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SWISS MERCANTILE SOCIETY.

On Wednesday, 8th April, Dr. Hans Müller, Secretary at the Swiss Embassy, gave a very interesting talk on:

"Switzerland's Hydro-Electric Power and her Programme for Atomic Development."

This subject being of general interest, we have much pleasure in publishing his address *in extenso*.

PART I.

1. Present consumption of energy (especially electric energy).

Switzerland is at present using energy at the rate of about 35 milliard KWh, which is three times more than in 1910.

In 1957 the repartition was as follows: coal 32 per cent, liquid fuel 31 per cent, electricity 27 per cent, wood and peat 8 per cent, and gas 2 per cent. Over 60 per cent of this energy has to be imported.

Electric energy alone is to a large extent produced from Switzerland's own natural forces. The two world-wars have forced us to do so; the steady rise in the living standard has also contributed to increase consumption, which is now 18.4 milliard KWh. It is not industry that uses the greatest amount of current, but a group embracing domestic households, small businesses and artisans, which accounts for 45 per cent, followed by industry with 44 per cent and the railways with 11 per cent.

With a consumption of 2,870 KWh per annum and per head of the population Switzerland takes to-day fifth place among all the countries of the world, after Norway, Sweden, Canada and the United States. Even more striking is the difference if we measure the consumption of electric energy in relation to the surface of the countries. Here, because of the very dense population per square kilometre, Switzerland is well ahead of all those other countries. We use twice as much electricity per head of population as the Germans, almost $2\frac{1}{2}$ times as much as the French, and more than three times as much as the Italians. Electric boilers for instance are to be found in 61 per cent of the households; 53 per cent of the housewives use electricity for cooking; and refrigerators exist in almost 20 per cent of the homes. In Europe, it is Switzerland that consumes the greatest amount of electric current per household (2,740 KWh), the country next in importance being Great Britain with 1,613 KWh.

2. Present production of energy.

I shall now give you a few facts about the national production of electric energy:

The first electric power stations were built in Switzerland in 1882, thanks to private initiative (Lausanne, Montreux, later Rheinfelden and Spiez). I should like to mention a few of these pioneering firms: Georg Fischer, Escher Wyss, von Roll, Rieter, Sulzer, Saurer, Bell, Charmilles, Sécheron, Gardy, Brown Boveri, etc. Let us not forget either that the Swiss Railways were the first in the world to be electrified, work having begun in 1913. Now 98 per cent of the network is electrified.

But at first official authorities were rather more hesitant than private firms. Fribourg was the first canton to have its own works, which is still in operation to-day. In 1901 we have the creation of the "Compagnie vaudoise des forces motrices des lacs de Joux et de l'Orbe", and in 1909 the "Bernische Kraftwerke". 65 per cent of the energy is now produced by official bodies, 35 per cent by private enterprises. It is interesting to note, however, that most of the works, whether private or not, operate in the form of limited companies or of co-operatives. The cantons decide on the utilisation of the water-power and, within the cantons, it depends largely on the autonomous communes how the produced energy is distributed. The Confederation only exercises general supervision and handles international problems, as for instance the export of energy and frontier power stations. The observance of the Confederation's security regulations is not the responsibility of a federal administration but of the Schweizerische Elektrotechnische Verein.

To-day Switzerland has more than 6,000 hydro-electric power stations, which produced 16.7 milliard KWh during the period from 1st October 1957 to 30th September 1958. This figure is 5,500 times bigger than the 3 million KWh produced in 1886 by a few small works.

It is hardly necessary to say how important the electricity industry is for the whole of the Swiss economy. It is true that the production of hydraulic energy is in our country cheaper than the production of thermic energy it is also important to know that the construction of dams, of power houses and transmission systems requires much more capital. 7 milliard Swiss francs is at present invested in the power stations and the transmission system. This tremendous amount goes back to a large extent into the Swiss economy, partly in the form of wages (the electric enter-

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prises occupy 15,000 employees and workers and another 12,000 at present working on plants under construction), partly in the form of orders to industry.

