SWEDISH WATER AND AIR POLLUTION RESEARCH LABORATORY

INSTITUTET FÖR VATTEN- OCH LUFTVÅRDSFORSKNING

TELEPHONE 22 25 40
TELEGRAMS WATERRESEARCH

DROTTNING KRISTINAS VÄG 47
114 28 STOCKHOLM SWEDEN

ENVIRONMENTAL POLLUTION TODAY - THE SCENE. THE SCANDINAVIAN VIEWPOINT

Leif Bruneau

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ENVIRONMENTAL POLLUTION TODAY - THE SCENE. THE SCANDINAVIAN VIEWPOINT

by Leif Bruneau,
Swedish Water and Air Pollution Research Laboratory, Stockholm

When speaking about the Scandinavian viewpoint on environmental problems it is necessary to have a look at the map and see what Scandinavia is (Fig. 1).

Scandinavia embraces four countries - Denmark, Finland, Norway and Sweden.

Denmark consists of a lowland peninsula and a row of islands. The country is surrounded by sea-water on the North Sea side and brackish water on the Baltic side. The freshwater consumption by communities and industry is chiefly covered by subsoil water. Most of the population and also of industry is concentrated to cities on the coast (Fig. 2).

Finland may also be characterized as lowland but is in general higher than Denmark. The Finnish coast faces only brackish water. Along the Gulf of Bothnia this water is hardly saline, the salinity amounting only to between 1 and 4 o/oo. Finland is known as the land of the thousand lakes, but they are very shallow. The total water volume of the Finnish lakes and streams has been calculated to equal the volume of the biggest lake in Sweden, Lake Vänern. The population of Finland is to some extent concentrated to the coast but not so markedly as in Denmark. Much of the heavy industry is located in the Finnish inland, especially pulp and paper mills.

Norway is the Scandinavian land of mountains and fjords. There is hardly any lowland at all in Norway except for very small areas in the neighbourhood of the capital Oslo. The Norwegian coast faces only sea-water. Norway has a lot of freshwater. The Norwegian population and industry are located along the coast and mostly in the southern part of the country.

Sweden is low-lying along the coast but the land rises towards the north. Sweden has sea-water on its west coast facing the North Sea, but the rest of the coast has brackish water with a salinity of 1 o/oo in the north and up to about 9 o/oo at the southern coast. - The reason why the Baltic, and especially the Gulf of Bothnia, has such a low salinity is that the Baltic is separated from the North Sea by very shallow sounds which do not permit the heavy saline water to enter the Baltic. On the contrary the Baltic is fed by freshwater from the big rivers in Sweden, Finland and Russia. The Baltic with its freshwater on the top and more saline water in the deeper layers is therefore quite opposite to the Mediterranean, where the top water is more saline but warmer than the bottom water - Sweden has many lakes and streams and the area of water is about 8 % of the Swedish land. In the south and middle of Sweden the population and industry are located both inland and along the coast, naturally with a preference for the coast. In the northern part of the country the main population and industry are located at the mouths of the big rivers.

The low pressure areas coming from the Atlantic Ocean eastwards bring air with a high content of sulphur compounds from the densely populated areas on the Continent and in Great Britain (Fig. 3).

These compounds are components of the rain falling down over Scandinavia.

From this review we may sum up the following facts about the environmental background in Scandinavia:

1. Denmark is most densely populated, is short of freshwater - possesses practically only subsoil water - but has a very long coast as recipient.

2. Finland has a sparse population even in the southern parts, which are most industrialised. There is enough freshwater. The recipient problems are serious in the inland.

3. Norway is densely populated in a small area in the far south. There is enough freshwater, and especially industry and cities located along the coast have rather good recipients.

4. Sweden is densely populated in the city areas of Stockholm, Gothenburg and Malmö. There is enough freshwater - less than 4 % of the precipitation is put to domestic and industrial use. To some areas the freshwater has to be transported over rather long distances. The inland recipients are not very good in the south.

Legislation and administration

The situation today is that all the Scandinavian nations have some sort of legislation on water pollution but only Norway and Sweden have special laws concerning air pollution.

Denmark has an old water law. (Revised in 1970.) An expert group "Fororeningsraadet", is working on the text for a new law and will also propose central administration for environmental control.

Finland has a rather modern water law and from July 1, 1971, the administration is handled by a central authority, "Vattenstyrelsen", which also has regional offices.

In Finland as well, however, a special committee is working on a new environmental law which is said to be close to the Swedish law.

Norway has long had water legislation which protected freshwater but not the coastal waters. In 1970 a modern water law was introduced, and Norway also has an air pollution law handled by a special authority, "Rygskaderådet".

Norway is also working on a combined law covering both water and air pollution. The administration is to be centralized.

The work in all these countries, both on legislation and administration, follows in its main lines the practice in Sweden. The Nordic Council - an assembly of members of the parliaments of the Nordic countries and acting as advisers to the governments - is devoting much effort to bringing uniformity into the law pattern of the respective countries.

It may therefore be practical in the following to review the state of affairs in Sweden as applying to Scandinavia as a whole.

Sweden has since July 1, 1969, one law covering water and air pollution as well as noise. This law is named the Environmental Protection Act. The principal intention of this law is that every technical measure must be taken to prevent pollution if this can be done at a reasonable cost.

The decision is made by the Environment Concession Board - a courtlike institution.

The central administration of the law is handled by the National Environmental Protection Board. Each county council has a nature conservancy section.

Subsidies or fees

On the community side subsidies for constructing sewage treatment plants are common and in Sweden the grants follow the reduction both of BOD and phosphorus, as will be seen from Table I.

