TOURISM IN ICELAND: PHASE TWO VOLUME ONE, BOOK THREE

PERSPECTIVE OF TOURISM DEVELOPMENT

A. Medical Hydrology in Iceland

This section contains a summary of a report prepared by Maurice Lamarche, Professor of Hydrology at the University of Nancy (France) Medical School, entitled "Medical Hydrology in Iceland". The full text of the report may be found in Volume Two, Book Six.

1. Definition of Mineral Waters

Although the intuitive sense of a "mineral" water would indicate any water that is capable of beneficial effects on human health, there is no commonly accepted definition in a formal sense. Current legislation in countries regulating mineral waters in all cases specifies that the water be obtained directly from a natural source, and that it be untreated, but there is no hard and fast distinction beyond this. Three possible criteria are:

- Temperature: breaks the waters down into three groups, hypothermal (less than 36 degrees Centigrade), thermal (between 36 and 45 degrees) and hyperthermal (above 45 degrees). While this is an interesting characteristic of the water (e.g., thermal water can be used directly for baths without heating or cooling), it is not the definition usually employed.

- Mineralization: A quantitative measure of the amount of dissolved minerals in the water (usually measured in mg. per liter).

- Physiological activity: definition adopted by countries not using the mineralization criterion. It is clearly a general designation, and should be taken in its broadest sense as meaning not only curative but preventive effects.

Relying on Tables I-G9 through I-G22 in Volume Two of the Phase One study, one can fit Iceland's waters into the above categories. The specifics of the Krisuvik area are well covered in Volume Two also.

- Temperature: of the 139 Icelandic sources analyzed, the overwhelming majority (127) are hyperthermal. Only four are thermal and the remaining eight are hypothermal.

- Mineralization: although there is a tremendous difference among the Icelandic waters as to the amount of dissolved minerals, most have very little mineralization and in fact would not be called "mineral waters" if the definition based on mineralization were used.

- Physiological activity: discussion of this aspect is deferred.

Professor Lamarche notes that there are two practical consequences to the above. First, if the development of Iceland's waters is to tap international markets, legislation should establish what waters are to be considered "mineral waters." Obviously, any definition should not be based on the quantitative measure of mineralization but on the more qualitative criterion of physiological activity. There are currently efforts underway within the EEC to establish a common definition for Common Market countries, and also within the FAO to do the same for all UN member countries. If either of these leads to an acceptable definition, Iceland would be advised to adopt it.

Second, the legislation should not be limited to a simple definition of the mineral waters themselves, but include the conditions for tapping the sources and for their development, and the characteristics for periodic checking on them. These last are technical problems requiring the advice of specialists.

2. Modern Concept of a Thermal Cure

By definition, a thermal cure is more than just use of mineral water, though this is of course indispensable. Secondary uses of the water, as mud, steam and gas, are also part of a cure; in a

larger sense, so are factors like climate, physical processes (e.g., massages), diet and psychological elements like amusements. This broad and varied aspect of a thermal cure is important since it is in fact certain that the mineral waters of Iceland, despite their great interest, still cannot be considered as unique in the world; there exist other springs with similar properties in other parts of the globe. It is in the broad concept of thermal cure, drawing on the package of factors specified above, that Iceland's thermal program can assume a specific character.

The principal uses (directly or derivatively) of the hot water are as follows:

- Baths (individual or pool, running or still water, partial or complete immersion)
- Showers (varied as to water temperature and pressure)
- Steam baths
- Application (total or partial) of muds, lichens, etc.
- Medical techniques related to certain illnesses (intestinal or vaginal irritations, etc.).

Aside from amusements and diversions, which are treated later, the most important related elements are: diet, massages, saunas, exercise rehabilitation, and the use of climate (including "climatic stress" which is so appropriate to Iceland).

Although the usual length of a cure is three weeks, it is not unwarranted to foresee cures of shorter duration for preventive reasons or complementary to treatments received elsewhere.

3. Classification of Mineral Waters

Since by definition mineral waters are those beneficial to

health, it would seem natural to classify them according to those illnesses for which they are most helpful. Since outright experimentation is difficult, this is not usually done. Rather, the classification is done by chemical content, since in any case this is closely related to the question of medical efficacy.

Rather than list all the elements present in any particular kind of mineral water, hydrologists normally classify waters by their dominant class. Exhibit III-1 on the following page summarizes the various kinds of mineral waters, their physiological characteristics and major medical applications.

