

## PHYSICAL GEOGRAPHY IN THE NETHERLANDS\*)

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*Zusammenfassung:* Die niederländische Geographie zeigt seit dem Ende des vorigen Jahrhunderts eine deutliche Aufspaltung in eine rein naturwissenschaftlich und eine rein sozialwissenschaftlich orientierte Disziplin. Zwar waren um 1900 in Amsterdam diese beiden Teildisziplinen der Geographie noch in einem Ordinariat vereinigt (das allerdings besetzt wurde mit Prof. C. M. Kan, der von seiner Ausbildung her klassischer Philologe war und erst relativ spät in das Lehramt der Geographie hineinwuchs), doch wurden 1908 mit der Einführung der Geographie an der Universität Utrecht zwei Ordinariate eingerichtet. Das eine war für die Physische Geographie bestimmt und wurde von Oestreich, einem stark geologisch ausgerichteten Schüler A. Pencks und W. M. Davis', übernommen, das andere (mit Niemeyer) für politische und ökonomische Geographie. Mit Oestreich, der seine Antrittsrede dem Thema „Die Landschaft“ widmete, begann die Entwicklung der physischen Geographie in den Niederlanden. Der Begriff „Landschaft“ freilich war für Oestreich (und seine Schüler) gleichbedeutend mit „Formenwelt der Erdoberfläche“. Diese ziemlich einseitige Ausrichtung ergab sich nicht nur aus Oestreichs persönlichen Interessen, sondern war auch eine Folge der lokalen Situation in Utrecht: die Vegetationsgeographie war den Biologen vorbehalten, und klimatologische Studien den Meteorologen.

Noch lange Zeit wurde physische Geographie als praktisch identisch mit Geomorphologie verstanden. Wohl erklärte Hol als Nachfolgerin Oestreichs in ihrer Antrittsrede (1946), daß die Geomorphologie zwar Kernwissenschaft der physischen Geographie sei, daß aber auch Klimatologie und Ozeanographie zu ihr gehörten. Schon 1937 hatte Bakker in ähnlicher Weise als das Ziel der physischen Geographie bezeichnet, den Formenschatz der Erdoberfläche zu erklären und darüber hinaus zu untersuchen, welcher Einfluß von der Erdoberfläche auf Hydrosphäre und Atmosphäre ausgeht. Oestreich selbst schrieb 1948 sogar, daß „das Objekt der physischen Geographie physische und biologische und auch vom Menschen umgestaltete Elemente enthält“. In der Praxis der Forschung jedoch blieb die physische Geographie einseitig geomorphologisch orientiert, so auch Bakker mit seinen Arbeiten.

Bakker war Schüler Oestreichs, hat aber neue Wege gesucht. Dabei versuchte er zunächst, die stark deduktive Geomorphologie mit „exakten“ mathematischen Berechnungen zu unterbauen, so etwa am Beispiel der Hangentwicklung.

Sein Ziel, sich nur „exakter“ Methoden zu bedienen, führte ihn ins Labor, wo er (mit Hilfe Müllers) die tonmineralogische Analyse in die (Klima-) Geomorphologie einbrachte.

Auch außerhalb des Faches Geographie wurden in den Jahren 1935–60 Untersuchungen durchgeführt, die der physischen Geographie eng verwandt waren. Edelman beispielsweise machte mit Hilfe sedimentpetrologischer Methoden paläogeographische Studien und entwickelte darüber hinaus (mit Oostingh) eine landschaftlich orientierte Bodenkunde, die später in der (von Edelman begründeten) „Stichting voor Bodemkartering“ angewandt wurde. Edelmanns sedimentpetrologische Methoden wurden beim Geologischen Dienst in Haarlem für geomorphologische und quartärgeologische Untersuchungen benutzt, wobei man im Rijkswaterstaat Küsten und Flüsse studierte.