Table I

Reduction of BOD	Reduction of phosphorus <50	50-89	≥90
	subsidy, per cent		
60-74	30	35	40
75-89	30	35	45
≥90	35	40	50

On the industrial side subsidies up to 25 % of the investment cost can be given to plant erected earlier than July 1, 1969. These subsidies will be given only during a 5-year period and will total about 50 mill. ₰.

All investments against pollution will be looked upon as machinery from the depreciation standpoint. This means that they are written off in 5 years.

No other country in Scandinavia has gone so far in the grant of subsidies. On the contrary Norway has taken the other course on the air pollution side, charging a fee of about 0.30 ₰ per ton heating oil and per 0.5 per cent sulphur content. Fees are being discussed also in Sweden, but up to now this method has not been tried by our government.

Prohibition and standards

The general rule in Sweden is that the best technical means to reduce pollution shall be employed; but in some cases the use of certain substances has been prohibited. Phenylic mercury compounds, for instance, may not be used. They were frequently used earlier for slime control in paper machines. The use of DDT and similar products is also forbidden, even in the forests.

Heating oil with higher sulphur content than 2.5 % is not allowed in Sweden, and in the very densely populated areas only 1 per cent sulphur content is allowed.

At the same time the discharge of stack gases may not cause higher sulphur dioxide concentrations than are shown in Table II. These are, however, not standards, merely recommendations.

Table II

Swedish immission limits for sulfur dioxide

Concentration ppm	Concentration mg/m^3	Sampling period	Frequency for exceeding
0.05	0.14	1 month	-
0.10	0.29	24 hours	once a month
0.25	0.72	30 minutes	1 % of time

On the water pollution side there are also some recommendations, but they cover only poisonous substances such as copper, chromium, cyanides and others. Up to now there are no standards in the other countries either, but it seems as if Norway is more interested in having standards than the others.

Dumping in international waters - especially the North Sea

Before the end of 1972 all the Nordic countries will have laws against dumping of non-degradable organic substances and poisons such as some heavy metals - which means substances which have a tendency to accumulate in the food chain. This was due to the initiative of Norway as a result of the finding of high contents of chlorinated hydrocarbons in fish outside the Norwegian coast.

Research

Denmark has a research and service laboratory called "Spildevandsutvalget". It works under the Academy of Technical Science on both community and industrial waste problems. The Steam Consumers Association has started some research on air pollution. Both laboratories are still at the beginning of their work.

Finland has governmental research bodies in the water pollution field. The forest products industry also carries out research projects in its "Centrallaboratorium".

Norway has set up "Norsk Institutt for Vannforskning", which is a rather big laboratory covering water consumption as well as waste water. The laboratory has for many years been working on the complicated pollution problems in the fjord of Oslo.

Sweden has a governmental laboratory under the National Environmental Protection Board. This laboratory is mainly dealing with the problems in our big lakes.

Especially for research on industrial waste and air pollution problems the government and industry together run IVL - "Swedish Water and Air Pollution Research Laboratory" - on a fifty-fifty basis. Industry itself runs a service company - IVLAB - parallel to the research laboratory and under the same management. This quite unusual arrangement means that the scientist will be close to the practical problems arising in the field assignments of the service company and the research results will be readily available to industry (Fig. 4).

The researchbudget of IVL totals about 0.7 million $/year and of IVLAB about 1 million $/year. Their combined staff totals about 120 persons.

In all Scandinavian countries research is also going on at universities and technical colleges. Besides the research done with industrial money the industrial federations of the Scandinavian countries have formed a group consisting of their central experts for exchange of information. Sweden has also, together with Germany and Holland, arranged a "knowledge bank" consisting of IVL - Sweden, IWL - Germany and Krachtwerktuigen - Holland.

The situation in Sweden today

Communities

Only a few years ago many, even experienced, people believed in the theory of dilution. We have so much water and even air up in the north that the environmental problem seemed to be only a question of getting wastes and stack gases mixed with recipient water and air in proper amounts.

The eutrophication of our lakes and the severe pollution of our coastal waters have shown us that we must treat domestic sewage. It is not enough with the first stage - sedimentation - and not even with the second - biological treatment - as microelements, phosphorus and other chelating substances are still left, together with virus, eggs of parasites and other things (Fig. 5).

This means that we have to use also the third stage - chemical treatment - and the forecast for the next few years is that there will be a series of new chemical treatment plants under construction. The picture is not at all optimistic - probably more plants will be built than less.

In this respect the difference between Sweden and the other Scandinavian countries is very wide. Sweden is far ahead of the others, but they are now coming along, all of them, since it has been clearly proved in the other countries as well that dilution is not sufficient.

Industry

The communities try to separate their different flows so as to get the most polluted water to the treatment plants and the less polluted drainage and rainwater down the storm water lines. The philosophy is, however, not quite clear, as the rainwater has a tendency to become more and more polluted. Probably the next step must be some kind of treatment for these waters as well in the future.

In industrial areas it is generally possible to calculate very well which areas will be polluted and which will not. It is also possible to take care of special flows inside the factories for reuse, treatment or temporary storage. All of this can rather easily be done when planning new factories or industrial areas.

In old factories, however, the pipes carrying different kinds of wastes are put together like a bunch of snakes. When trying to solve the pollution problem of such a factory the first costly step will be just to bring some order into this bunch of snakes. If this is not done, a proper solution of the waste problem is hardly possible.

The fact that our authorities know about this may be the mean reason for the subsidies offered to old industrial enterprises. Despite these subsidies the reconstruction of old plants may cause tremendous problems and the result from the environmental standpoint is seldom the best.

As an example of the cost I may refer to the cleaning up of a 1 million ton a year steel mill in Sweden. This is estimated to cost about 7 million $.

