IUCN PUBLICATION NEW SERIES Supplementary Paper No.30

LANDSCAPE PLANNING

Papers presented
at the

INTERNATIONAL SYMPOSIUM
ON THE RELATIONSHIP BETWEEN ENGINEERING AND BIOLOGY
IN IMPROVING CULTURAL LANDSCAPE

held in
Brno, Czechoslovakia, 9—12 June, 1970

Published with the assistance of the

BRNO UNIVERSITY OF AGRICULTURE, BRNO, CZECHOSLOVAKIA

International Union
for Conservation of Nature and Natural Resources
Morges, Switzerland
1971

IUCN PUBLICATION NEW SERIES Supplementary Paper No.30

LANDSCAPE PLANNING

Papers presented
at the

INTERNATIONAL SYMPOSIUM
ON THE RELATIONSHIP BETWEEN ENGINEERING AND BIOLOGY
IN IMPROVING CULTURAL LANDSCAPE

held in
Brno, Czechoslovakia, 9—12 June, 1970

Published with the assistance of the

BRNO UNIVERSITY OF AGRICULTURE, BRNO, CZECHOSLOVAKIA

International Union
for Conservation of Nature and Natural Resources
Morges, Switzerland
1971

International Symposium of the Brno University of Agriculture
"The Relationship between Engineering and Biology in Improving Cultural Landscape"

Publisher: Brno University of Agriculture, Brno, Czechoslovakia
Editor-in-chief: Professor Dr Josef Žák
Executive editor: Professor Dr Vlastimil Vanícek
Editor, IUCN technical publications: Sir Hugh F.I. Elliott

Date of printing: 1971
Total number of copies: 1200 (for IUCN 1000)

The International Union for Conservation of Nature and Natural Resources (IUCN) was founded in 1948 and has its headquerters in Morges, Switzerland; it. is an independent international body whose membership comprisea states, irrespective of their political and social systems, government departments and private institutions as well as international organizations. It represents those who are concerned at man's modification of the natural environment through the rapidity of urban and industrial development and the excessive exploitation of the earth's natural resources, upon which rest the foundations of his survival. IUCN's main purpose is to promote or support action which will ensure the perpetuation of wild nature and natural resources on s world-wide basis, not only for their intrinsic cultural or scientific values but. also for the long-term economic and social welfare of mankind.

This objective can be achieved through active conservation programmes for the wise use of natural resources in areas where the flora and fauna are of particular importance and where the landscape is especially beautiful or striking, or of historical, cultural or scientific significance. IUCN believes that its aima can De achieved most effectively by international effort in co-opei-etjon with other international agencies such as UNESCO and FAO.

The World wildlife Fund (WWF) is an international charitable foundation for saving the world's wildlife and wild places. It was established in 1961 under Swiss law and has headquarters near those of the International Union for Conservation of Nature *and Natural* Resources (IUCN). Its aim is to support the conservationof nature in all its *forms* (landscapa, soil, water, flora and fauna) by raising funds and allocating them to projects, by publicity and by education of the general public and young people *in* particular. *For* all these activities it takes scientific and technical advice from IUCN.

Although WWF may occasionally conduct its own field operations, it tries as much as possible to work through competent specialists or local organizations.

Among WWF projects financial support for IUCN and for the International Council for Bird Preservation (ICBP) have highest priority, in order to enable these bodies to build up the vital scientific end technical basis for world conservation and specific projects. Other projects cover a very wide range, from education, ecological studies and surveys to the establishment and management of areas as national parks and reserves and emergency programmes for the safeguarding of animal and plant species threatened with extinction.

WWF's fund-raising and publicity activities are mainly carried out by National Appeals in a number of countries, and its international governing body is made up of prominent personalities in many fields.

THE BRNO UNIVERSITY OF AGRICULTURE, CZECHOSLOVAKIA

SYMPOSIUM

THE RELATIONSHIP BETWEEN ENGINEERING AND BIOLOGY IN IMPROVING CULTURAL LANDCSAPE

The Conference was organized in cooperation with
The Czechoslovak Agricultural Academy
and
The Czech Scientific and Engineering Society

at the Castle of Židlochovice near BRNO,
from 8 to 12 June 1970

on the occasion of the 1970 annual meeting of the
IUCN's LANDSCAPE PLANNING COMMISSION

Report published with the assistance of the
BRNO UNIVERSITY OF AGRICULTURE, BRNO, CZECHOSLOVAKIA
for the

INTERNATIONAL UNION
for Conservation of Nature and Natural Resources
Morges, Switzerland, 1971

C o n t e n t s

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

THE LANDSCAPE PLANNING COMMISSION OF IUCN

Definition of Landscape Planning

Landscape planning is a continuing process that strives to make the best use for mankind od the limited area of the earth's surface while conserving its productivity and beauty.

Its aim is to reconcile the needs of competing land uses and to incorporate them into a landscape in which man's civilizations can prosper without destroying the natural and cultural resources on which societies are founded.

Based on an understanding of the nature and potential of landscape, it endeavours to conserve and create the widest diversity, which implies a landscape capable of multiple use; in a way, it is creative conservation, since it may involve deliberate modification of existing landscapes.

The basis of landscape planning is survey and analysis. They are as important a component of basic planning as the more widely recognized methods used in economic and social development. Data on the physical features of the land are recorded and their interaction or interdependence are assessed. Various specialists concerned with climate, water resources, geology and soils, topography, the living content of the landscape, scenic qualities and visual landscape characteristics, features of special scientific or cultural significance, as well as the effect on all these of human interventions, are involved in this compilation. Survey and analysis should always precede the design process.

This approach is essential if development, management and maintenance of a landscape are to be guided to create a healthy environment and viable landscapes in which the long-term interests of mankind always prevail and in which a choice of further development is left for future generations.

Purpose and Scope of the Landscape Planning Commission

Purpose and objective

Within the framework of IUCN's main objectives, and in cooperation with its other Commissions, the Union's policy and action programmes in the fields of landscape planning and management are guided by the Landscape Planning Commission.

The aim of the Landscape Planning Commission is to promote, and maintain an optimum relationship between the landscape as a resource and the human activities planned therein, in order to achieve the best possible long-term social and economic benefits for man, as well an ecologically balanced, diversified landscape as a healthy environment for man and other forms of life.

Scope

The Landscape Planning Commission participates in the following programmes of IUCN through projects undertaken by the Secretariat, often in cooperation with other IUCN Commissions, as well as other organizations, both govermental or private:

1. Research - conducting scientific studies on particular problems related to the planning, use and assessment of the landscape and its resources, to establish guiding principles and the scientific background on which action programmes can be based.

2. Information - gathering, assessing and disseminating information related to the principles and practice of planned land use on an ecological and rational basis, including development, management, reclamation and maitenance.

3. Monitoring - bringing to the attention of the proper agency or authority any situation where the lack of proper land planning and/or management is leading to the deterioration or destruction of the quality of the resource and/or endangering human life and welfare.

4. Education - developing and assisting the establishment of public and professional educational programmes that will ensure the training of experts in this field and result in a better understanding of the purpose and scope of the Commission.

5. Promotion - promoting and actively supporting, in cooperation with other organizations -

   a) The integration of landscape planning on an ecological basis in development programmes.

   b) The systematic survey of landscape as a prerequisite to planning future land use.

   c) Government and private structures and services for the protection, rehabilitation and improvement of rural landscape.

   d) National and international budget policies for improvement of the countryside.

   e) Laws for the protection and improvement of the landscape.

6. Assistance - advising and offering technical assistance to any national or international group or organization which requests such advice and assistance; priority will be accorded to situations where the landscape or human welfare are likely to be endangered or need to be restored.

Organization

The Commission consists of a Chairman, a Vice-Chairman, a full-time Secretary, who acts as the Executive Officer of the Commission, and as many Members as the Chairman may see fit to appoint, with the approval of the Executive Board of IUCN. Membership is selected on the basis of experience, professional qualifications and geographical location.

Meetings of the Commission take place at least once a year, when topics of special concern to the Commission within the programme of IUCN are considered in detail. Local conservationists and scientists are invited to attend symposia and seminars of the Commission, to enable the Commission to have the benefit of local experience in planning courses of action in the region concerned.

The Commission will establish specialist advisory/action groups to facilitate the implementation of the IUCN programme. Specialist Groups are relatively permanent bodies whose Chairmen become ex-officio members of the Commission. Their main function is to furnish the Commission with specialized data and to act in an advisory capacity. All Groups will have precise terms of reference. Specialist Groups may be responsible for reclamation,watershed development, etc., as may be considered appropriate; their main purpose is to harness enthusiasm and to coordinate research and conservation effort. It is hoped to arrange for meetings of Group Chairmen at two yearly intervals.

Much of the Commission's work is, of necessity, done by correspondence and all Members of the Commission and its Groups are required to deal with inquiries as quickly as possible.

IUCN's

LANDSCAPE PLANNING COMMISSION

M e m b e r s h i p

Chairman:	Mr R.J. B e n t h e m, Netherlands.
Vice-chairman:	Mr Dewar W. G o o d e, Australia.
Members:	Mr E.N. A k a h, Nigeria.
	Mr G.L. A n a g n o s t o p o u l o s, Greece.
	Herrn Egon B a r n a r d, Fed.Rep.of Germany.
	Mr P.B. B h a g w a t, India.

Members LPC (Cont.)	Professor Lynton K. C a l d w e l l, U.S.A.
	Mr Fernando M. C h a c e l, Brazil.
	Mr S. C h a l l e n g e r, New Zealand.
	Miss Sylvia C r o w e, CBE., PPILA., England.
	Professor Arturo E i c h l e r, Venezuela.
	Professor Brian H a c k e t t, U.K.
	Professor W. Douglas H a r p e r, Canada.
	Professor Charles W. H a r r i s, U.S.A.
	Monsieur Théo H u n z i k e r, Switzerland.
	Herm Gert K r a g h, Fed.Rep. of Germany.
	Professor Chung-Myun L e e, Republic of Korea.
	Mrs Joyce Earley L y n d o n, U.S.A.
	Professor Ian L. Mc H a r g, U.S.A.
	Dr L.V. M o t o r i n a, USSR.
	Herm Prof.Dr. G. O l s c h o w y, Fed.Rep. of Germany.
	Mr Soo Hai T a n, PJK., Malaysia.
	Professor Vlastimil V a n í c e k, Czechoslovakia.
	Mr C.J. V y l e, U.K.
Executive Officer:	Mr A.H. H o f f m a n n, Switzerland.

P R E F A C E

On the occasion of the 1970 annual meeting of the IUCN Landscape Planning Commission, which was held on 8th June at Castle Židlochovice near Brno, in Czechoslovakia, the Brno University of Agriculture organized a Symposium entitled "The Relationship between Engineering and Biology in improving cultural Landscape". This Symposium, which was attended by experts, scientists and practical men in the field of landscape planning, was held on 8 - 12 June 1970 also at Židlochovice Castle, in co-operation with the Czechoslovak Agricultural Academy and the Czech Scientific and Engineering Society.

The Symposium was chaired by Mr R.J.Benthem, Chairman of IUCN's Landscape Planning Commission. It was attended by 80 experts from the following countries: Australia, Canada, Czechoslovakia, Netherlands, Poland, Switzerland, the UK, USA and Venezuela. On the three subsequent days participants of the Symposium took part in excursions to South Moravia, the Moravian Karst and the Bohemo-Moravian Upland, where objects of interest in Czechoslovakia in regard to conservation of nature, land use and landscape improvement, engineering landscaping, historical and archaeological monuments were shown. The following institutions co-operated in organizing the excursions: the South-Moravian Regional National Committee, Brno; the District National Committee, Breclav; the Morava River Watershed Management, Brno; the Brno Hydroproject; the National Land Reclamation and Improvement Management, Brno Regional Branch; and the State Forests Service, Brno.

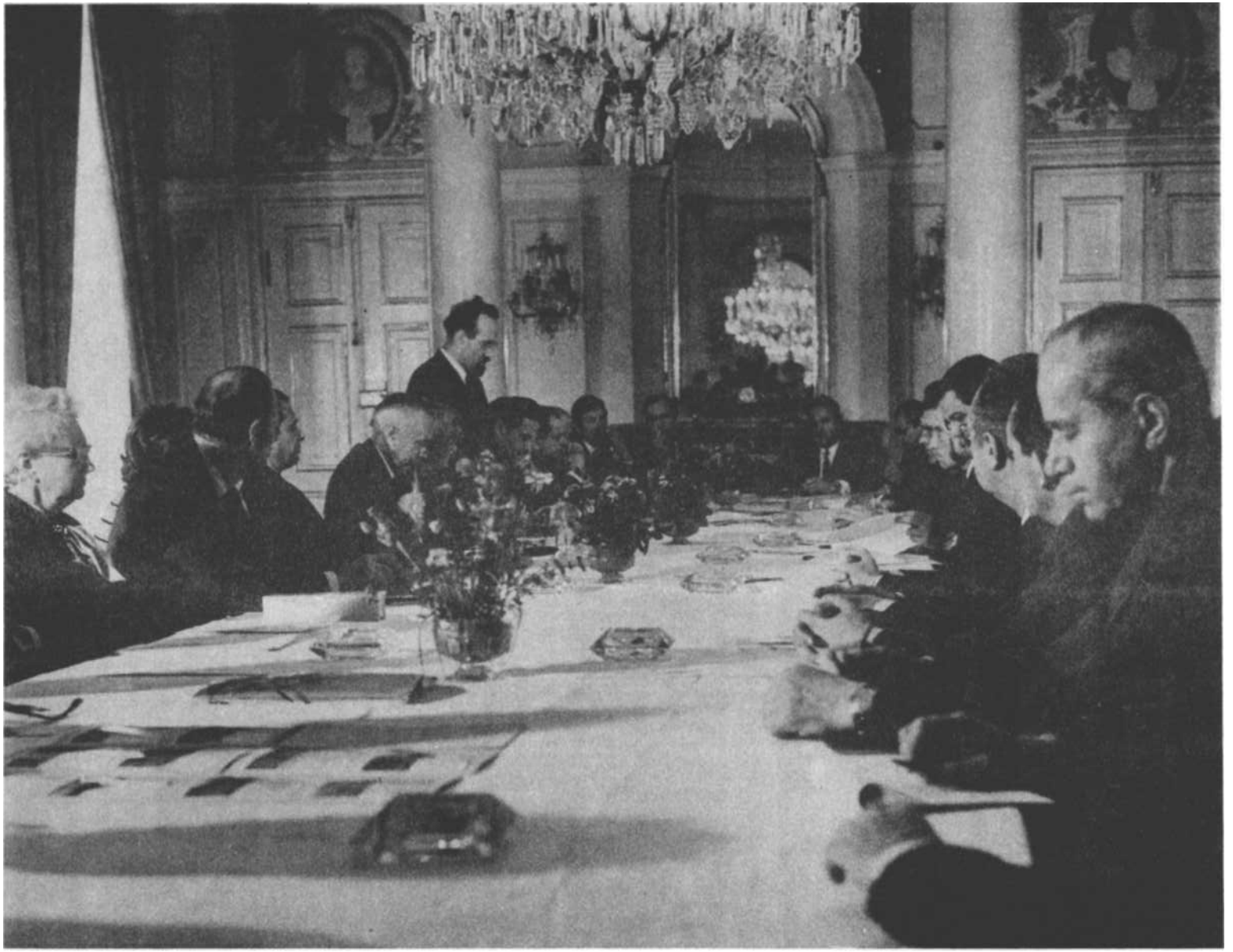
On the occasion of the LPC meeting and the Symposium, a special brochure named "Complex Landscaping in South Moravia" was published by the Government Commission for Coordination of Water Condition Treatments for the region of South Moravia.

A total of nine papers were presented at the Symposium; they are published here in full.

The problems dealt with in the papers and in the discussions which followed revealed that Man, in his efforts to use the landscape and its natural resources, had not always taken the right approach to ensure its continued fertility and beauty. The reason for this is that the advance in technology and engineering has exceeded his knowledge of ecology as well as his material possibilities. This in turn has resulted in damaging his natural environment, the biosphere. It is urgent for Man to realize that he is part of Nature; therefore, he must relate all development to the total landscape and take full responsibility for its actions. All engineering works within the natural environment ought therefore to be guided by the various kinds of specialist in land use planning and in its effects both from the scientific and practical aspects which includes taking due account of the conservation of Nature and natural resources. Only a well balanced landscape constitutes a healthy human environment.

Brno, 1971.

V.Vaníček
Preparatory Committee of the Symposium, Chairman.



Showing participants of the Conference in session, ŽIDLOCHOVICE CASTLE. /Photo by F. Wohlgemuth/

INTRODUCTORY ADDRESS TO THE SYMPOSIUM

R.J.BENTHEM
Chairman of IUCN's Landscape Planning Commission

Management of environment is becoming a problem of global importance and a topic of governmental policy in many different parts of the world. The comprehensive task of promoting a wise use of the world's natural resources cannot however be solved by national initiatives alone. It is evident that effective control of water pollution in the great rivers and the sea can only be achieved by international cooperation. Thus the protection of migratory birds can only be successful if there is international agreement and a coordinated system of adequate legislation.

The preservation and management of several big European recreation areas is no longer a matter of importance solely for the respective national populations. Modern transport and the exchange of tourists from one country to another has led to a mutual interest of all Europeans in the upkeep of European Open Space. People of West and Central Europe are using the Mediterranean coastal districts in ever increasing numbers. Inhabitants of the Ruhr area are visiting the Dutch beaches, even for week-ends, in the summer season. Dwellers in the big cities of England, Holland, Germany and France come to Swiss mountains and are interested in the careful protection of the shores of the mountain lakes of Central Europe, which they use as a recreational, scenic playground. National parks in the Tatra are of an importance which goes far beyond the national boundaries of Czechoslovakia and Poland.

Engineers are changing the face of the land to adapt this old planet to the requirements of a new technical and mobilized society. They open up unforseen possibilities for the material well-being of mankind. But at the same time the urban-industrial impact on our rural environment often ends in the loss or irreplaceable natural and cultural elements which are essential for human life and happiness.

Biologists and landscape planners, together with foresters, physical planners and other experts, are meeting here, in these beautiful surroundings of the old castle of Židlochovice, to discuss for the duration of this symposium, some aspects of biology and angineering. The members of IUCN's Landscape Planning Commission highly appreciate the invitation of the Agricultural University of Brno to join in this meeting. In the name of its members I should like to express our gratitude in particular to our Czechoslovakian representative on the L.P.C. and good friend, Professor Vlastimil Vaníček.

Moreover we feel specially privileged that the Union's Director General, Dr Gerardo Budowski, has done us the honour of attending the opening session of the Symposium.

The fact that several of the Commission's members, gathered here, came from very different parts of the globe may be seen as striking evidence of the international character of environmental problems. Just like the birds which are frequently crossing geographical boundaries and the seeds of trees and other plants whose dispersal does do not stop at political frontiers, our common concern with the future of nature throws us together. Let us use our short and precious time to take our work a good step forward.

SYMPOSIUM ON THE RELATIONSHIP BETWEEN ENGINEERING
AND BIOLOGY IN IMPROVING CULTURAL LANDSCAPE

B r n o , C z e c h o s l o v a k i a , 9 J u n e 1970

COASTAL ENGINEERING AND LANDSCAPE PLANNING IN THE NETHERLANDS DELTA PROJECT

by

Roelof J.Benthem, Chief, Landscape Planning Department,
Netherlands State Forest Service, Prof. Reinwardtlaan 23, Utrecht, Netherlands.

Not many countries in the world show a closer relationship between land and water than Holland. In fact, there have been no stable boundaries along large sections of the Dutch coast in the course of centuries. By comparing the maps of the coastal districts in successive eras, the never ending battle between man and water is clearly demonstrated in the changing picture of the country's natural boundaries. The Frisian Islands and the Wadden Sea in the north, the central basin of the former Zuiderzee and the archipelago of Zeeland and Zuid-Holland in the southwestern region, have taken on various outlines in the many stages of their development over the long history of the Low Lands.

Man and Nature, ally and enemy, alternately fighting and co-operating, are the forces responsible for the changing appearance of this country. Again and again they tried to find a compromise and settled the boundaries for a shorter or longer period. The sea took the land away in heavy storms, but created it in more quiet times in the form of dunes, marshes and saltings. And man lived on this unstable ground, which he enlarged at one time and lost at another. He came to prosperity on those fertile clay soils, but he also paid a toll in the bad days of flood disasters, just as the people do who inhabit the fruitful slopes of volcanoes in other parts of the world.

Man s living space in these strange surroundings was not restricted to the land. He also found a living on the sea by fishing and trading. And even in the intermediate areas between land and water, on the saltings and the mudflats and on the tidal streams, he skilfully explored the natural resources, harvesting several kinds of molluscs and halophile vegetation, like Salicornia, Obione, Statice and Aster tripolium.