Um 1960 fanden derartige Forschungen Eingang auch in die „offizielle“ Geographie der Universitäten. Die physische Geographie der Niederlande wurde damit zu einer Disziplin, die sich mit einzelnen Themen aus dem Bereich von Geomorphologie, Bodenkunde und Quartärgeologie beschäftigte. Regionale Zusammenhänge und Wirkungsgefüge von Landschaften hingegen waren wenig gefragt. Doch ist als positiv zu bewerten, daß man auf diese Weise versuchte, nicht nur oberflächliche Beschreibungen und weitläufige verbale Deduktionen hervorzubringen, sondern mit empirischen Daten und gesicherten Argumenten physische Erklärungen zu geben. Die heutige physische Geographie in den Niederlanden hat daher überwiegend nomothetischen Charakter. Dem Studium der physisch-geographischen Prozesse (und auch der Morphometrie) widmen sich verschiedene Institute. Dabei ergab sich zwanglos der Anschluß an die in den angelsächsischen Ländern entwickelte, ebenfalls nomothetische quantitative physische Geographie. Daneben aber blieb auch in den Niederlanden die jetzt sehr „klimabewußte“ und mit Quartärgeologie verknüpfte „klassische“ Geomorphologie bestehen. Auch die geomorphologische Kartierung wird von physischen Geographen (Maarleveld, Verstappen) gepflegt.

Eine interessante Entwicklung ist gegenwärtig insofern zu verzeichnen; als man gerade mit Hilfe der aus nomothetischen Untersuchungen gewonnenen Erkenntnisse sich nunmehr wieder der Synthese zuwendet, und zwar besonders der landschaftsökologischen Synthese. Die Landschaftsökologie (cf. Troll, Schmithüsen) wurde besonders von solchen Geographen (Verstappen, Vink, I. S. Zonneveld, J. I. S. Zonneveld) stark vertreten, die sich mit der Luftbildinterpretation in tropischen und subtropischen Ländern beschäftigt hatten.

Schließlich haben auch die Probleme des Umweltschutzes das Interesse für die Landschaft geweckt. Gerade mit diesem Problem eröffnet sich der physischen Geographie ein Arbeitsfeld als angewandte Wissenschaft. Es sind jedoch nicht nur Geographen, die in der Landschaftsökologie zusammenarbeiten. Vielmehr ist diese in den Niederlanden ein Wissenschaftsgebiet, in dem physische Geographen, Bodenkundler, Hydrologen, Klimatologen und auch Fachleute der

\*) Dieser Aufsatz wurde in seinem wesentlichen Inhalt bereits in der Geogr. Tijdschrift (1977) in holländischer Sprache publiziert. Wegen seiner Bedeutung für die Entwicklung der Geographie in Forschung und Lehre hielten es die Herausgeber für angebracht, ihn in englischer Sprache und überarbeiteter Form mit einem den üblichen Umfang überschreitenden Zusammenfassung in dieser Zeitschrift zu veröffentlichen.

Planung mit ihren jeweiligen Methoden für ein gemeinsames Forschungsziel zusammenwirken.

Der Kontakt der physischen mit der „politischen und ökonomischen Geographie“ (in den Niederlanden spricht man von „soziale geografie“) ist bis in die Gegenwart kaum untersucht worden. Wie sollte auch eine intensive Zusammenarbeit zustandekommen angesichts zweier „Geographien“, von denen eine sich (nur) für geomorphologische und die andere nur für sozialwissenschaftlich-räumliche Probleme interessierte, wobei man die Landschaft als eine vielleicht interessante, für das sozialgeographische Studium jedoch nicht relevante Nebensache betrachtete. Während der letzten Jahre aber ist – vor dem Hintergrund der Umweltproblematik – auch das Interesse für die Landschaft zurückgekehrt. Mag man sich in der niederländischen Geographie stets – und bis heute – gegen die Einheitsgeographie im alten Sinne ausgesprochen haben, so wächst doch die Einsicht in die Notwendigkeit einer neuen „Einheitsgeographie“, in der Geographen verschiedener Spezialisierung sich einem gemeinsamen – wissenschaftlichen oder angewandten – geographischen Problem widmen.

