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THE DIATOMITE INDUSTRY OF ICELAND : THE DEVELOPMENT OF A SUB-ARCTIC RESOURCE

by

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Despite its small size, a population of only 200 000, and a marginal position within the North-Atlantic marine region, the Republic of Iceland is receiving increasing attention from geographers. The political and economic geographers are especially interested in that country. The former are becoming increasingly aware of Iceland's strategic situation within the Northlands, mainly since Iceland forms the northern cornerstone of the 'North Atlantic Triangle', a vital area of sea defined as lying between the islands of Newfoundland, Iceland and Ireland. To the economic geographer, Iceland is a country worthy of detailed study because its mineral resources are limited and there is almost no industry based upon them. The Icelandic economy is faced with two basic problems : inflation and dependence on fish (see tables 1 and 2), so that the diversification of activities has been an urgent policy objective for some time. The smallness of the domestic market also greatly hinders development. Nevertheless, Iceland's huge reserves of hydro electric power and geothermal energy should provide the basis for much growth and diversification. It is in the context of such statements that the importance of the recently created diatomite industry has to be understood.

The evolution of diatomite mining and processing is industrially unique since up to now the development of the Icelandic economy has been achieved with comparatively little participation, financially, from abroad. Yet much of the initial capital and know-how needed to start diatomite exploitation came from the U.S.A. and Canada, and was provided by the Johns-Manville Corporation of Denver, Colorado, whose subsidiary also developed Quebec's asbestos mining. Canadians particularly helped the diatomite project by offering loans for engineering works. Nor is such Canadian involvement surprising, when one considers that Iceland is geographically Canada's neighbour and it is estimated that Canada now has more people of Icelandic origin than Iceland itself.

The regional setting of the diatomite-yielding area

All the diatomite deposits of commercial importance in Iceland come from one Lake. This is called Myvatn, and is situated in North-Eastern Iceland, E.S.E. of the town of Akureyri and S.S.E. of Húsavík (figure 1). Near the Lake are landscapes so desolate that they have been compared to

Table 1

Iceland : Exports by branches of processing

FOB values in millions of kr.	*Jan.–Dec. 1973*		*Jan.–Dec. 1974*		*Jan.–Dec. 1975*	
	M. kr.	*%*	*M. kr.*	*%*	*M. kr.*	*%*
01–09 Marine products	19189	73,7	24588	74,8	37339	78,7
01–07 Fish processing total	17357	66,7	22422	68,2	35440	74,7
01 Freezing plants	8983	34,5	10622	32,3	17793	37,5
02 Salted fish processing	3065	11,8	6358	19,3	9880	20,8
03 Stockfish processing	343	1,3	423	1,3	898	1,9
04 Herring salting	18	0,1	–	–	234	0,5
05 Fish meal and oil factories	4044	15,5	3983	12,1	5064	10,7
06 Canning factories	293	1,1	491	1,5	466	1,0
07 Other fish processing	611	2,4	545	1,7	1105	2,3
08 Direct landings abroad	1599	6,1	1805	5,5	1458	3,1
09 Whale processing	233	0,9	361	1,1	441	0,9
11–19 Agricultural products	765	2,9	945	2,9	1374	2,9
11 Slaughterhouses, meat processing	556	2,1	708	2,2	1025	2,2
12 Dairies	97	0,4	154	0,5	198	0,4
13 Wool	32	0,1	12	0,0	61	0,1
19 Other agricultural products	80	0,3	71	0,2	90	0,2
21–29 Manufacturing n.e.s.	5784	22,2	6535	19,9	8058	17,0
21 Furs, hides and tannery products	446	1,7	438	1,3	664	1,4
22 Wool products	523	2,0	769	2,3	1407	3,0
23 Aluminium	4442	17,0	4788	14,6	5047	10,6
24 Diatomite	*249*	*1,0*	*329*	*1,0*	*572*	*1,2*
29 Other manufacturing	124	0,5	211	0,7	368	0,8
90 Other products	301	1,2	812	2,4	668	1,4
Total	26039	100,0	32880	100,0	47439	100,0

Source : The Statistical Bureau of Iceland

Table 2

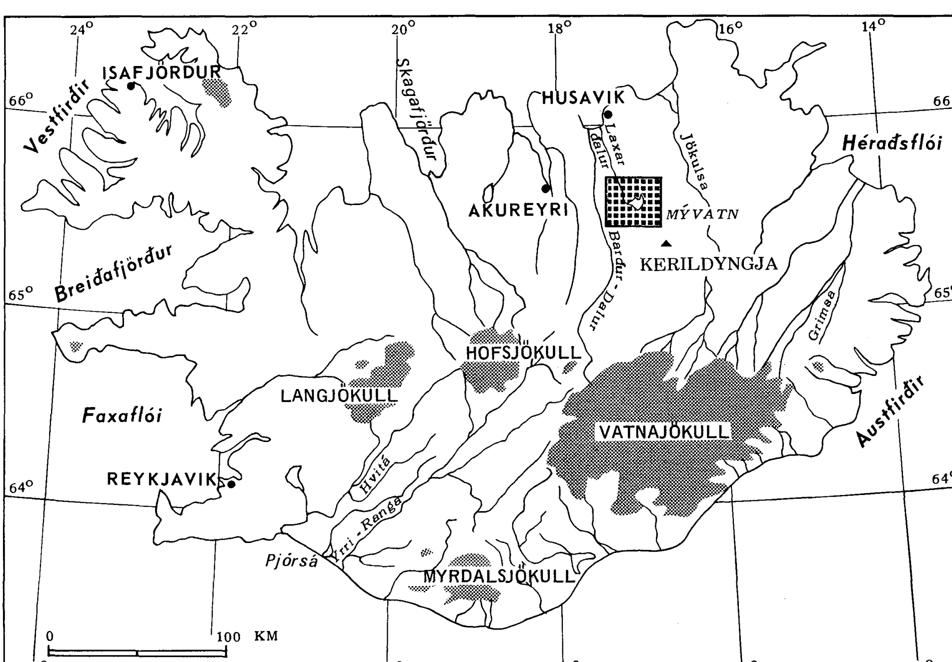
Iceland : Quantity and value of exports of manufacturing products by commodities

		Jan.–Dec. 1974		*Jan.–Dec. 1975*	
		1000 kg	*M. kr.*	*1000 kg*	*M. kr.*
	Manufacturing products, n.e.s.	89751,7	6533,3	67239,1	8056,0
80	Articles of furskins (842)	1,9	9,4	2,7	11,3
81	Tanned or dressed skins (613)	469,9	427,8	495,3	652,5
82	Wool tops and wool yarn (262, 651)	358,3	236,9	358,5	370,4
83	Blankets of wool (656)	142,7	88,9	178,9	171,2
84	Knitted clothing, mainly of wool (841)	225,9	419,5	281,9	819,9
85	Cement (661)	–	–	–	–
86	*Diatomite (275)*	*24055,0*	*328,8*	*20263,9*	*571,6*
87	Primary aluminium, aluminium alloys (684)	63070,6	4788,5	43635,8	5046,9
88	Outer garments, not knitted or crocheted (841)	7,4	22,3	9,8	43,4
89	Other manufacturing products, n.e.s.	1420,0	211,2	2012,3	368,8
	Other commodities	31648,1	751,8	10555,7	562,3
91	Metal scrap (282, 283)	5765,9	70,2	3929,9	79,6
92	Stamps (896)	–	46,7	0,0	46,6
93	Ships, old (735)	13221,0	493,5	963,0	313,9
99	Miscellaneous	12661,2	141,4	5662,8	122,2

Source : The Statistical Bureau of Iceland

Figure 1

POSITION OF LAKE MÝVATN WITHIN ICELAND



the lunar surface. Indeed, Neil Armstrong and some other astronauts trained here prior to their historic moon landings. The Lake itself is shallow, and is situated in a vulcanically active part of the country. Out of the lava surface contiguous upon Myvatn itself rises Hverfjall, which has the longest ash cone in Europe. The lake itself is believed to have been formed by an igneous explosion and the consequent damming of water in pre-historic times.