A very peculiar culture evolved in these regions: beautiful cities, flourishing harbours, carefully tended landscapes with sheltered fields and richly-stocked meadows, estates and farms surrounded by trees and an abundance of shrubs and flowers in well-kept gardens. For the upkeep of this society a comprehensive system of dykes, canals and windmills was established to keep the water out, day after day, year after year.

The old saying that "God made the world with the exception of Holland which was created by the Dutch" still sounds up to date. It is possibly even more true in these days than it was ever before. The mere fact of the reclamation of the greater part of the old Zuiderzee means, after completion, an enlargement of the land by about 224,600 hectares (555,000 acres) in the very heart of the country.

x X x

Seventen years ago, a new stage began in the traditional battle against the sea. That was in the dreary days of February 1953, when terrible floods broke the dykes in several places, and large stretches of land, particularly in the southwest region, were inundated, causing many casualties and heavy damage to the land.

The effects of this disaster challenged the old fighting spirit in the Dutch people when it comes to defending their soil from the water. In a new act, the Delta Act of 1958, a comprehensive strategy was planned to promote security by executing a system of huge barrier-dams in the mouth of the different estuaries in the southwestern area. An extra advantage of the plan would be a very considerable shortening of the coastline which had to be defended,,

Thanks to modern engineering, this Delta Plan could be designed and brought to the stage of execution. The use of transportable large concrete caissons, first practised in the artifical harbours at the Normandy coast on D-day, opened up new possibilities for dyke-building in deep tidal waters. Gradually, this Delta Plan is being carried out. Some of the dams are already completed, others are in preparation.

Apart from the main purpose, the protection of the land from the sea, a number of other aims are being striven for in this enormous undertaking.

Over the dams a complete new system of higways will be constructed, connecting the big towns in the conurbation of Holland, like The Hague and Rotterdam, with the recreation areas in the Delta. For hundreds of thousands of people, this formerly isolated archipelago will come within easy reach and the whole accessibility of the area will be greatly improved by the new road pattern.

From the point of view of water control and water supply, a completely new situation will arise after the realization of the Delta Plan roundabout 1980. Large freshwater basins will come into being when the sea is cut off by the dams, and the rivers will gradually replace the salwater by freshwater. Even for a country which has always had an abundance of water this will be welcomed. The growing population and rapidly developing industry need ever increasing quantities of water for several purposes.

Recreation, already mentioned, will have new possibilities along the tamed waters of the former estuaries as well as in the coastal areas. The new infrastructure of the region, the roads and waterways and the numerous facilities, which are already coming into being or are planned for the future, will surely promote a multiple use of the Delta. Undoubtedly, it also will have important effects in the economic and social spheres.

The creation of a new landscape is an integral part of the broadly based teamwork for the Delta. Being of fundamental importance, landscape planning is, already from the very beginning, one of the main topics of deliberation. Planning policy with respect to landscape is directed to the protection of valuable existing elements as well as to a great many creative measures.

Some of the sandbanks in the former tidal streams are, after dam construction, transformed into permanent islands with partly protected shores. Instead of being a habitat for seals as in former days, these islands will serve new aims. Some of them will be set aside for recreation purposes. They will be partly planted and provided with facilities like yacht havens and camp sites. Others will be managed as nature reserves and protected as refuges for migratory as well as breeding birds. Especially as winter haunts for geese, these islands in the Delta lakes will prove to be of great importance for the preservation of certain species.

Along the new shores of the lakes, extensive woods will be planted for recreation, shelter and amenity purposes. For the promotion of recreational use as well as for bird life, the establishment of gently sloped beaches and lagoons are being considered. New possibilities will be opened up for water-sports when the rough waters of today have been tamed by the barriers. Artificially-made new islands will possibly provide additional facilities to enhance the recreational use of the new lakes.

New settlements of various kinds are being planned to meet the great demand for overnight facilities. Landscape planners try to fit the varying pattern of land use into a comprehensive whole. Along the new freshwater shores of the lakes, their efforts are being directed to the creation of a landscape of great recreational value which also will prove to be a suitable habitat for flora and fauna.

The latter is necessary for there are surely losses to mention. The rare and interesting biotopes of the salt and brackish waters will nearly completely disappear. The specific natural processes in these long estuaries where the North Sea tides wash the islands and peninsulas up to 30 miles inland, will be stopped as soon as the last barrier has been completed. The halophile vegetation, the specialized flora and fauna of the saltings and the marshes, the marine fauna of the tidal streams, including the famous ostreiculture which is the northernmost of the European continent, they all will be lost.

The conservation measures, described above, cannot be looked upon as a compensation for these losses in natural wealth, for the habitats concerned are unique and really irreplaceable. Nevertheless, such measures must be takan to ensure a new balanced whole, although it may be different from the former situation. The present-day approach in land and water use development requires a careful, creative attention to the natural framework of man's environment, whatever the kind of project may be.

x X x

An interesting phenomenon can be expected, and partly already be observed, after the completion of the successive dams along the seashores. The tide run will have to follow a new direction, and the transport of sand and silt and the deposit of this material will influence the future coastline considerably.

The research done so far through coastal engineering makes it possible to predict to a certain degree the results of the natural processes. They will be reflected in a partly new, partly adjusted seashore, which will come into being after 1980, in the coastal area between Hook of Holland and Flushing.

Even now it is possible to see how a new sandy beach is evolving from the sea beyond the dam which has cut off the old town of Veere from the North Sea waves. More of similar developments can certainly be expected in the years to come. The much longer barrier-dams, which will close the mouth of the large and deep estuaries of the Oosterschelde, the Grevelingen and the Haringvliet will eventually also be screened on the seaside by new dune ranges, possibly interrupted by gullies and creeks with sandbanks and mudflats.

A new "natural" seashore originated by the forces of man but reshaped and adapted by nature will develop little by little - a seashore with probably high potentialities for flora and fauna as well as for different kinds of recreation. In the footsteps of the American conservationists, the concept of "national seashore" should be adopted for this Delta coast in order to ensure a proper management for this growing valuable asset of the Netherlands' landscape. It is to be hoped that a Governmental decision in this respect may be taken.

x X x

Detailed landscape plans for the different sections of the Delta area are in several stages of preparation and execution. The Landscape Planning Department of the Netherlands State Forest Service is in charge of the landscape design. Through the broad teamwork of civil engineers, physical planners and landscape architects, the various aspects of environmental planning are being considered and eventually co-ordinated.

The execution of the Delta Plan clearly indicates the position of landscape planning within the framework of present-day land and water use development. In the short history of postwar landscape work in Western Europe, it might serve as another example of a creative and multipurpose approach in the treatment of man's natural surroundings.

Conscious design of landscape can no longer be restricted to the urban zones, but needs to be extended to the rural areas and to the countryside as a whole.

In this Netherlands Delta Project, an effort is going to be made to create a new landscape, based on the impressive achievements of modern technology, to serve the requirements of a growing urban society, in harmony with the old aims of conservation. If this effort should prove to be successful, an extensive park area of a very special character will be added to the developing network of parks in this part of the world.

S u m m a r y

The author describes first the history of Netherlands coastal districts with its alternate conflict and co-operation between man and nature for ground and living space.

As a consequence of the flood disaster of 1953, the new Delta Act opened a chapter in this traditional struggle of the Dutch against the water. A comprehensive strategy came into being to promote better security by executing a system of huge barrier-dams in the mouths of the estuaries in the southwestern area.

The enormous works are being carried out as a multipurpose project. A new system of highways will greatly improve the accessibility of the region, as roads will be built over the dams. This opens up new possibilities for recreation and brings formerly rather isolated islands within easy reach of the big towns of Holland.

Another objective of the project is the creation of big freshwater reservoirs, since when the dams are completed saltwaters will be replaced by freshwater which, even in the Netherlands, is considered to be of great importance.

Landscape planning is an integral part of the Delta project, as is co-operation between the ecologists, landscape architects and foresters of the Netherlands State Forest Service and the civil engineers and physical planners of other State. and provincial authorities.

Landscape plans are being made to anticipate the future land use pattern. For example part of the former sandbanks, which will be transformed to permanent islands, will get the status of nature reserves, especially for the promotion of bird life. Other shorelands will be planted with forests in order to enhance environmental qualities and to further recreation possibilities. For the promotion of recreation, a great number of facilities will be created such as camping grounds, yachting havens, new beaches, bungalow areas, picnic sites, parking areas and so on.

But there are also losses to mention. Interesting ecosystems of the salt and brackish estuaries will greatly disappear after the dams have been constructed.

After completion of the dams, a new coastline will be formed by the natural tidal process of sand being carried and deposited along the coast. This will open up new possibilities for nature conservation. Dutch naturalists are advocating the establishment of a "national seashore" on the whole Delta coast.

The Delta project can certainly be considered as an example of careful and detailed design in the field of landscape planning.

R é s u m é

L'auteur esquisse d'abord l'histoire des régions côtières des Pays-Bas, les luttes et la collaboration successives de l'homme et de le nature pour la conquête du sol et de l'espace vital.

A la suite des terribles inondations de 1953, une nouvelle loi, la Loi du Delta, marqua un tournant dans l'histoire de ces luttes traditionnelles des Hollandais contre les eaux. Un plan d'action détaillé fut mis sur pied pour assurer une plus grande sécurité, par la création de vastes barrages à l'embouchure des différent estuaires de la région sud-ouest.

Ces gigantesques travaux on été conçus comme un projet à objectifs multiples. Un nouveau réseau de grand'routes doit considérablement améliorer l'accès de cette région, étant donné qu'elles seront construites sur les barrages. Ceci ouvre de nouvelles possibilités de récréation et met ces îles, auparavant assez isolées, à la portée des grandes villes de Hollande.

Un des autres objectifs de ce projet est la création de grands reservoirs d'eau douce. En effet, une fois les travaux terminés, l'eau salée sera remplacée par de l'eau douce, ce qui même dans les Pays-Bas présente une grande importance.

L'aménagement du paysage a été intégré à ce projet du Delta, auquel travaillent ensemble écologistes, architectes paysagistes, et forestiers du Service National des Forêts des Pays-Bas, et ingénieurs des Travaux Publics et planificateurs d'autres organismes nationaux et régionaux.

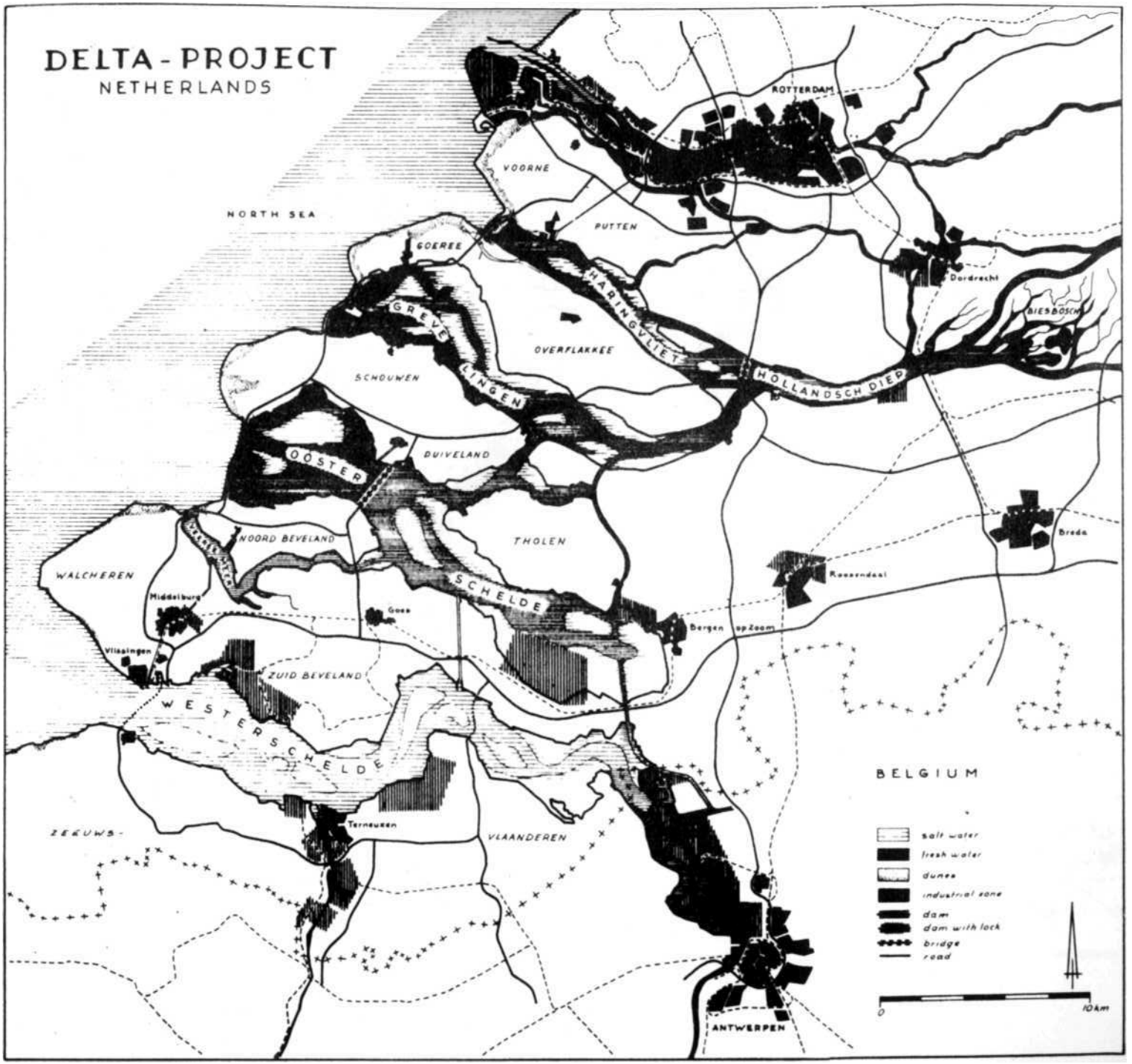
On a établi des plans d aménagement du paysage dans lesquels il est tenu compte du schéma d'utilisation futur des terres. Une partie des anciens bancs de sable qui seront transformés en îles permanentes auront le statut de réserve naturelles, en particulier pour y développer l'avifaune.

Certaines autres zones côtières seront afforestées afin de rehausser les qualités de l'environnement et d'étendre les possibilités de loisirs. Un grand nombre d'aménagements doivent assurer le développement des loisirs: terrains de camping, ports de plaisance, plages nouvelles, lotissements pour bungalows, terrains de pique-nique, zones de stationnement, etc.

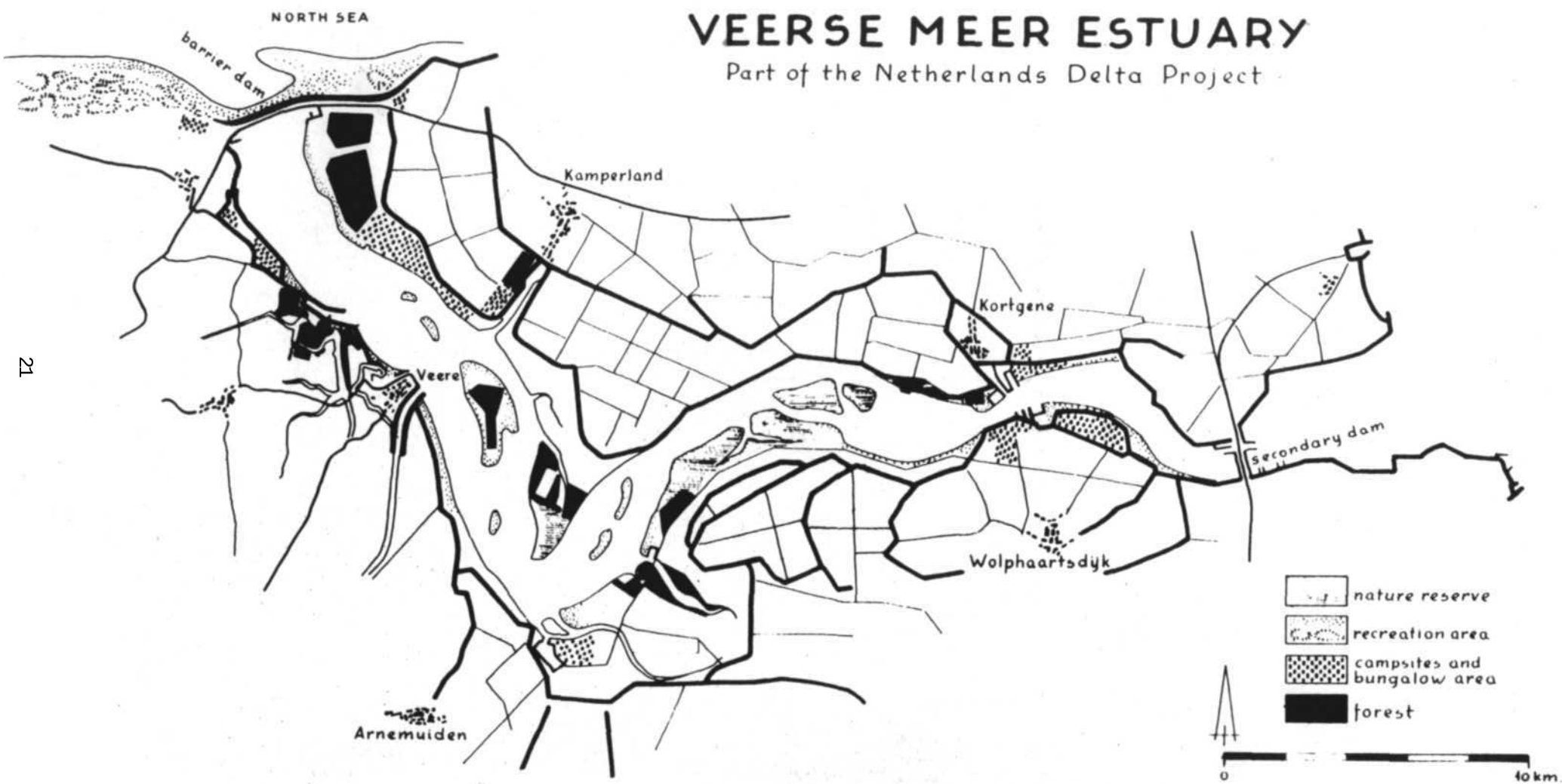
Mais il faut aussi mentionner certains aspects négatifs du projet, tels que les écosystèmes estuairians des eaux salées et saumâtres appelés en grande partie à disparaître après la construction des barrages.

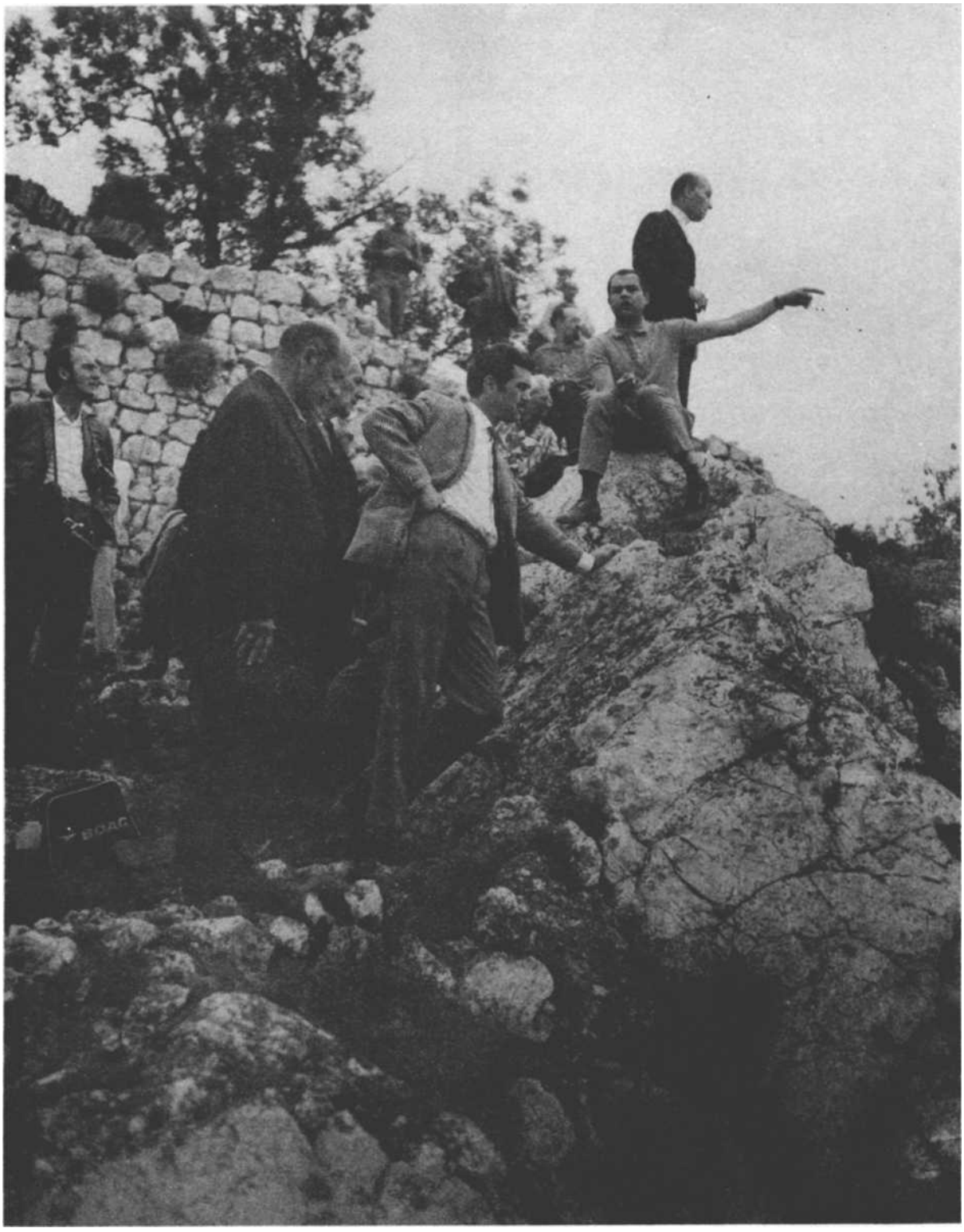
Une fois ces barrages achevés, il se formera une nouvelle ligne côtière sous l'effet du processus naturel de transport de sable le long du rivage. Ceci créera de nouvelles possibilités de conservation de la nature. Les naturalistes hollandais préconisent la création d'un "rivage national" sur toute la c3te du Delta.