When planning a new plant the actual location is one of the most important factors for the environment. The Swedish Environmental Protection Act, therefore, requires alternative locations for proposed industrial plants.

The general principle for environmental control is not only to present a low discharge to the recipient and to the air. Our authorities are very interested also in how these values can be attained, and they have a clear preference for internal measures over treatment facilities. This means that industry is under continuous pressure to improve the technical processes in the direction of more product, less waste and more closed systems, the ideal being the totally closed enterprise. Only

a few years ago this seemed to be utopian, but in some branches we now have technical solutions in our hands which enable us to clean up dirty, shabby plants and replace "blue-clothed" by "white-coated" labour.

Just to show that this is not utopian I will end up by presenting a nearly totally closed pulp and paper mill planned in Sweden. The different parts are already functioning in other plants, which made it possible for the projectdesigner to put them together inot an integrated system.

In the south of Sweden, on a river with a minimum water flow of 15 m^3/s one of our forest product enterprises plans to reconstruct a small old mill for production of mechanical pulp and paper into a large modern unit.

The production will be
800 tons/day unbleached kraft pulp
200 tons/day mechanical pulp
400 tons/day paper

The BOD load from the small unit today is about 1 ton/day and it must not be too much higher with the new production if the enterprise is to get permission to build the new plant.

As late as 1969 a government committee published a report about the future of the forest products industry in southern and western Sweden. The figure used in that report for the specific BOD_7 load of unbleached kraft pulp was 23 kg BOD_7/ton of 90 % dry pulp. This figure was looked upon as a good one for a modern kraft pulp mill and seems to be so still in many countries. (Fig. 6)

In the next year, 1970, however, a reconstructed kraft pulp mill was put into production and received a permit from the Water Court to discharge waste water equal to a specific BOD_7 of 4.5 kg/ton. This jump had naturally not taken place in one

year, but until the reconstructed plant was in continuous operation the experts did not dare to use a lower specific value than 23 kg BOD_7/ton.

For the new mill a discharge of 4.5 tons of BOD/day compared with the 1 ton discharged today seemed to be too great an increase of the pollution load on the river. The only way to reduce the pollution is naturally improvement in process technology. Another way may be a more extensive treatment of the effluent than was proposed, namely chemical precipitation with alum sulphate.

In this case improvement in technology was chosen, and the guiding principle was to close the circulating systems even better. (Fig. 7).

Without going into details of the flow chart of the plant I will relate the main features.

The mechanical pulp mill is "cross-recovered" with the kraft mill, which means that the "polluted water" from the mechanical pulping - water containing the organic substance released in the mechanical process - is used in the recovery system for the kraft mill. The organic substance is burnt and the chemicals reused.

The kraft pulp is washed in the washing zone of the continuous digester, in two continuous diffusors in series, on the filter after screening, and at least on a new washing press where the dryness will be over 50 %.

Normally freshwater is expected to enter the system only as diffuser water on the paper machines, but now and then it may be necessary to use freshwater also on the presses. In the normal case the only waste water discharged from the mill should be some excess condensates after conventional stripping. The flow should be about 2-3 m^3/ton pulp, compared with a very

well operating mill today discharging about 50 m^3/ton.

This closing of the water systems will, however, result in a rise of temperature. As a higher temperature than 85 ^{o}C is not wanted, the back water has to be heat-exchanged. The cooling water will be used for different purposes in the mill. The heat corresponds to a use of 20,000 tons of oil. Counting with a sulphur content of 2.5 % this oil saving means a reduction of the sulphur dioxide discharge by about 800 tons a year.

This mill is only planned, but as it consists of well known parts and is designed by the some technicans as built the "4.5 kg BOD/ton" mill, there is no doubt that the discharge can be maximized to 2.5 ton BOD/day for a production of 1,000 tons of pulp a day and that the discharge of polluted water is very close to the ideal - the totally closed mill.

Even if we may look rather optimistically at the development of the pollution situation in Scaddinavia, there is a very serious problem left, namely the sludge and solid wastes.

We have to solve this problem in all countries and this project seems to be an ideal one for international cooperative research. We all need solutions and there is no competition involved - they just have to be solved.

Due partly to our sparse population and to our favourable water resources the fight against pollution, especially in Sweden, has been rather successful both on the domestic and on the industrial side.

We know that our situation is favoured and that many people may ask what problems we are actually fighting. The truth is that we have a chance to conserve a rather good situation and even improve it, and at the same time expand our industrial activity and our overall standard.

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Summary

The actual situation of environmental control is not uniform in Scandinavia. Sweden is ahead of the others both concerning legislation, administration and actual work against pollution.