The southern part of the lake rests on a lava flow emitted by the crater row called Threngslaborgir, some 2000 years ago (figure 2). Further to the east one finds hot springs and mud volcanoes. The gullies behind these have been stained with sulphur and other deposits, which are so characteristic of the district called Namafjall, a sub-glacial moburg ridge. The mud pots and fumeroles here are sometimes associated with haematite and gypsum, as well as with the ever-present sulphur. Many of the mud volcanoes have been shrinking in recent years because geo-thermal steam power has been harnessed in this area, and also there has been limited sulphur exploitation.

Other mountains, composed of basalt, are situated to the West of the Lake. Some areas of lava desert also occur to the east of Myvatn, often devoid of surface water. The landscape to the north of the Lake, and towards Húsavík is different. The river Jökulsa frequently forms bogs, covered with heather and scrubby dwarf-willow and birches (figure 3). In the 19th century the farmers benefitted greatly from the vegetational assets of this feature and frequently collected Iceland-moss here, which is apparently edible.

Near the Lake one can also encounter patches overgrown with a wild oat called melgrass, which was often eaten at times of famine in the past.

The climate of the area is also interesting. Rainfall is not abundant near the Lake. Indeed, the Odahraun between Vatnajökull and Myvatn has the lowest figures recorded in the country. The central depression has only 400 mm p.a., but the climate is still considered mild by Icelandic standards. Storms are quite frequent and tend to be severe throughout the year, and much of the rain comes in heavy downpours. These are followed by drying winds which cause much damage due to their erosional power. This type of climate implies that the area near Myvatn is not as favoured with respect to hydro-power potential as the regions of southern and western Iceland. Nonetheless, it is still an energy-rich zone. Electricity can be generated from natural steam derived from this area and some of it has now been fed into the national grid. Indeed, the diatomite enterprise was the first major consumer of industrially applied geo-thermal power in Iceland. In this way, the factory is also of great indirect, as well as direct, benefit to the Icelandic economy. It is particularly significant for the growth of the town of Húsavík, and also is conducive to the rise of tourism in Northern Iceland. The Lake is a major vacational attraction, even though it is situated in a sparsely settled area remote from the main population centres, and entertains a considerable proportion of the total of visitors coming to the country.