Le Projet Delta peut certainement être considéré comme un exemple d'aménagement soigneux et détaillé du paysage.


DELTA - PROJECT
NETHERLANDS
NORTH SEA
ROTTERDAM
VOORNE
PUTTEN
GOEREE
HARINGVLIET
Dordrecht
BIESBOSCH
GREVE LINGEN
OVERFLAKKEE
SCHOUWEN
HOLLANDSCH DIEP
OOSTER
DUIVELAND
THOLEN
NOORD BEVELAND
WALCHEREN
SCHELDE
Middelburg
Goes
Vlissingen
Bergen op Zoom
Roosendaal
Breda
ZUID BEVELAND
WESTERSCHELDE
Terneuzen
ZEEUWS-
VLAANDEREN
ANTWERPEN
BELGIUM
salt water
fresh water
dunes
industrial zone
dam
dam with lock
bridge
road
0
10km


GREVELINGEN ESTUARY
Part of the Netherlands Delta Project
Stellendam
Ouddorp
Melissant
Dirksland
Nieuwe Tonge
NORTH SEA
barrier dam
secondary dam
drinking water supply basin
proposed highway
Brouwershaven
Scharendijke
nature reserve
recreation area
campsites and bungalow area
forest
0
10km


VEERSE MEER ESTUARY
Part of the Netherlands Delta Project
NORTH SEA
barrier dam
Kamperland
Kortgene
Veere
Secondary dam
Wolphaartsdijk
Arnemuiden
nature reserve
recreation area
campsites and bungalow area
forest
0
10km.



Part of the participants inspecting the 'PALAVA HILLS ' Nature Reserve.
/Photo by F. Wohlgemuth/

SYMPOSIUM ON THE RELATIONSHIP BETWEEN ENGINEERING
AND BIOLOGY IN IMPROVING CULTURAL LANDSCAPE

Brno, Czechoslovakia, 9 June 1970

THE ENGINEER AND THE HUMAN ENVIRONMENT

by

Lynton K. Caldwell, Department of Political Science,
213 Woodburn Hall, Indiana University,
Bloomington, Indiana 47401, USA.

A major change appears to be occurring in the role of the engineer in the modern world. New functions of engineering are emerging as consequences of the growth of science and technology. New fields of engineering study and practice have been established in the course of developlents in atomic energy, in exploration of outer space and the ocean depths , and in automation and computers. The sciences of biochemistry and biophysics sustain growing fields of bio-technology and bio-engineering. Increasingly, engineering is becoming involved in living processes. In partnership with medicine, it now acts to supplement human physiology - milieu intérieur - through artifical organs. And, its impact on man's milieu extérieur - the living and artificial environment of human society - is greater than ever before. But these developments, although dramatic and highly significant, may not represent the most important change that has occurred.

The change in the role of engineering that is most fundamental relates to the social responsibility of the engineer for the quality of human life. In the world of today the engineer cannot limit his responsibility to professional competence in executing the plans of others. His work increasingly intermeshes with that of other professionals, and he must, therefore, help to blend his contributions with theirs. He cannot escape responsibility for the total results of his work, the cultural and ecological as well as the technical. He does not bear the total responsibility for engineered changes in the environment, but he must acknowledge the nature and extent of these changes to which his special competence has contributed. This means that he has a moral obligation to consider the total outcome of activities in which his engineering skill is employed. He is, in the language of the law, "accessory to the fact" in those human enterprises that reshape the human environmant and alter the condition of life on earth.

But objectors to these remarks may say that none of this moralizing is new. They may say that engineering has always been a social art, has always involved the co-operation of many crafts and skills and that it has no purpose other than to serve human needs. These objections are valid, but they do not refute the thesis that the role of the engineer appears to be changing and that the change is toward a greater sense of social responsibility for the quality of human life. The important change that we see occurring is not so much in the functions of the engineer - even in the dramatic new fields of applied science. The change is in concept and interpretation. To the extent that physical engineering affects the welfare of man in relation to his environment, it is also human engineering, that is to say the engineering of human society.

It is simultaneously bio-engineering and cultural engineering considered in relation to its results.

In the long history of engineering one may find many examples of the regard shown by engineers for the aesthetic and ecological qualities of their work. Over long periods of history there was little if any practical difference between engineers, architects, and designers. Thus, we find in the public works and civic monuments of Classical Antiquity and the Middle Ages a harmony in the siting and design of structures in their environments. Perhaps this apparent harmony is essentially a subjective reaction. It may be that our norms for judging harmony are historically derived and could not be defended by any logic of pure reason. None the less, it does seem that, in large measure, the engineering theories and practices of the historical past more often took account of the needs or desires of the whole man than has generally been true in the modern age of specialization.

When the engineer was simultaneously artist, architect, land-use planner and memorializer of civic events, he was, by the very nature of his role, a multi-disciplinary practitioner. He could not confine his responsibilities, even in theory, to technical considerations. Moreover, his employers - princes, prelates, and republics - characteristically represented a broad range of human values. If governments in the past performed fewer functions than today, they were often more closely integrated into the fabric of society. Impersonal bureaucracy and professional public administration are largely products of modern life. True, they did exist in old China and in the Roman Empire. But in these cases there was a close relationship between the actual conduct of public affairs and the daily lives of people. Government was neither abstract nor psychologically remote.

In the world since 1800, and especially since 1900, size, complexity, and impersonality have increasingly characterized human affairs. The magnitude and concentrated densities of human populations have required recourse to artificial systems of life-support. Food supply, water supply, sewage disposal, communication and manufacturing, for example, have been organized on increasingly large scales. The need to keep these systems functioning has led to the rise in the influence of economists whose role is to discover how to obtain and distribute the material resources available for the support of these systems. Economists and engineers have increasingly become specialized and both have tended to become concerned more with operational means than with values sought or with the total life experience of people. The modern engineer has often been the executor of plans formulated by specialized economists in whose abstract calculus there is noway to consider the total human personality.

Modern engineering has also been influenced by a greatly advanced technology that has opened many new opportunities for manipulating and changing the natural environment. These possibilities emerged at the same time that professional specialization and a growing influence of abstract economic thinking in public affairs narrowed the range of values that engineers normally considered, Engineers could dream of changing the face of the earth and increasingly they discovered the tools to realize these dreams. But more often than not, they pursued their ambitions under the sponsorship of specialized technical, economic, and military interests in which cultural and ecological values were disregarded. As a consequence, the engineer in the Twentieth Century was increasingly perceived by his

critics as well as by many of his own fellows as a destroyer of the natural environment and an indifferent reshaper of the cultural landscape.

By Mid-Twentieth Century, the engineer had become for many thoughtful critics a personification of the destruction of humane and natural values. The dominance of abstract technological thinking in modern society was attacked or deplored by a large number of critics of whom Lewis Mumford (Technics and Civilization, 1934), Sigfried Giedion (Mechanization takes Command, 1948), Jacques Ellul (La Technique, 1954, 1964), and Friedrick George Juenger (The Failure of Technology, 1956), are among the better known. Leo Marx has described the conflict between the emergent engineering technology of industrialism and the aesthetic and ecological values of modern society in his book "The Machine in the Garden: Technology and the Pastoral Ideal in America" (1964). This criticism of technology for the sake of technology or for narrowly conceived and ecologically destructive purposes has attracted public support and has also elicited a response from the professional engineering community.

Popular dissatisfaction with narrowly conceived engineering of the environment has been expressed in the public news media (including cartoons), in the activities of groups organized to protect cultural or ecological values, and more recently in statutory legislation. Until recently these efforts to control and reform engineering practice were largely confined to Western Europe and the United States of America. Concern is now growing in the hitherto technologically less developed countries in which vast engineering projects dama, highways drainage,irrigation and resettlement projects - threaten swift and irreversible destruction of the cultural and the natural landscape. There are fortunately leaders in Africa, Asia and Latin America who do not wish to see their countries merely exchange one set of problems for another, perhaps a more difficult, set.

In the United States of America the signing of the National Environmental Policy Act (Public Law 91-190) on January 1, 1970, marks a new era in American public policy toward the environment in both its cultural and natural aspects. This law declares, for the first time in the history of the nation, that the quality of the environment is a national and public responsibility. The Act establishes criteria and procedures to make sure that ecological and aesthetic values are taken into account in the environment-shaping activities of the government. A three-member Council on Environmental Quality is established in the Executive Office of the President to oversee the administration of the Act and to report to the President annually upon the state of the physical environment within the United States. The Act also declares that co-operation with other nations in the protection of man's global environment is a policy of the Congress of the United States.

The engineering community in the United States had already shown concern over environmental deterioration and over public criticism of narrowly conceived engineering practice. For at least a decade there has boon a movement among schools of engineering to broaden and enrich the engineering curriculum and to rectify a long-standing imbalance between technical and social or humanistic considerations. The American Society of Civil Engineers has played a major part in the effort to build environmental awareness back into engineering education and practice. The Interprofessional Council on Environmental Design has been

formed including the American Society of Landscape Architects, the American Institute of Planners, the Consulting Engineers Council, the National Society of Professional Engineers, and the American Society of Civil Engineers. This collaborative effort to improve the shaping of the environment, including the landscape, hopefully initiates a new era in man's treatment of the Earth. If this multi-disciplinary co-operation is effective in America, it should also be possible in other countries.

These among other developments in the United States are hopefully indicative of a world-wide trend to bring biology, engineering and the cultural landscape into a coherent, ecologically valid and economically feasible relationship. International efforts in this direction have been undertaken over at least two decades. One may note the Ambuklao Symposium on Hydroelectricity and the Protection of Nature sponsored by the International Union for the Protection of Nature (now International Union for Conservation of Nature and Natural Resources - IUCN) in 1950, and the recommendations of the 12th Session of the General Conference of UNESCO concerning the safeguarding of the beauty and character of the landscape and sites.

Man has now extended his influence over the entire surface of the earth and the harmful consequences of his misuse of technology have become direct threats to his welfare, happiness and survival. Modern society could not dispense with engineering technology even if its people wished to do so.. Society has become dependent for its continued existence upon applied scientists and engineers. And so, if human welfare is the goal, there is no alternative to making engineering serve the needs of the whole man, and this requires it to play a major role in protecting and improving the cultural and natural qualities of the human environment.

The Commission on Landscape Planning of IUCN contributes to this effort by promoting international multi-disciplinary efforts to guide man's engineering of the environment toward humane and ecologically valid goals. Although landscape planning has traditionally been concerned primarily with the natural and cultural features of open space in the less urbanized and rural areas, it has also contributed to improving the environment within the cities. A major landscape planning mission lies ahead in the restoration of urban and suburban landscapes ruined by short-sighted, unguided economic and industrial developments of the past century. The major cities of the world have increasingly become unfit for human happiness and mental health. It will take the combined efforts of ecologists, architects, engineers, economists, landscape planners, public administrators and many others through concerted effort to create human habitats capable of nourishing and sustaining higher levels of human civilization.

In this task no nation or no profession has a monopoly or even a preponderance of wisdom. The future of all mankind now depends upon the wise management of man s relationships with the biosphere - the planetary life-support system. If he is to survive, the human animal must learn new arts of co-operation and self-control and must develop a capacity to see more clearly and readily than before interrelatedness of things and the meaning of this interrelatedness for human goals and values. All activity in the world of nature exacts some price and there are no known exceptions. The costs in money and effort of a

humanistic approach of engineering and a determined and effective public effort on behalf ot the cultural and natural landscape will exact much less in human freedom and resource than the non-monetary costs of failure to pay this price.

S u m m a r y

Major changes in the role and new function of engineering are emerging as a consequence of growth in science and technology.

The moat fundamental change in the role relates to the social responsibility of the engineer for the quality of human life. He cannot limit hie responsibility to professional competence in executing the plans of others as his work intermeshes with other professionals. He cannot escape responsibility for the total results of his work, the cultural and ecological as well as the technical. He has a moral obligation to consider the total outcome of activities in which his engineering skill is employed.

The important change that we see occuring is not so much in the functions of the engineer, it is in concept and interpretation. To the extent that physical engineering affects the welfare of man in relation to his environment, it is also the engineering of human society, simultaneously bioengineering and cultural engineering, if considered in relation to its results. In the long history of engineering, when the engineer was simultaneously artist, architect and land use planner, he was, by the very nature of his role, a multidisciplinary practitioner. He could not confine his responsibilities, even in theory, to technical considerations.

The magnitude and concentrated densities of human populations have required recourse to artificial systems of life-support. The need to keep these systems functioning has led to the rise in influence of economists. Economists and engineers have increasingly become specialized and more concerned with operational means than with values sought or with the total life experience of people.

Modern engineering has also been influenced by the greatly advanced technology which gave new opportunities for manipulating and changing the natural environment. These emerged at the same time that professional specialization and a growing influence of abstract economic thinking in public affairs narrowed the range of values that engineers normally considered.

The criticism of technology for the sake of technology or for narrowly conceived and ecologically destructive purposes has attracted public support. Concern which was until recently confined to Western Europe and USA is now growing in the hitherto technologically less developed countries in which vast engineering projects threaten swift and irreversible destruction of the cultural and natural landscape.

The author then touches on the progress made in the USA in respect of environmental awareness and the concern shown by the engineer's community over environmental deterioration. For at least a decade, there has been a movement to broaden and enrich the engineering curriculum and to rectify the long standing imbalance between technical and social or humanistic considerations. These among other developments are hopefully indicative of a world-wide trend to bring biology, engineering and the cultural landscape into a coherent, ecologically valid economically

feasible relationship.

Man has extended his influence over the entire surface of the earth and the harmful consequences of his misuse of technology have become direct threats to his welfare, happiness and survival. Modern society could not dispense with engineering technology even if it wished to. And so, if human welfare is the goal, there is no alternative to making engineering serve the needs of the whole man, and this requires it to play a major role in protecting and improving the cultural and natural qualities of the human environment.

It will take the combined efforts of ecologists, architects, engineers, economists, landscape planners, public administrators and many others, through concerted effort, to create human habitats capable of nourishing and sustaining higher levels of human civilisation. In this task, no nation or no profession has a monopoly or even a preponderance of wisdom. The future of all mankind depends upon the wise management of man's relationships with the biosphere.

R é s u m é

Une transformation fondamentale du rôle de l'ingénieur et de nouvelles fonctions apparaissent sous l'impulsion du progrès de la science et de la technique.

Le changement le plus profond qui s'opère dans le rôle de l'ingénieur, porte sur sa responsabilité sociale vis-a-vis de la qualité de la vie de l'être humain. Il ne peut pas limiter sa responsabilité à sa compétence professionnelle, en exécutant des plans établis par autrui, car son travail est lié à celui d'autres professions. Il est inéluctablement responsable du résultat de son travail, que se soit du point de vue culturel, écologique ou technique. Il est dans l'obligation morale de tenir compte des résultats finaux des activités dans lesquelles son génie professionnel est utilisé.

Le changement important que nous constatons ne se rapporte pas tant aux fonctions de l'ingénieur, qu'au concept et à l'interprétation. Dans la mesure où le travail technique de l'ingénieur influence l'aspect du bien-être humain lié à l'environnement, il est également un travail de "modelage" de la société humaine et simultanément un "engineering biologique" et un "engineering culturel", si nous considérons les résultats.

Dans la longue histoire du métier d'ingénieur, quand l'ingénieur était à la fois artiste, architecte et planificateur, il était, par la nature même de son rôle, un maître-d'oeuvre multi-dieciplinaire. Il ne pouvait pas limiter ses responsabilités, même pas en théorie, à des considérations d'ordre technique.

En raison de l'importance et de la densité concentrée des populations humaines, on a du recourir aux systèmes artificiels pour subvenir aux besoins vitaux. La nécessité d'entretenir ces systèmes a augmenté l'influence des économistes. Les économistes et les ingénieurs se sont, de plus en plus, spécialisés et sont devenus plus concernés par le "modus operandi", que par les valeurs basées sur la recherche ou l'expérience de la vie de l'homme.

Les réalisations de l'ingénieur ont aussi été influencées par les progrès de la technique, qui ont ouvert la voie à de nouvelles possibilités de traitement et de transformation du milieu naturel. Ces possibilités surgissent au moment où la spécialisation professionnelle et l'influence croissante de la pensée économique abstraite dans les affaires publiques ont réduit la gamme des valeurs que les ingénieurs considéraient comme normales.

La critique de la technique, ou de ses plans étroitement conçus, qui détruisent l'équilibre écologique, a gagné le soutien du public. Les efforts déployés pour contrôler et réformer la réalisation des travaux publics étaient confinés, jusqu'à récemment, à l'Europe de l'ouest et aux Etats-Unis. De nos jours, l'anxiété croit également dans les pays qui, jusqu'à présent, étaient moins développés sur le plan technique et dans lesquels de vastes projets menacent de détruire rapidement et irréversiblement le paysage culturel et naturel.

L'auteur alors touche à l'avancement fait dans les Etats-Unis à l'égard de la conscience de l'environnement et à l'anxiété des milieux des ingénieurs devant la détérioration de l'environnement. Pendant une décade, un mouvement s'eut dessiné dans le© écoles d'ingénieurs en vue d'élargir et d'enrichir les programmes et de rectifier le déséquilibre existant depuis longtemps entre les considérations d'ordre technique et d'ordre social ou humanitaire.

Il faut espérer que cette évolution, observée aux Etats-Unis, est le Digne d'une tendance mondiale vers l'instauration d'une relation cohérente, écologiquement valable et économiquement réalisable, entre la biologie, les grande travaux, techniques et le paysage culturel.

L'homme a étendu son influence a toute la surface de la terre et les conséquences néfastes de son mauvais usage de la technique constituent une menace directe pour son bien-être, son bonheur et sa survie. La société moderne ne pourrait se passer de la technique, même si elle le souhaitait. Et, si donc on recherche le bien-être humain, il n'y a pas d'autre solution que de mettre la technique au service de l'homme et de ses besoins; et il est alors nécessaire que celle-ci joue un r3le majeur dans la protection et l'amélioration des qualités naturelles et culturelles de l'environnement humain.

Il faudra tous les efforts combinés et concentrés des écologistes, des architectes, des ingénieurs, des économistes, des architectes-paysagistes, des administrateurs et de beaucoup d'autres, pour créer un habitat humain capable de nourrir la population et de maintenir un niveau de vie élevé.

Dane cette tache, aucun pays, aucune profession, n'a de monopole, ni même de compétence prépondérante. L'avenir de l'humanité dépend à présent d'une planification avisée des relations de l'homme avec la biosphère.

Part of the participants inspecting the archaeological excavations in South Moravia. /Photo by F. Wohlgemuth/

SYMPOSIUM ON THE RELATIONSHIP BETWEEN ENGINEERING
AND BIOLOGY IN IMPROVING CULTURAL LANDSCAPE

Brno, Czechoslovakia, 9 June 1970

A MULTI-PURPOSE RESERVOIR

by

Sylvia Crowe, CBE, Hon. FRIBA, PPILA,
182 Gloucester Place, London NW I.England.

To some people it may be surprising that the wet and misty British Isles are short of water. Yet at the moment that shortage is giving serious concern.