4. Icelandic Mineral Waters

The Icelandic waters can be classified according to this breakdown, although two remarks should be made first. First, though no study has been made of the gasses at the springs, it is clear from the odor that considerable amounts of hydrogen sulfide are present in many sources in Iceland. Likewise, no work has been done on the possibility of radioactivity in any of the waters, a possibility which should of course be studied. In any case, Professor Lamarche recommends that when the choice of eventual thermal installations is made, new analyses of the selected springs would be necessary to better specify their medical interest and best means of using them.

Existing analyses suffice to show that all kinds of mineral waters are to be found in Iceland, except for the sulphurous waters; and in view of the large concentrations of hydrogen sulfide, these too must exist. Thus, all possibilities of classical balneology are to be found in

EXHIBIT III-1

PRINCIPAL PHYSIOLOGICAL CHARACTERISTICS AND MEDICAL USES OF MINERAL WATERS, BY CHEMICAL TYPE

MINERAL WATERS CHEMICAL TYPE	PRINCIPAL PHYSIOLOGICAL PROPERTIES	PRINCIPAL MEDICAL USES
Bicarbonated waters	Stimulating action on the hepatic function	Gastro-intestinal illnesses
	Stimulating action on the intestinal motivity	Hepatic insufficiency
	Action on certain general metabolisms (excretion of uric acid, hypoglycemiating effect,...)	Gout
Sulphated waters	Diuretic action	Gastro-intestinal illnesses
	Stimulating action of the biliary function	Hepatic insufficiency
	Stimulating action on the intestinal motivity	Problems with the accumulation of organic waste
Sodium chlorinated waters	Stimulation of the growth	Pediatry
	Stimulation of cicatrizations (osseous tissue in particular)	After effects of osteo-articular traumatisms Chronic infections of the mucous membranes
Sulphuretted waters	Trophic effects on the skin and mucous membranes	Chronic infection of the mucous membranes (O.R.L. in particular) Rheumatology
	Antalgic, antispasmodic action	Rheumatology All spasms (digestive in particular) Metabolic illnesses (gout, lithiasis)

Iceland. It is important, however, that many of the sources studied display concentrations of sodium of some consequence, which may be a problem, given the number of cure patients who are restricted to a low sodium diet. This is particularly important, of course, in the case of bicarbonate and sulphate waters which are ingested.

It is helpful to make a quick comparison between four well-known French springs (Vichy, Contexeville, Plombieres-les-Bains, Aix-les-Bains) and four Icelandic sources (Lysuholl, Engjahver, Reykhus, Jokulgil) in terms of their chemical compositions. In general, the pairings show that the Icelandic waters are quite similar to their French counterparts, except for the very much higher level of silica found in the former. The comparison is interesting because it demonstrates that *one finds in Iceland varied mineral waters whose medical applications could be very broad.* It confirms also that *the Icelandic mineral waters do not present, insofar as their chemical composition is concerned, characteristics that separate them clearly from other well-known sources.* Thus, as was mentioned in the first part, it is confirmed that *balneology in Iceland can acquire a focus only in the utilization of the entire range of factors making up a thermal cure and not just by the quality of its waters.*

The sanatorium at Hveragerdi is not really a "thermal" institution, as the term is used today. Diet is the focus of the treatment, and insofar as the water is used, it is the temperature that is important. The principal problems treated there are those related to bones and joints (e.g., rheumatism) and neurological disorders.

5. Development Potential

To repeat the foregoing, *any development of Iceland's waters*

must be a comprehensive one, including health services and diversions, not relying just on the water.

One can envision development for foreigners and for Icelanders as well. Concerning the latter, it is clear that although there are many kinds of waters and thus of potential medical use, the population constraint makes it impractical to envision the opening of many places. It does seem that the same kinds of maladies treated at Hveragerdi are those that any future installation should be equipped for. In addition, the possible role of radioactive treatment and treatment of cardio-vascular problems should be investigated.

As to the type of establishment, it should contain a portion for treatment, a portion for lodging, and a component for amusements. The exact lay-out will depend on the range of medical services planned, but it is of course important that the treatment center be separate from the lodgings and diversions, but not so far removed that patients cannot move between the two in house-clothes.

For foreigners, it is difficult to imagine much traffic in patients with bone and joint problems; this part of the establishment will thus have to be uniquely for the local population. International patients are more likely to be those suffering from cholesterol problems, obesity, gout and (secondarily) allergies, particularly those affecting the respiratory system. These difficulties are susceptible to thermal treatment, and where water is ingested, require weakly mineralized waters. The waters' chemical composition is ideally one of sulphate and bicarbonate ions, and this is characteristic of most of Iceland's water. Locationally,

there really can be only one spot attracting foreigners in a country the size of Iceland, and it should be placed near the airport and yet still in an unspoiled part of the country, where the air and climate can have their fullest effects. And it might be, given the income level of foreigners who would travel to take a cure in Iceland, that the accommodations would have to be of certain quality.