Figure 2

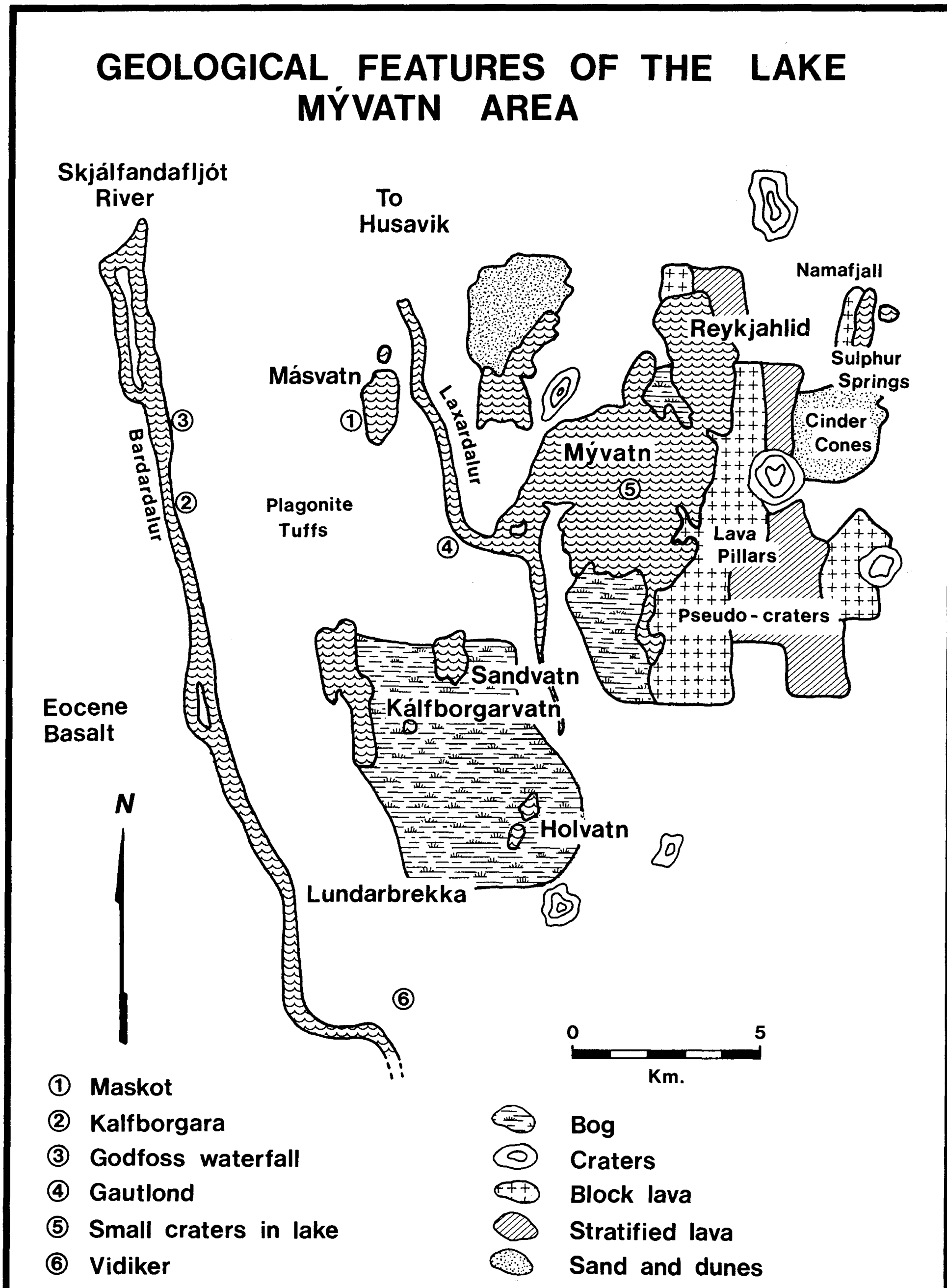
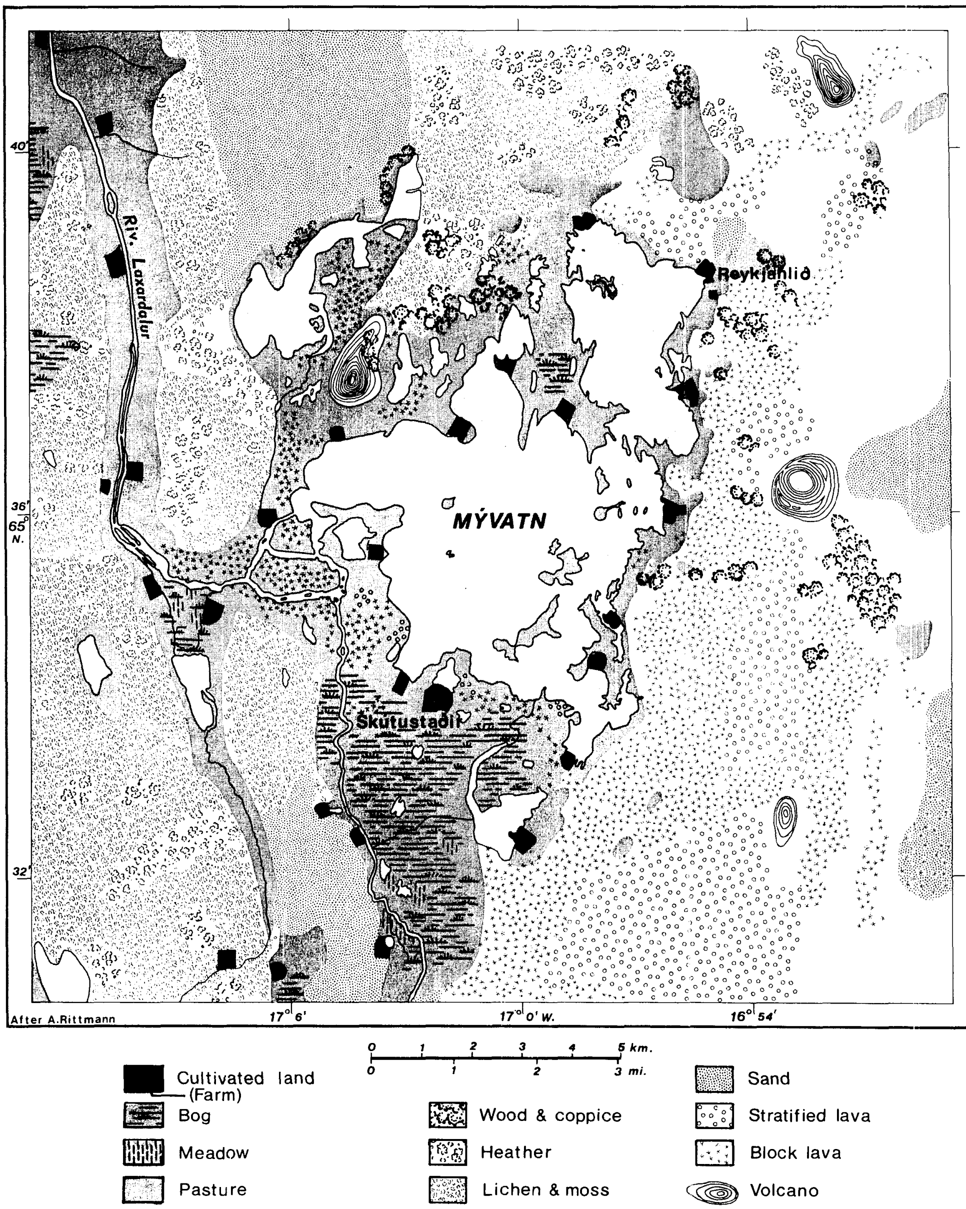

GEOLOGICAL FEATURES OF THE LAKE MÝVATN AREA
Skjálfandafljót River
To Husavik
Namafjall
Reykjahlid
Sulphur Springs
Cinder Cones
Másvatn
Laxardalur
Mývatn
Bardardalur
Plagonite Tuffs
Lava Pillars
Pseudo - craters
Sandvatn
Kálfborgarvatn
Eocene Basalt
N
Holvatn
Lundarbrekka
0 5
Km.
① Maskot
② Kalfborgara
③ Godfoss waterfall
④ Gautlond
⑤ Small craters in lake
⑥ Vidiker
Bog
Craters
Block lava
Stratified lava
Sand and dunes

Figure 3

THE VEGETATION TYPES NEAR LAKE MÝVATN



The geographical character of Lake Myvatn

Myvatn is a large, shallow lake, some 38 sq. km in area, and situated at a distance of 55 km from the town of Akureyri. It is the third biggest lake in Iceland, and is found on a plateau 300 meters in elevation. In the Icelandic language, the word « Myvatn » means 'midge lake', and this is remarkable, since, generally speaking, Icelandic fauna is characterized by a paucity of such insects. The Lake is drained by the Laxardalur, while its source is the Kraka River, together with an underground drainage system in the N.E. section of the Lake. The Laxa River is fast-flowing and the valley is U-shaped, showing much evidence of glacial erosion, together with youthful features such as waterfalls, rapids and potholes. The river flows north, and empties into the sea near Húsavík. A part of the Lake is called Kalfarstrond, and in this zone the shores twist into tiny bays and display huge rock-pillars.

The origins of the Lake have incompletely been studied, but there is a consensus amongst the geologists that, on or around 3800 B.C., a lava flow of the pahoe-hoe type, originating from a point 25 km E.E. of the region at Ketildyngja, was responsible for the formation of the Lake. In the process of motion it dammed the river Laxa by its present exit and thus caused it to assume lacustrine configurations. This basic pattern was subsequently modified by chronologically later eruptions and their ensuing flows. The original lava flow, from Ketildyngja, is known locally as the 'older laxarhraun'. The material from the Threngslaborgir is called the 'younger laxarhraun', and has been dated at 2500 B.C. The various flows differ from one another not merely in age and configuration, but also in composition and chemical structure, for instance, the clay content. Many of the small islands in the Lake are also small volcanoes, as can clearly be perceived by looking at them from the air.

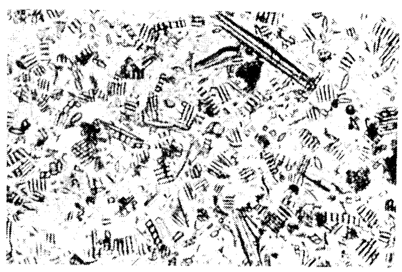
Besides its diatomite-bearing potential, and its complex geology, Lake Myvatn is of interest to scientists for a variety of other reasons. Because the Lake is shallow and highly entropic it supports a considerable biomass of diatoms, most of which are benthic, though planktonic species are also found. Algae tolerate the harsh volcanic environment of Iceland very well, so that it is not surprising that they are abundant here. Indeed, they are known to have been one of the earliest forms of life to colonize firey Surtsey Island. Included in these generalizations concerning algae are also the species of diatoms, from which diatomite was ultimately derived.