A survey of the present state of physical geography in the Netherlands could conceivably consist simply of an account of what happened in that subject in our country after, say, 1965. However, to understand any situation properly it is essential to have some idea about the traditions, principles and ideas of the preceding period (the historical ‘input’). First of all then let us take a look at the state of physical geography before and shortly after the Second World War.

#### *The state of physical geography in the Netherlands from 1930–50*

In physical geography from 1930–50 the main emphasis was on geomorphology and the figure in the background was Oestreich (cf. Jong, 1958). Oestreich, who was appointed Professor of Physical Geography in 1908 in Utrecht, was a geomorphologist with a geological bent. He had made a name for himself through his important studies of the Austrian Alps, the Himalayas and the Rhenish Schiefergebirge; he had worked in close conjunction with that Grand Master of geomorphology, W. M. Davis. His inaugural lecture in Utrecht (1908) was entitled: “The Landscape”. From this title one might have expected the young professor to treat the landscape as a whole in the Humboldt tradition. However, his lecture dealt exclusively with the relief of the earth’s surface, i.e. with geomorphology. Vegetation, soil, atmosphere and water, which are also all elements of the landscape, were hardly mentioned. For Oestreich “landscape” was identical with relief. The reasons for his interpretation are obvious. The fact that relief is the predominant feature in mountain scenery and that the geomorphologist Oestreich was interested primarily in mountainous areas was probably the main reason why he concentrated on studying the relief of the landscape only. (It should be pointed out, however, that in his

“Bulgarian Journeys” (1934) Oestreich had shown interest in other aspects of geography besides geomorphology.)

The local situation in Utrecht was also significant as far as physical geography was concerned; when Oestreich was appointed, the scope of physical geography was clearly defined: Physical geography was not to deal with the subject of vegetation; the “geography of plants” was to quite definitely part of biology. Up to a few years ago it was the task of one of the professors of botany to lecture on the “distribution of plants”. As far as climatology was concerned, things were slightly different in as much as this branch of science was one of the subjects that had to be studied by undergraduates reading physical geography as their main subject. But the staff who lectured on climatology were not geographers either. They were meteorologists who did splendid work in the field of meteorology and gave excellent meteorological instruction to the geographers. However, by reason of their own interests they were not prepared to engage in truly geographical research and to investigate, for instance, how (meso-)climatological conditions in the Netherlands were linked with physical features such as relief, rivers and types of soil.

So, through a combination of circumstances, physical geography in the Netherlands appeared to the outside world to be synonymous with geomorphology. Physical geographers were geomorphologists.

In connection with the above it is interesting to hear opinions of “insiders” during the period around the Second World War. Their opinions or “credos” were often expressed in their inaugural lectures. From the public lecture delivered by Bakker when he was appointed as Visiting Lecturer (Privaat Docent) at the Municipal University of Amsterdam (1937) we gather that he, Bakker, regarded the tasks of physical geography to be as follows: in the first place it should account for the shapes of the earth’s surface (the relief), and, secondly, it should “study the influence of the earth’s surface on the water (rivers and seas) and on the atmosphere round about it”.

Oestreich’s successor, Jacoba Hol, said in her inaugural lecture in 1946: “Physical Geography is the science of the earth’s surface; it is based on the science of geomorphology but, in a wider sense, it also comprises the science of climatology and oceanography which are essential constituents”. And Oestreich himself wrote in 1947 in his booklet on the history of Physical Geography: “. . . and since geography is still traditionally connected in people’s minds with the voyages of discovery, physical geographers have been attracted in recent years to geomorphology, and for many people the latter has become the physical geography of our time”. But after he had expressed this view, which one would expect in the light of his geomorphological interests, Oestreich goes on to write: “But one wonders if this

is really true. The new observation technique of aerial photography has opened up the way for new methods of investigation . . . in the Netherlands phenomena such as the action and effects of water-flow in rivers have once more become objects of study". An later on, after explaining the term "landscape" in greater detail and after drawing a distinction between "natural" landscapes and "cultivated" landscapes (i.e. cultivated and/or inhabited by man), he writes: "Physical geography includes the study of physical, biological and "socially-influenced" factors (the latter meaning elements consciously altered by man)". According to Oestreich "landscape" includes the "total sum of all the effects or influences exerted in a certain area . . . comprising several classes of factors . . . such as the composition and structure of the subsoil, the soil, the flow of water (whether it is influenced by man or not), the wind and the vegetation (in its natural state, or altered by man)". And he finishes his book with the sentence: "It appears that the concept "landscape" now, or once again, expresses for all time unity of geography as a science and defines its content and the method of study".

