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THE DEVELOPMENT OF THE LAXÁ-RIVER.

GENERAL INFORMATION.

Worked out in the Office of the
Government Inspector of Electrical
Affairs.

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THE DEVELOPMENT OF THE LAXÁ-RIVER.

GENERAL INFORMATION.

Situation.

Akureyri is the biggest village in the North of Iceland, and the largest but one in the whole of the country. It is situated on the western side of the bottom of the fjord Eyjafjörður. Eyjafjörður runs up into the country about the middle of the north coast, between Skagafjörður and the gulf Skjálfandafloi. The length of the fjord is ca. 60 kilometres. Along both sides of the fjord there are comparatively thickly populated districts and several trading-stations. The chief of these are Grenivík on the eastern side and Dalvík and Ólafsfjörður on the western one. In the outer part of Eyjafjörður is the island Hrísey where there is also a trading-station.

A short distance to the west of the mouth of Eyjafjörður and between it and Skagafjörður, the fjord Siglufjörður lies. The town of Siglufjörður is the biggest herring-station in Iceland and is the seat of a considerable herring industry (rendering factories). The distance between Siglufjörður and Akureyri in a straight line is 65 kilometres, but it lies across two high mountain ranges.

Inland from the bottom of Eyjafjörður there is also a comparatively well populated and flourishing rural district, all called by the name of Eyjafjörður.

Population.

At the end of 1936 the population of Akureyri was reckoned as ab. 4520, but in addition to this there are over 400 inhabitants in Glerárþorp, which is roughly 1 km from Akureyri. The number of inhabitants has increased very rapidly of late years, as the following table shows:

Year:	Inhabitants:
1910	2084
1920	2575
1930	3966
1931	4001
1932	4065
1933	4243

Year:	Inhabitants:
1934	4374
1935	4503
1936	4520

The number of inhabitants in the trading-stations in the west of Eyjafjörður was at the end of 1935 computed to be:

In Ólafsfjörður 711, in Hrísey 346, in Dalvík about 250 and in Siglufjörður 2643. The number of inhabitants in these places has also rapidly increased of recent years.

The number of inhabitants in the country districts and hamlets of the area, other than those mentioned above, was at the same time 3600.

Occupations.

The chief occupations in Akureyri are: manufacture, trade, agriculture and fishing.

There are no detailed statistics as to how many of the inhabitants of the town are engaged in each occupation, but manufacturing is the occupation which has grown most of late years. It is calculated (Á.P.: "The development of Goðafoss") that the existing manufacturing enterprises in Akureyri need about 1.120.000 kilowatt hours of electricity a year, but the need for power for manufacture is rapidly increasing.

As example of factories we may mention: a clothing factory, a wool pullery, a refrigerating plant and a shoe factory. Also a barrel factory, a dairy, two margarine factories, some engineering shops, many joiners shops etc. In accordance with information provided by the government inspection of machines there is now in use in Akureyri machinery with a total of 1100 h.p., and in addition to this some small machines which are not registered. Besides this there are at a comparatively short distance from Akureyri 3 large herring-rendering factories, at Krossanes, Dagverðareyri and Hjalteyri (see below). The shortage of electricity has hampered the development of industry in Akureyri of late years.

Akureyri is the centre of the tourist traffic in the north of the country in the summer. The three chief hotels there have about 150 beds. - Then there is a hospital with 50 beds and a new hospital in the course of construction which is to have ca. 100 beds. Likewise there is a tuberculosis sanitorium with 75 beds. The Grammar School for the north of the country is at Akureyri. It usually has about 225 pupils. There are also several other schools.

Trade.

There is a proportionately great deal of trade and business in

Akureyri. It may be said that the whole Eyjafjörður district, with the exception of Siglufjörður, goes to Akureyri to market, and the same is true for the most westerly districts of South Þingeyjarsýsla.

Akureyri is the headquarters of one of the most influential business concerns in Iceland, the Kaupfélag Eyfirðinga (Eyjafjörður Co-operative Society, KEA).