It is of course partly our own fault. We have in the past, been criminally wasteful in polluting our water and then flinging it into the sea, and to a large extent this practice still continues. Until very recently there was no attempt to achieve co-ordination between the various supplies and uses of water.

At last efforts are being made to establish an effective national coordination of water resources, and eventually we hope to overcome the more serious oases of waste and pollution. But the past inroads on our water have been so serious that many small streams have dried up, and within the last century the level of the water table has dropped some 50 to 70 metres.

However, the wetness of Britain is largely illusory. We have no large rivers and no eternal snows. The rainfall of London is 50.5 centimetres (less than that of Rome, and half that of Sydney in Australia). We make it seem wet, by bringing it down gently, over a long period.

Water consumption is high and constantly rising, both for domestic and industrial use, and now farmers are discovering the benefits of irrigation for their crops.

So far the water supplies have been drawn from watercourses pumped from water-bearing strata or provided for by reservoirs.

At last the possibilities of obtaining water from estuarial barrages is being investigated, and there is little doubt that some of these will be constructed. But this will take time and meanwhile the position is that more and more reservoirs are being constructed to meet the needs of the next decade or so.

Wherever a reservoir is proposed there is opposition. This is inevitable in a land as densely populated and closely settled and cultivated as Britain. Whatever land is flooded semeone will be disturbed, some land use will be changed.

Many of the new reservoirs are in the western areas of high rainfall and mountainous terrain. This has brought several reservoirs in recent years to

Wales, and here the opposition is sometimes very strong indeed, as the Welsh do not see why any of their land should be inundated for the benefit of the more populated and industrial areas of England.

In general the opposition to reservoirs is based on one or more of the following objections:

1. It takes agricultural land.
2. It displaces residents and landowners (they are of course fairly compensated, but that may not reconcile them to losing their home and moving elsewhere).
3. Interference with river flows, fishing interests, etc. (This is a keenly argued subject, and some compromise is worked out by which the water authority has to ensure that an agreed minimum flow is discharged into the river below the dam.)
4. It is often objected that the amenity of the countryside will suffer, either through the introduction of large engineering structures into a hitherto wild or agricultural landscape, or that the sheer attraction of the reservoir for sailing and fishing will cause crowding into a hitherto quiet area.

When a controversial development is proposed, it is usual to hold a public inquiry. The promoters put forward their reasons for wanting the development in that particular place, and the objectors put forward their arguments against. The objectors may be private individuals, public bodies, or associations, such as the Council for the Preservation of Rural England. The arguments are heard by a government inspector, who advises the minister responsible for planning whether or not the development should be allowed, and if so under what conditions. Quite often the condition is attached that the developer must obtain the advice of a landscape architect.

In the case of Bough Beech, the reservoir I now want to describe, - the chief objection came from Kent County Council, the local authority responsible for planning in the county in which the reservoir is situated. The grounds of their objection were that the reservoir would detract from the amenity of the area. The reasons they gave were:

1. It would destroy the peaceful country atmosphere.
2. So large a body of water would be alien to the landscape.
3. The dam and associated works would be intrusive.
4. The mud exposed by draw-down would be unsightly.

I was asked by the Water Company to appear at the inquiry and explain my views on these points, and what I would suggest to overcome or mitigate any objections I considered valid.

To understand the problems involved it is necessary to appreciate the type of country concerned.

The county of Kent stretches from the S.E. edge of London to the S.E. coast. The part near London is densely populated and industrial towns spread along the Thames and Medway estuaries. The coast is also mainly built up with sea-side resorts and between these two urban belts are several fair sized towns and residental areas.

Nevertheless, the county contains some exceptionally beautiful landscape. It is of very ancient settlement, with areas of great fertility where there is very high-grade fruit and hop growing. It lies across a section of the classic Weald geology, and therefore contains a wide range of soils. A ridge of chalk hills runs diagonally from N.W. to S.E. reaching the sea at the white cliffs of Dover. These hills are rich in Fagus woods, while the valleys are an intricate, small-scale pattern of mixed farms and orchards set in trees and small woods, mainly of Quercus robur and Corylus with some Fraxinus. These woods are rich in spring flowers. The farms are often old and generally very beautiful, of soft red brick and timber.

The site of Bough Beech is in a clay valley within this complex of farm and wood. It is overlooked by a particularly fine part of the chalk hills, clad with Fagus. The whole area lies within the London Green Belt and it is only this fact which has kept it in a state of quiet green countryside, since development in the Green Belt is strictly controlled. The hills overlooking the site are also designated as an Area of Outstanding Natural Beauty, which gives additional protection. They are much used by the public for walking, picnicking and horse riding as well as visiting by car.

It was, therefore, right to give the most careful consideration to whether or not the reservoir would detract from the attractions of this very beautiful and very precious countryside.

I did not agree that the water itself would be a discordant element. It was true that it would be bigger than any other element in the view, but it would be a pleasant feature, and was moreover of a basically good shape, with inlets and promontories.

I did, however, agree that the long straight line of the dam would appear out of scale and rather harsh in the very gentle, soft pattern of the fields and copses. I also agreed that the periodic exposure of muddy banks presented a problem.

In a normal year the fall from top water level is expected to be about 3 metres. In exceptionally dry years this could increase to 12.2 metres. At the natural gradients of the ground this represented a rim about 45.7 metres wide in normal years.

The period of draw-down is expected to be from late summer to early spring, which at least means that it will not be at its worst during the most popular time for visiting the countryside.

One of the means I suggested to overcome both these objections was to accentuate the natural promontories which occurred on the lake's perimeter by extending them and moulding them up to a greater height. Fortunately, unwanted soil was available from the works to enable this to be done.

The double effect of this is that, seen from the view points on the hills, the long line of the dam will be broken and brought into scale by the tree-planted promontories. At the same time these promontories cut off the view of certain sections of the exposed mud. The worst visual effect of this would be if it appeared as an unbroken, parallel band all round the reservoir. It will be far less

objectional if it is broken by the protruding promontories.

Planting these as far out as possible is also going to be helpful. In other reservoirs, on similar soil, Salix caprea and Salix cinerea, both native to the area, have established themselves well below high water mark. We are also planting Salix alba and Alnus glutinosa at and below the water's edge. Some of the planting is frankly experimental. We are going to see how far down the grass can be grown, using Agrostis stolonifera and its variety aquatica. We also have some trial patches of Littorella uniflora but I fear the soil may be too heavy for it. We cannot use the more invasive Carex and Juncus for fear of interference with the pumping machinery, or seriously reducing the water content.

The views looking northward to the back of the dam are from lower ground and not so critical. But wa have swept the contours of the dam into the surr-ounding land form and grassed the embankments, and are planting native trees below the toe.

New buildings have been necessary for the small maintenance staff and for treatment works. The cottages have been grouped together into the traditional village cluster, and extensive tree planting will break the view of all the works buildings.

Materials and colourings have been carefully chosen to blend with the old established landscape. The wave wall, for instance, is of concrete with dark exposed aggregate.

Since the catchment area is not large or very well watered, the functioning of the reservoir involves pumping back water at times of high flow from the ri-ver at some distance below the dam. For this purpose, a pump house has had to be built. This has been designed to accord with the traditional old farm buil-dings of brick, tile and timber and now fits very pleasantly into the scene of hop fields and water meadows.

All approach roads and fencing for the whole scheme have likewise been carried out in the simple country tradition of unkerbed roads and oak post and rail fences. This attention to detail contributes as much as the larger work to conserving the country character.

Except where the waterside planting is selected to accord with the new ecological situation created by the water, the species natural to the locality are being adhered to throughout.

The most serious losses caused by the flooding of the valley were the destruction of a farm, with almost all its land, and the drowning of a very beautiful and historic small house. This house was dismantled and has been re-built near Chichester, in an open-air museum which specializes in old country buildings and tools.

The owner of the farmland took the very sensible decision to become the land-manager of the reservoir. He is now helping me to implement the landscape plans and will look after the whole area and all its activities.

The smaller and more crowded one's country is, the more important it is to practise multiple land use wherever this is possible. The objections which our water engineers used to have to using the reservoirs for any other purpose than water supply are fortunately now being overcome. This is partly due to improved purification methods which reduce or eliminate the risk of pollution.

Bough Beech will cater for sailing, fishing and for the activities of naturalists. It will also, we hope, be an added attraction to those who just enjoy the country by looking at it and strolling through it. Agriculture in the form of sheep grazing will be practised to the water's edge and some timber will be grown in the woods.

As the total area of the reservoir is only 117.36 hectares, it was felt that sailing and fishing carried on at the same time might conflict with each other, so it has been agreed that sailing shall take place only out of the fishing season, that is during the winter. It appears that most of the sailors take their boats down to the sea in the summer, so that this arrangement suits them quite well. The fishing will be fly-fishing for trout, and the reservoir will be stocked with small fry to grow on into sizable fish. It is not expected that the trout will breed at Bough Beech and there will be periodic re-stocking. In years to come there may be a problem of invasion by coarse fish which would eat the trout. Fishing will be from rowing boats and from the bank.

A combined club house is being built for the sailors and fishermen and a car park will be sited amongst trees at the rear.

Perhaps the easiest pastime of all to cater for is bird watching. No sooner had the first pool of water collected in the bottom of the reservoir than the birds moved in. Great crested grebe and pochard were two of the earliest arrivals. Whoever else does not like mud banks, the birds will love them and it should be a great place for waders.

The naturalists' clubs are hoping to arrange a hide on one of the promontories. Their great interest will of course be at the shallow end, so they will not conflict with the sailors or the fishermen. Already we have had comments that the sheet of water has improved the view, and I have no doubt that Bough Beech will be an asset to both the appearance and the recreational value of London's Green Belt, besides filling its primary function of supplying water.

S u m m a r y

The British Isles are short of water, as we have been criminally wasteful and co-ordination between the various supplies and uses has not yet been achieved. The past inroads on the water have been so serious that the level of the water table has dropped some 30-70 metres. So far, the water supplies have been drawn from watercourses, pumped from water-bearing strata or provided for by reservoirs.

Many new reservoirs are situated in the western areas of high rainfall and mountainous terrain. Every new reservoir raises opposition such as loss of agricultural land, displacement of residents and owners, fishing, interests, loss of amenity, etc. It is usual therefore to hold a public inquiry where the argu-

ments are heard by a government inspector, who advises the Minister responsible for planning.

For Bough Beech, the reservoir described, the main objections were: destruction of peaceful country atmosphere, a large water body would be alien to the landscape, the dam would be intrusive and the mud exposed by draw-down, unsightly. The author describes at this point the surrounding countryside, its landscape and geology, and its main vegetation.

In this concept, the objections are studied very carefully and it was decided to overcome the mud exposure and the unsightly dam by accentuating the natural promontories which occurred on the lake's perimeters by extending them and moulding them up to greater height, as unwanted soil was fortunately available. The double effect of this is that, seen from the view points of the hills, the long line of the dam will be broken and brought into scale by the tree-planted promontories, which at the same time cut the view of certain sections of exposed mud. The contours of the dam have been swept into the surrounding land form and grassed. The necessary new buildings have been grouped together into the traditional village cluster, materials and colourings carefully chosen to blend with the old established landscape. Approach roads and fencing are likewise carried out in simple country tradition. Except where the waterside planting is selected to accord with the new ecological situation, the species natural to the locality are being adhered to.

The reservoir will cater alternately for sailing and fishing, sailing being only allowed out of the fishing season, as it was felt they might conflict with each other. Activities of naturalists such as bird watching will be greatly favoured by the new water body. Bough Beech will be an asset both to the apperance and the recreational value of London's Green Belt, besides supplying vital water.

R é s u m é

Les Iles Britanniques sont à court d'eau par suite d'un gaspillage quasi-criminel et d'un manque de coordination entre les diverses sources d'approvisionnement et d'utilisation.

Par le passé, les prélèvements sur l'eau ont été d'une telle envergure que le niveau de la nappe phréatique s'est abaissé de quelque 50-70 mètres. Jusqu'ici, l'approvisionnement se faisait par les cours d'eau, la couche phréatique ou les lacs réservoirs.

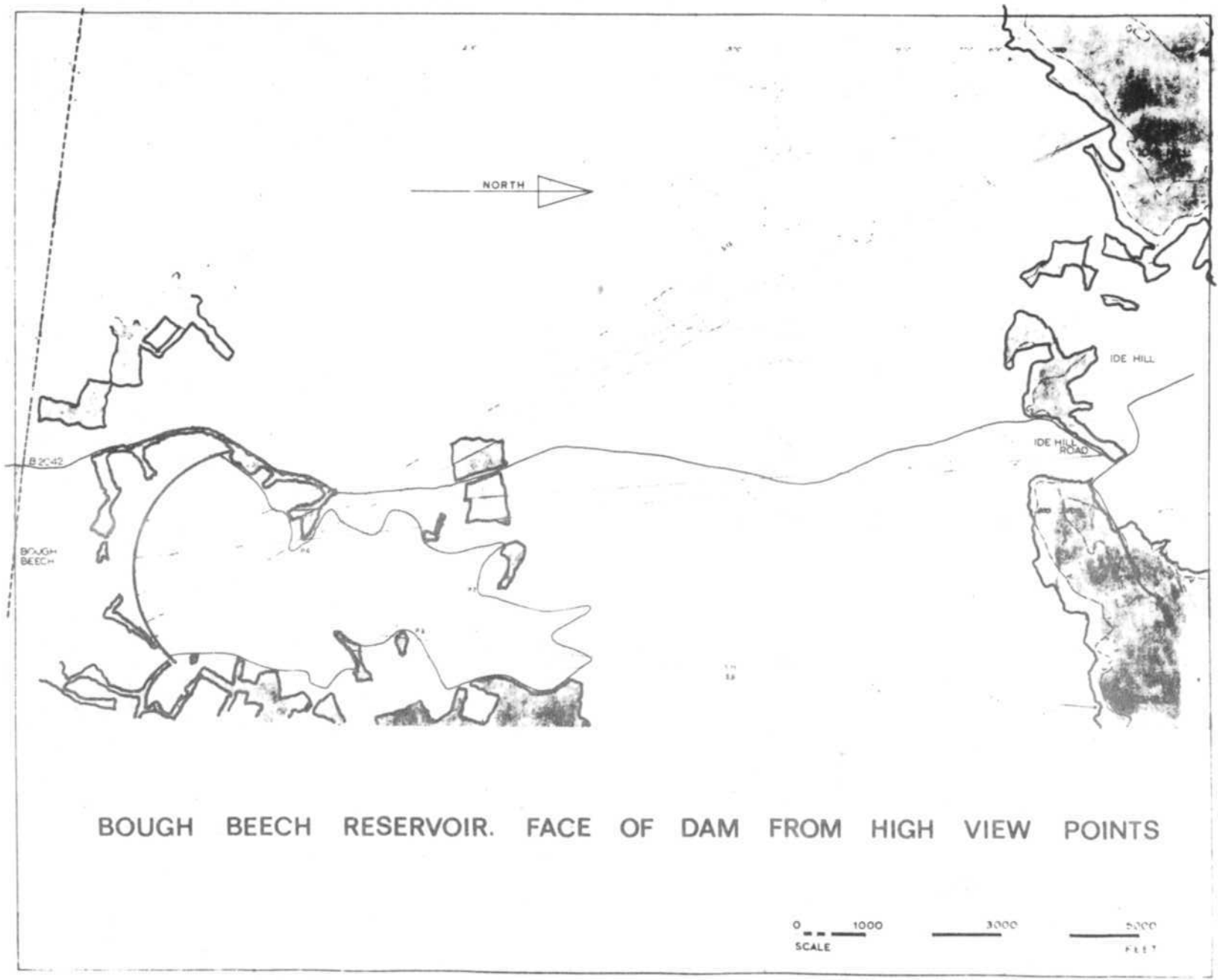
Un certain nombre de nouveaux lacs de retenue sont situés dans les régions montagneuses à pluviosité élevée de l'ouest. Chaque nouveau réservoir suscite une opposition, à cause de la parte de terres agricoles, la nécessité de relogement des résidents et des propriétaires, la perte de l'agrément du pays, des intérêts des pêcheurs, etc. Il est donc d'usage d'effectuer une enquête publique où les arguments sont exposés à un inspecteur du gouvernement qui conseille le ministre responsable de l'aménagement.

Dans le cas de Bough Beech, le lac réservoir décrit ici, les objections majeures étaient les suivantes: destruction d'une ambiance campagnarde paisible, le vaste plan d'eau ne se fondrait pas dans le paysage, le barrage serait désagréable à voir et le étendues de boue découvertes en saison sèche inesthétiques.

L'auteur décrit alors la contrée, le paysage, la géologie et la végétation dominante du site.

Dans ce contexte, les diverses objections sont examinées de très près et il a été décidé de remédier à l'exposition des étendues vaseuses et à l'aspect inesthétique du barrage en accentuant les promontoires naturels qui bordent le lac et en les surévelant avec de la terre rapportée disponible sur place. Ceci aura un double effet : vu du sommet des collines la longue ligne du barrage apparaitra coupée et ramenée à l'échelle du paysage par les promontoires plantés d'arbres qui, en même temps, cacheront à la vue certaines étendues de boue découvertes. Les contours du barrage on été intégrés au paysage environnant et enherbés. Les nouveaux bâtiments indispensables ont été groupés à la façon des villages traditionnels de l'endroit. Les materiaux et les couleurs ont été soigneusement choisis pour s'allier au paysage déjà existant. Les routes d'accès et les clôtures sont également conçues dans un style campagnard simple. Sauf aux endroits où la végétation riveraine a été choisie pour répondre aux nouvelles conditions écologiques, les espèces indigènes ont été conservées.

Le lac réservoir sera utilisé alternativement pour la pêche et la voile, ce sport n'étant autorisé qu'en dehors de la saison de pêche, car on a pensé qu'ils pourraient se nuire réciproquement. Les activités des naturalistes, des ornithologues en particulier, seront grandement favorisées par le nouveau plan d'eau. Bough Beech sera donc un élément positif aussi bien du point de vue de l'aspect esthétique que de la valeur récréative de la ceinture verte de Londres, tout en constituant une réserve d'eau indispensable.



BOUGH BEECH RESERVOIR. FACE OF DAM FROM HIGH VIEW POINTS

SYMPOSIUM ON THE RELATIONSHIP BETWEEN ENGINEERING
AND BIOLOGY IN IMPROVING CULTURAL LANDSCAPE

Brno, Czechoslovakia, 9 June 1970

HIGHWAYS AND AMENITY[1]

by

Dewar W. Goode, 3 Mandeville Crescent,
Toorak' 3142, Victoria, Australia.

Higways, freeways or Autobahns can have an enormous adverse impact on the beauty of the natural landscape. If this is to be avoided, disciplines other than engineering will need to be consulted to ensure that the aesthetic[2] values in the landscape are protected and, where possible, enhanced. The rural environment[3], particularly undefiled landscape[4], is becoming increasingly important and rare.

People are concentrating in urban areas which are becoming needlessly unattactive as a result of noise and pollution. Increasing affluence, and the mobility of these people is leading to a mass exodus from the urban environment at overy opportuinity. To aggravate the situation, populations are increasing and so too are their periods of leisure.

Many surveys from a number of countries indicate that more and more people drive into the countryside seeking passive recreation in open space. In an affluent society they go to their mountain or beach home or to a farm or farmlet but even in an affluent society the larger proportion of the people is obliged to return to an urban home on the same day.

---

1 Amenity is a new word in planning and its broad interpretation is attractive, pleasant and stimulating living and working conditions. An amenity is more than a needed or essential service.
Clause II of the New Countryside Commission, 3,8,68 (United Kingdom) obliges every Government Department and public authority to have due regard for amenity.

2 Aesthetic standards are intangible and not suited to legal intepretation because they vary with the individual, with the cultural group concerned, with the locality and with the period. However, in the case of environmental design involving architecture, landscape architecture and engineering aesthetic principles can be established.

3 A Council for Environmental Education has been appointed by the Standing Commitee of the Countryside 1970 (United Kingdom).

4 "Undefiled landscape does exist but in planning for future increased leisure activity there must be an awareness of the proportionately increasing use pressures upon landscape". An introduction to the IFLA 11th Congress in Montreal, June 16-20,1968: the theme "Planning for Leisure".

Roads have a dual role: to provide for safe, economical and utilitarian transport, and secondly to serve the ever-increasing number of people who want to savour the aesthetic and recreational values of the countryside. The road must therefore serve the business and industrial world; but it must serve the tourist and recreational world too.

There is no particular technical difficulty in locating and designing a road for through traffic - it is an engineering problem. However, to put other needed values into the transport system requires much more than an engineer's blueprint. The design of engineering structures should not be purely functional. Engineers need to consult and work with landscape architects, botanists, conservationists and ecologists to obtain these objectives. In this paper, I am referring essentially to engineering roadworks in natural landscape and countryside and not in urban areas, though here too other disciplines need to be brought in before the blueprint stage, and certainly co-operation can prevent or mitigate the impact of unsightly engineering and architectural structures.