Bakker in his inaugural lecture on his appointment as Lector (Reader) in 1939 went even further: "the physical geographer . . . studying natural landscapes must certainly study separately and in great detail relief, climate, hydrology etc., but his task must be regarded as incomplete unless he also carefully analyses the complex relationship between these various factors and the interaction between the earth's surface, the atmosphere and the hydrosphere" (BAKKER, 1940).

So each of the experts quoted above indicates in a different way that physical geography includes more than simply a study of the relief of the land. But nevertheless in practice physical geography was reduced to a study of geomorphology and particularly of mountainous areas. That was the attitude in Utrecht where Hol succeeded Oestreich and in Amsterdam where Bakker (who had also been a student of Oestreich) in 1946 was appointed Professor of Physical Geography, Climatology and Cartography at the Municipal University. At the beginning of the nineteen forties Bakker began to tread new paths, but his work—especially at the beginning—was confined to geomorphology (BAKKER, 1947). He adopted a critical attitude to the cyclic models of Davis and felt an affinity with the new "climate morphology" of the 1930s, promulgated by people like Jessen, Passarge and Büdel. For some time Bakker devoted his energies to constructing mathematical models for studying the development of slopes (BAKKER & LE HEUX, 1952). He did this largely because he had misgivings about and was highly critical of the vague, imprecise reasoning he so often encountered in Davis' writings and was even more dissatisfied with the recent geomorphological conclusions which took climate into consideration. He felt that more accurate methods than

verbal reasoning were needed and that these should be based on a number of qualitative observations on shape. After he had come to the conclusion that the mathematical calculations were only part of the solution to the problem he began to introduce geological and mineralogical laboratory work into physical geography. His starting point was that research in geomorphology must include a study of the material and he concentrated particularly on clay-minerals and on grain size analysis. Bakker promulgated these ideas in other countries besides the Netherlands and in this way he helped to make the work of the Netherlands School of Physical Geography (cf. UHLIG, 1967) known abroad (particularly in Central Europe), thereby ensuring its continuance (cf. BAKKER, 1957, 1960).

The new study of clay-minerals concentrated chiefly on weathering material and on the weathering phenomena which play such an important role in the geomorphology of the tropics. Most of Bakker's data were obtained during expeditions to Surinam (cf. BAKKER 1960; BAKKER and MÜLLER, 1957). In the Netherlands studies were carried out of the (morpho) genesis of the holocene lowland; thereby a link was established on the one hand with historical geography which was concerned particularly with the history of the inhabitation of these areas and the occurrence of flood-tides and transgression phases, and on the other hand with field soil science (BAKKER, 1958).

#### *Developments beyond the pale of "official" geography*

In the meantime, outside "official" geomorphological studies, things had been happening that were to be of great significance for geographical thinking in the future. One of these activities was the geological mapping of the Netherlands, which, by reason of the geological situation of the land, was based mainly on quaternary geology. People like Tesch, his co-workers and their successors in the course of their work had also come up against geomorphological problems, for instance in connection with the formation and location of dunes, moraines, river levees, river terraces and the like (cf. TESCH, 1920–1930; PANNEKOEK v. RHE-DEN, 1936). Before the war and soon after it some sort of link had been established between the (quaternary) geologists of the Geological Foundation and geography; this can be seen from the fact that Tesch and his co-workers published many of the results of their investigations in geographical journals, particularly in the T.K.N.A.G.\*) But this connection was fairly onesided, as WIGGERS pointed out (1977).

At the Agricultural University in Wageningen after 1933 the study of sedimentary petrology under EDEL-

\*) T.K.N.A.G.: Tijdschrift van het Koninklijk Nederlands Aardrijkskundig Genootschap.