In 1935 there were imported into Akureyri from abroad goods to the value of ca. kr. 3.180.300, but the value of goods exported in the same year was ca. kr. 1.430.400. The reasons why the exports are so much lower than the imports are chiefly as follows:-

The districts farther up in the country beyond Akureyri produce a great deal of agricultural produce which is sold in the country and does not appear on export returns.

The greater part of the herring- and fish-products which are produced in the various fishing stations in the outer part of Eyjafjörður are sent direct abroad and do not therefore appear on the export returns from Akureyri.

Financial Position.

The value of houses, sites and land in Akureyri is, in accordance with assessment, about 11 million krónur. Taxable incomes for the year 1936 reached a total of 1.600.000 krónur.

Assets of the municipality of Akureyri at the end of the year 1936 were valued at 1.924.000 krónur, and liabilities at the same time were 1.105.000 krónur, of which 135 thousand krónur were for municipal enterprises (the harbour and electric power plant).

In addition to this the assets of the Akureyri Harbour Fund at the close of 1936 were 768 thousand krónur, and its liabilities at the same time 179 thousand krónur.

Moreover, the assets of the Akureyri Electric Power Plant at the end of 1936 were 365 thousand krónur, and the liabilities at the same time 217,500 krónur.

Unencumbered assets at the end of the year 1936 were:

Akureyri municipality	819.059
Akureyri Harbour Fund	589.039
Akureyri Electric Power Plant	<u>147.534</u>
Total of unencumbered assets kr.	1.555.632

The Electric Power Plant.

The Akureyri electric power plant was erected in 1922 on the River Glerá, a small river which flows into the sea quite near the village. Its capacity was 330 horse-power.

The station was used for lighting purposes in the village, for minor industries and a little for cooking purposes.

It was soon apparent that the plant was too small. One of the reasons for this, among others, is that in frosty periods in winter the water power of the river Glerá does not correspond to the machine power.

In 1930 the most urgent need was met by erecting in the station a 165 h.p. diesel engine to supplement the water-driven engines, but now the power is again too little, so that the shortage of electricity hampers in various ways the natural development of the town.

The amount of energy produced by the plant has steadily increased. In 1925 it was 490 thousand kW hours, but in 1936 it had reached 970 thousand kW hours with 3320 hours period of use of the maximum load.

In the following tables (I and II) is a survey of the working of the power plant from 1925 - 1936.

Table I.

Year.	No. of Inhabitants.	Income from Running.	Generate of Pro-duction of energy. kW-hours	Maxi-Hours load of the kW maxi-mum load.	Hours of use of the maxi-mum load.	Income per kW hour worked	Per head:			
							Maximum load watt.	Production kW hours.	Income kr.	Debts kr.
1925	3033	84400	490400	175	2800	17	58	162	27,8	142
1926	3050	79025	515500	182	2830	15,3	60	169	26,0	137
1927	3150	82800	569600	171	3330	14,5	54	181	26,1	126
1928	3348	90105	596100	188	3175	15,1	55	181	27,0	113
1929	3613	102265	671800	206	3260	15,2	57	186	28,3	103
1930	3966	112990	752300	237	3180	14,9	60	190	28,3	99
1931	4001	129630	751900	237	3180	17,2	59	188	32,3	88
1932	4069	126800	745800	243	3070	17,0	60	183	31,3	79
1933	4243	132680	775300	243	3190	17,2	57	185	31,5	60
1934	4374	143000	813000	260	3130	17,6	59	186	32,7	55
1935	4503	144100	881200	275	3210	16,3	61	195	31,8	50
1936	4519	154015	970000	282	3440	15,9	62	215	34,2	48

Table II.