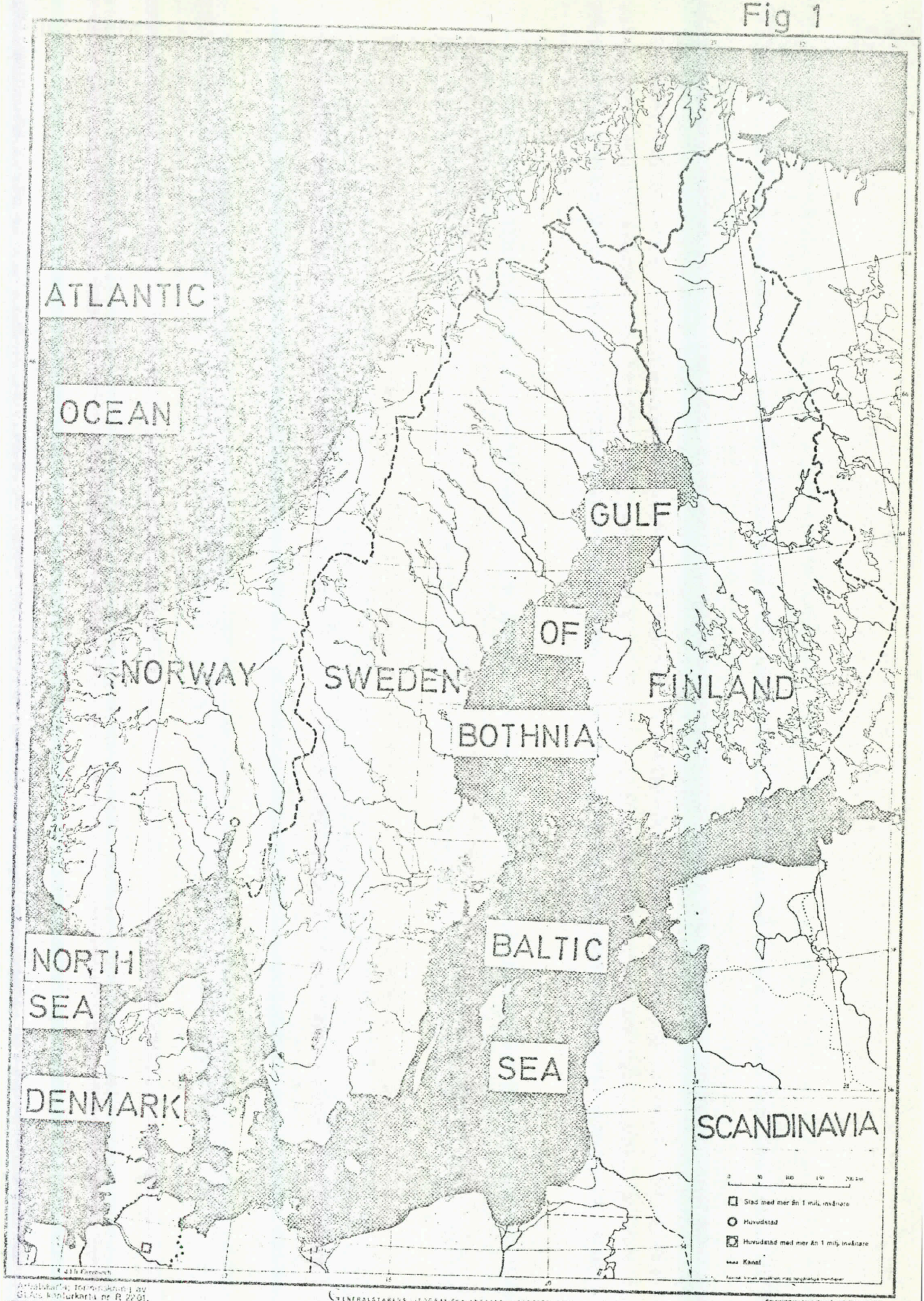
The trend is, however, against more uniform handling of these matters in Scandinavia.

The treatment of sewage in Sweden is built out even with the chemical stage. 1975 about 50 % of the densely populated areas will be served by three step treatment plants.

The reduction of pollution from industries is dealt with preferably by internal measures such as new or transformed processes. Naturally conventional measures are also taken.

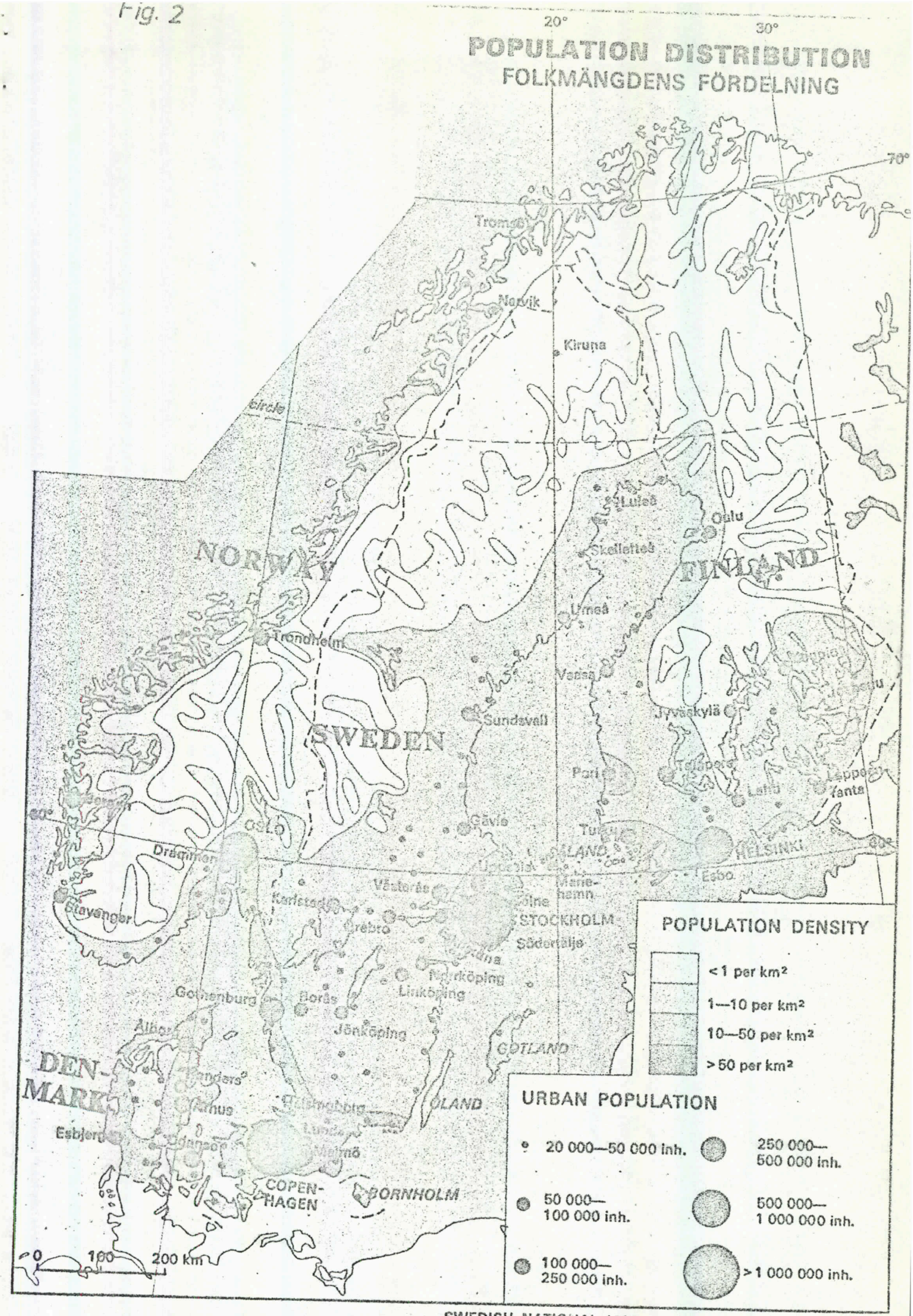
There is an optimistic look upon the environmental problems and the possibilities to solve them. This may to some extent be depending on the sparse population and richness in water in most Scandinavia.