6. The Conditions for Balneologic Development in Iceland

In addition to all the previously mentioned matters, two particular aspects are important:

- As a thermal cure is a medical process, it requires the advice and administration of doctors. This supposes, on the one hand, that there are doctors informed of the processes, and on the other that certain doctors be truly specialized in balneology.

It seems at the moment that Icelandic doctors are rather uninformed as to the potential for thermal medicine. Information of the profession should take place through the professional medical society, Laeknafelag Islands. This would consist of medical conferences and conventions, articles in the association's journal, and publication of a booklet on balneology. As for the education of balneological specialists, this would have to be done at foreign universities.

- It is in general better to include all costs of a cure for foreigners in a lump-sum tariff covering the following:

  - medical expenses
  - lodging (full pension)
  - round-trip air fare from certain foreign cities.

There is reason to believe that the expenses of a thermal cure in Iceland have little chance of being covered by the social security systems existing in other countries. It is thus likely that this international bal-

neology can only interest a particular clientele. The practice of such a lump-sum tariff would doubtless enlarge the possible market, which risks otherwise to hold back in the face of costs which it cannot compute exactly.

B. Icelandic Geosciences Research Center

This section explores the possibility of establishing a research center in Iceland which would be organized as a branch of the United Nations University. Those concerned with tourism development in Iceland need to be cognizant of the fact that Iceland's appeal tends more to the intellect. Although it is recognized that an increased emphasis on tourism would help in the diversification of the Icelandic economy, protecting the fragile ecology is essential and suggests that the flow of foreign visitors must be controlled. *The development program should therefore concentrate on projects that will be of permanent value to Iceland, over and above their touristic use, as a tool for cultural enrichment and economic development.*

The Phase One report on Iceland's tourism potential suggested that a "Government sponsored science museum could be supported on a large scale by the international scientific community in the form of a research center linked to it in the fields of geothermal sciences and technology, solid earth geophysics, oceanography and aeronomy."[1/] As part of the

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1/ Checchi and Company, Tourism in Iceland, Executive Summary, January 1973, page xiii.

tourism development program outlined in Book Two of this volume, the utilization of research and science as a tourist attraction has been included in the proposal for mini-museums. However, the full implication of "scientific tourism" has not been viewed as a major development theme and, therefore, the concept of an international center for research as potentially one of the most cost beneficial emphases for Iceland has not yet been explored.

Current world-wide economic and energy conditions have had severe repercussions on all nations, but especially on the least developed, land-locked and island developing countries due to their vulnerability to external economic constraints.[2/] These crises have shed new light on the reality of the interdependence of nations and the need for expanded cooperation. This is especially true with regard to science and technology and promoting the transfer of technology.

At least two major events have occurred that make the concept of establishing a large-scale international research center in Iceland of immediate relevance. The first is the so-called energy crisis, the immediate aftermath of the oil embargo and steep price increases by the OPEC countries, that has severely affected the economy of Iceland as well as that of many other countries. This event alone has rekindled

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2/ See United Nations General Assembly Resolutions:

1. Declaration on the Establishment of a New International Economic Order, 9 May 1974; and
2. Programme of Action on the Establishment of a New International Economic Order, 16 May 1974.

interest in non-fossil fuel energy sources, which may be to Iceland's advantage in the long run. The second relates to the formulation of plans for setting up the United Nations University consisting of several dispersed campuses throughout the world.

In January 1975, the U.N. University Council adopted the management and use of natural resources as one of three initial priorities for the proposed university. This commitment was again reiterated in March 1975 when Iceland, India, Italy, Japan and Kenya submitted a recommendation to the U.N. Committee on Natural Resources as follows:

> "A) To recommend that the Council of the United Nations University consider including in its programme of priorities the research in the field of geothermal and solar energy and the practical applications of these energy sources.
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> "B) To invite the administrator of the United Nations Development Programme in collaboration with all relevant organs of the United Nations system and bilateral technical assistance programmes to give favourable consideration to the funding of information systems, training courses and seminars in the exploration and utilization of geothermal energy and of research and development of solar energy, and to support the developing countries in participating in these."

It is difficult to predict the future world energy situation; however, it is fairly certain that the cost of fossil fuels will increase significantly as their known reserves decrease, the costs of production increase, and the demand for such products continues to grow with the increased participation of the developing countries in the world economy.

Iceland, and other countries which do not have fossil fuels and other essential natural reserves, are presently faced with adverse balance

of payments because of energy and raw materials requirements. This situation has necessitated both a re-evaluation of development plans and greater emphasis on energy and materials conservation while alternative sources are developed.