Diatomite as a raw-material and resource

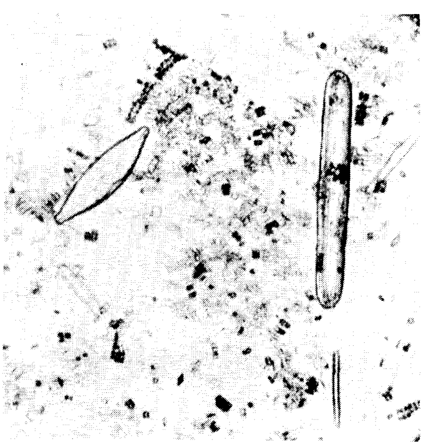
Diatomite is a product derived from fossil diatoms, or rather from their skeletal structures. Diatoms are single-celled algae, known also as colonial algae (figure 4). They are found deposited in the sediments at the bottom of Lake Myvatn and other lakes, and the raw-material has been described as « cell-laden mud ». While most of the commodity being mined at present derives from fossil diatoms, some scientists postulate that deposits can slowly be replenished by present-day biota in the Lake and this will permit a greater tonnage to be obtained. The biggest single source of diatomite in the world is the Lompoc Mine in California, but the layers at the bottom of Lake Myvatn are the most extensive in Europe. The particles are extremely minute, about 1/10 000 th of a sand-grain in dimension (tables 3 and 4). Despite their tiny overall size, they have great relative strength, and can

Figure 4

A. SAMPLE OF DIATOMITE



magnified x 300



magnified x 500

B. FRUSTULE OF A TYPICAL PENNATE DIATOMITE

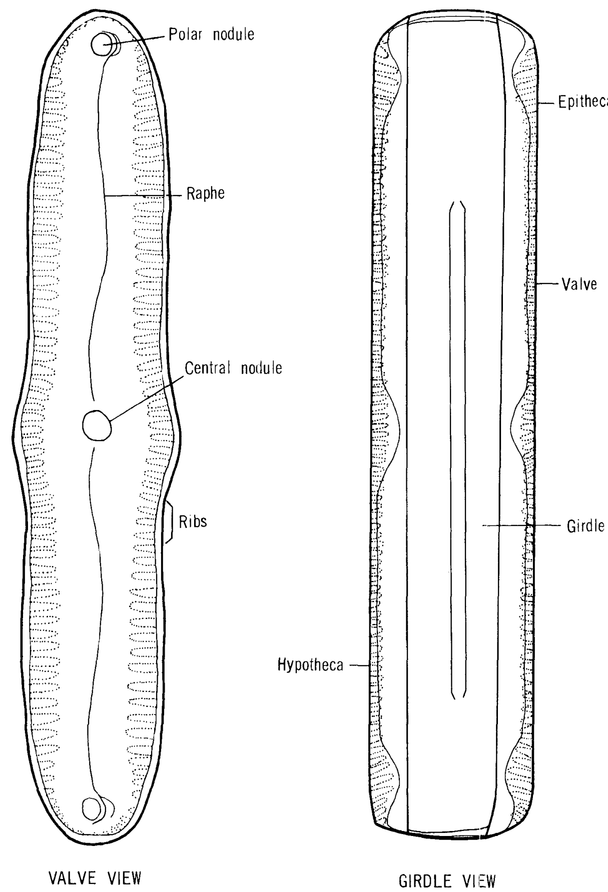


Table 3

Percentage of Particle Size of an Average Sample of Diatomite from Lake Myvatn

MICRON	%
100	0.5
100–60	3.9
60–30	0.2
30–20	0.9
20–10	11.4
10–6	27.8
6–2	15.6
Others	39.7

Source : After K. Richter, 1956.

Table 4

Chemical Composition of Myvatn Diatomite & Earth Sample

SiO_2	89.37%
Al_2O_3	2.06%
CaO	0.68%
Fe_2O_3	2.32%
K_2O	0.18%
Others	5.39%

Source: After Lindal, B., 1959

further be sub-categorized according to criteria of micro-dimensions and durability. The type of diatomite currently being exploited appears to be restricted to volcanic zones, but there is no inherent reason why this should be so, as technology may make it possible to use otherwise derived sources elsewhere, for instance in the highly diatomiferous lakes of Labrador or of the European Alps.

Very little has been published on the diatom flora of Lake Myvatn, from which diatomite is derived, and some of the existing data is contradictory. Even the authorities in this field cannot agree on some important issues. For instance, the research who is familiar with the contributions of Ostenfeld, Olafsson and Hallgrímsson may find it hard to decide if most of the forms are benthic or planktonic. According to such investigations, the most common diatoms of Lake Myvatn are : *Synedra ulna, Fragilaria* (mostly *capucina* and *construens*), *Diatoma* species, *Melosira* species and *Tabellaria* (*genestrata* and *flocculosa*).

Diatomite has a multi-utilization advantage over competing substances, and the range of applications for which it can be deployed is constantly growing in parity with research on the material. The literature contains three statements on this topic, and the author of this paper verified them as being correct. One writer has gone on record as saying that the diatomite is used for polishing, toothpaste and insulation. Another described the uses of diatomite, by postulating that it is utilized for holding phosphorus on the end of the match stick ; non-coking additive in chemical fertilizers ; fillers in plastic materials, explosives, building agents ; filter-aids in wine-making ; antibiotics. Finally, the annual report of the Johns-Manville Corpn. describes the deployment of the material thus : filtering liquids ; clarifying liquids ; functional filtering in paints ; in plastics ; agricultural chemicals ; polishes ; sludge-removal from municipal water treatment systems ; removal of solids from tertiary sewage ; specialty paper ; absorbents, and as a free agent in manufactured and consumer products. Diatomite filter aids have a distinct advantage over conventional paper filters, while the fact that the mineral is non-metallic also opens out many research possibilities for its deployment. At present, pilot plant studies are continuing in the U.S.A., the purpose of which is to improve the manufacture and utilization of synthetic silicates made from diatomite. These may initiate a whole new industry for Iceland

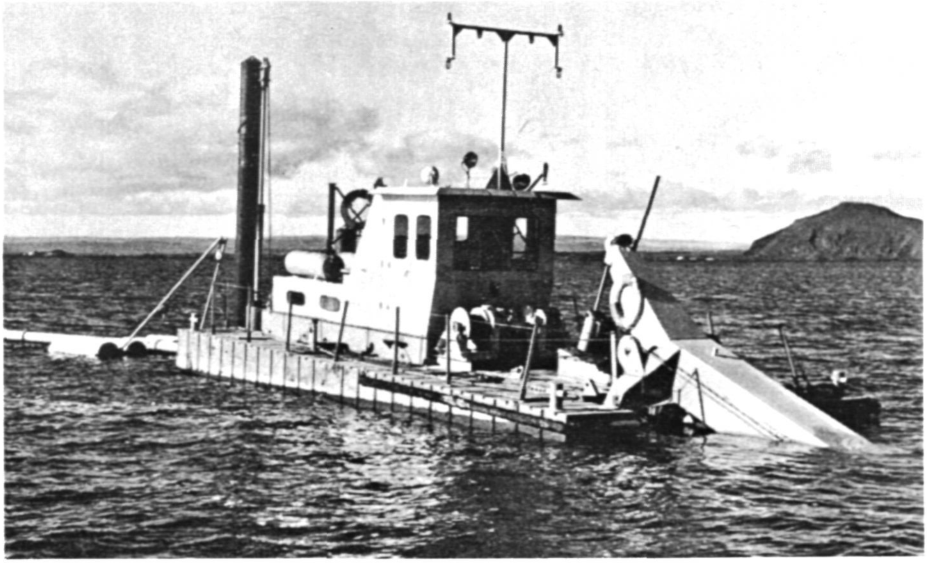
and give Lake Myvatn extra importance amongst multinationally important industrial regions.