MAN (1933, 1948), EDELMAN and DOEGLAS (1933) and their students cast new light on the palaeogeography of the Netherlands. These studies were further developed after 1945 by research workers of the Geological Foundation and made a contribution to quaternary-stratigraphic, palaeogeographic and geomorphological studies (J. I. S. ZONNEVELD, 1947, 1958a; DE JONG, 1955). Edelman's research during and after the war was mainly in the field of soil mapping and later extended to historical geography as well. Because Edelman's soil science (inspired by Oosting and used by the Foundation for Soil Mapping "Stiboka") had a definite geogenetic character and was thus closely linked with the formation of the landscape, there were also close connections with geomorphology, particularly with lowland-(morpho-)genesis. The investigations carried out under Edelman's inspiring guidance and in his footsteps significantly increased our knowledge about the geomorphology of glacial, periglacial and holocene terrains (see also CROMMELIN and MAARLEVELD, 1949; VAN DER MEER, 1952; PONS, 1957; VINK, 1949 I. S. ZONNEVELD, 1957, 1960). This research also helped the geographer to realise that the Dutch landscape was not simply a matter of geomorphology. At the Agricultural University the relief was studied in conjunction with the composition of the soil, the groundwater level and (sometimes too) the original vegetation, as well as the soil's suitability for agricultural purposes.

Within the physio-geographical world the considerable geographical value of Edelman's work was quickly recognised; as a result the soil science-oriented "lowland genesis" was also enthusiastically studied as part of physical geography in Amsterdam and in Utrecht in the 1950s (cf. VAN DORSSER, 1956). This was three decades after T. Vink, working alone among geomorphologists who were mainly interested in mountain ranges abroad, had carried out his survey in the fluvial district of the Netherlands (VINK, 1926). The only other students of Oestreich who published material relating to lowland morphogenesis were VLAM (1943) and VISSCHER (1931).

At the Technical University in Delft studies were made with the help of hydraulic models and artificial channels; and along the coasts and in the estuaries observations were made by the "Rijkswaterstaat", which were very important for geomorphology (e.g. VAN VEEN, 1936). In physical geography there was great interest in such matters (e.g. BOISSEVAIN, 1941). Investigations such as those carried out by Van Veen were reported in the T.K.N.A.G., for instance in an issue devoted entirely to the investigation of the tidal flat area in the northern part of the Netherlands (1950); the same journal also published the results of a study by aerial photography of the coast of Surinam (ZONNEVELD, 1954). There was great interest in the important work done by Hjulström at the Geographical Institute in Uppsala (Sweden), but the

study of the actual processes was nevertheless still regarded as the province of engineers.

#### *Physical geography around 1960*

Thus physical geography towards the end of the 1950s was a composite subject in which geomorphology still played a leading part, but it covered a much wider range of interests than ten years earlier. Its subjects ranged from "classical" morphogenesis of mountainous areas to X-ray analysis and differential thermal analysis of clay-minerals, and from the interpretation of the stepwise succession of peneplains to the detailed study of soil samples and weathering processes. Even field and laboratory soil science were now regarded as part of physical geography (e.g. WIGGERS, 1955).

Because physical geography now included among other themes the investigation of material, soil and minerals, one could speak of applied physical geography, i.e. it could be applied to the study of subjects connected with the water supply, soil science, mining, and also to town and country planning (cf. BAKKER, 1959).

The peculiar feature of physical geography in the Netherlands was that it was not really an integrated subject; research tended to concentrate on separate and very distinct aspects of the abiotic landscape. Physical geography continued to be concerned primarily with monothematic studies. The only difference between the present and the former situation was that now not only geomorphology but also themes belonging to other "geographical sub-sciences" such as soil and quaternary geology were studied; physical geography hardly touched on, or ignored completely, the study of broader physio-geographical relationships. It was only via historical geography and landscape oriented soil science that geogenetic ideas and concepts began to have points of contact with other areas of interest such as vegetation and human activity (e.g. EDELMAN, 1949; PONS, 1957; I. S. ZONNEVELD, 1957; BAKKER, 1958).