3. Future need of energy.

We have seen that the demand for electric energy has steadily increased during the last years. Especially in winter it has not always been possible to satisfy it without having recourse to imports of current. The rise in consumption averaged 6 per cent from 1945 to 1955, and 7 to 8 per cent in 1956 and 1957. The general prosperity, the necessity for mechanisation because of manpower shortage, and the relatively low price of electricity, compared with other energy sources, are the main reasons for this development.

Switzerland is a highly industrialised country; it seems that the recession which has affected some of our industries (and which reduced to a certain extent the rate of increase of the demand for power in 1958) is drawing towards its end. Therefore, we have every reason to believe that the consumption of electric energy will be getting higher and higher. Detailed studies made by the Eidgenössische Amt für Elektrizitätswirtschaft have resulted in the forecast that the consumption will rise to 30 milliard KWh in not more than 15 years (in 1959 it will probably reach the 20 milliard mark).

But not only will requirements for electric energy increase, but also those relating to fuel for the production of heat for industry, commerce and domestic households, as well as to petrol for road traffic and aviation. The production of coal in Europe is not at its best, and import possibilities may soon pose a difficult problem. Consequently Switzerland will even more than other European countries depend on liquid fuel. Experts think that its share in the total energy consumption will in 20 years' time be around 45 per cent against 31 per cent to-day.

4. How can future energy requirements be satisfied.

The problem which faces Switzerland is clear: The need of energy will increase in practically every sector of life. How can the demand be satisfied?

I had better first speak about the conventional sources of energy. It is obvious that as a Swiss I begin with electricity:

(a) Hydro-electric energy.

Let us first consider the average energy locked up in all the glaciers, rivers, streams and lakes of our country. The result is impressive: 140 to 150 milliard KWh a year! But this is, I am sorry to say, theory. Because (according to the figures given by the Eidgenössische Amt für Wasserwirtschaft) less than 25 per cent of this power can in practice be used; in other words: 32 milliard KWh a year could economically be produced. From the geographical point of view over 60 per cent of this stock of energy belongs to the three alpine cantons: the Grisons (8½ milliard KWh), Valais (8 milliard KWh), Ticino (3 milliard KWh).

How far is this frozen or flowing energy being used? The existing works produce 18.6 milliard KWh, or 58 per cent, of the possible total production. The schemes under construction will produce 5.1 milliard KWh, or another 16 per cent. In approximately four years 24 milliard KWh, or 75 per cent of the potential energy will be produced.

As far as the amount of energy produced is concerned, the following new works are the largest: Grande Dixence, Valais (1,670 million KWh average yearly production), Valle di Lei, Grisons (1,384 million KWh), Maggia, Ticino (1,100 million KWh), Blenio, Ticino (981 million KWh), Sedrun/Tavanasa, Grisons (800 million KWh), Mauvoisin, Valais (761 million KWh), Zervreila (Grisons), Lienne (Valais), Mesocco and Bregaglia (Grisons), Göschenalp (Uri).

There is, as you can see, a very great activity in the field of power schemes construction, and there is no sign that it may decrease in the near future. Sketch or detailed plans are already in existence for most of the remaining works needed to bring Switzerland's production of electric energy to the 32 milliard KWh mark. In several cases questions of concessions or international conventions are pending, and will take some time to solve. May I just mention a few of the more important schemes planned for building by 1975, the year which should normally see the completion of all the projects for the utilisation of the national sources of hydro-electric power: The Engadiner Kraftwerke in the Grisons seems to have become the greatest-ever of all such works in Switzerland; others to come are Mattmark, Emosson and even Gletsch in the Valais, Albula and Landwasser in the Grisons.

Most of the schemes now under construction are located in the Alps, and that will bring a notable change in the production pattern, for 70 per cent of the winter energy is still derived from the power plants situated on the rivers of the plateau.