The evolution of the diatomite industry

The unusual character of the Myvatn district, and of the Lake itself, was already commented upon in mediaeval times. The earliest recorded description of this region was written by the Danish historian Saxo Grammaticus, in his book *Gesta Danorum*. In one of his chapters are described « silicious incrustations » and « hot springs ». Nevertheless, it might be too optimistic to interpret such remarks as evidence of knowledge about diatomite, though the possibility cannot entirely be ruled out. Whatever is the historic meaning of this remark, nothing was done about the resource till the 20th century. In a 1939 text-book on Iceland, V. Stefansson drew the attention of his readers to « various clays of commercial possibilities ». However, no specific actions connected with the exploitation of the resource followed till 1951, when the full potential of diatomite mining was finally realized by the Icelanders. Considerable debate and study ensued from this realization so that, in 1964, the Althing granted permission for a company to be formed in order to mine the resource and this became known as Kísilidjan hf. of Myvatn. Parliamentary approval was needed for a variety of reasons. For a long time, the policy of the Icelandic government has been to forbid foreign firms from having unlimited investment opportunities in the country, so that any new undertaking is considered according to its merits and needs legislative endorsement. Even if such is granted, the maximum allowed foreign participation is not to exceed 49% of the company's stocks. However, the nature and scale of the Myvatn mine was anticipated to be such that some exceptions had to be made, particularly in the sector of financing. Thus, Kísilidjan hf., was incorporated under a separate act passed by the Althing and the precedent thus created is in no way typical of Iceland's attitude to foreign capital. There has always been a great need in Iceland for private investment by Icelanders, and the government also hoped that this new venture would satisfy such a demand.

Commercial activity started on the Lake in 1965, when a special dredger arrived from the Netherlands, and started taking up the cell-laden muds (photo 1). This was then piped to a storage centre on the site of which a factory was being built (photo 2 and figure 5). The deposits were both analyzed as scientific samples and also experimentally processed with the help of natural steam and geothermal power. A nearby high-earth-temperature zone was the decisive factor in the project, as a great deal of heat is needed for drying this matrial. The Myvatn district is one of the most prosperous farming zones in Iceland, despite its high latitude and altitude. Consequently, no food-supply problems for the adventitious labour force were anticipated. However, the Lake is situated in an area which is remote from the main population centers so that some concern was initially felt about worker-recruitment for the plant, and time has shown these to be justified. In fact, the company had to build houses to get them. The legal

Photo 1 *A modern barge dredging diatomite in lake Myvatn*



arrangements connected with the formation of the company were finally completed by 1966 and test mining runs were continued in that year and also in 1967. Since then, the progress of the company has been quite rapid. By 1968 production reached 4 figures, while as many as 7503 tons were won in 1969. This made it imperative to start increasing the size of the plant. By the end of 1969 the number of full-time employees was 38.

Photo 2 *The diatomite processing plant on the lake Myvatn*

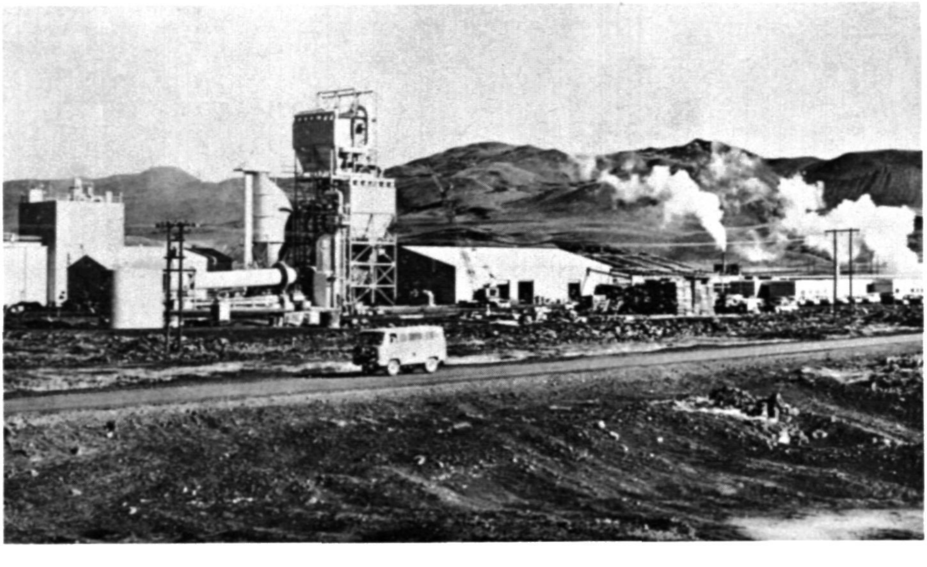
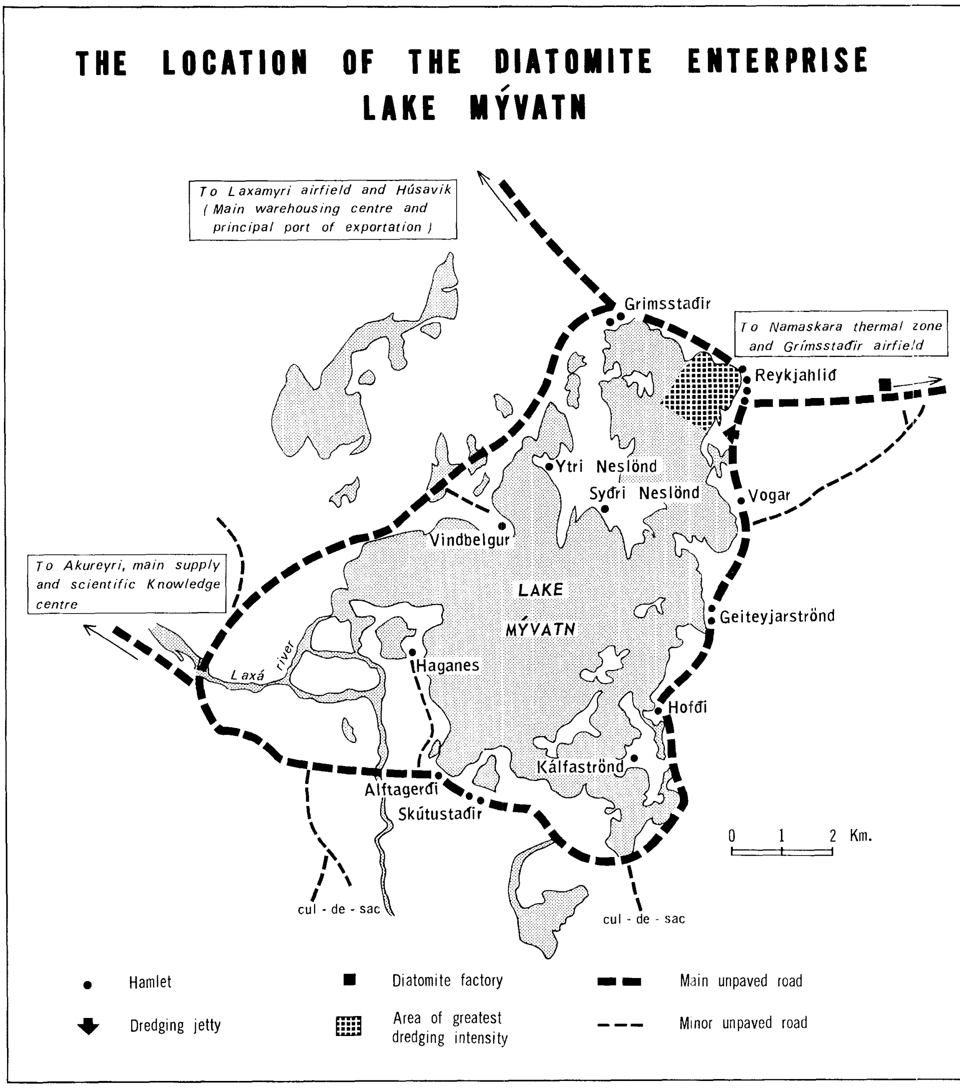