#### *The special character of Dutch Physical Geography*

One may well wonder to what extent the development discussed above was inspired by events in international physical geography or whether it arose from the special circumstances in the Netherlands. We know for certain that the latter was largely the determining factor. In the Netherlands, where there had already been for some time a definite division between social and physical geographers, it was clear to most research workers that the concept of a "unified geography" where one geographer in principle studies all the subjects that crop up in the field he is investigating—whether they relate to man or nature—had in fact become meaningless. Geographers realised that

if their research was to have scientific value they would have to use the ways of thinking and the methods of either the natural or the social sciences. Thus it followed that within physical geography too the main emphasis was on a thorough study of only parts of the whole. This may have been a strong reaction against the old fashioned "länderkundliche" regional synthesis which seemed to lead either to one-sided, unproved causal conclusions or to compilations of an encyclopaedic nature. Geographers wanted to do scientifically sound, fundamental research and they sought—and as we said, Bakker was one of the leaders—to use, within physical geography accurate methods which would either replace the traditional "Belvédère-geomorphology" or at least give it some backing.

Furthermore, if one wanted to study the landscape as a whole, only the relief, the soil and the quaternary geological development could be regarded as the province of the physical geographer: in the Netherlands landscapes are for the most part "cultivated" ones, i.e. landscapes designed, made or at least almost completely changed by man; the original vegetation has long been replaced and the drainage in a large part of the country is entirely artificial.

The study of such "cultivated" man-made landscapes was obviously regarded as the task of social (= human) geographers. But it so happened that the social geographers—with some exceptions e.g. KEUNING, 1965), BROEK (1932), KUPERUS (1935) and HESLINGA (1949)—had excluded landscape from their field of study; at the time they were primarily interested in human society and its "striving for prosperity" and certainly not in the effect of man's actions on the environment (COOLS, 1950). And so here too there was no real reason for individual or for combined efforts to build up landscape synthesis. The only points of contact, as we have noted, were to be found in the field of historical geography, but there were only a few geographers who worked in that field.

### *Physical geography today*

Dutch Geography today, as one might expect, is largely a continuation of the geography outlined above. Some aspects previously present in an embryonic form were further developed; some activities which were formerly outside the province of geography proper are now regarded as part of geography. As far as geomorphology is concerned, there was continued interest in "classical" investigations concerned with the relief-development of entire landscapes (palaeogeomorphology). The Davis concept, with its rigid cycles and stages, was sooner or later pushed aside and superseded: in the course of the palaeogeomorphological work people were no longer interested in the possible position of certain forms in the Davis cycle but in the sequence of relief generations, and the climatic changes

that influenced the evolution of the relief (cf. PIKET, 1960; BAKKER & LEVELT, 1964; DE WAART, 1971; ZONNEVELD, 1975) as well as in geomorphological mapping (cf. VERSTAPPEN & v. ZUIDAM, 1968; v. DORSER & SALOMÉ, 1973). To a greater extent than before the investigation of weathering-products, sediments and pollen analysis were carried out by geographers themselves (cf. KWAAD, 1977). Quaternary geology was practised more intensely than before, particularly in connection with the constantly developing study of "lowland (morpho)genesis" and also prehistory (for instance: MAARLEVELD, 1956, 1966; ZONNEVELD, 1963; ROELEVELD, 1974; HACQUEBORD, 1974; LOUWE KOOIJMANS, 1974; BERENDSEN, 1976; GRIEDE, 1978). The investigation of soil-forming processes and soil profiles became more and more important (cf. SEVINK, 1977). At present at the University of Amsterdam soil science is part of physical geography (in Utrecht soil science continued to be an important subsidiary subject, because it was already part of another faculty).