Fig 1



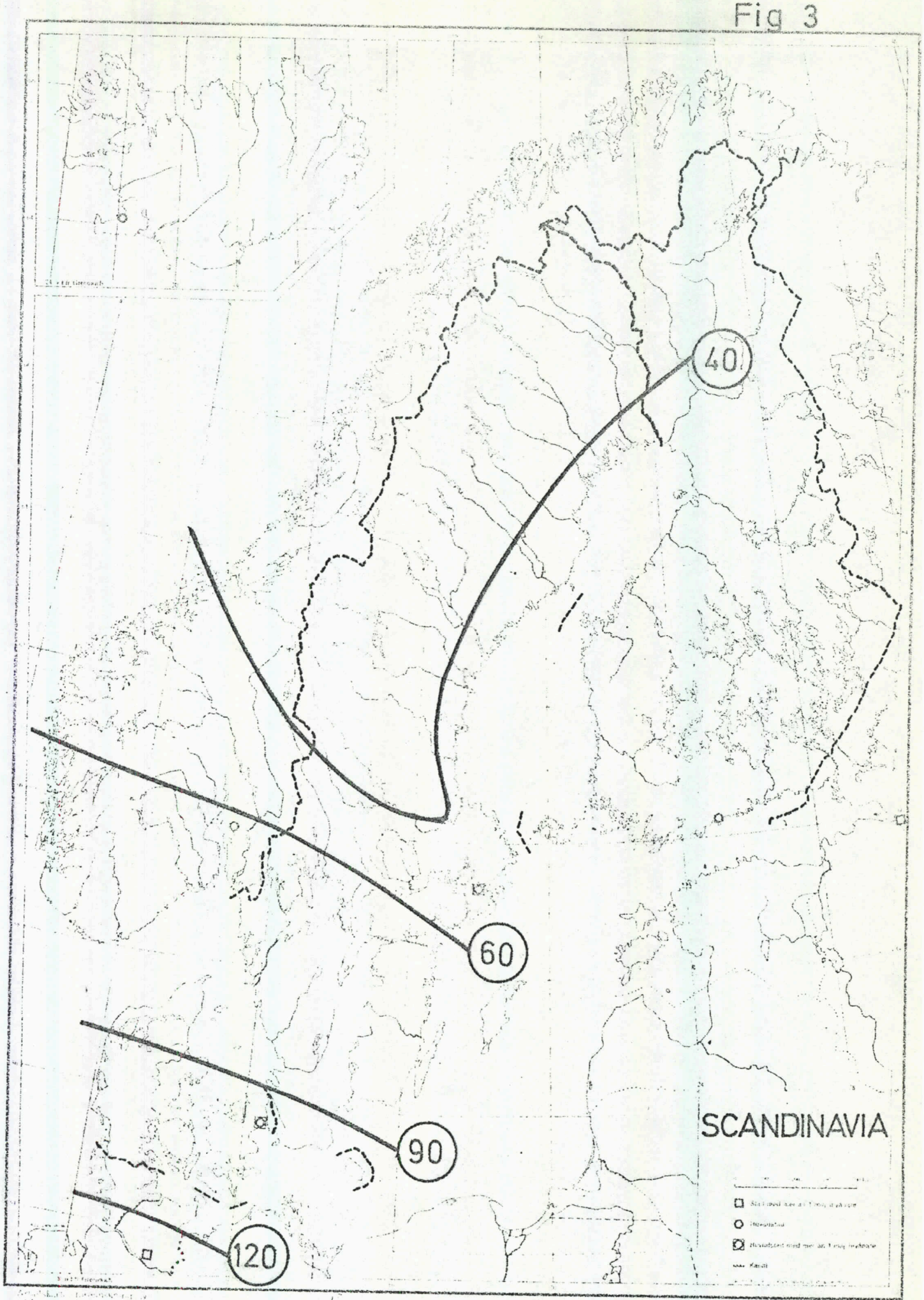
Sea water — Brackish water

Fig. 2



SWEDISH NATIONAL MAP AND PRINTING ORGANIZATION