Year.	Entered assets.	Written off.	Entered liabilities	Surplus of assets over liabilities.	Sale of energy. kr.	Hire of meters. kr.	Running expens-es.	Interest and instalments.	Total.	Surplus.
1925	435350	41190	432250	3100	79600	4800	33000	43460	76460	7940
1926	419650	61780	417700	1950	73745	5280	34600	43890	78490	535
1927	399100	82370	398920	180	76900	5900	33800	50100	83900	÷ 1100
1928	378720	102970	378480	240	83865	6240	34700	49000	83700	6405
1929	374930	132540	372310	2620	95450	6815	36700	59630	96330	5935
1930	396140	165680	392190	3950	104440	7750	86200	61950	148150	÷ 35160
1931	378730	185350	352630	26100	120780	8850	51200	53480	104680	24950
1932	385610	205950	323630	61880	117130	9670	44400	53590	97990	28810
1933	346640	247135	255700	90960	122380	10300	42820	86460	129280	3400
1934	375700	267730	240960	134740	131800	11200	62860	33070	95930	47070
1935	349792	331088	224300	125492	138086	6044	77840	26990	104830	39300
1936	365041	356279	217507	147534	147470	6545	80384	31144	111528	42487

The above tables are taken from Mr. Árni Pálsson's plan for the development of Goðafoss (Tímarit V.F.Í., 1936, p.28). The figures for 1936 are however added here.

It will be seen from the tables that in 1936 the income per head is kr. 34,20 for the maximum load of 62 watts per head, and 215 kW hours per head and year. The income for a kW hour produced proved to be 15,9 aurar, and there was a surplus of kr. 42.500,00 when interest on loans and contracted instalments are paid.

The assets of the power-plant at the end of 1936 are entered as follows:-

Power-plant by the Glerá with turbines, alternators, pipes, dam etc. Distributing system with transformer-stations, street-lighting, house service connections etc.	Total	102973,09
Electric meters		41680,55
Diesel engine (with generator)		39938,79
Shares		3200,00
Debts owed by customers		29772,65
Money in funds and in the bank		33875,49
Credit with the municipality		113600,00
	<u>Total kr.</u>	<u>365040,57</u>

At that time the following had been written off:-

Off the power-plant and distributing system 75%	308919,24
Off the meters	30243,46
Off the diesel-engine	<u>17116,62</u>
<u>Total kr.</u>	<u>356279,32</u>

The liabilities of the power-plant at the end of 1936 were kr. 217.507.

Of this over 11 thousand krónur was accounted for by two small loans which have already been paid almost in full.

The remainder, or kr. 206.400 is a bonded loan, which is paid in yearly instalments of kr. 21.000. The holder of the loan is the municipality of Akureyri, but the assets and income of the power station are not mortgaged.

The Environment of Akureyri.

As mentioned above, Akureyri is surrounded by a comparatively well populated and flourishing area.

Farther up the fjord, beyond Akureyri, a population of over 1100, situated on 108 farms might be served by a 44 km long high-tension line. Then each farm would represent roughly 0,4 km of high-tension line and 0,36 share of a transformer-station on an average.

About 7 km farther down the fjord than Akureyri, but on its eastern side, about 2 km from the high-tension line where it passes over Vaðlaheiði, is the hamlet of Svalbarðseyri. In it there is a refrigerating plant with 87 h.p. engines. The country round Svalbarðseyri is well populated.

Along the western side of Eyjafjörður is a thickly populated area and there are three herring-factories there. They lie in line with each other along the fjord and so all might be reached by one high tension line. The innermost is Krossanes, about 3 km from Akureyri, then Dagverðareyri at about 10 km and finally Hjalteyri, about 20 km from Akureyri. There are in these factories at present machines with a total of ca. 650 h.p.

Roughly 20 km beyond Hjalteyri is the trading-station Dalvík. In this place a good deal of fishing goes on; there is a refrigerating plant and a fish-meal factory with machines with a total of ca. 100 h.p.

West of Dalvík lies a populous valley, Svarfaðardalur.

Out in the Eyjafjörður, east of Dalvík, is the island of Hrísey. It lies 3 km from land at the nearest point. There is a great deal of fishing from Hrísey, cod-fishing and herring-salting. There is also a

refrigerating plant there.

Húsavík.

Húsavík lies on the east side of the gulf Skjálfandaflói, farther inland. It is a considerable agricultural and fishing settlement.