The spread of town and village, of industry and of the services of man (roads, electricity and water supplies) are diminishing valued open space. In addition to these visible agencies are the less apparent but none the less environmentally destructive pollutants; the wastes of man, from his machines, his chemicals, his industry and himself.

The engineer should use and must use his enormous power to create a better environment along with the creation of mechanical, utilitarian and service aids.

Society is far too specialist-oriented. Decisions are made in unidirectional disciplines without understanding their significance and relationship to the whole. This is particularly applicable to engineers. When do aesthetic values become more important than engineering? Can there be a separation of divisions or should there be close collaboration with disciplines other than engineering?

These questions must be resolved if amenity services are not going to destroy the landscape of the countryside of the future. If they do, then the quality of life and the purpose of living itself can be destroyed.

Not very many decades ago roads plunged into the valleys, rose to the top of hills and followed the ridge-tops. Demands on these roads were limited. Roads constructed with horse and manpower, were of necessity simple in structure and design. Hence, many old roads followed the ridge-tops and bridges were usually found near the old fords. We now have massive machinery with a machine equalling scores of those simple implements of yesterday. A mountain, a valley, or a river are no problem to the engineer today. But what is happening to our landscape? The demands of the motoring public and transport systems are such that aesthetic values are being destroyed, impaired or threatened. Much more is required of a road system than the convenience of going from A to B as quickly and as comfortably as possible.

The essential properties of highways, freeways and Autobahns are: the median strips of varying width which divide the opposing streams of traffic; and the limited access and egress with complex but efficient interchanges and intersections. These highways require special landscape design to reduce accidents.

They are not straight with curves as were the original Autobahns. They curve very gently or have a series of curves. They are specially designed to promote interest in the landscape - to prevent boredom. Landmarks can be featured in such a way that they do not negate each other through competition. They are the things remembered after the tour. Varied densities of foliage along the road verge can create perspective changes from close to distant along an otherwise monotonous route. Variety stimulates the senses and thus acts for safer driving. This aspect should therefore be provided for in the overall design.

A road can be designed into the landscape in sympathy with the contours of the rural environment. Its location should not jar or unduly impinge on the landscape. It can be sited so that a vista can be opened up by a sweep around a hillside rather than a deep cutting through that hillside. The slope, extent and even the shape of both that cut and fill need careful planning, for too deep a cut, too large a fill, or a straight cut and fill in a gently contoured landscape, can be equally destructive of aesthetic values. Clearly our concern is to retain the intimacy of nature in an environment providing the amenities desired by civilized man. A big problem of course is not only to create a highway and merge it into the environment, but to see that there is no destruction of landscape by ditches, curbs, poles, cables and other services.

The retention of aesthetic values, we are told, costs much more. This is because the constructing authorities do not accept landscape preservation as a- norm, but look on it as an added problem. Landscape of exceptional aesthetic value, such as can be found in an unspoiled natural area or national park, deserves very special care. Of course, preservation goes hand in hand with the enhancement of natural beauties. The national parks in the United Kingdom are largely man-made, but it is "the duty of the Local Planning Authority to ensure, wherever it is appropriate, that, in granting planning permission for any development, adequate provision is made by the imposition of conditions under the Planning Act, for the preservation or planting of trees." (Civic Amenities Bill 1966 Explanatory Memorandum). In Germany land use restrictions have existed since 1869, when they were imposed against "disfigurement" which could " offend the sensibilities of an aesthetically intelligent observer". It is clear that to keep open countryside intact there should be positive, thoughtful planning.

We human beings consider that we are the masters of our environment, that the natural resources are ours for the taking. We feel that with our machines, technological practices and knowledge we can do with nature what we want. This may be true in part, for we can remedy many of the evils of exploitive practices, but with all our knowledge we cannot re-create a natural environment once it is destroyed.

If we accept the fact that motoring through the countryside is a major form of recreation, then the rehabilitation of areas modified or destroyed is even more vital. Not only do trees and shrubs contribute to the absorption of the noise, exhaust smells, carbon monoxide and smoke, they also screen unsightly structures and poor land use. Ideally indigenous species should be used. In a natural environment, bacteria, fungi, birds and animals live in a dynamic society, the basis of which is the trees, bushes, shrubs and grasses in which they live. Not only can the aesthetic values of a highway through native forest be

destroyed by a thin planting of exotics along the road verge, but the introduction of non-indigenous species will upset the natural balance, usually with a deleterious effect. However attractive exotics may be, they are usually not accepted by native fauna. Travellers come to Australia to see its wonderful bird and animal life which only occurs in natural bush and forest. They go to other countries to see their indigenous flora and fauna. American and Canadian visitors to Australia do not want to see pines, because the pine-covered hills and mountains in the USA and Canada team with bird, animal and other life. We Australians, with our wealth of birds and animals, do not want to see eucalypts void of wild life as they are in other countries.

Very attractive rest areas can be designed into the borrow-pit and fill areas resulting from massive earthworks along highways. If raw native topsoil is stockpiled and spread over bared areas, native plants, grasses, shrubs and trees can be re-established. Too often the destruction of indigenous flora by earthworks leads to an unsightly proliferation of weeds and exotic plants. If an attempt is made to re-establish the native habitat then the traveller while resting should be able to observe bird and animal life in a natural setting.

A great deal of work is being done by the United Kingdom, USA, Japan and indeed many other countries in an endeavour to cope with the growth of urban areas and the problems inherent in such growth. But they are mainly coping with a landscape considerably modified by man. In Australia and some other developing countries, there is little or no research into the aesthetic values of the countryside, and there is little planning for wild life preservation programmes except in wild life reserves and national parks. Here the farmer, the planner and the engineer are to blame. Neither is there any assessment of priorities for preservation and there is little or no advice or encouragement to local groups or councils who are keen to encourage wild life or to make use of the natural environment in a design for living. However, I do feel that all this will improve, that there will be research, and that the governments will provide funds and technical advice on preservation and planning matters.

The countryside can and must be developed fully under its land use capabilities to produce the economic crops or fibres needed in a civilized community. The land itself must be kept in a state of permanent productivity - it cannot be a diminishing resource. Through this same landscape we must have roads, railways and services which are seemingly purely engineering works. I hope this short paper will stimulate co-operation between the many disciplines to ensure that there is no dilution of quality of living through engineering structural environmental pollution.

Total land use must be the concern of every engineer because "total land use envisages a designed plan for recreational use as well as for economic land use within the conservation ideals." [1]

---

1 GOODE, Dewar, "The position of landscape planning for agricultural land use in Australia". A paper delivered to the 11th Technical Meeting of IUCN, New Delhi, December 1969 (IUCN Publications new series No.21).

S u m m a r y

Roads have a dual role: to provide for safe, economical and utilitarian transport and to serve the ever-increasing number of people who want to savour the aesthetic and recreational values of the countryside.

The author stresses the point that roads should not be purely functional, that it is essential that the professions concerned with design and construction should consult with ecologists, conservationists, etcnext the history of road construction is mentioned and its impact on the design of the highways of today.

Essential properties of highways, freeways and Autobahns are: the median strips of varying width which divide the streams of traffic; and the limited access and egress with complex interchanges and intersections. They require special landscape design to promote interest in the landscape, to prevent boredom and reduce the hazard of accidents. Road verges should be varied to avoid monotony along the route.

If we accept the fact that motoring through the countryside is a major form of recreation, then the rehabilitation of areas modified or destroyed is even more vital.

The author emphasizes the importance of good ecologically based land use, avoiding the plantation of exotics in the landscape, and concludes by asking for more research in aesthetic values, a design for living which keeps the land in a state of permanent productivity.

R é s u m é

Les routes ont un double rôle: assurer des transports sûrs, économiques et utilitaires et servir les gens qui, toujours plus nombreux, veulent jouir des valeurs esthétiques et récréatives de la campagne.

L'auteur insiste sur le fait que les routes ne doivent pas être purement fonctionnelles, et qu'il est indispensable que les professions responsables de la planificiation et de la construction des routes consultent des écologistes, des conservateurs, etc. lors de la conception des plans. Il présente ensuite briévement l'historique de le construction des routes et son influence sur la planification du système routier actuel.

Les grand routes et les autoroutes sont caractérisées par les facteurs suivants: bandes médianes de largeur variable séparant les deux voies de circulation et accès et sorties limitées avec des échangeurs et des intersections complexes. Ces routes exigent des tracés spéciaux afin de rendre le paysage qu'elles traversent intéressant, d'empêcher l'ennui et de réduire les risques d accidents. Les bas-c3tés des routes devraient être aménagés de façon variée, afin d'éviter la monotonie.

Si l'on admet que le tourisme automobile à travers la campagne est une des principales formes de loisirs, il devient alors encore plus important de restaurer les régions altérées ou ravagées.

L'auteur souligne l'importance d une bonne utilisation des terres sur des bases écologiques, en évitant la plantation d essences exotiques dans le paysage, et conclut en demandant que les valeurs esthétiques fassent l'objet de recherches plus poussées et qu'il soit trouvé un mode d'aménagement qui maintienne la terre en état de production permanente.

SYMPOSIUM ON THE RELATIONSHIP BETWEEN ENGINEERING AND BIOLOGY IN IMPROVING CULTURAL LANDSCAPE

Brno, Czechoslovakia, 9 June 1970

SOURCES OF WATER SUPPLY AND THE LANDSCAPE

by

Brian Hackett, Professor of Landscape Architecture,
University of Newcastle upon Tyne, England.

The landscape has always supplied Man with his basic needs, both in food and materials for construction and clothing. But the manner in which the supply takes place has changed radically from primitive times when Man went to the source. Today, his basic needs are brought to him from the source by means of technological advances. The management of water catchment areas and of other sources of water supply is a good example on which to base a discussion about engineering works and the landscape, and this should include the effect of various systems for transporting water from the source to the supply point.

Many engineering works that have been sited in landscape or have had a marked impact upon the landscape were the result of a brief which required a cheap but effective solution, financed by one agency with its own purposes in mind. Under these conditions, the engineer - as planner and designer - has not been able to embark upon a comprehensive solution that would also benefit other persons and organizations. This must be said in fairness to the engineer. Even so, many engineering solutions, such as the supply of water, are better in an engineering sense if they are related to other matters. An example is that a water supply system based upon gravity - and this must be related to the topography - is more reliable than a system based upon pumping mechanically against gravity. The engineer is also often restricted to a limited solution to a problem, when, if it was examined first as a regional planning matter, the solution could benefit from other factors end possibilities.

There are very few, if any, engineering projects in which forces, either actively in movement or contained in tension or compression, are not present. This situation is not unlike that prevailing in landscape where an ecological appraisal will reveal similar forces. Also, most engineering solutions to a problem involve the idea of balance, as with movement of one part matched by the compensatory movement of another part or by a durable surface capable of withstanding the movement. A similar situation prevails in a healthy landscape, which as with good engineering practice, provides for the operation of forces and does not allow them to run amok.

An engineer who accepts the validity of these principles should not find difficulty in making an engineering design which can be accommodated in the landscape in an acceptable way. The canals and railways of the 18th and early 19th centuries are often praised for the way in which they related the landscape. It may be true that the engineers concerned were unfamiliar with landscape design principles and that it was the technological limitations of the times that forced them to conform with the topography. Even so, there are few signs that they ever attempted to dominate Nature.

Today, many engineering operations have increased in magnitude and in scale - to an extent where they often compete with land uses, especially agriculture and forestry in the case of water supply. In Britain, it is possible for some large projects, like motorways and reservoirs, to be established through special legislation and not under the supposedly comprehensive planning legislation, although a public inquiry may be set up if there is sufficient pressure from the public and organizations. Nevertheless, in the cast of catchment areas and water supply, there are provisions in the special legislation for taking account of the effect of a new reservoir in relation to its surroundings, and for the recreational use of reservoir's. Also, it is an interesting situation in which, under recent legislation, the River Authorities find they have the double duty of protecting the rivers while at the seme time developing water supplies, including through reservoirs. They now must consider carefully the extent to which a new reservoir in a catchment area may interfere with the natural flow of the river below the reservoir.

Landscape planning is founded upon the principles of ecology which, in turn, have been arrived at by studying the "modus operandi" of the natural landscape. If the supply of water is to take place within a regional plan, which has a landscape planning component, an investigation would first be made of the way in which water is gathered naturally in the landscape and transported outside the region or to some particular place within the region. The investigation would observe that water is supplied and transported for many purposes in the natural landscape, instead of being concentrated as regards source and supply by Man. Thus, in conformity with landscape planning principles, rivers and streams would not be deprived of water; also, the surface of the catchment area would have arrangements for slowing down run-off so that the vegetation is not deprived of water which, if it happened, would lead to erosion. These arrangements might include the formation of several small reservoirs, terraced-cultivation practices, and drainage channels running closely to the contours, - all designed to hold back the flow of water off the catchment area at a number of places instead at the bar of one immense dam.

The "regulating" type reservoir, as opposed to the "direct supply" type, is now being used for many water supply projects, and it is more acceptable from the point of view of landscape planning because the flow of a river can be kept more easily at levels which are not too far removed from a constant flow. Also, public access to the reservoir is no longer a pollution hazard, because the river is the channel for supplying the water to a point many miles downstream and has its own cleansing system against the level of pollution that might be expected with public access under some method of control.

Many water supply projects have some connection with flood control, but the relationship is not always sufficiently integrated to meet landscape planning standards. Unless there is a landscape plan covering the entire catchment area and the whole course of the river and its flood plains, the measures to combat flooding are likely to benefit some interests and harm others. Under landscape planning, flood plains would be regarded as essential land uses, and not as hazards to be removed as so often happens with planning and engineering proposals. I would go further and suggest that flood plains are often considered a disaster, when in fact they constitute a normal overflow or safety valve provision.

There are also many occasions when flood control measures which lead to a freer and more rapid flow of water downstream operate against landscape planning principles. Although the flood waters may be taken away from an area hitherto liable to flooding, some other area downstream may suffer as a result. Also, these measures often take the normal flow away from the area hitherto liable to flooding and thus, in all probability, lower the water table with unfortunate results for the cover of vegetation. An alternative which relates better to the requirements of the landscape is to divert the flood waters along several indirect channels, thereby spreading the benefit of the water and avoiding a rapid flow. Such a proposal must, of course, be part of a comprehensive plan for the catchment area which accords with landscape planning principles.

The most successful engineering projects have been those which make full use of the skills of the engineer. When he tries to design architectural works, like the much-criticized "Gothic" structures on reservoir dams, or solve landscape problems, like landform modelling and vegetation-type decisions, his works lack the purity and efficiency of, for example, the new Forth Bridge in Scotland. But the fault lies at the government policy level by not requiring landscape plans for vast landscape changes, within which the various specialists can operate.

S u m m a r y

Many engineering works that have been sited in landscape or have had a marked impact upon the landscape were the result of a request for a cheap but effective solution, financed by one agency with its own purposes in mind. Consequently, the engineer - as planner and designer - has not been able to embark upon a comprehensive solution that would also benefit other persons and organizations.

A water supply system based upon gravity (topographical) is more reliable than a system based upon pumping mechanically against gravity. The engineer is also often restricted to a limited solution to a problem when if it was examined first as a regional planning matter, the solution could benefit from other factors and possibilities. There are few engineering projects in which forces, either actively in movement or contained in tension or compression, ere not present. This situation is not unlike that prevailing in landscape where an ecological appraisal will reveal similar forces.

The examples of engineering design of the 18th and early 19th centuries are often praised for the way in which they related the landscape. This may be due to technological limitations that forced the engineers to conform to topography, but there are few signs that they ever attempted to dominate Nature. Today, engineering operations often compete with land uses, due to their magnitude.

The legislation relevant to motorways and reservoirs in Britain is briefly described.

Landscape planning is founded upon the principles of ecology which have been arrived at by studying the "modus operandi" of the natural landscape. If the supply of water is to take place within a regional plan, an investigation would first be made of the way in which water is gathered naturally. It would observe that water is supplied and transported for many purposes in the natural landscape, instead of being concentrated as regards source and supply by Man.

The "regulating" type reservoir, as opposed to the "direct supply" type, is now being used for many water supply projects. The author asks for • landscape plan covering the entire catchment area and the whole (Bourse of the river and its flood plains. Under landscape planning, flood plains would be regarded as essential land use, and not as hazards to be removed as to often happens with planning and engineering proposals.

The most successful engineering projects have been those which make full use of the skills of the engineer. When he tries to design architectural works, like "Gothic" structures on reservoir dams, or solve landscape problems, like landform modelling and vegetation-type decisions, his works lack purity and efficiency. But the fault lies at the government policy level by not requiring landscape plans for vast landscape changes, within which the various specialists can operate.

R é s u m é

De nombreux ouvrages du génie civil inscrits dans un paysage ou ayant eu un effet marquant sur celui-ci sont le résultat de projets nécessitant une solution économique mais efficace, financés par un organisme ayant ses propres objectifs en vue. Dans de telles conditions, l'ingénieur, à la fois planificateur et architecte, n'a pas eu le loisir de rechercher une solution d'ensemble qui profiterait aussi à d'autres personnes et d'autres organisations.

Un système d'alimentation en eau basé sur le principe de la pesanteur (topographique) est plus sur qu'un système d élévation d'eau par pompage (antigravitationnel). L'ingénieur est aussi fréquemment contraint d adopter une solution partielle à un problème, alors que, si celle-ci avait d'abord été considérée comme un probleme de planification régionale, elle eut pu bénéficier d'autres facteurs et possibilités. Il est peu d'ouvrages architecturaux de ce genre dans lesquels n'interviennent pas des forces soit effectivement actives, soit main-

tenues sous tension ou en compression. Cette situation présente certaines ressemblances avec celle qui règne dans la nature, comme peut le révéler une étude écologique.

Certaines réalisations architecturales du génie civil du XVIII et du début du XIX^{e} siècle sont souvent citées comme exemples d'une bonne intégration dans le paysage. Ceci était dû peut-être à ce que l'ingénieur, limité sur le plan de la technique, était obligé de se conformer à la topographie du paya} mais il est peu d'indices qu'il ait jamais tenté de dominer la nature. Aujourd'hui, l'amplitude des travaux entrepris fait qu'ils entrant souvent en compétition avec le paysage environnant.

La législation relative aux routes et aux réservoirs en Grande Bretagne est décrite brièvement.

L'aménagement du paysage est fondé sur des principles écologiques qui ont été mis en évidence par l'étude du "modus operandi" d'un paysage naturel. Si par exemple on voulait intégrer l'alimentation en eau à un plan régional, il faudrait d'abord étudier la façon dont l'eau s'accumule naturellement. Cette étude montrerait que l'eau est produite et transportée à de multiples fins dans un paysage naturel, au lieu d'être concentrée artificiellement.

Le réservoir de régulation est maintenant utilisé dans de nombreux plans d alimentation en eau, au lieu du type de réservoir à approvisionnement direct. L'auteur demande qu'il soit établi plans d'aménagement du paysage couvrant l'ensemble du bassin d'alimentation ainsi que tout le cours du fleuve et ses plaines d inondation. Dans le cadre d un plan d aménagement du paysage, les plaines inondables seraient considérées comme un aspect essentiel de l'utisation des terres, et non comme un danger a éliminer, comme c'est souvent le cas dans les plans d'aménagement et de travaux publics.

Les projets de travaux publics les plus réussis sont ceux qui ont fait appel à tous les talents de l'ingénieur. Lorsqu'il essaie de créer des oeuvres architecturales telles que les structures "gothiques" sur les barrages des lacs réservoirs, ou qu'il tente de résoudre des problèmes d aménagement tels que le modelage des contours et le choix du type de végétation, ses réalisations manquent de pureté et d'efficacité. Mais la faute en est à la politique du gouvernement qui n'exige pas l'établissement de plans du paysage pour la transformation de vastes secteurs du pays, plans auxquels collaboreraient les divers spécialistes concernés.

Showing a landscape typical of the Bohemo-Moravian Uplands. (Photo by V. Vaníček;

SYMPOSIUM ON THE RELATIONSHIP BETWEEN ENGINEERING AND BIOLOGY IN IMPROVING CULTURAL LANDSCAPE

Brno, Czechoslovakia, 9 June 1970

THE RELATIONSHIP BETWEEN LANDSCAPE PLANNING, BIOLOGY AND ENGINEERING IN MAINTAINING LANDSCAPE QUALITY

by

Douglas Harper and Friedrich Oehmichen
Landscape Architecture Division, Université de Montréal, Canada.

The theme of the meeting is one that is very pertinent in the context of establishing and maintaining a certain equilibrium between the natural and man-initiated processes of the landscape.