SRA Stockholm 1970

Fig 3



ppm Sulphar/km^2

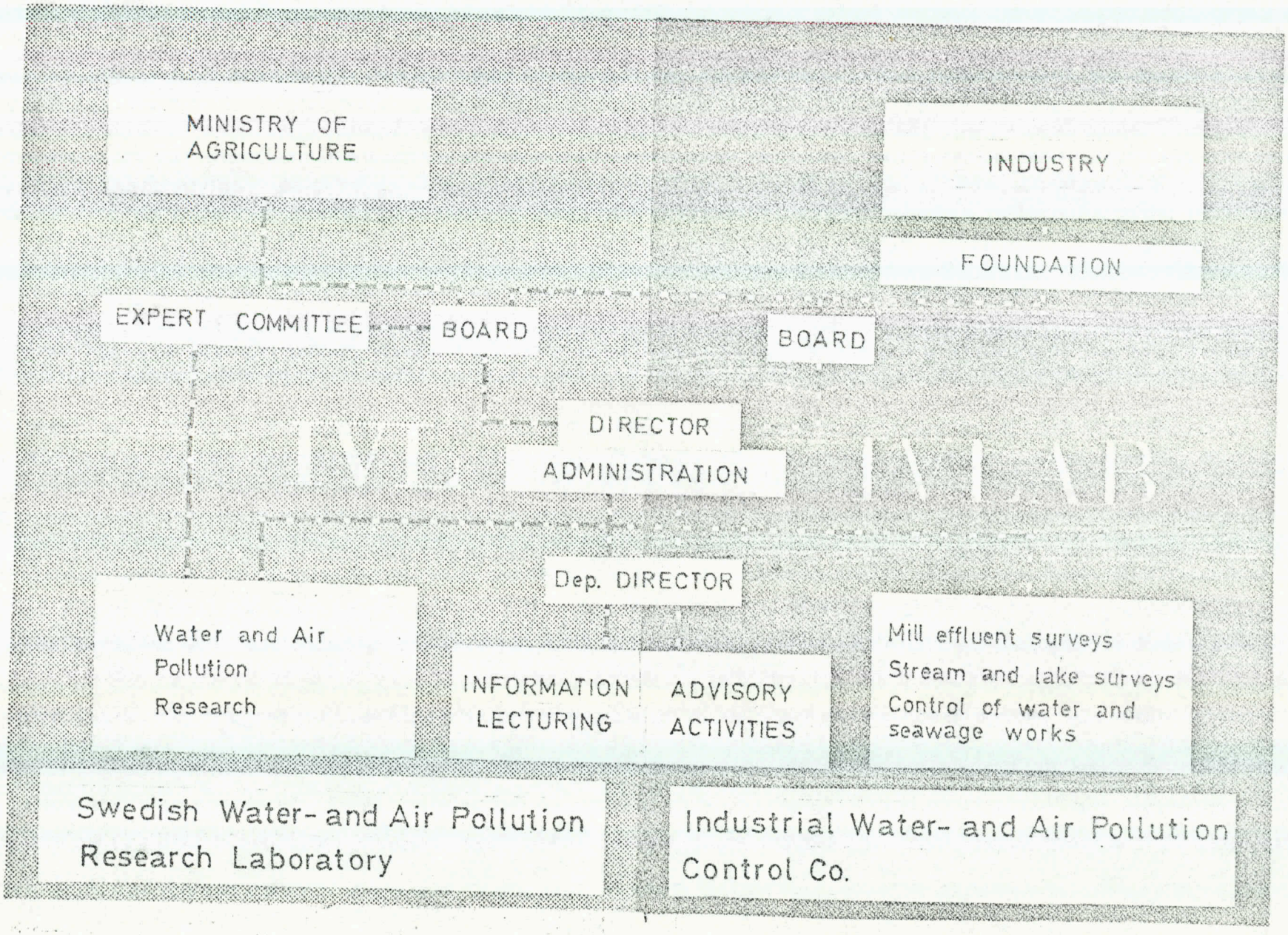
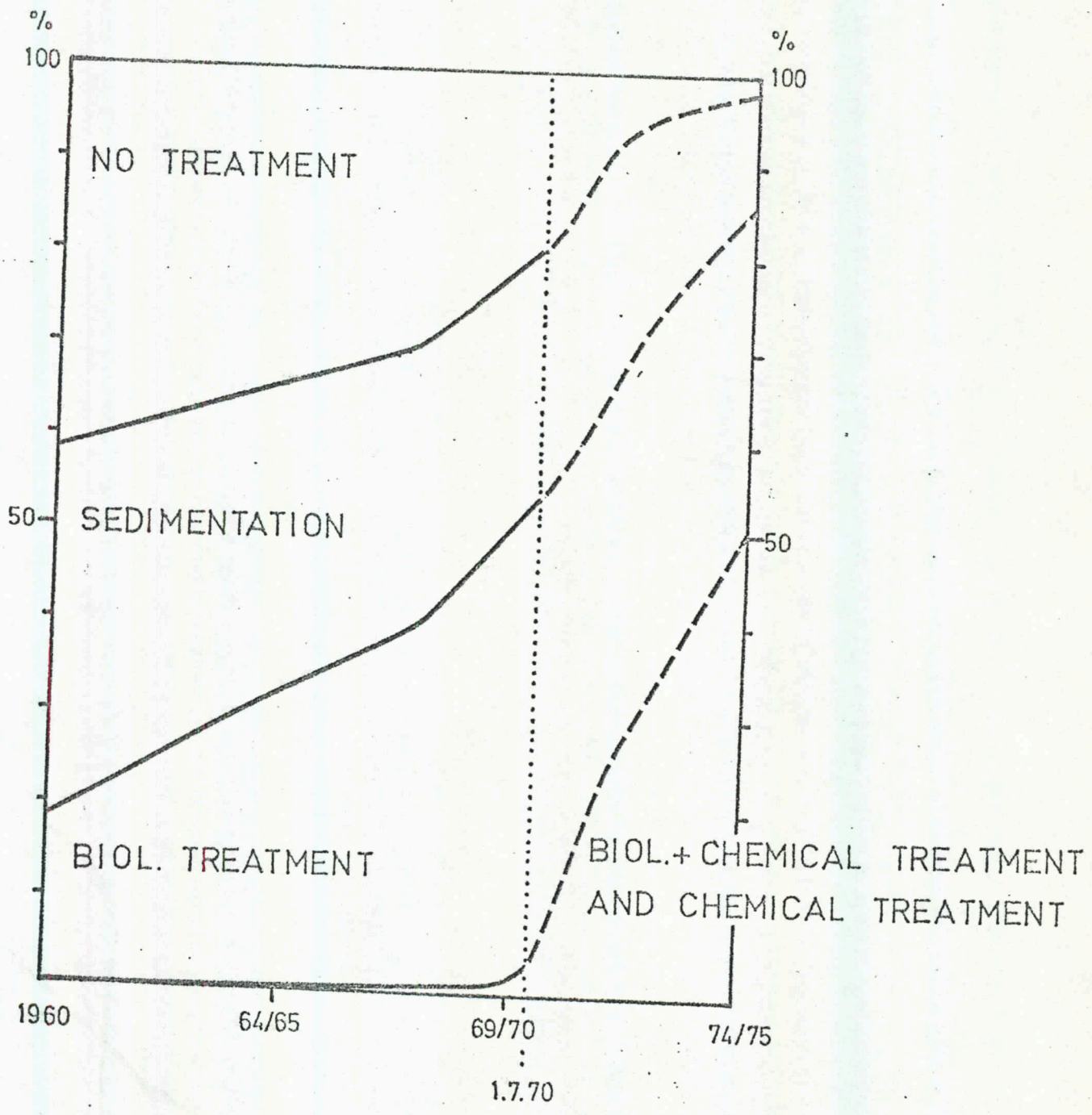