In 1920 there were 628 inhabitants in Húsavík

" 1930	"	"	874	"	"	"
" 1935	"	"	945	"	"	"
" 1936	"	"	970	"	"	"

A stone-pier for ocean-going ships has recently been built in Húsavík. There is also a newly erected herring-factory there. Its machine power is 60 h.p.

In 1935 goods were exported from Húsavík for a total of 354 thousand kr., and goods imported in the same year amounted to ca. 378 thousand kr.

There is an electric power station in Húsavík. It was erected in 1919 on a small stream which runs through the place. It is of 75 h.p.

Húsavík is well situated for the herring fishing and the conditions for manufacturing from the herring there are good.

Inland from Húsavík, but away from Skjálfandaflói runs the valley Aðaldalur along which the river Laxá flows. From Húsavík to the power station on the Laxá is ca. 26 km. It is all inhabited country and in some places quite thickly populated.

The site of the power-station.

The electric power station on the Laxá river is ca. 39 km (in a straight line) distant from Akureyri and about 26 km from Húsavík.

To Akureyri the way lies across two ranges of mountains (Fljótsheiði and Vaðlaheiði), and by the high road it is 74 km.

To Húsavík, on the other hand, the way lies over flat country and this distance by road is 33 km.

The transport of heavy goods to the power station would therefore mostly be through Húsavík.

Roads.

From Akureyri there is a raised automobile road across Vaðlaheiði and east by Litlutjarnir in Ljósavatnsskarð. From there a motor road, rough but still fairly passable continues east past the Djúpá river where it runs out of Ljósavatn. From here the road is raised again east over Fljótsheiði and down Reykjadalur. West of Grenjaðarstaður the road runs east to the bridge across Laxá. This part of the road is ca. 5,5 km long and reasonably good. From the Laxá bridge there is a

newly constructed road up along the river to the power station, a distance of ca. 700 metres. The highest point on the road from Akureyri over Vaðlaheiði is over 500 metres above sea-level. There is often a great deal of snow on the heights in winter. It is very dependent on the weather how long the road over the height is open to motor traffic, but it may be said that it is usually possible for cars from the beginning of June until October.

Over Fljótshéiði the road lies at over 300 m above sea-level. There is also a great deal of snow on Fljótshéiði but it is on the whole open to motor traffic as long as or even longer than Vaðlaheiði.

From Húsavík there is a raised motor road in along Skjálfaflói and Aðaldalur, as far as the cross-roads to the west of Grenjaðarstaður. There is not a great deal of snow on this route so that the road is very often passable for motor traffic the greater part of the winter. But there may be periods, especially towards the end of the winter, when the road is impassable owing to snow.

Bridges.

On the way from Húsavík there are several bridges. The capacity of the weakest of them being 8 tons for a fourwheeled vehicle.

Wages and conditions of work in Akureyri.

The usual wage for a labourer in Akureyri is kr. 1,50 per hour. There is no payment for the tea-time interval. The working day is 9 hours.

In addition to the foregoing one would have to allow for the fact that workmen who worked on the power-plant or the distributing system would demand the privileges which are usual, i.e.:-

Free board at the place where they worked, with light and heating.

Free conveyance to and from the work, and home at week-ends once or twice a month as agreed.

Free cooking (a cook, and full cooking utensils).

Free carriage of food to the place of work.

Overwork by ordinary labourers is paid at the rate of kr. 2,10 per hour.

Carpenters are paid kr. 1,60 for day work and kr. 2,20 per hour for overwork.

Lorry-drivers with a lorry receive kr. 4,50 per hour for day work and kr. 5,00 for over-work.

Accident insurance.

An employer is obliged to insure those working on the construction against accidents.

The week is the unit of payment for premium. If the work is paid by the hour, 48 hours are counted as one week. The hours of all those who are insured together shall be added together but a fraction of a week which is left over shall count as a whole week.

For the kind of labour which would be chiefly necessary here, the premiums are:

For quarrying and blasting rock kr. 1,00 a week.