Canada, unfortunately, has not too frequently, in the past, recognized in its exploitation of the land its ecological and biological viability. Surely the dust bowls in the western plains speak of the mismanagement of our agricultural land. The despoliation for miles around of the environs of our open-pit mining areas in Northern Ontario and Quebec indicates our lack of forethought. The harnessing of our rivers in British Columbia, Quebec and Labrador demonstrates our lack of concern for the impact that these developments have on their surroundings.

Why has this happened? Until recently we Canadians have felt that our vast reserves of land resources were inexhaustable, that whenever a piece of land became unproductive we could leave it and move to another site to repeat the same process. Coupled with this philosophy existed the spirit of the pioneer-man against nature. Nature was something to be conquered, to be tamed and dominated. Man was not a part of nature, he was above it, it served his needs.

In the late 1960's we began to see an amazing about-face, an awareness of the havoc we were inflicting on our environment and the conviction that something must be done immediately to reverse this trend of self-destruction. The significant part of this phenomenon was that the awareness originated at the grass-roots- the people, and not within the political hierarchy. The Government was soon forced, however, to take cognizance of this force and, as a result, we have witnessed recently a flood of legislation, at all governmental levels, dealing with such environmental problems as air and water pollution, natural resource development, pesticide control and many other activities in which man has for years exercised very little restraint.

Coupled with this regulatory legislation came new programs for the comprehensive development of the landscape. Typical of these programs was the Agricultural and Rural Development Program, which provided for an exhaustive inventory

of resources of a region and its economic prospects and, above all, involved the people of the region in the decision-making process regarding their future.

A notable example and one which may be considered a case-study for this type of program, is the Gaspé Peninsula of the Province of Quebec, an area roughly the equivalent in size to the Country of Albania.

The choice of this area is no accident since it offers evidence of all the abuses mentioned earlier - hillsides denuded by uncontrolled timber and pulp operations, abandoned open-cast mining operations, and a great deal of agricultural land which had become no longer economically productive. In essence, the region was tormented by its engineered past. No mere biological treatment would restore it, but rather it required comprehensive landscape and economic planning on a scale hitherto never explored in Canada.

Before considering this example of integrated landscape planning perhaps it would be worthwile if we first examined some of the general aspects of biology and engineering as they relate to planning.

We can say that biology-engineering relationships have passed through three basic stages:

1. Where engineering has ignored or dominated biology;
2. Where engineering has begun to adapt to biology;
3. Where engineering has been brought under control of the biological processes.

Agriculture and Forestry were in the forefront in the early industrialization movement in the adoption of new techniques. The machine became not only its symbol but also its all-directing force, subordinating old but well-balanced relationships between man and his environment. Soon the machine started to dictate this relationship. Field patterns became regular with straight edges. Roads and highways followed this trend; even brooks and rivers were realigned and their banks and slopes shaped uniformly regardless of their surroundings. When technology failed to keep up with the repair necessary to stem the erosion, floods and other land destruction caused, biology, or the wisdom of the man-nature relationship of the past, was called upon and, reluctantly, engineers, agriculturalists and foresters started applying biological means to improve the effectiveness of their engineering structures. It became evident that a new land ethic would have to be developed and that specialists such as landscape architects must be trained to incorporate engineering projects into the landscape. It was at this time that the development of the science of biological-engineering received its initiation. The application of engineering techniques is increasing rapidly with the growth of advanced technology and, while applied under guise of improving the human environment, is also responsible for worldwide destruction of that environment and the growing ugliness which accompanies it, not only through misuse but also by over-use - by an over-engineering of the environment. There is a growing concern that the amount of waste produced by a modern technological society is a serious threat to man-land relationships.

It is essential that ways be devised to keep the environment of inhabited places as natural as possible and that what is taken from nature should somehow be ploughed back into it in a equivalent or superior form. Industrialization of

agriculture could play an important role in this process by releasing a greater area of the countryside to other amenity uses such as parks and other natural leisure areas.

U.S. sociologist Paul Goodman thinks that science and technology have become, at least in the advanced countries, "the system of mass faith" - "Yet to many they are regimenting hand-in-glove with power and are even diabolical". Goodman goes on to say that "it is necessary to alter the entire relationship of science, technology and social needs both in men's minds and in fact". This will involve changes in the organization of science, in science education and in the very philosophy of the people who make scientific decisions.

Technology must have a place on the university faculty as a learned profession but technologists must know something of the social sciences, law, fine arts, medicine and, most importantly, the revelant natural sciences. The goals of technology must be absolutely compatible with the values of society - people a values.

There is no doubt about the usefulness of technology as a tool to improve human living conditions, but man must realize that it has its limitations.

The emergence of ecology as the science of survival is certainly promising to help to reestablish the lost equilibrium in our environment. So we have reached the third stage, where engineering must be recognized as a tool that is controlled by biology and by all the eternal laws of man-environment and man-nature relationships. Since over-engineering has caused a great many environmental problems, we must reconsider profoundly the relationship between engineering and biology. It may sound strange to hear these words from a representative of a continent which is actually so proud of its technological achievements. However, it is certainly also in that continent that the results of an over-engineered environment are at their visible worst. When I refer to over-engineering, I ask the questions Do we really need to control the last river, the last brook? Do we really need to drain the last swamp and to irrigate the last dry land? Certainly there must be other priorities to be considered.

What considerations, then, must be taken into account in landscape planning, if we are to rationalize this new biology-engineering relationship and achieve an environment of quality?

There are many ways of determining environmental quality but there are two interrelated means which I believe are of the utmost importance in landscape planning: first, the visual impact that is the result of a dynamic equilibrium existing between the man-made patterns and processes and the geomorphological formations created by the natural processes; and, secondly, the natural capacity of the land to support an optimum human occupation under conditions that are socially and economically feasible.

These qualities can be extremely significant, particularly when considering the mainstays of the rural economy - agriculture and forestry.

An excellent example of the public concern for the visual quality of a landscape, as related to its economic use, may be found in the United States in the

harvest of certain forest resources. There the people have raised their protest against the destruction of the visual landscape values that have resulted from the use and abuse of certain highly mechanized harvesting and management methods of the U.S. Forest Service. This protest reached such an intensity that the forestry administration was forced to atop their operations and to undertake a total reevaluation of their forestry management practices. This is now underway under the direction of staff landscape architects who have hitherto been merely occupied with recreation planning within a concept of limited multiple-use.

It is evident from thi3 that as the public acquires a greater environmental appreciation so will it demand an environment of higher quality. As the necessity to consider activities of the landscape in a multiple-use concept grows, so must engineering adjust to the demand for environmental quality. This is particularly relevent for those dealing with hydro-electric power distribution systems: where in the past large rights-of way have been indiscriminatly cut through valuable forest reserves and agricultural land, public indignation now forces more amenable practices.

Sometimes nature itself rebels against ill-considered practices. This past winter we have witnessed in Quebec the destruction of an important power transmission line by wind and sleet because insufficient consideration had been given, in its location, to the biophysical characteristics of the terrain. As a result the line has to be relocated at a cost of over one million dollars.

While these may be isolated instances they do point up the need for a much broader approach for the installation of man, his activities and his structures in the landscape.

The Gaapé Regional Study, referred to at the beginning of the paper, is a case in point. The region in question is a non-industrial thinly populated area where income is derived primarily from mixed agriculture, forestry, fishing, mining and tourism. It is a peninsula with over 500 miles of coastline with a unique character which is expressed in its particular biophysical features, combining both interior and coastal plains and mountain areas - a seascape into which the pattern of woodlands, farms and fishing villages are interwoven to produce an area of exceptional visual and cultural quality.

While mining and fishing activities are considered in the light of the total potential of the region; agricultural and forestry practices are the major visual determinants. It is in the determination of strategies in these fields that the greatest physical impact can be made. Some of these are as follows:

1. The optimum development of those areas capable of supporting such activities and feasible within the economic and social framework established for these activities.
2. The removal from cultivation of 88,220 hectares (218,000 acres) of land and the stopping of land clearing practices except to accomplish a rational consolidation of land. This is to be followed by reforestation of land taken out of cultivation.
3. Adoption of new production techniques to replace traditional ones, which will produce optimum benefits within the constraints established by the natural characteristics of the land.

4. Grouping of farms and the zoning of forest areas for efficient management and production practices.

5. Consolidation of the population in areas of highest growth potential, thus eabling services and amenities necessary for a more meaningful way of life to be provided and alleviating some of the pressures in areas particularly subject to deterioration or not economically feasible to develop.

6. The establishment of a technical service to advise and carry out proposed changes in conjunction with the development of experimental agricultural and forestry stations.

There are however certain conditions which are difficult to evaluate. On the one hand you attempt to rationalize the use of land for an activity which will hopefully achieve greater social and economic values, yet in doing so you inevitably eliminate conditions which may be incentives for other activities. In attempting to rationalize agricultural and forestry practices you endanger the very qualities expressed in the existing land-activity patterns as being important for some other activity, such as tourism. The establishment of a 235 km^2 (91 sq. miles) area as a national park will assure, to some extent, the preservation of important scenic values and act as a pole of attraction to encourage the expansion of the tourist activities of the region.

While the execution of planning proposals is only in a preliminary stage, there is reason to believe that such measures, which seriously attempt to provide a comprehensive approach, will eliminate in the future the need for other short-term engineering treatments that may only partially solve the problem.

We are at present technically capable of modifying our environment to any degree we may wish, but in doing so we must recognize the social as well as the physical costs of our acts. Development must be at a rate that will permit nature to restore its natural processes and its equilibrium with man and his activities. Man must plan, design and build with nature if he is to survive.

S u m m a r y

The extensive despoliation in the region of Canada s open-cast mining areas in Northern Ontario and Quebec indicates lack of forethought. Until recently Canada has felt that its vast reserves of land resources were inexhaustible. Coupled with this philosophy existed the spirit of the pioneer-man against nature.

In the late 1960's a change began to be apparent in public opinion, an awareness of the havoc inflicted on the environment and the conviction that something must be done immediately to reverse the trend of self-destruction. The Government was forced to take cognizance of this force and has recently produced a flood of legislation at all government levels, dealing with environmental problems such as pollution, resource development, pesticide control etc. Linked with this legislation came new programmes for the comprehensive development of the landscape, for example the Agricultural and Rural Development programme, which provided for an exhaustive inventory of resources of a region and its economic prospects.

Typical of such a region is the Gaspé Peninsula of the Province of Quebec, with all its signs of misuse - uncontrolled timber and pulp operations, abandoned openpit mining, and agricultural land no longer economically productive.

Some aspects of biology and engineering as they relate to planning are discussed. There are three stages in the relationship:

1) where engineering ignores or dominates biology;
2) where engineering begins to adapt to biology;
3) where engineering is brought under the control of biological processes.

The two related considerations of very great importance in Landscape planning, if the biology-engineering relationship is to be rationalized and an. environment of quality achieved, are: the visual impact that is the result of a dynamic equilibrium between man-made patterns and processes and the geomorphological formations created by natural processes; and, secondly, the natural capacity of the land to support an optimum human occupation under conditions that are socially and economically feasible. As the public acquires a greater environmental appreciation it will demand and environment of higher quality. As the necessity for a multiple-use concept grows, engineering must adjust itself to the demand for environmental quality.

The paper concludes with a description of the Gaspé Peninsula Regional Study, which takes the total potential of the region into account in retionalizing the use of the land for greater social and economic values.

R é s u m é

Au Canada, les kilomètres de terres dégradées, dans les régions de mines à ciel ouvert du nord de l'Ontario et du Québec, témoignent d'un manque total de prévoyance de la part des exploitants. Jusqu'à récemment, le Canada considérait ses réserves en terres comme étant presque inépuisables. A cette conception, s'ajoutait l'esprit pionnier de l'homme à l'égard de la Nature.

Vers la fin des années 1960, il s'est produit une évolution dans l'opinion publique, une prise de conscience des dégâts causés dans le milieu naturel, et la conviction qu'il fallait immédiatement faire quelque chose pour renverser cette tendance à l'auto-destruction. Le Gouvernement s'est vu contraint de prendre ce mouvement en considération et a récemment adopté une multitude de mesures législatives concernant des problèmes de l'environement, tels que la pollution, le développaient des ressources, le contrôle de l'emploi des pesticides, à tous les niveaux de l'administration. A cette législation sont venus s'ajouter de nouveaux programmes d'aménagement global du paysage; le "Programme de développement agricole et rural" en est un exemple, il a permis de faire un inventaire exhaustif des ressources d'une région et de ses perspectives économiques.

La péninsule de Gaspé, au Québec, constitue un exemple typique d'une région de ce genre; elle présente des traces d'exploitation forestière incontrôlée - abattage d arbres, production de pâte à papier- des mines à ciel ouvert abandonnées et des terres agricoles ayant perdu toute rentabilité économique.

Les auteurs examinent alors certains aspects de le biologie et du génie civil dans leurs rapports avec la planification. Ils voient trois stades dans les rapports entre l'ingénieur el la biologie:

1) L'ingénieur ignore les données de la biologie, ou n'en tient pas compte;

2) L'ingénieur commence à adapter ses travaux aux données biologiques;

3) L'ingénieur conforme ses travaux aux données biologiques.

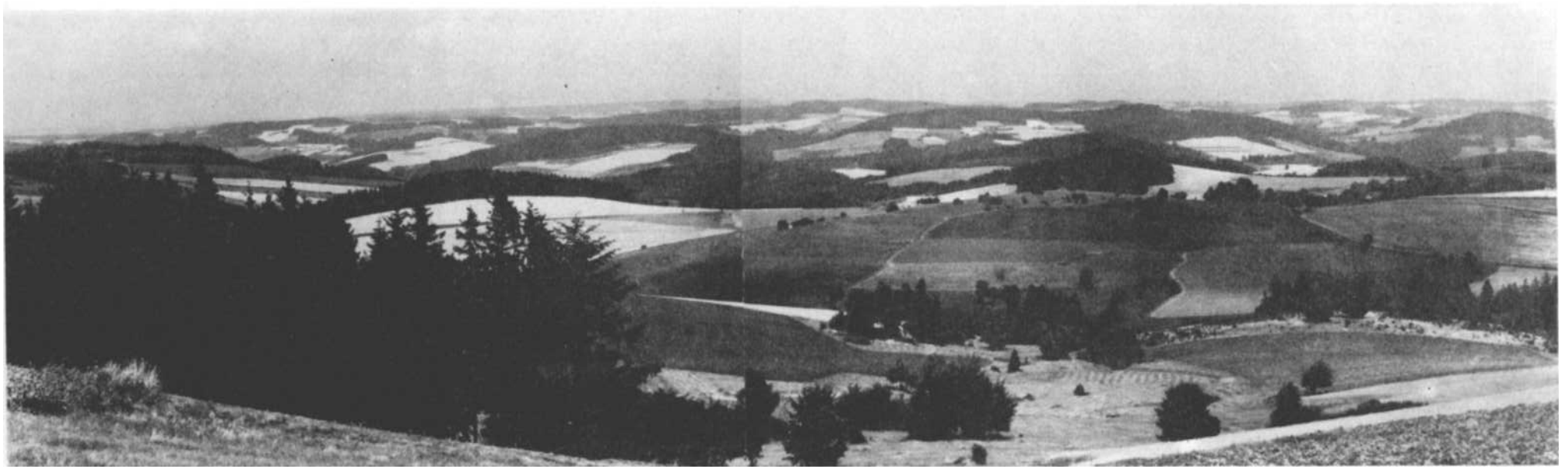
De quelles données doit-on tenir compte dans l'aménagement du paysage pour rationaliser les rapports ingénieur -biologie et créer un environnement de qualité? Il existe deux facteurs qui se tiennent et qui sont d'une grande importance:

1) L'impact visuel qui résulte de l'équilibre dynamique existant entre les structures et les processus créés par l'homme et les formations géomorphologiques créées par les processus naturels;

2) La capacité naturelle du site à supporter une occupation humaine optimum dans des conditions qui soient socialement et économiquement réalisables.

A mesure que le public apprendra à mieux apprécier son environnement, il exigera un environnement de plus grande qualité; à mesure que grandira la nécessité d une utilisation des terres a des fins multiples, l'ingénieur devra adapter ses ouvrages et ses entreprises à la demande d'un environnement de qualité.

L'ouvrage se termine sur une description de " l'Etude Régionale de Gaspé", qui tient compte de toutes les potentialités de la région, en rationalisant l'utilisation des terres afin de développer les valeurs sociales et économiques de cette région.



Showing a view of the Bohemo-Moravian Uplands. /Photo by M. Spuritý/

SYMPOSIUM ON THE RELATIONSHIP BETWEEN ENGINEERING
AND BIOLOGY IN IMPROVING CULTURAL LANDSCAPE

Brno, Czechoslovakia, 9 June 1970

LANDSCAPE TREATMENT OF THREE DAMS ALONG THE GRANDE RIVER

by

Almir de Lima Machado,
Fernando Magalhães Chacel,
and Luiz Emygdio de Mello Filho,

Paisagem-Empreendimentos Paisagísticos e Florestais Ltda.,
Rua Pinheiro Guimaraes, 101 - 3.° andar,
Rio de Janeiro, Guanabara, Brazil.

The Grande River a tributary of the Parana River, stands out in the hydrographic system of the Central-South region of Brazil due to its deeply uneven course. It flows through falls and narrow canyons between rock walls. From a geological viewpoint it flows on a bed marked by the contact between basaltic rocks and ancient metamorphosed mesozoic sediments.

The Grande River ranks nowadays as the most important river in Brazil due to the use of its hydroelectric potential through successive dams. The work of installation to the full foreseen capacity is almost complete in three of these dams. There are some others under construction and still others in project.

As is always the case, the building of the three dams has been done without regard to the preservation of the original countryside. After the work was completed, great disfigured spots remained on the surface with consequent problems of erosion, climatic discomfort, dust, reverberation, etc. This situation affects not only the operational staff, but the surrounding population as well, which makes the problem still more serious.

The present paper deals with the analysis of the above-mentioned problem in relation to the three dams of the Grande River, and with the landscape work done on them.

The dams in question are those built for the Furnas and the Estreito Power Stations which are operated by the "Central Elétrica de Furnas", and the Peixoto Power Station dam, midway between the others, which is operated by the "Companhia Paulista de Fôrça e Luz".

The work carried out by us on these sites included analysis and diagnosis of the present situation, as a starting point for the design of specific projects according to the peculiarities of each site. We then proceeded to the execution of the project which included shaping of the soil, drainage, and the use of moved earth, thus permitting subsequent plantings where previously the broken surface

as a whole has been unfit for any kind of planting.

Aesthetic aspects were included among the objectives of the planting programme, together with the integration of created and original elements with a view to enhancing the native vegetation. In spite of this policy, the landscape planners found it necessary in some cases to use exotic vegetal specimens, which had proved effective in earlier experiments, as holding ecological compatibility with the local conditions. Conflict between the phyto-physiognomy of mass plantations of trees and the general aspect of the local landscape was carefully avoided throughout the project. Several native species like Platycyamus regnellii (a big leguminous tree), Ficus enormis (white fig), and Pseudobombax cyatophorum. have been for the first time put to use in landscape projects as a common practice.

In the evaluation of the landscape problems of the three dams, three factors have been considered - soil, climate and vegetatior.

The local soil showed a simultaneous presence of red and yelow argilloid soil and quartzolitic intrusions, a common occurrence in the plateaux of Central Brazil. Most of the areas to be treated showed large spots of sterile sub-soil which had to be covered with moved earth either on flat or sloping areas. Argilaceous soils of medium fertility found in beds by the dam were used for this purpose.

The climate is typical of tropical latitudes with a rainy hot summer of the type CWA (Köppen) characteristic of intercontinental regions. The most pluvious months are December to February, the heaviest annual precipitation occurring in December. The most favourable season for planting is between November and March.

Native vegetation covered the "cerrado" and the plateau, the first being of a savanna type and the latter undergrowth and grassy. At the bottom of the valleys where fertility and humidity concentrate grow groups of trees of forest type. At spots where forest and "cerrado" join species of both types occur.

The particular problems of each of the dams are as follows.

I. Furnas Dam

The Furnas dam was the first hydroelectric power station to receive landscape treatment in Brazil. The landscape planners were appointed in the second half of 1964, to design three areas of priority importance, due to the date of inauguration set for May of the following year. There were three independent areas:

1. A rocky peninsula projecting into the dam's lake with a maximum axis of about 100 metres.
2. A rocky scarp upstream where a belvedere was to be built to receive visitors and be used for official ceremonies.
3. A flat area around the substation plant supporting the control station and the power centre.