MINISTRY OF AGRICULTURE
INDUSTRY
FOUNDATION
EXPERT COMMITTEE
BOARD
BOARD
DIRECTOR
ADMINISTRATION
IVL
IVLAB
Dep. DIRECTOR
Water and Air Pollution Research
INFORMATION LECTURING
ADVISORY ACTIVITIES
Mill effluent surveys
Stream and lake surveys
Control of water and seawage works
Swedish Water- and Air Pollution Research Laboratory
Industrial Water- and Air Pollution Control Co.

FIG 4

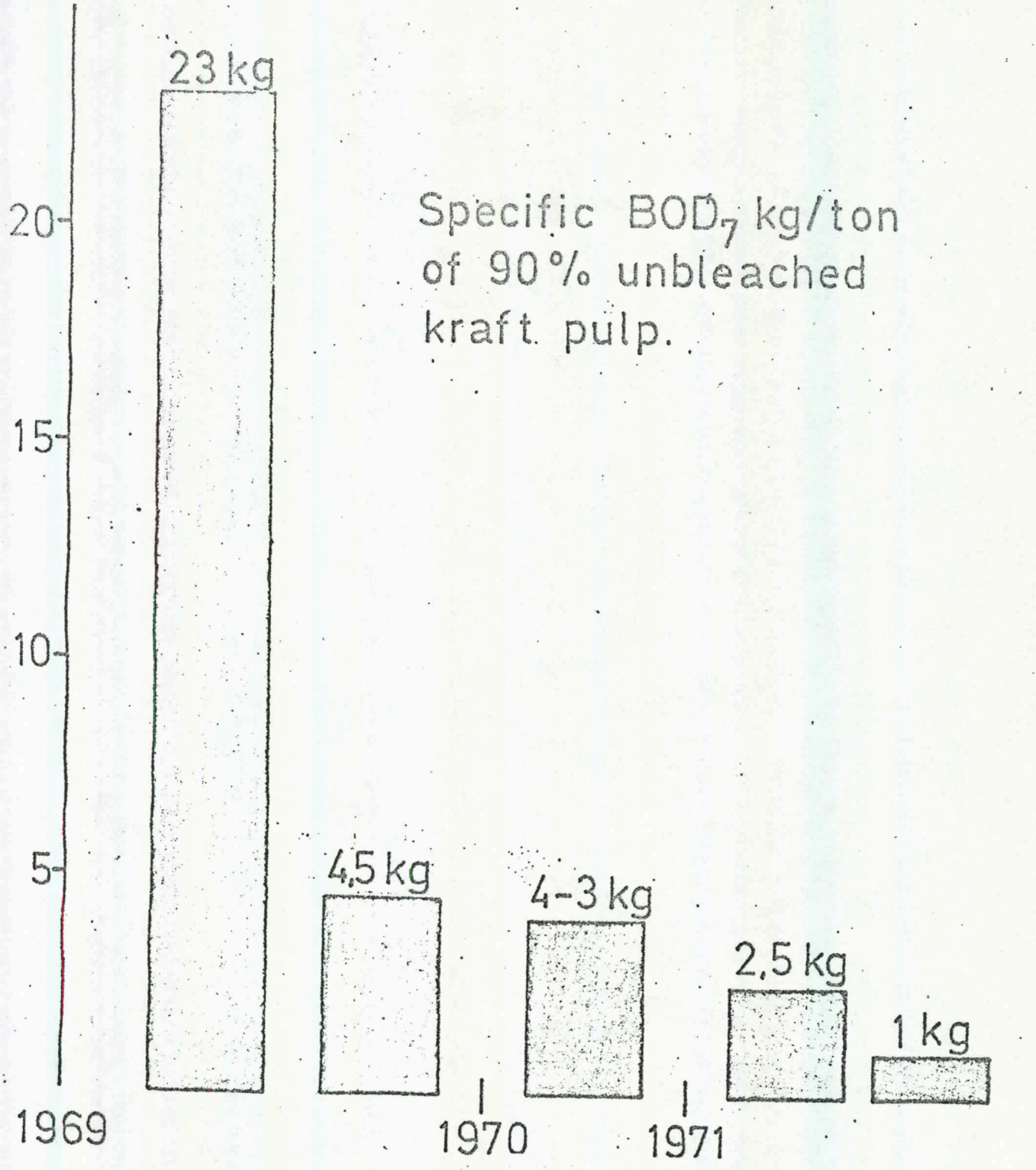
Fig 5

SEWAGE TREATMENT IN SWEDEN 1960 - 1975
PERCENT OF POPULATION IN URBAN AREAS



THE NATIONAL SWEDISH
ENVIRONMENT PROTECTION BOARD

Fig 6


Specific BOD_7 kg/ton of 90% unbleached kraft pulp.