Figure 5



The year 1970 proved particularly significant for this enterprise. In that year the output of diatomite filter-aids reached 13 662 tons, so that the proportional increase over the previous year had been 82%. This was quite impressive for a firm which then reached only its 3rd year of full operation. The rise in output made it possible to diversify the product and so 4 new grades of filter aids were added to the list of types sold. Of these, hyflo-supercell was the most important (table 5). The company also started marketing more diatomite under the brand name of celite. In the first part of 1970, the plant's operating efficiency depended upon the performance of the 'wet' stage of manufacture, i.e., dredging, cleaning, filtering and drying. It was anticipated at the inception of the project that 'phase one' in the process of manufacture would end when production levels had reached 12 000 tons, and this indeed happened in 1970. Thus, by March of that year, the diatomite factory entered into 'phase two', which was to raise its total capacity due to expansions and improvements to the plant. By April 1970 the construction of the new expanded system was sufficiently advanced to be connected into the existing structure, so from that time onwards the two systems operated side-by-side and with considerable success. The older method was called the « dirty » system by the engineers, and the new process thus became known as the « dry » process. However, due to the late delivery of some equipment such an expansion was not completed till December 1970. Upon the finalization of these arrangements, the diatomite factory entered into a new operational level which enabled it, in theory, to acquire an output of up to 24 000 tons. A profit was not expected in 1970 on account of the costs of all such expansions ; nevertheless, the company managed to pay off the debt for the dredger purchased in the Netherlands. The labour force at the plant also increased to 50 during the year and this, too, prevented profit from resulting, as high salaries had to be paid. Besides accepting these regular employees, the Company hired people on an ad hoc basis to work on the various expansion schemes, and in the transportation systems. In 1970, some 39 ships loaded filter aids at Húsavík, and the average shipment was 355 tons.

Table 5

Product Grades of Diatomite, Lake Myvatn, 1973

	Tons
Hyflo regular	14 926
Hyflo A	2 783
Celite 281	448
Celite 503	564
Celite 535	972
Celite 545	2 627
Total	22 320

The next 3 years were not characterized by such rapid change. By 1971, the facilities needed to entirely enter phase two of production became fully operative, and this materialized in February of that year. The total costs of all such expansions could now be computed at 200 million Krona. * The 1971 output of diatomite filter-aids amounted to 21 966 tons — a considerable increase over the previous year.

* Note. Average rates of exchange, krónur per US $ 1,00:1973:kr. 90,02 imports kr. 89,67 exports, 1974:kr. 100,24 imports, kr. 99,84 exports. Rates of exchange relating to foreign trade figures : January–Dec. 1975:kr. 152,17 imports, kr. 151,77 exports. Sept. 1975:kr. 162,42 imports, kr. 162,02 exports. — On February 14 1975 the Icelandic króna was devaluated by 20,01% but imports and exports were until close of that month calculated at the rates in force prior to the devaluation.

In 1972 the plant reached its 5th year of operation and the production levels became stabilized in conformity with the original plans concerning phase two. The year's output of fully-processed diatomite filter-aids was 21 996 tons or 99,9% of the planned figure. The principal technical problems seem to have been solved though there was still much scope for improvement. Strenuous efforts were also made to maximize the output of the plant. During 1972, production from a 24—hr. shift reached a total of 100 tons for the first time, so that the completion of the new warehouse at Myvatn had to be speeded up and the facility was finalized during the year. Early in 1972 some problems were encountered in the pumping of the raw diatomite from the storage ponds, because the viscosity of the material had increased on account of the extra efficiency in ash removal prior to storage in the pond.

Developments in 1973, the last year for which statistical data is available, have also been interesting. For the first time since the plant's formation did the enterprise actually make a net profit. For this reason the year 1973, the 6th of the plant's operation, is generally regarded as the most successful one to date. Production was good and reached 22 320 tons or 97% of planned targets. At the same time, export sales were even higher, and reached a total of 23 734 tons, while domestic sales topped 17 tons. In this way, all stored back logs of diatomite were disposed of, and the Company found itself unable to meet the demand for its produce. Few major problems were encountered during the year, other than those connected with monetary instability and labour recruitment. To deal with the former the Government of Iceland re-valued the krona while the latter snag was alleviated by the building of a new 4-apartment family house near the plant. The developments of 1973 (table 6) thus prove that the diatomite venture can be profitable even under adverse economic conditions and considerable international financial uncertainty.

The geography of diatomite marketing

The marketing pattern of diatomite is both complex and export orientated. While is has never been difficult to dispose of this product, the Icelanders have, nevertheless, always been hampered by the lack of domestic demand for the raw-matrial. Thus, in 1969, only some 9 M.T. of diatomite were sold within Iceland and, by 1973, this figure rose to an insignificant 17 M.T. This situation brings both advantages and difficulty. On the positive side, one could argue that an entirely export-motivated trade is good, as it diversifies the economy and brings in much needed foreign revenue. The disadvantages of this position lie in the fact that the enterprise demands expensive transport links and distribution channels, and also the entire business is vulnerable to international industrial growth cycles and world-wide currency fluctuations and instabilities.