This is quite an important point, because the river plants depend too much on the amount of rain falling during the winter months and render the importation of winter energy necessary. The construction of high dams, however, makes possible, through the storing of water, a much better tuning of energy production to

consumption. This is particularly important if we look ahead to the time when energy will partly be produced by atomic power plants. To be economical, these must provide a constant volume of energy. whereas the hydro-electric plants will have to meet, if necessary, sudden and very high spurts of consumption. That is why they are provided from the beginning with a very high efficiency.

It may be interesting to hear some figures about the cost of such a large construction programme. Until the beginning of 1958 3.3 milliard francs had been invested in the power plants, without taking the transmission system into consideration. We have to add another 8 milliard for the plants under construction or at the planning stage. The network for the transmission of the current will cost about 4 milliard, making a total expenditure of 12 milliard francs (or 600 million a year, a quota which has already been reached in the last few years).

It is to be hoped that money will remain cheap enough in Switzerland so that this work of real national importance can be achieved in time, that is by 1975 at the latest. If so, our need of electricity could be satisfied until other sources of energy are available.

And let us hope, too (or is that a personal feeling?), that somewhere an alpine valley and a wild brook and a quiet lake will be forgotten and left untouched, so that we can show our children what Switzerland was for us.

(b) Fuel energy.

Switzerland's hydro-electric power is not inexhaustible. What are we to do when, in 1975, the ever-increasing demand for additional energy can no longer be satisfied and when the atomic power stations are not yet ready to supply enough energy and at reasonable prices?

The experts propose the immediate construction of thermic power stations, using, that is to say, the so-called conventional fuels. Our industry is well equipped and can fortunately tackle the construction of such plants. The great problem is how to secure the amount of fuel which is necessary to make them work. Here our dependence on foreign countries is again clearly demonstrated.

Coal, for instance. It is true that some seams can be found in Switzerland, and some have been exploited during the war. But in peacetime the effort would not pay. Anyway, the quantities are far too small to cover our needs, which amount at present to 2.5 million tons a year.

What about **oil**? The Swiss subsoil does not seem to be completely lacking in fuels of fossil origin. Experts familiar with the geological structure of the country are even very optimistic. Important foreign oil companies have been in touch with the governments of all the cantons with the aim of securing concessions for the prospection and future exploitation of oil. A syndicate grouping a number of major Swiss industries has been created, and several cantons are studying the possibilities of co-ordinating their efforts in searching for oil. Considerable capital has been found among Swiss enterprises. Oil prospection is no longer Utopian. Until now, however, the results of the bores undertaken in the cantons of Berne, Lucerne, Soleure, Vaud and others have not been satisfactory. And even if they were, the deposits could not be expected to cover one day the country's total needs. The same applies to the exploitation of **natural gas**, of which some traces have also been discovered.

Consequently the only solution consists in building up very large stocks of these energy carriers. That is a task of national importance, and it is an urgent one.

Why? Because the day may not be far away on which even the importation of these raw products could become difficult or impossible. Detailed studies made by an OEEC commission of experts under the leadership of Sir Harold Hartley have shown that one cannot be pessimistic enough about the discrepancy between the capacity of European energy production and the future needs of our continent. 22 per cent of the energy consumed in 1958 has already had to be imported from other continents. In 1965 this figure will rise to 30 per cent, and to 37 per cent in 1975.

The reasons for this in many respects fatal development — because it may affect security, political independence, cost of living — lie in the technical, economic and social difficulties facing the European coal mines, in the deplorable shortage of natural gas and liquid fuel, and finally in the fact that even the maximum exploitation of hydro-electric power in Europe will in 20 years' time satisfy not more than 11 per cent of requirements.

We know that in spite of our white coal our energy sources, compared with those of the other European countries, are relatively much smaller and that therefore our situation could be even worse if no answer is found to this problem.

(To be concluded in our next issue.)

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