Georgia is Akhtala, which belongs to the Tyulki-Tapa group of mud volcanoes. Here, volcanic mud has been used for centuries to treat rheumatism, and warm water was used to treat women's diseases. Both these applications date to early times and still are very popular.

The Dashghil and Koturdag mud volcanoes are located in the southern sector of Azerbaijan. At Dashghil, ponds have been constructed for treating a number of skin diseases, since the mud eruptions are accompanied by outflows of a mixture of thermal water, organic gas, and oil films.

At Koturdag, a "paste" of viscous mud and very dense oil squeezes out slowly but continually from a 50 m long/15 m wide fracture across the crater's top. A huge amount of this paste has accumulated over the centuries, and it has long been used to prepare therapeutic muds to treat arthritis and skin diseases.

In addition to balneological applications of mud and thermal water, some of the mud volcanic extrusions of Georgia and Azerbaijan contain organic fluids and have been exploited locally to produce oil for lamps. In the 12th century at Lok Batan, shallow wells were hand dug to produce oil. Similar wells were excavated in the following centuries. They continued to be dug by hand until the early 20th century. With the passing of time, of course, the excavation technique improved, resulting in larger quantities of oil. One of the last wells of this type was excavated at the beginning of the 20th century and yielded some 20,000 tons of oil and gas per day.

### *Everburning Lights*

"Everburning lights" are manifestations that consist of perennial flames springing to the surface from open fractures in certain areas near thermal springs related to mud volcanoes. The flames are supplied by an organic gas, such as methane, released from oil-bearing structures underlying confined thermal aquifers. Thus the everburning lights are related tangentially to geothermal phenomena and are particularly abundant in the southeastern sector of Azerbaijan.

The existence of the lights has been known since ancient times. Early and pre-Christian Transcaucasian peoples considered them to be a surface expression of some underground power, and they began a cult of fire worship. This cult may have started in early Neolithic or Upper Paleolithic times, based on 11,000 year old petroglyphs depicting fire features, which are found in Azerbaijan's Gobustan Natural Reserve. The cult spread across the Transcaucasus region to remote areas, but its center remained the Apsheron Peninsula near Baku, which bears the name, "Land of Everburning Lights."

The existence of a sect of fire worshipers has been documented in this area since the 6th century B.C. The sect had, and still has today, two special temples: Atashkyakh (near Sura Hani) and Yanardag (near Länkäran). These temples and other localities with everburning lights were visited by fire worshipers from many distant lands, such as Arabia, Persia, Afghanistan, India, and even China.

The ancient cult continues to flourish. Masudi, an Arabian geographer of the 10th century, beautifully depicted the temples and described in detail the nightly torchlight ceremony held at a certain time of the year on the shores of the Caspian Sea near Baku. In 1825 the Russian scientist Ekhwald, during a study visit to Baku, described the climax of the fire worshiping ceremony. He wrote, "In the temple there is a hole from which gas escapes.... At a certain point the mouth of the hole was covered with a carpet, resulting in the accumulation of gas inside.... Afterwards, a wisp of burning straw was thrown into the hole; a strong burst of fire occurred...and everybody was happy."

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Interpretation of "Alyonushka," the oil painting by Victor Vasnetsov, sketched by Valentina Svalova. The 1881 painting, illustrating the folk tale "Sister Alyonushka and Brother Ivanushka," shows a very sad Alyonushka after Ivanushka has been turned into a baby goat for drinking water from the magic well.