The landscape treatment given to each area is as follows:

1. Peninsula Area

Sustaining walls built of quartz slabs, the local rocky material, have been erected in order to make possible the covering of the basic rock with a depth of soil sufficient to hold trees. On the periphery the height of the walls has been balanced by a series of platforms built at different levels where groups of plants have been placed, whose height, colouring, blooming and texture are so ordered that the original rock formation has been followed. The walls, the slope and the access stairway delimit an inner area, making a kind of belvedere overlooking the water outlet and the lake, where people can come to view, rest and stroll.

2. Belvedere Area

The belvedere has been formed by reshaping of the local topography and vegetation. The scarp was improved through proper grading and relief, so as to become a link between the belvedere and the rest of the area through a series of built-in elements such as platforms, stairways, etc.

Transition between the native vegetation covering the slope of the scarp downstream and the planted vegetation upstream has been achieved through the use of plants, specially shrubs, capable of adapting to the infavourable conditions of the "cerrado" soil (Bougainvillea , Yellow Bells, etc.). On the outer side of the stairway, a group of Liliaceae, Cactaceae and Agavaceae has been planted as a protection fence. Above the belvedere a large lawn almost flat but sloped towards the periphery has been planted. In the centre of it, a circulating track for automobiles as well as a parking lot have been built. The creation of a denser unit of vegetation of a woodland character has also been planned for this area. Stands of Delonix regia, Jacaranda semiserrata, Cassia; Cereus, Tecoma, Tibouchina, Triplaris philippensis, Schizolobium parahyba, Caesalpina leiostachya, and palms (Latania, Acrocomia sclerocarpa, Chrysalidocarpus lutescens) have been planted.

Finally, adjacent to the actual belvedere building, a type of characteristic garden, achieved through the utilization of the areas created by the formation of plateaux connected by stairways and pathways, has been created. Unity of the composition was obtained through making the pavement out of local quartzolite squares. Plants established contiguously to the built-up volumes of the belvedere, such as massed Philodendrum, Azaleas and Cereus, are meant to achieve an integration between the planted and built elements. Footpaths allowing complete circulation of pedestrians around the building distribute visitors and keep them entertained by the ever changing perspectives and angles of vision of the scenery.

3. Substation Area

The first thing to be done was to define the type of surface to be laid under the towers and the other elements of the substation. Then, the question of the ground covering of the slope next to the spillway had to be settled. Furthermore. it was necessary to give a landscape composition to the peripheral area of the substation next to the buildings (control centre and power station), to lay out the circulation track for automobiles, and to delimit the private parking lot for the control centre.

On the ground around and beneath the structures a continous covering made of gravel of a light tone of grey has been laid. The result was particularly attractive because of Che extensive stone surface, the harmonization between the colour of the stone and the colouring inherent in the metallic framework above it, and the large contrasting peripheral lawn.

The scarp was treated with quartzolitic slabs of a larger size laid down manually, with open joints.

On certain spots of the peripheral lawn of the substation, groups of shrubs were plented, in order to enhance the composition.

The garden of the control centre has been planned with the aim of achieving unity of composition with the existing architecture. In this area apots of vivid colour have been placed, thus forming a marked and significant contrast with the rest of the area, which is characterized by its great expanses of single-toned atone and grass.

After the priority areas had been completed, the necessity for integrating the planted areas with the surrounding woodlands became evident. The landscape planners accordingly called the attention of the "Central Elétrica de Furnas" to this, showing the advantages such work would bring to the whole region. Projects were later designed to plant patches of ornamental woodland and to reafforest the areas lying between these plantations. This work is still being carried out with the help of an allocation in the yearly budget. Another item emphasized by the landscape planners has been the importance of protecting the native vegetation and preserving all the residual samples of such vegetation as exist within or in the immediate neighbourhood of the Substation.

II. P e i x o t o D a m

Peixoto is a concrete dam which has been in operation for some years and which, because of its situation at the mouth of the canyon and the fact that it is built of concrete, has caused rather less disturbance to the surroundings. Most of the surfaces effected have lain along the side of the lake which was created by the dem.

The exposed residual, soil was composed of broken down rocky material of low fertility and inadequate texture to support vegetal life. This has been covered over with a layer of fertile soil good enough for the planting of trees and shrubs and, at the same time, allowing the recomposition of the landscape in harmony with the profiles of the adjacent undulating terrain.

The proposed landscaping projects has provided for pedestrian and automobile traffic to be directed to different stopping places. The lay-out of routes along the flanks of the slopes has made it possible to create areas downhill from them, which are suitable for the planting of groups of palms and other trees without disturbing the stability of the slopes and without damage to the natural vegetation.

Scattered lawns, paved surfaces and groups of trees and shrubs have been established under the project and, at the highest point in the vicinity of the dam, a belvedere has been built and an ornamental wood has been created. This area is earmarked as a recreation area for local residents, chiefly due to its being situated within easy reach of the lake.

Finally, the last stage in the project involves peripheral reafforestation of the whole surrounding area of the dam, thus completing the over-all landscape treatment.

III. E s t r e i t o D a m

Situated downstream of the Peixoto dam, the Estreito dam like the others is constructed across one of the Rio Grande canyons, the walls of which serve to support it. It is an earth-filled dam, with an argillaceous core and outer covering of rock. The soil, climate end vegetation are similar to those of the other dams.

Only one peculiar circumstance has to be emphasized in respect of Estreito. It has been accorded landscape treatment right from the beginning of the work, when the operational centre was being laid out. Consequently, trees and some considerable blocks of natural vegetation have been preserved and were absorbed into the landscape plan, contributing effectively to the integration of the man-made and original landscapes.

Initially, the plan adopted consisted of dividing the landscape into a number of Zones and defining the types of treatment to be applied to each one of them. Thus a park-style treatment was given to the more densely urbanized area comprising the residential zone, guest-house, commercial centre, general services area, belvedere and the actual dam itself with its typical buildings - spillway, power station and substation.

Along some of the main roads, woods of ornamental trees have been established, to give travellers the enjoyment of surroundings embellished by this kind of plantation. For the areas where the soil has been laid bare by earth-moving operations during the construction of the dam, reafforestation has been planned to blend into the mass of natural vegetation, thus reconstructing the unity of the vegetal cover.

In some spots planting related to the architecture, in the form of shrubby gardens, has been undertaken. These can be seen in the vicinity of the guest-house, the local club, high-grade housing, the school and the hospital.,

Around the actual dam, the landscape planners have succeeded in getting their views accepted in respect of the location of roads and pathways, which has resulted in a better formal concord between the lines separating land and water and improvements in the design of the tracks themselves. This in turn has influenced the planting programme and led to a better distribution and lay-out of the various groups of vegetation.

C o n c l u s i o n

The landscape planners have agreed that the type of work accomplished, as described above, marks a significant step towards a better understanding by the Administrators of the necessity for landscape treatment of any large-scale works likely to exert a major impact on the natural equilibrium,,

The importance of the work undertaken, which in a country like Brazil is very much of a pioneer nature, does not lie in any claim that it has been fully and successfully accomplished or that it is free from criticism, but rather in the fact that it constitutes a starting point and provides good evidence of the necessity for landscape treatment as a complimentary factor to technology, as a means of achieving integration and as an instrument for the conservation and rehabilitation of nature.

Furthermore, we are agreed that the right solution is always to consider the affected area as a whole, in terms of reconstituting the vegetal cover and using the highest possible proportion of local species. It is not a matter of imitating nature, but of making an ecological composition integrated floristically and phyto-physiognomically with the natural landscape of the region concerned.

We believe that the main importance of the landscape work done on the three dams on the Grande river, therefore lies in the fact that once the planned reafforestations have been fully achieved, they will act as reserves for the local flora and fauna. Such reserves are of vital importance because the whole region is now being subjected to a growing pressure of rural occupation in the form of large-scale agricultural enterprises or cattle ranching.

S u m m a r y

The Rio Grande now ranks as the most important river in Brazil, due to the exploitation of its hydro-electric potential by the construction of a series of dams. Such construction has left behind large areas where the surface of the ground has been disfigured, with erosion, climatic changes and other adverse consequences.

The paper describes the landscape planning work carried out to remedy this situation at three of the dams and power stations, namely Estreito, Peixoto and Furnas.

The landscape designs were based on analysis and diagnosis. Aesthetic considerations were a principal objective of the planting programme, as was the integration of man-made structures into the original surroundings. Some exotic species of plants, which had proved effective in earlier experiments and in keeping with local ecological conditions, have however also been used, but conflict between the photo-physiognomy of planted and natural areas has been carefully avoided.

In the evaluation of the landscape problems of the three dams, the soil, climate and vegetation have been particularly considered. The main features and the landscape treatment of the three power stations are described, mention being made of the fact that the Furnas dam was the first hydroelectric power station in Brazil to be so treated. The importance of the work lies chiefly in the fact that it is a starting-point and that it shows clearly the necessity for landscape planning as a method of achieving integration and as an instrument for rehabilitation and creative conservation.

R é s u m é

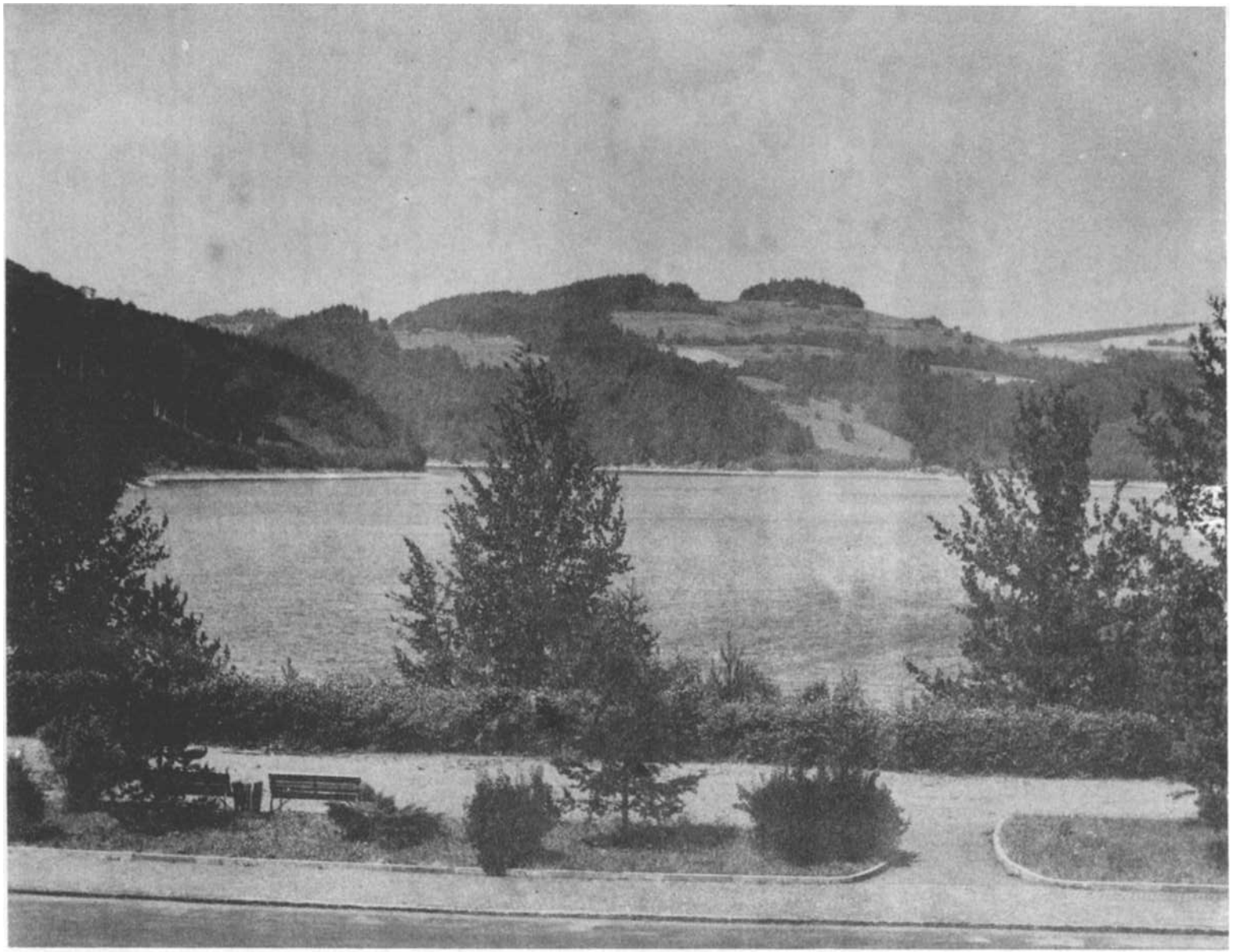
Le Rio Grande est aujourd'hui le fleuve le plus important du Brésil du fait que plusieurs barrages successifs ont été construits sur son cours pour produire de l'énergie motrice. A la fin des travaux, il reste aux alentours de grandes surfaces dénudées, où se développent des phénomènes d'érosion, de variations climatologiques, et des autres conséquences négatives.

Le présent article examine le cas de trois stations hydroélectriques - Estreito, Peixoto et Fumas.

Le plan des ouvrages a été établi en fonction de l'analyse et du diagnostic des situations respectives. Lors de la plantation, on a essentiellement tenu compte des aspects esthétiques ainsi que de l'intégration des structures artifi~cielles dans l'environnement original. Certaines espèces végétales exotiques qui se sont montrées efficaces dans des expériences antérieures et qui s'accordaient aux conditions écologiques locales, ont été utilisées. On a évité qu'il y ait des discordances entre la physionomie végétale ces régions plantées et le paysage local environnant.

Les facteurs sol, climat et végétation ont été particulièrement pris en considération dans l'analyse des problèmes paysagers des trois barrages. Les conditions régnant dans chacun de ces sites sont décrites.

Les auteurs exposent ensuite la façon dont a été traité le paysage environnant les trois stations motrices, en indiquant que le barrage de Furnas est le première centrale hydroéloctrique à avoir fait l'objet d'un aménagement du paysage au Brésil. L'importance de cette réalisation tient surtout à ce qu'elle constitue un point de départ et qu'elle met clairement en évidence la nécessité de l'aménagement du paysage en tant qu'élément d'intégration et d'instrument de remise en valeur et de conservation créatrice.



The VÍR Dammed Lake. In the foreground, special setting of trees and shrubs. /Photo by V. Vaníček/

SYMPOSIUM ON THE RELATIONSHIP BETWEEN ENGINEERING AND BIOLOGY IM IMPROVING CULTURAL LANDSCAPE

B r n o , C z e c h o s l o v a k i a , 9 J u n e 1970

THE AESTHETIC VALUE OF VEGETATION IN RELATION TO LANDSCAPE ENGINEERING

by

Vlastimil Vaníček, Professor of Land Reclamation and Improvement,
Brno University of Agriculture,
Brno, Czechoslovakia

The ever-increasing penetration of all those elements that are generally referred to as "civilization" into Man's way of life results in a gradual, artificial transformation of Nature. Under the influece of various engineering works the landscape changes its appearance, as well as its aesthetic, productive, sanitary and habitable values. Some of these interferences with Nature may bring positive advantages to the biology of the landscape, while others may prove adverse, because, while they seem to have certain beneficial effects, they are also introducing damaging elements. It is highly d«sirable that such damage should be reduced to a minimum, or eliminated. Nature's wealth should be protected at the same time as engineering development takes place, and ecological knowledge should be applied whenever natural resources are to be used to meet human needs.

It is evident that human activities, which modify the landscape, no matter whether intentionally or indirectly, to a certain extent conflict with conservation of Nature. The more these activities are multilateral and effective in their qualitative and quantitative results, the more conspicuous and profound will be the alterations to the landscape. It is therefore understandable that, under the present conditions of utilization and transformation of the landscape, those branches of engineering which, in respect of their activity, are closely connected with the natural environment, have become the object of concentrated interest.

The conservation of water and land reclamation and improvement, amongst others, may be grouped under the above-mentioned branches of engineering. The first of these covers all the various methods of water management, taking into account that, in Nature, water may fulfil a beneficial or harmful function. In other words, water as such must be considered from the point of view of all its contradictory effects, as an element which is both beneficial and harmful. Instances where water occurs in the cultural landscape under ideal conditions deserving conservation of its existing status are rare. Man must therefore interfere in most cases to improve the water systems of a landscape. In doing so, he naturally influences the ecological character and the appearance of the landscape.

Land reclamation and improvement (in some countries referred to as amelioration) are to be considered in a similar way. In Czechoslovakia the importance attached to the sciences concerned has recently shown an upward trend, in the process towards the creative conservation and planned utilization of basic natural

resources - soil, water and vegetation. The sciences concerned with lend improvement do in fact have a creative approach to the natural environment as a complex whole, the aim being to make it more suitable and valuable for human habitation. If, in some places, undesirable phenomena have appeared in the landscape following upon engineering works, this can be explained as due to imposition of the engineering aspects on the biological aspects in an ill-considered and unscientific way. The proper solution is to be found in a creative and constructive co-operation of these two apparently diverging sciences. Alteration to the environment should be the result of a positive and a sensitive approach of Man to Nature. The never-ceasing advance of modern society with its growing requirements for a higher standard of living is not only antagonistic to conservation in their existing state of large tracts of country, it even, to some extent, forces Man into the transformation of the landscape. In principle, two types of landscape are to be distinguished: natural landscape where Man, in accordance with his own scientific interests, must play a secondary role and take into account the landscape s natural character and evolution, and cultural landscape which Man intentionally transforms and utilizes as the environment most suited to his own existence. But, once Man has lost his contacts with Nature and fails to consider it in its entirety, a gradual deterioration of the landscape results, for its ecological balance has been upset.

On the other hand, engineering works based on detailed and duly applied ecological studies are in no way in conflict with the landscape, they even may become an organic part of it. This can be shown by the example of a number of landscapes which, despite the changes brought about by landscape engineering, have retained their economic, scientific and aesthetic values.

In undertaking engineering works in a particular landscape, proper attention must also be paid to the aesthetic values of the landscape, these being represented most conspicuously by the spatial setting of vegetation. In the past, Man ha3 approached Nature and the landscape when engaged on engineering projects largely as a mere site of operations, as a source of building materials, raw materials or power, or even in some cases as a threat to his own existence. Instances in which the landscape was considered for its aesthetic values were rare. Until recently, there was only one human profession which intentionally utilized vegetation as part of the material to be manipulated when designing the environment for engineering constructions, namely the profession of landscape gardener. In the spatial planning of housing estates and prominent buildings both components - buildings and vegetation - command an equal share of creative and specific attention.

The question may be asked - "Are the parks which are planned as the setting for engineering and building projects, works of art and thus attributable to an aesthetic function?" - I personally believe so, for the aesthetic function covers a much wider field than Art in the ordinary limited sense. Any objective or action that results from human cultural activity may become a vehicle of the aesthetic function. Accordingly, this function is also applicable to deliberate modification of the vegetation in association with building and engineering works.

The above interrelationships and interconnections have not been fully recognized and understood until very recently, when scientifically conceived landscape planning and the need for a highly complex approach to the problems involved, in which serviceability, perfection and aesthetic effect must all be allowed expression, began to be emphasized. Thus, a new scientific field has gradually come into being: engineering biology. We suggest the use of this term to define the science concerned with the incorporation of engineering structures such as water works, roads and highways, land reclamation and improvement etc., into the landscape environment by employing vegetation as the integrating factor for reasons dictated by biology, engineering, aesthetics, sanitation and economy. In short, engineering biology should act as an intermediary between Nature and engineering.

The aesthetic creative activity in the field of landscape gardening is, of course, an essentially easier matter than what is involved in the newly developing science of engineering biology. Landscape gardening has been developed for a long time to reach its present level and is a science which has already established a tradition in its treatment of space, using standards that have been adapted and refined through an evolutionary process. On the other hand, there are no such established standards available to engineering biology which can guide Man in his extensive impacts on the landscape} what is worse, no similar aesthetic standard have yet developed to the extent required.

Unlike landscape gardening, conditions available to engineering biology are much less favourable for special manifestations of art. The former, using vegetation as the supporting element, adds the finishing touches to a definitely formed space dominated by architectonic structures. Engineering biology, on the contrary, finds its field of action in the vaster expanse of countryside where the engineering structure only very occasionally occupies a dominant position and for the most part must necessarily conform to Nature and its laws. Moreover, on the basis of what has already been said, the conclusion can be drawn that any arrangement of vegetation associated with engineering works must also categorically conform to the over-all character of the landscape, both ecologically and aesthetically. Not the mere unscientific and inactive imitation of Nature is meant here; the concept implies a creative adaptation of the structure to bring it into line with the aesthetic and biological values of and the requirements for a cultural landscape.