Research and development, in conjunction with a comprehensive science policy, is not only a prerogative for large developed countries; it is also a vehicle to promote economic and social development. *For Iceland, an expanded scientific research and development effort would substantially contribute to the country's economic stabilization and could help establish technology as an export commodity. Internationally, the establishment of a geosciences research center, with an initial program concentrated on the development of geothermal energy research, would significantly contribute to lessening the dependence on fossil fuels as an energy source.*

Historically, Iceland has assisted the developing countries through its scientific community by providing advisors and by training foreign students in Iceland. However, due to the small size of the Icelandic scientific community the amount of assistance outside of Iceland has been limited. By instituting a geoscience research center linked to the U.N. University, Iceland could increase its contribution to the developing countries, and also offer a basis for diversification of its own economy. The selection of Iceland as the location for an international geoscience center is supported by opinions similar to those expressed by Dr. Bodvarsson when asked what areas of scientific exploration could best be done in Iceland:

Iceland is a particularly fertile ground for field work and theoretical research in the following areas of the earth sciences.

(1) Geology. Iceland is a flood-basalt area located at the crest of the Mid-Atlantic ridge. Volcanism is very active, perhaps more active than in any other comparable area in the world. The volcanic products are mainly tholeoitic basalts with a slight intermixture with more silicic igneous rocks. The structure of the flood-basalts is a very interesting area of research in the geological sciences and has important bearing on the geology of flood-basalt areas in general, and probably also for the geology of the deep ocean floor. Icelandic geologists have made very important contributions to the geology of Iceland.

Moreover, the many frequent volcanic eruptions in Iceland offer a very important platform for observing some of the most important processes in physical volcanology, physics of lava flow, ash flow and other related phenomena.

(2) Geophysics. The geological revolution during the past decade has created a great interest in sea-floor spreading and global tectonic phenomena. Since Iceland is one of the few parts of the Mid-Atlantic ridge above sea level, many of the global geophysical phenomena can be observed there on dry land. This applies, in particular, to strain and stress analysis, rifting and other plate boundary phenomena. Associated with this is a very active macro- and micro-seismicity which has already attracted the interest of prominent seismologists. Well-known academic institutions such as the Lamont-Doherty Geological Observatory in Palisades, New York, have had active field groups in Iceland. A considerable amount of interesting work in seismology is also carried out by Icelandic scientists.

It is important to note that modern paleomagnetism was initiated by the work of the Dutchman Hospers in Iceland during the early fifties. His work can be claimed to have been the first step in the modern geological revolution.

Important contributions have since been made by scientists on the basis of field work in Iceland, including a considerable number of Icelandic geophysicists.

(3) Geochemistry. The geochemistry of mafic igneous rocks and their metamorphic derivatives can be studied with great profit in Iceland. The recently erected Nordic Institute for Volcanology in Reykjavik, Iceland, is very active in this area. Moreover, the geochemistry of thermal waters is another field which is of great interest and where considerable contributions have been made on the basis of field work in Iceland.

(4) Development of geothermal energy. Iceland was one of the first countries in the world to harness geothermal energy for commercial purposes and has been a world leader in the utilization of this energy resource for non-power purposes. The Reykjavik District Heating System is by far the most important project of its type and has served as a model for similar development elsewhere.

Iceland has a great abundance of all types of geothermal areas with the base temperatures varying from above 300°C down to almost normal values. There are not less than 250 geothermal areas and many hundred geothermal boreholes have been completed. The maximum depth drilled is now of the order of 3,000 meters. There is a great wealth of geothermally related geophysical, geochemical and engineering data available. The National Energy Authority of Iceland has made very important contributions to the geothermal sciences and engineering. The knowledge and material available in Iceland is currently of great interest since there is a world-wide enhanced interest in the harnessing of geothermal energy. This is of particular interest for many of the developing nations since they may reap the most benefit from utilizing geothermal energy for both power generation and industrial heating.

(5) Glaciology and oceanography. It is worth while pointing out that glaciology and oceanography are two other sub-disciplines of the

earth sciences where Iceland offers a platform for fertile work, both theoretical and practical. 3/

Geothermal energy offers an economical alternative to present world energy sources. However, expanded and efficient utilization of this resource is limited by

- a lack of reliable information on the extent and location of resources,
- unsolved technological and environment problems and,
- shortage of trained personnel.