For work in or with water kr. 0,75 a week.

For other work (digging, building, cable-laying etc.) kr. 0,60 a week.

Harbour dues, wages and cost of unloading in Húsavík.

Harbour dues.

Harbour dues must be paid on all goods which are imported into the country at Húsavík. For those goods with which we are most concerned in Húsavík the duty is:

Cement and coal 10 aurar per 100 kg.

Oils, all kinds, 20 " " 150 "

Other goods which are reckoned by weight, 20 aurar per 100 kg.

Timber 5 aurar per cubic foot.

All other goods reckoned by volume 10 aurar per cubic foot.

Wages.

The wages of workmen engaged in unloading ships etc. are kr. 1,25 per hour. For lorry-drivers with lorries kr. 4,50 per hour.

Unloading.

When a ship is able, for the weather, to tie up at the pier, unloading costs kr. 5,50 per ton.

If it is necessary to unload into boats, as may happen, if the weather is bad, the cost may come to a great deal more: Usually 10 - 11 kr. per ton.

Harbour dues and cost of unloading in Akureyri.

Harbour dues.

Harbour dues must be paid on all goods which are imported into the country at Akureyri. For those goods with which we are most concerned in this case the duty is:

Cement and coal 12,5 aurar per 100 kg.

Iron (not wrought) 25 " " 100 "

Motor cars 35 " " 100 "

Tools (shovels etc.) 20 " " 10 "

Electric goods, explosive material 30 aurar per 10 kg.

Timber 5 aurar per c.foot.

All other goods reckoned by volume 10 aurar per c.foot.

Unloading-expenses.

0,30 kr. per piece up to ca. 100 kg. Otherwise kr. 6,00 per ton. There is on the quay at Akureyri a crane with a lifting capacity of 3 tons.

Customs and Import Duties.

In accordance with "A list of customs and import duties in accordance with laws now in force, published by the Ministry of Finance in 1936. The right to make corrections reserved", the customs duties on the chief articles concerned are:-

	Duty on weight and volume. on 1000 kg. on 1 c.foot. kr.	Temporary ad Valorem and duty. % of f.o.b.value.
Iron sheets	20,00	2
Section iron	20,00	2
Iron pipes	20,00	2
Iron rails	20,00	2
Iron (wrought)	20,00	2
Corrugated roofing iron	20,00	
Iron bolts and nuts	60,00	5
Aluminium	60,00	21
Copper and copper wire	60,00	2
Timber		0,09 2
Electric generators	20,00	2
Electric motors	20,00	
Electric insulators	60,00	2
Electric apparatus	60,00	2
Turbines, over 100 h.p. (Not in the list, but in accordance with the usual custom)	20,00	2
Pumps	60,00	2
Explosive material	60,00	2
Cement	6,00	2
Coal	2,00	
Carbolineum (Creosote)	6,00	2
Timber door-frames		0,09 21
" window-frames		0,09 21
Iron " "	20,00	21
Floor-plates, cast or baked	6,00	2
Wheelbarrows	60,00	21

	Duty on weight and volume. on 1000 kg. on 1 c.foot. kr.	Temporary ad Valoren and duty. % of f.o.b.value.
Cement-mixers	60,00	21
Iron-doors	20,00	21
Timber doors		0,09 21
Roofing felt	20,00	2
Underground cable	60,00	2
" " joints	60,00	21
Motors and spare parts of motors	20,00	
Machine oils	20,00	
Paraffin oil	3,00	
Petrol (extra duty on each litre kr.0,08)	6,00	2
Slates	6,00	2
Cross-pieces on cable-poles (iron)	60,00	21

THE DEVELOPMENT OF THE RIVER LAXÁ.ESTIMATED COSTS.Cost Estimate.

The estimates of the cost of the hydro-electric development of the river Laxá from lake Mývatn to produce energy for the use of the town of Akureyri have been drawn up by Mr. Árni Pálsson, civil engineer and the electric engineers of the State electricity control department, and a synopsis of them follows below:-

The following estimate of the construction cost is based on the arrangement of all the work for which tenders are invited in the chief tender dated October 1937.