Foreign sales of diatomite are generally synonymous with production in Iceland. The Myvatn plant has an anticipated sale potential-peak of 30 000 M.T. and untapped reserves are not running out. Indeed, the deposits are constantly being replenished by the biological processes in the Lake. In 1970, a high level of output was maintained by differentiating in grades and qualities of the diatomacea and also by utilizing different layers of the lacustrine deposits. By 1972 production totals were stabilized but 1973 was the best year to date. Sales were brisk, and by the end of the year not only were current outputs disposed of, but high demand peaks permitted the disposal of stockpiles and past product inventories. In fact, by the end of the year, the company could not meet the demands for its goods. Some surplusses do accumulate at time if there are strikes and labour stoppages in consuming countries. The number of orders filled fluctuates from year to year with such trends. Thus, some 99 separate orders for filter-aids were filled in 1969 but as many as 183 in 1970. However, the average size of each order is falling. It was 76,8 M.T. in the former year and 75,5 M.T. in the latter. The storage facilities at the plant had a capacity of 3000 tons of fully-processed diatomite. This proved useful in December 1971, for instance, when a maritime strike was hindering exports so that stock-piles started accumulating, and sales were lost because of foreign competition, which was not affected by the disruptions. To increase holding space, a warehouse owned by a local co-operative was rented and accomodated surplusses which were reaching 4000 tons by mid-1972.

Table 6

Average net to Plant Price of Each Ton of Diatomite produced in each Month of 1973

Month	Net price in Ikr.
January	8931
February	9341
March	9334
April	9929
May	9398
June	9575
July	9103
August	9184
September	8661
October	8575
November	7615
December	7723

Hitherto, financial problems were not a serious worry for the company. Thus, in 1969, the income from product sales totalled 54 000 000 kr. and this increased to 101 500 000 kr. Thus, the proportionate increase was 88%. Some of this was due to price hikes on the European market and to a drop in import charges within the E.F.T.A. block as from the 1st of March, 1970. Also, money could be saved because the cost per unit of raw material has declined on account of an improvement in the pumping facilities at Myvatn.

World market prices remained constant in 1972 and as a result, the operating deficit was reduced to a mere 1 880 000 kr., even despite the fact that manufacturing costs rose greatly. However, a considerable loss was suffered in 1973 due to the re-valuation of the Krona and the fluctuations in the value of world currency. Yet, because of high export tonnages (23 734 M.T. in 1973 due to the re-valuation of the Króna and the fluctuations in the enterprise. The Johns Manville Corporation also helped out by decreasing its technical assistance fees from 6% to 1% by the end of 1973, and this produced considerable capital savings.

Labour recruitment has always given trouble to the management of the factory. The supply of local operators, both skilled and untrained, is severely limited by scarcity imposed through demographic factors, and Icelanders show a strong repugnance towards immigrant workers. It is particularly hard to recruit people to man the loading and handling of goods to and on exporting vessels. Húsavík remains the principal port of disposal and houses a subsidiary company whose task it is to facilitate expeding of the filter-aids out of Iceland. The town of Akureyri is 55 km away and is thus considered too far to be of practical use. In general, Iceland vessel-owning companies handled all the overseas freightage, but two shipments in 1970 had to be made on chartered ships, because of lack of capacity on local boats. In that year some 39 ships loaded filter-aids at Húsavík, and the average consignment size was 355 M.T. Such an arrangement is especially vital to the Icelandic maritime economy, because most ships coming to Iceland frequently returned in ballast, and this can now be avoided ; indeed they are presently able to travel with cargo both ways. A road passable in winter has been constructed from Myvatn, in order to facilitate such commerce. A new agreement with Hafskip hf. of Reykjavík was signed in 1972, enabling a reduction in shipping costs, and is proving very beneficial to the plant as profits were often governed by the economies or diseconomies of transport to purchasers. Nevertheless, Icelandic shipping companies have fallen behind their foreign competitors in handling technology, particularly in the introduction of such improvements as containerization, pallets and side-ports on vessels. Also, as stated, they are having labour problems in loading and discharging of vessels. It is generally easy to convey diatomite, as the small size of the shells and their great porosity enables them to be packed into a small volume and still have a large amount of pore-space. A cubic foot of diatomaceous earth weighs only 8 lbs., while the same volume of silica alone scales at 130 lbs.

In general, product quality is being maintained at the plant, and the customers are satisfied with the filter-aids received. After drying, cleaning, calcining and grading, the material is packed for export into 50 lb. bags. During 1970, production began of 4 new grades of filter aids, but Hyflo-supercell remained the principal selling item. New qualities were constantly being experimented with, and may be added to the sales list if market demand expands. Marketing studies undertaken by consumers, and made available to the author (Confidential data, source cannot be quoted, 1974) show that much of the global output of diatomaceous earth is used for non-filter aid purposes, so that Iceland has a distinct advantage on the market. For instance, a considerable volume of this material originating within the U.S.S.R. is used for insulating bricks. It is likely that the quality of the Soviet material is such to prevent its use for filter-aid purposes. The filler and brick grades do not lend themselves to export as there are too many competing and often cheaper substitutes in other lands. This situation is proved by the fact that the U.S.S.R. does not export significant quantities of diatomaceous earth and yet she would certainly do so in order to get 'hard currencies' if the product was acceptable overseas.

Finally, in concluding this analysis of the geography of diatomite marketing, something must be said about the international situation. In general, the wider market prospects look good for Iceland. To begin with, she has few real present-day competitors, because only the Lompoc mine in California and the Mingan River area of Québec could yield filter-earth of comparable quality, and the former is already a major source and is worked to full capacity. Also, diatomite is becoming a vital strategic commodity. In the initial stages of the Myvatn project, Iceland hoped to concentrate on the European market, which thereto secured supplies from North America, because transit from Húsavík is much cheaper and this renders the product 30% less expensive at receiving points.

Accordingly, of the 1970 sales, some 5 687 M.T. went to Europeen Free Trade Association countries and 8 119 M.T. to all other lands. By 1972, the product was being exported to 19 countries, including all members of E.F.T.A. and the European Economic Community, plus some four states within COMECON. West Germany was the principal consumer, followed by Britain and France. The destinations of the sales did not change in 1973. Special efforts were made that year to step up sales to the U.S.S.R. but with no result. Samples were also sent to Mainland China and while the Chinese expressed some interest, they were only prepared to consider such trade if it came as part of a 'package deal' including the purchases of Icelandic aluminium products. Demand for diatomite is increasing elsewhere, and other potential markets could be opened. The U.S. production in both 1972 and 1973 was around 500 000 M.T. p.a. and all other capitalist countries except Iceland yielded a further 600 000 M.T. The Soviet Union had a probable output of 375 000 M.T. and all other Communist-ruled states, including China, a further 100 000 M.T. Thus, the present author estimates that, if one includes Icelandic figures, the total world diatomite output is in the region of 1 600 000 M.T. per annum. Confidential information, supplied to the author, indicates that the sale of diatomaceous earth filter-aids in the world, (excluding the U.S.S.R.) will rise some 28% by 1977. However, there is no evidence that production will grow accordingly, because global output of the material remained reasonably static since 1967, while sales of filter-aids have increased. Diatomite mining has become big business, and Iceland has a vital and growing part to play in this enterprise.