The multidisciplinary character of geothermal energy utilization and development requires a cooperative venture between specialists in industry, the sciences, and the engineering disciplines The rationale for the establishment of the United Nations University takes the same approach. "It will not be organized on the basis of traditional academic departments. Instead, the university's institutes will employ multidisciplinary approaches to specific major world problems." 4/

To accomplish its goals, the U.N. University will both utilize existing institutions and establish new centers. *For Iceland, whose future economic welfare is dependent on application of a coordinated multi-disciplinary approach toward diversified industrial development, these goals could best be served by a national center utilizing existing facilities.*

3/ Dr. Gunnar Bodvarsson, Oregon State University Corvallis, letter dated 23 June 1975.

4/ The United Nations University, Present Status Summer/Fall 1975, UNUE 1 - June 1975 - 30 m.

The U.N. University has been conceived of as an international network of advanced study institutes, devoted to research, postgraduate training, and the dissemination of knowledge. It will serve as a reliable repository for vital data, and concern itself almost entirely with the application of knowledge to the solution of practical problems. Energy is an international problem which requires solutions today. As pointed out by Dr. Joseph Barnea at the Second United Nations Symposium on the Development and Use of Geothermal Resources, there is an immediate need for the establishment of a U.N. University Institute for geothermal research to promote an extensive exchange of research, personnel and experience.[5/]

Iceland is not unique as a source of geothermal energy; however, unlike many countries, its estimated potential of geothermal (and hydro) reserves significantly exceeds its current requirements. In addition, the country has expertise in both industrial and non-industrial utilization of geothermal power to form the basis for a center dedicated to solving practical problems related to this energy source in the context of a developing country. The initial emphasis of the center should be directed toward non-power industrial and multi-use processes, utilizing existing facilities. An initial set of program areas could include

- A resource inventory and assessment program designed to improve techniques for locating and evaluating

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5/ Dr. Joseph Barnea, Multi-Purpose Geothermal Resource Development - An Overview, San Francisco, May 1975.

geothermal resources, to develop better methods for predicting the power potential and longevity of geothermal reservoirs...

- A research and development program designed, among other things, to develop drilling methods to operate at high temperatures; to explore new concepts for fracturing rock; to improve equipment, technology, and methods for extracting and converting geothermal resources and for controlling emissions and wastes...

- A demonstration program designed, among other things, to develop economical geothermal resources production systems and components which meet environmental standards...

- A scientific and technical education program to encourage the development and maintenance of programs to provide the necessary trained personnel to perform required geothermal research, development, and demonstration activities.

As part of the resource inventory and assessment program, the center should establish an international documents depository concerned with geothermal utilization which could eventually be expanded to include material on other areas of the geosciences.

To help support an international demonstration program, Iceland could in the future construct test facilities at existing well sites. One such location is at Hveragerdi where existing well sites could support a 10-15 mwg research station.[6/] Hveragerdi is also a center for applied horticulture using geothermal power which increases the site's multi-purpose potential. However, one of Iceland's greatest advantages is that no new physical facilities need to be constructed to establish a center.

6/ S.S. Einarsson, Proposed 15-Megawatt Geothermal Power Station at Hveragerdi, Iceland, National Energy Authority, 1964.

By utilizing existing National Energy Authority, University, and industrial facilities, an institute with a real program can be established. Eventually, as international support increases, a center with its own facilities could evolve as part of Iceland's contribution to the United Nations University.

A significant amount of coordination and effort will be required to establish a center consistent with the United Nations University concepts. In addition, the structure of the center, and its initial set of programs, needs to be developed on a non-partisan basis. As a steering committee, representation from the following seems appropriate:

- National Research Council
- National Energy Authority
- University of Iceland, Faculty of Engineering & Science
- Nordic Volcanological Institute
- Industrial Development Institute of Iceland
- Industrial Development Committee.

The tourism implications of a research establishment of this nature could be significant for Iceland. Assuming that the program supported a total average foreign population of 100 scientists and researchers for the full academic year of nine months, this could be translated into 27,000 bed-nights in Iceland. Assuming that the average tourist spends three nights in Iceland, the 27,000 bed-nights accounted for by the research center would be equivalent to having 9,000 more tourists in Iceland each year--or an increase of almost 13 percent over the total tourists visiting Iceland in 1974. If any accommodations used by the

Research Center population were used by general tourists during the three summer months, this would increase the total impact of the Research Center even more.

The primary attraction of this program for Iceland at the present juncture is that the major portion of the initial capital cost of the Research Center as envisaged would be forthcoming in the form of grants from the world community. This would not only assist Iceland's balance of payments on the capital account but would constitute a continuing source of invisible exports with regular injections of foreign exchange into the Icelandic economy in the form of the proceeds of bilateral and multilateral research grants.