1. Dam and intake	77000,-
2. Penstock of wood, 690 m long, 2400 mm wide	223000,-
3. Power-house with foundations for machines	151000,-
4. Dwelling house for operators	20000,-
5. Machinery and switch-gears in the power-house. One unit of machinery, 2000 h.p.	231000,-
6. Transmission line: 60,4 km, 30 kV, 3 x 50 mm ² on single wooden poles	340000,-
7. Main transformer station at Akureyri. 1 transformer, 1700 kVA	69000,-
8. Supervision, interest in the construction period and unforeseen, ca. 25%	<u>277000,-</u>
Total kr.	1388000,-
Preparation and various expenses	<u>112000,-</u>
Total kr.	<u>1500000,-</u>

The cost of extensions by 2000 h.p. up to 4000 h.p. by adding another unit of machinery in the power plant and another transformer in the main transformer station at Akureyri, together with the necessary switch-gear is estimated as kr. 233000,-.

In these estimates of the cost of construction an allowance is made for the expense of repairing roads and bridges because of the carriage of materials and machinery to the plant.

The cost estimate is divided approximately as follows between imported materials, freights etc.

Imported materials, cost price (fob)	ca. kr. 550 thous.
Freights	" " 47 "
Import duties	" " 44 "
Wages and supervision	" " 450 "
Carriage in this country	" " 20 "
Loss of interest, various expenses and unforeseen	" " 389 "
	<u>Kr. 1500 thous.</u>

Estimated Operating Expenses.

The number of inhabitants in Akureyri was 4520 at the end of 1936. The increase in the population has been as follows:-

in the years 1910 - 1936 on an average 55 a year.

" " " 1920 - 1936	" " " 61 " "
" " " 1930 - 1936	" " " 97 " "

It therefore does not seem a rash estimate in this connection to expect an increase of 80 by the end of the year 1938, and the number of inhabitants in Akureyri will then be 4600. In addition to this there are 400 inhabitants in Glerárþorp and present buyers outside Akureyri number ca. 100, i.e. a total of 5100 people.

The Laxá-river power plant with 2000 h.p. or a maximum load of 1350 kW, besides the present power-plant on the Glerá river with up to 250 kW, a total of 1600 kW, now produce 300 watts per head at maximum load, if we reckon with a population of 5100. In investigations into the receipts of Icelandic power-stations and in comparison with foreign power stations, the conclusion has been reached that we may assume an income of ca. 49,00 krónur per head of inhabitants in the towns in this country, with the exception of Reykjavík, when consumption at maximum load of the power plant reaches 300 watts per head. If we accept this figure the income of this power-plant will therefore be from sale of energy $5100 \times 49,00 = 250000,00$ krónur when it is fully utilized.

Annual expenses of the power-plant are estimated as follows:-

1. Cost of maintaining the power-plant, transmission line and main transformer station,
1/4% of 1500 thous.kr. 21000
2. Cost of maintaining the town net in Akureyri
in acc.with estimate by Árne Pálsson and
K.Otterstedt 12000
3. Extending the network in the town (est.ÁP&KO) 20000
Transp. 53000

	Transp.	53000
4. Care and collecting (est. ÁP&KO)		<u>57000</u>
	Kr.	<u>110000</u>

There would remain to defray the expenses of the loan for the foundation of the Laxá-development scheme, those loans which rest on the present power station and the maintenance of that station, 140000 krónur.

Now it is not wise to anticipate a full load in both power-plants, the Laxá and Glerá, unless at the same time we assume that another reserve unit of machinery will be set up in the power-plant on the Laxá-river. We may assume that the estimate for the yearly cost of this extension will be ca. 4000,- krónur, excluding interest and instalments.

The remaining 136000 krónur can then be used to pay the expenses of the initial loan, which will then amount to 1.733.000 kr., and the expenses of the Glerá power-plant.

Reykjavík, October 30th, 1937.

JAKOB GÍSLASON (sign.)