The fringe-benefits of the diatomite venture

Attempts have been made in this paper to analyse the regional setting, past growth and present status of the Myvatn diatomite undertaking. In this way, the scholar was acquainted with the direct benefits of this industry to the Icelandic economy. However, much of the accumulated advantage of this development is latent, as the country's commerce is likely to experience the full impact of it in an indirect way. The formation of the factory, for instance, helped the development of hereto neglected marginal northern zones of the country. Employment opportunities were created in areas and sectors where none existed before. The shipping and electric power industries were given a new boost while the construction industry prospered. New road and air links were developed, new vessels were ordered, and the facilities of a port were up-graded. Modern residential housing units were initiated. Touristic links were ameliorated and a demand was created for local agricultural, horticultural and fisheries produce, as the adventitious workers had to be fed. Schools and hospitals had to be enlarged and improved. The research institutions of Iceland were given a vital new research direction, and were aided with grants of money, particularly in the fields of engineering, hydrological, limnological and economic investigations. Much new knowledge was thereby won and new personnel was trained scientifically. The depopulation of fringe zones was arrested and young men were given a chance of staying in their native areas. They were encouraged to earn good wages there, rather than be compelled to contribute to the urban sprawl of the bigger towns. A new sense of communal pride started to manifest itself in the directly affected part of Northern Iceland. More than that, international links were forged between the country and the world business community at large, and the good will contacts thus established will prove useful in the development of other new industries in the future. Last but not least, the Icelandic currency, and hence the whole economy, was strengthened and its base broadened and diversified. It is thus reasonable for the author to postulate that the evolution of the diatomite industry has been one of the most significant industrial ventures in modern Icelandic history, and it is likely to have exceptionally beneficial repercussion in shaping the country's geography.

BIBLIOGRAPHY

ALLEN, F. (1972) A natural earth that catches insects. *Organic Gardening and Farming,* Nov. 1972 : 50-56.

BOURCIER, S. (1971) *Spectroscopic data relative to diatomic molecules.* Oxford, Pergamon Press. 165 p.

CHAUDHURI, M., & OTHERS. (1974) Virus removal by diatomaceous earth filtration. *J. of the Environm. Engineer. Div.,* A.S.C.E., 100 (EE4) : 937-953.

CHOLNOKY, BJ. (1968) *Okologie der Diatomeen.* New York, Hafner Reprint. 18 p.

HALLGRIMSSON, H. (1971) Private communication from, dated 30.12.1971. 1 p.

HUSTEDT, F. (1937) Susswasserdiatomeen von Island, Spitzbergen und den Färöer-Inseln. *Botan. Arch.*, vol. 38, 29 p.

JOHANNESSON, B. (1960) The soils of Iceland. *Reykjavík, Univ. Res. Inst., Dept. of Agric., Repts.*, Ser. B., Nr. 13, p. 140.

KRASSKE, G. (1938) Beitraäge zur Kenntnis der Diatomeen — Vegetation von Island und Spitzbergen I. Diatomeen isländischer Thermalgewässer. *Archiv Für Hydrobiologie*, Stuttgart, 33 (3) : 503-533.

LINDAL, B. (1966) Kísilgúrverksmidjan vid Myvatn i ljósi rannsókna og tacknilegrar thróunar.
Tímarit Verkfraedingafélags Islands, Reykjavík, 3 (6) : 76-81.

LINDAL, B. (1959) Kísilgúrvinnsla úr ledju Myvatns.
Tímarit Verkfraedingafélags Islands, Reykjavík, 2 : 19-29.

MASSEY, R.D. (1974) International treasurer of the John's Manville Corpn. Private correspondance from, dated 1.4.1974.

NOWAK, W.S.W. (1970) *Industrial progress and diversification in Iceland.* Report of Delegation, Visit to the Federation of Iceland Co-operative Societies, F. Kempton, Editor., Education Committee, Royal Arsenal Co-operative Society. Woking, London, p. 20-30.

OLAFSSON, JON. (1971) Private correspondence from, dated 10.11.1071. 2 p.

OSTENFELD, C.H., & WESENBERG-LUND, C. (1905) A regular fortnightly exploration of the plankton of the two Icelandic lakes : Thingvallavatn and Myvatn.
Proc. Roy. Soc. Edinburgh, 25 : 1092-1167.

PETERSEN, J.B. (1928) Algefloraen i nogle jordprover fra Island. *Dansk Botan.* Ark., Copenhagen, No. 9, 39 p.

PÉTURSSON, P. (1966) Kísilgurverksmidjan vid Myvatn.
Tímarit Verkfraedingafélags Islands, Reykjavík, 3 (6) : 82-89.

REINSCH, F..K (1928) Limnologische Untersuchunger auf Meiner Islandreisse, 1925. *Arch. für Hydrobiol.*, 19 ; 381-422.

RITTMANN, A. (1938) Die Vulkane am Myvatn. *Bull. volcanologique*, vol. II : 1-38.

SAEMUNDSSON, J., *Ein ny relation um Brennesteinfuöllin vid Myvatn í Islandi og Nordursyslu.*
Safn til sögu Islands og Islenzka Bókmenta and Fornu og Nyju. 4th ed., Reykjavik. 1907-1915, p. 389-411.

SCHMIDT, A. (1972) *Atlas der Diatomaceen-Kunde.* New York, Hafner Reprint. 123 p.

STEFANSSON, U. (1970) Fáeinar athuganir á efnafraedi Myvatns sumariot 1969. *Náttúrufraedingurinn*, Reykjavík, 40 : 187-196.

STEFANNSSON, V. (1939) *Iceland : The First American Republic.* New York, Author. 214 p.

THORODDSEN, Th., *Skyrslur um Myvatnselda 1724-1729, etc.* Gefin út af hinu islenzka bokmentafelagi, 4 vols., 1907-1915, Copenhagen & Reykjavík.

TRYGGVASON, T. (1959) Kísilmold. *Tímarit Verkfraedingafélags Islands*, Reykjavík, 2 : 17-18.

VAN LANDINGHAM, S.L., *Catalogue of fossil and recent genera and species of diatoms and their synonyms.* 4 parts, New York, Hafner Service Reprint, 1967-1969.

VARIOUS AUTHORS (1971) *Report of the Board of Directors and Management: Activities of Kisilidian hf. in 1970.* Myvatn, Iceland, June 1971, 11 + 11 p.

VARIOUS AUTHORS (1972) *Annual Report of the Johns-Manville Corporation.* Denver, Colorado, (1973), 32 p.

VARIOUS AUTHORS (1972A) *Kísilidjan hf. at Myvatn.* Annual Report for 1971 (1972), Akureyri, 12 + 12 p.

VARIOUS AUTHORS (1973) *Kísilidjan hf. at Myvatn.* Annual Report for 1972 (1973), Akureyri, 12 + 12 p.

WILBUR, M., (1973) The Livestock feed idea that stops flies. *Organic Gardening and Farming,* Oct. 1973 : 114-115.