20
15
10
5
23 kg
4,5 kg
4-3 kg
2,5 kg
1 kg
1969
1970
1971
Modern kraft pulp mill in official report 1969
Permission in water-court for Vaggeryd kraft pulp
Measured at Vaggeryd 1970
New plant Estemated discharge when the normally production is irregular

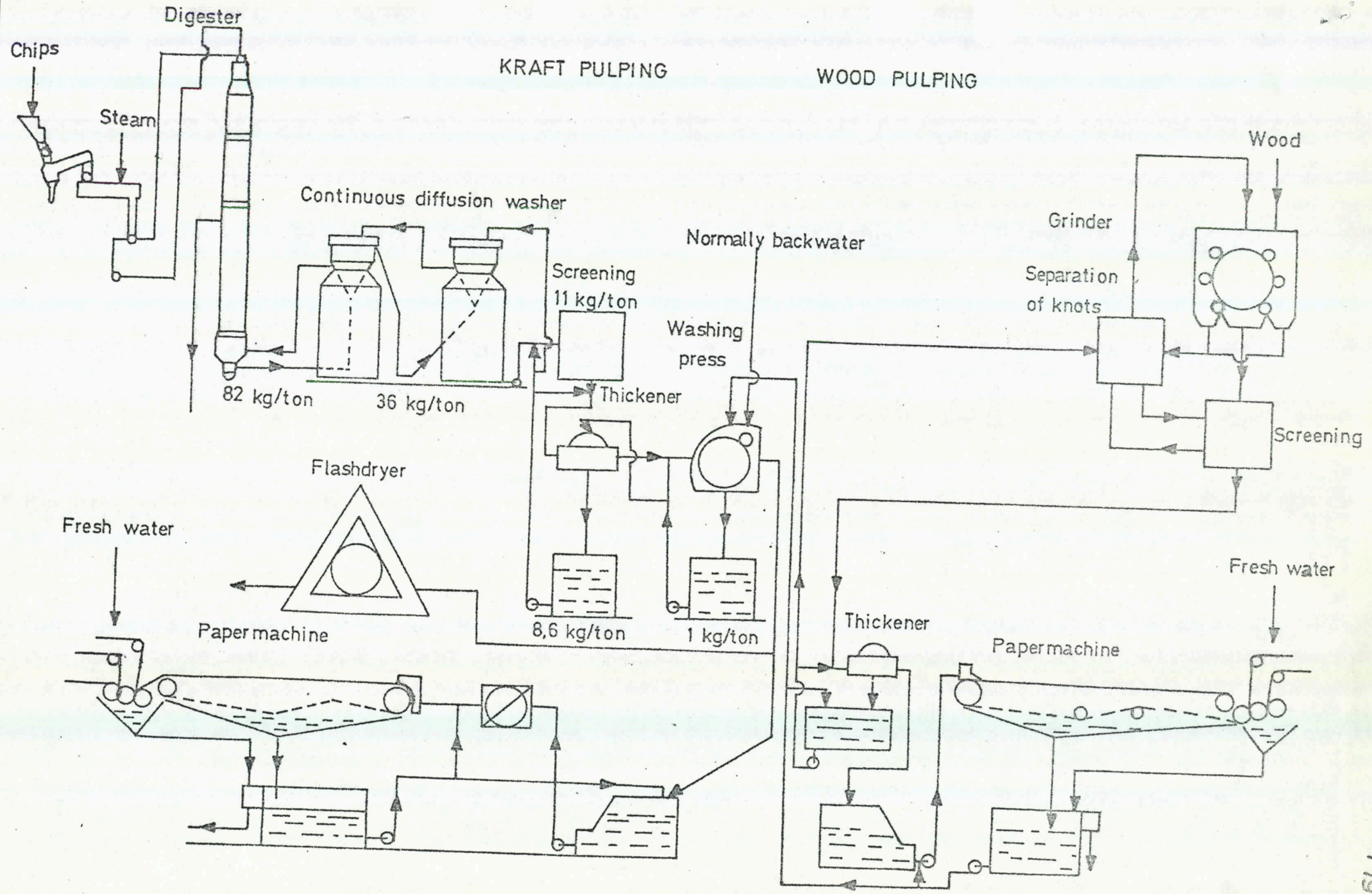

KRAFT PULPING
WOOD PULPING
Digester
Chips
Steam
Continuous diffusion washer
82 kg/ton
36 kg/ton
Screening
11 kg/ton
Normally backwater
Washing
press
Thickener
Flashdryer
Fresh water
Papermachine
8,6 kg/ton
1 kg/ton
Wood
Grinder
Separation
of knots
Screening
Fresh water
Thickener
Papermachine

Fig. 7