Thus, for instance, in evaluating from the viewpoint of engineering biology some of the major works which have been in the past undertaken to regulate water courses, it is evident that projects have often been conceived in a one-sided manner, with only some specific aim, such as to serve the purpose of eliminating the threat of floods, to provide for better utilization of the water supply, etc. Few examples of water regulation can be found where due account was taken, in the design, of the natural environment as a whole and of the aesthetic requirements for a landscape. The regulation of a river means a great deal of alteration to the general character of the flood plain; the natural course of the stream is straightened and the bed excavated, the meanders disappear and the trees and shrubs on its banks are felled. Land in the river valley is often drained, and converted into fields, orchards and even recreation facilities, replacing the former inundated forests and waterlogged meadows. New plantations of trees and

shrubs on either side of the river may give the valley its final appearance both in the vertical and horizontal plane.

In incorporating a water course into the landscape, the composition of plant species and the spatial distribution of them prove most effective if they correspond to the actual ecological conditions and aesthetic requirements of the landscape which is being altered. The planting pattern ought to be chosen in such a way that the Basic function to be fulfilled by the vegetation becomes dominant: this may be either biotechnical or aesthetic, or both. Most often both functions are involved, as when vegetation is used for the consolidation of river banks. It is only quite seldom that the first or biotechnical function predominates to the extent that the aesthetic effect of the plants becomes suppressed. in most cases plants have an aesthetic function, as when the vegetation intentionally integrates the stream into the landscape and is used as a plastic method of mitigating the effect of consolidating the channel by stone or concrete.Plants, of course, also fulfil climatic, sanitary and economic functions. Varied and abundant vegetation acts as a connecting link between the stream and its adjoining open area, acting as a counterbalance to the straight lines of channel which has been regulated.

It is advisable to distribute trees and shrubs irregularly when planting up the banks of water bodies such as ponds, dams and reservoirs. Reservoirs located in hilly situations require simpler plantations, lighter in composition, for their surroundings, as compared with those constructed in open lowlands. Regular lines of trees are convenient for planting round some dams and along transport or irrigation canals, so arranged as to direct the eye towards some dominant natural or artificial feature in the landscape.

Vegetation which is rich in form and varied in colour offers a pleasing contrast to engineering structures, which are conceived with mathematical accuracy and apt to be aesthetically austere. Trees and shrubs planted along water courses, canals, roads and highways, or in proximity of reservoirs and ponds should, therefore, never be limited to featureless and dull plantations, but should fit in nicely with the surrounding landscape. In this way engineering works supplemented by carefully selected plants can become valuable elements for the enrichment of the cultural landscape.

S u m m a r y

The measures aimed at improving water management and land reclamation and improvement works are justified in landscape transformations that aim at the general improvement of agricultural, silvicultural, sanitary and economic conditions. However, if such structures are to develop as organic elements of the landscape's biology, their execution must be based on preliminary evaluation of the prospective relationship between the structures and the other factors that form a particular territorial complex. Properly designed and skilfully executed structures of the above kind aim at a more dynamic development of the cultural landscape. In any engineering works in a given landscape proper attention must be paid also to the aesthetic value of that landscape, these being achieved most

conspicuously by the spatial setting of vegetation in accordance with the principles of engineering biology. This term is defined as the science which, in terms of ecology and landscape planning is concerned with the incorporati. on of engineering structures into the landscape environment and with making use of supplementary vegetation to integrate these structures with the landscape for reasons of biology, engineering, aesthetics, sanitation and economy.

The engineer of today should be able to master and transform the landscape environment not only in accordance with the requirements, scientifically founded, for technical serviceability, but also to meet the aesthetic needs of Man.

The present cultural landscape is not only the result of manifestations of natural forces, but has also been under the influence of human activity over long periods of time, which has profoundly affected the former features and natural development. Therefore, in incorporating engineering works into the landscape we can well afford to include the artistically effective planting of species that will also introduce into the landscape new aesthetic elements and aspects.

R é s u m é

Des mesures destinées à améliorer l'aménagement des eaux et la mise en valeur des terres se justifient lorsque la transformation apportée au paysage a pour but d'améliorer la situation agricole, sylvicole, sanitaire et économique. Toutefois, si de telles structures doiven être développées en tant qu'éléments organiques de la biologie du paysage, leur mise a exécution doit être basée sur une évaluation préalable des rapports présumés entre ces structures et les autres facteurs qui forment l'entité territoriale considérée. Des structures de ce genre, conçues et réalisées, permettront un développement plus dynamique du paysage cultivé. Lorsque des ouvrages techniques sont implantés dans un paysage, il faut aussi tenir suffisamment compte des valeurs esthétiques du paysage, celles-ci étant représentées le plus perceptiblement par l'ordonnance spatiale de la végétation selon les principes de "l'engineering biology", ou biologie technologique. Ce terme est défini ici comme étant la science qui, dans le cadre de l'écologie et de l'aménagement du paysage, s'occupe de l'incorporation des ouvrages construits par l'ingénieur dans le paysage et de la plantation de végétation pour y intégrer ces structures pour des raisons biologiques, techniques, esthétiques, sanitaires et économiques,

L'ingénieur contemporain est supposé pouvoir maîtriser et ransformer le paysage, non seulement en fonction des exigences d'utilité technique, mais aussi en fonction des besoins esthétiques de l'homme.

Le paysage cultivé actuel est le produit des forces naturelles, mais il a aussi été influencé par les activités humaines tout au long des siècles, se qui a profondemment affecté ses caractéristiques primitives et son développement naturel. Par conséquent, en intégrant les travaux d'architecture dans le paysage, nous pouvons inclure en même temps des plantations d'espèces qui apporteront au paysage des éléments et des aspects esthétiques nouveaux.

Showing the vegetation planted along the trained stream of the Svratka River /near Brno/ to give an aesthetic impression. /Photo by V. Vaníček/

SYMPOSIUM OK THE RELATIONSHIP BETWEEN ENGINEERING
AND BIOLOGY IN IMPROVING CULTURAL LANDSCAPE

Brno, Czechoslovakia, 9 June 1970

AMELIORATION OP LANDSCAPE DESPOILED BY INDUSTRIAL WASTE

by

C.J. Vyle
1, Ashford Road, Chelmsford, England

Throughout the world landscapes have been despoiled, by the winning of minerals in an age when the landscape was not considered as a cultural resource. It is important that with increased technological possibilities the landscape is no longer damaged by the operations needed to win the minerals. In dealing with the amelioration of landscapes, engineering tests can provide vital information on the nature and properties of materials; the results may have a limiting effect on the ultimate use of the site. Engineering plant enables earthmoving to be undertaken and the creation can improve the living conditions of local inhabitants by returning winter sunshine to them. The integration of the new landform into the surrounding landscape necessitates the skills and information afforded by biology. Thus the synthesis of engineering and biology through an appreciation of the landscape can lead to the main aim of reclamation which is to return land from an unproductive, infertile or devastated state to a fertile and pleasing landscape for agricultural, silvicultural or other purposes.

Engineering Assessment of Industrial Waste

In colliery wastes there is a need to assess the coal content and bearing capabilities of the materials as these two factors can influence both the design and after use of the site. Materials which are in the nature of soils may be assessed with the standard range of engineering tests. Chemical and physical activity in colliery spoil heaps may be assessed by observations of superficial signs of combustion, surface temperature, grids of shallow bore holes 0.9-1.8 m deep, deep bore holes, gas analysis, and the boring report.

Thus it is possible to plot the extent and intensity of any fire in the heap, the liability of the material to further ignition if moved and redisposed and any hazards to machine operators arising from heat, cavitation and toxic gases or other incidental problems.

If high percentages of coal are present it may be possible to win the coal from the heap and leave the remaining material when redisposed in a fit condition for any end use.

The quality of the red shale may be good enough for use as a road fill. Black shales with a low coal content may also be used as deep road fill.

Sulphur as pyrites is useful to assess as it may reveal latent acidity which could be corrosive to pipes and concrete work if building development were contemplated later.

The toxis gases which may be encountered are carbon monoxide, carbon dioxide and hydrogen sulphide, and the oxides of sulphur. Heat itself may be a hazard: on sites with which the University of Newcastle has been concerned temperatures of up to 470°C have been experienced. On other Northumberland sites flame combustion of 800°C has been reached.

Thus being aware of the Engineering properties and some physical and chemical properties which may influence the design and after use, a short form of landscape survey and analysis undertaken on lines described by Briggs (1966) provides the basis for a landscape plan. Consultation with soil scientists will reveal the soil forming potential of the parent material and may suggest the burial of more toxic materials with material which is better able to sustain plant growth. Botanists, agriculturists, horticulturists and foresters may all make valuable contributions in deciding the appropriate species to use for the particular circumstances.

Suitability of waste material to sustain plant growth

In the light of experience in the project under study, reasons for the absence or sparsity of vegetation may be seen to be the dominance of rock material or stones, impermeability of the soil to air or water, high water table, exposure to extreme climate, air pollution , lack of plant nutrients, inability to hold nutrients in soil, inability to retain moisture in soil, toxic levels of chemicals, and salinity.

There are two approaches to the establishment of vegetation. The first is to plant vegetation of low nutrient requirement, e.g. pioneer grass/legume mixtures and trees. The second is to ameliorate the site conditions with lime and fertilisers so that agricultural species may be grown.

Nature of waste materials and soil testing

Colliery spoils have formed the bulk of the materials on project sites and exhibit a wide range of physical and chemical attributes. Having determined these characteristics each site may then be classified into "parcels" related to the treatment and subsequent management, which in turn is related to the use. Required levels of liming and nutrient levels of nitrogen, phosphorus, and potassium for various end uses such as agriculture, forestry and recreation, may then be put forward.

Physical and chemical characteristics of shale soils

The shales encountered at Roddymoor were black, grey, red, and mixtures of red and black; other materials were slurry, coke breeze, building foundations and stacked drift, sub-soil and top soil. The shales were stony and had been heavily compacted by earthmoving machines.

The surface materials at Big Waters were ash which had been used for agriculture, black shale with a high coal content overlain with soil, black shale with mixed shale and soil, end black mixed shale with red mixed shale. The shales were stony at Big Waters but impermeability to air and water was not a problem over most of the site. Areas of high water table are present because of the

levels at the boundaries of the site in relation to the water level in the subsidence flash.

At Big Waters the pH of the shales before regrading varied between 2.8. and 3.8., and during regrading these rose to 3.5. - 4.4. The agricultural ash areas had a pH of 6.7. which rose to 7.1. on regrading. The imported Dinnington shale had a pH of 8.0 to 8.5 with free calcium carbonate present. Lime was applied to the north area west of the road prior to the placing of the Dinnington shale; 2 ha (5 acres) to the south were similarly treated. Salinity has not been a problem on Big Waters and has never exceeded the designated safe limit of 4 mmhos/cm.

At Nothbourne Park, an area previously occupied by the old lead works had some areas which had been used for acid standing, the pH being 3.5.

Definition of "Parcels" for later management

At Roddymoor the groups defined for management treatment later were the "soiled" group where the shale was covered with stacked sub-soil and top soil, or drift or top soil alone, and the "shale" group, which included all those areas not soiled and with the spoil surface exposed.

Lime and fertiliser requirements in relation to use

No lime was considered necessary for the Roddymoor site, as the pHs at the seeding time were reasonable for grass establishment for agricultural use.

At Big Waters lime was applied at the appropriate rate to achieve optimum conditions for plant growth at the surface and part neutralization of the sub-surface. The pH of the black shale surface after liming was 7.0, the pHs of the Dinnington shales after placement were 7.7, 7.3 and 6.9 (Parcels 3,4,5). The incorporation of lime to neutralize or part neutralize the sub-surface may help to prevent deep rooted species from going into check when their roots meet the less favourable medium. The severe lack of phosphorus at Big Waters is likely to be due to the fixing properties of the parent materials.

It is becoming apparent with increasing experience of shale soils that phosphorus is a limiting factor. It may help to explain why trees planted on some heaps have remained in check.

Where tree planting has been the aim following autumn grass establishment, no extra fertilizer has been applied until the spring of the following year, the intention being to maintain grass cover but not to cause undue competition with the trees.

Thus bearing in mind the widely differing characteristics of shale soils and other materials found on derelict sites, soil testing is imperative and lime requirement tests should be included, particularly on those materials where is a likelihood of increasing acidity. In these circumstances such a test should be undertaken as a matter of routine over the first five year period, during which time the soil fertility cycle is being established. Nutrient requirement tests are also vital, adjustments being made according to the type of management which is to be adopted.

Other site characteristics

There is no air pollution problem at Roddymoor. At Big Waters local sources of pollution in the form of burning pit heaps are in the process of being removed, At Nothbourne Park the heating coal by-products plant exits fumes which have given a tarry deposit on trees at the eastern end of the site.

Exposure is a problem on the top of the Roddymoor heap. Exposure is not a severe problem at Big Waters or any of the other project sites under way.

Seed-bed preparation

Precultivations comprise ripping, stone picking and removing hollows.

Ripping

The most important item to relieve compaction is ripping. The specification indicated this should be at 0.9m (3'), centres 0.6m (2') deep. However, site experience at Durham has suggested that this is not adequate to provide cones of shattering which meet. The County Council now specify that ripping must be at 0.6m (2') deep to obtain a reasonable seed bed later. Certainly at Roddymoor the ripper tended to ride out of the ground: at Big Waters the tendency was also to ride out and the depth of ripping was only 0.3m (12") deep. However, by insisting that the machine operator drove slowly, using a Drott with its 3 tynes set at 0.9m (3') apart, adequate depths of ripping were achieved.

Stone Picking

The removal of, firstly, large stones, and then smaller stones was undertaken. The tracking of loaded trailers on damp soil and shale was a problem as it led to wheel compaction which in turn led to water running down the tracks and eventually opened up small gulleys.

Removal of Hollows

The hollows left by. removal of stones could be filled in by scrubbing. Spring tyne and fixed tyne cultivators have also been used with success in removing hollows.

Cultivations

Discing

Heavy discing helps to break up the surface and create a rough seed bed.

Harrowing

This breaks the rough seed bed down to provide a better surface and finer tilth to receive the seed. It is also useful for covering the seeds and giving a better environment for germination.

Liming and Fertilising

It may be useful to apply lime before ripping and thereby obtain a distribution through the profile which will help to neutralize acid being formed within the top 0.6m (2'). Basic slag incorporated in this way could also be beneficial for deeper rooting species.

Cultivating with fixed or spring tyne cultivators could help to incorporate slag to between 152-229mm (6" and 9") depth where it helps to encourage more

vigorous rooting.

Fertilizer harrowed into the surfaces encourages seedling rooting. Care must be taken to ensure that no long gap occurs between fertilizing and seeding, otherwise the fertilizer will be simply leached away due to the nature of surface materials. Scorch was thought to occur if fertilizing and seeding took place together and in some cases seeds were applied a few days after testing. However an autumn seeding with a low nitrogen fertilizer application, followed by seed distribution the same day, has not proved damaging to the germinating seedlings.

Type of plant cover

Plant cover was selected for a number of factors including variations in soil, use, aspect, steepness of slope, shelter and visual improvement.

Spacies Selection

Species were chosen in relation to soil type, aspect, slope angle and use. Selections were made based on the examination of literature and correspondence with various authorities.

Examples of Grass Mixtures

A successful Agricultural mixture has been-

CP1	Strain British certified	on soil Kg/ha	CP2 colliery on shale
Lolium perenne	S.24	15.7	31.2
Dactylis glomerata	S.37	7.9	15.6
Phleum pratensis	S.51	4.5	9.0
Trifolium repens	S.100	2.3	4.5
Trifolium pretense	S.123	3.4	6.7
		33.8	67

gl 10 A mixture showing promise for low maintenance —

Phleum bertolonii	S.50	9	13.3
Trifolinm repens	S.100	2.3	3.4
		11.3	16.7

Examples of Tree Species used -

Acer platanoides, A.paeudoplatanus, Alnus corda ta, A.glutinosa, A«incana, A.rubra, Betula verrucosa, Crataegus monogyna, Fagus sylvatica, Fraxinus excelsior, Picea sitchensis, Pinus nigra calabrica, P.contorta, P.sylvestris, Populus slba, P. x berolinensis, P.canescens, P.x "Eugenii", Populus x "Gelrica", P.x "Robusta", P.x "Seroutina", P.tachamanaca x trichocarpa 32, P.tremula, P.trichocarpa, Prunus avium, P.padus, P.padusa, Quercus robur,

Q.borealis maxima, Robinia pseudoacacia, Salix alba, S.alba "Liempde", Sorbus aucuparia, S.aris, S.intermedia, Tilia platyphyllos.

C o n c l u s i o n

Having made an engineering assessment and landscape survey the most important aspect in vegetating industrial waste is to treat each site on its own merits. The following general principles may be put forward: -

a) The first essential is to assess the waste material as a soil forming agent and to undertake lime and major nutrient requirement tests (particularly phosphorus and potassium).

b) The preparation of the site must ensure adequate relief from compaction, by heavy ripping. If the site has a history of industry then the foundations or other waste should be covered with at least a 0.9m (3') depth of suitable material so that ripping could provide a reasonable medium for plant growth. If possible at the design stage the incorporation of slopes no greater than 1:8 will ensure maintenance problems are reduced to a minimum by allowing agriculture to take place. If steeper slopes are designed, then access to allow for mechanical fertilizer spreading should be built in.

c) Removal of stones and preparing the seed bed so that a favourable environment for plant growth is created is an essential part of the process. Deep ripping of lime and basic slag, deep cultivation of triple superphosphate and harrowing in of a combined complete fertilizer in a phosphorus deficient material should help to reduce the possibilities of plants going into check.

d) Having assessed the soil forming capabilities of the material, and made good any deficiencies of the major nutrients, suitable seed mixtures could be selected and applied at the appropriate rates. The more fertile the material the nearer to an agricultural rate may be used. One and a half times should be adequate but under adverse physical conditions twice the rate would be more appropriate. Three times the agricultural rate should be sufficient for the most rapid cover on slopes prone to erosion or used for recreational purposes.

S u m m a r y

In dealing with the amelioration of landscapes, despoiled by industrial waste, engineering tests can provide vital information on the nature and properties of materials. Engineering plant enables earthmoving to be undertaken to improve living conditions. The integration of the new landform into the surrounding landscape necessitates the skills and information afforded by biology. Thus the synthesis of engineering and biology through an appreciation of the landscape can lead to the aim of reclamation.

The engineering assessment of indutrial waste (coal content and bearing capabilities of materials, chemical and physical activity) in colliery spoil heaps is of great importance, as this may influence the design and after use. This assessment and a short form of landscape survey and analysis provide the

basis for a landscape plan. Consultation with soil scientists reveals the soil forming potential. Botanists, agriculturalists, horticulturalists and foresters make valuable contributions in deciding appropriate plant species to use. The whole process of assessment and testing is well shown by an example situated at Roddymoor and the procedure, step by step, until final reclamation is achieved is described in detail. However, it is emphasized that each site has to be treated on its own merits. The paper concludes with the following general principles:

1. Assessment of waste material as soil forming agent;
2. Preparation of the site must ensure that compaction is adequately relieved by heavy ripping;
3. Removal of stones and preparing the seed bed in order to obtain a favourable environment for plant growth;
4. Selection of suitable seed mixtures after assessment of soil forming capabilities and correction of nutrient deficiencies.

R é s u m é

Pour restaurer des paysages dégradés par les déchets miniers, les teste technologiques peuvent fournir des informations fondamentales sur la nature et les propriétés des matériaux. Les engins de terrassement permettent de remuer d'énormes volumes de terre et a'améliorer les conditions de vie des habitants. L'intégration du nouveau site dans le paysage environnant fait appel aux techniques et aux connaissances fournies par la biologie. Ainsi la synthèse des techniques de l'ingénieur et de la biologie permettra d'atteindre l'objectif fondamental de la restauration des terres.

L'analyse des déchets industriels afin de déterminer leur teneur en charbon et leur capacité portante, ainsi que l'activité physique et chimique dans les terrils miniers, présente une grande importance, car elle peut influencer la structure et le type d'utilisation future du site. Cette analyse et une forme abrégée d'étude du paysage fourniront les bases du plan de paysage.

En consultant des pédologues, il sera possible de connaître le potential pédogénétique de matériaux. Botanistes, agronomes, horticulteurs et forestiers apporteront aussi d'utiles contributions en indiquant quelles espèces utiliser pour la replantation.

Ce processus d'analyse et d'expérimentation est très bien illustré par l'exemple de la zone minière de Roddymoor. L'auteur décrit pas à pas les étapes qui ont conduit à la restauration complète du paysage.

Selon l'auteur, chaque site devrait être traité suivant ses caractéristiques particulières. Quatre principes généraux sont donnés en conclusion:

1) Analyse des déchets en tant qu'agents pédogénétiques potentiels;
2) Préparation du site, en empêchant la compaction du sol par un hersage approprié;

3) Epierrage et préparation de la couche a ensemencer afin de créer un milieu favorable à la végétation;

4) Choix de mélanges de semences appropriés après analyse du potentiel pédo-Rénétique et la correction des carences en éléments nutritifs.