"Sedimentary-morphological" studies received valuable support from various techniques such as the analysis of sedimentary structures. These analytical techniques were applied not only to the investigation of coastal deposits but also to the investigation of fluvial, glacial, fluvio-glacial and eolian formations in the Netherlands (e.g. AUGUSTINUS and RIEZEBOS, 1971; KOSTER, 1978), in Denmark and in other countries. And for studying slopes, particularly where mass movements have taken place, the various techniques of soil mechanics began to be used (cf. VAN ASCH, 1979).

The use of modern techniques for observing and processing data (cf. JUNGERIUS, 1973; KWAAD, 1977; v. STEIJN, 1977; RIEZEBOS & SEYHAN, 1977) gave a tremendous impetus to the study of morphological processes both in the field and in the laboratory. Since there was already considerable interest in sedimentation and erosion and in the formations they caused, for instance along the coastline and in estuaries in the Netherlands and in Surinam, it was comparatively simple to convert this interest into effective research (TERWINDT, 1971; AUGUSTINUS, 1978).

This need for accurate observation and for investigations of a more quantitative nature led in the Netherlands to progress in the field of morphography (cf. VAN ASCH and VAN STEIJN, 1973; SEYHAN, 1976; HERWEIJER, 1979). And in connection with the study of surface water and underground water, the subject "geographical hydrology" developed (see ENGELEN, 1974).

In brief then, during the last fifteen years the branch of physical geography that is concerned mainly with investigating processes has developed still further. During this time geographers here have adopted the quantitative approach and systems analysis, both of which had previously developed mainly in Anglo-Saxon countries; during this same period, however,

they also continued—with good reason—the process of geomorphological and soil mapping. Maarleveld is one of the important figures in geomorphological cartography. He initiated the geomorphological mapping of the Netherlands on the scale 1:50,000 which is now being carried out by the State Geological Service and the Foundation for Soil Mapping “Stiboka” (MAARLEVELD, TEN CATE and DE LANGE, 1974). The first sheet appeared in 1975. Geomorphological mapping was further stimulated at the Institute for Earth Sciences (I.T.C.) in Delft and later in Enschede, where Verstappen made important contributions to the development of geomorphological mapping systems and to the study of applied geomorphology (e.g. VERSTAPPEN, 1968; VERSTAPPEN, 1970; VERSTAPPEN & V. ZUIDAM, 1968).

At the same time—and this has perhaps been the most interesting development in the last 10–15 years—a growing need for synthesis arose. The synthesis required was not so much one that consisted of geographical summaries and “länderkundliche” regional surveys but it was a synthesis based more on ecological relationships at various levels of integration (cf. BOBEK and SCHMITHÜSEN, 1949; TROLL, 1950; J. I. S. ZONNEVELD, 1958b). This implies a landscape-ecological approach. Naturally the “(mono)thematic” investigators were also aware of these relationships. Their studies were also concerned with the connections between, for instance, soil-forming factors and morphogenetic factors. Research however still concentrated on one theme—the relief, the soil, the water—which is at a fairly low level of integration. The landscape-ecological approach on the other hand is marked by an interest in and a study of systems at the integration level of the landscape; the various parts that are studied “monothematically” then are in fact partial systems. The intensification of “monothematic” research meant that there were more opportunities for finding out how various factors interact and it gave a firmer basis for an “ecological approach” than the earlier “unified geography” concept could give. In fact there is less difference than one might think between the “monothematic” and “polythematic” (or ecological) approach. One can speak of a gradual transition. Fundamental research on less complicated systems can yield useful information about higher systems and provide a valuable basis for research into these systems (cf. JUNGERIUS, 1973).

The renewed interest in the landscape as a complex system was a result of various factors. One factor was that geography, after studying the separate components of the landscape, needed to know how these various parts of the landscape function together. This renewal of interest, was partly (which Oestreich had foreseen), fostered by the practice of aerial photography. In interpreting aerial photographs one notices—particularly if one is concentrating (monothematically) on for instance the geological situation,

the soil or the vegetation—to what extent these geo-factors are interrelated and interdependent (cf. ZONNEVELD, 1961). It is no coincidence that the landscape-ecological approach in geography has been propagated principally by research workers who have had something to do with the interpretation of aerial photographs, particularly in developing countries where the natural interrelations are fairly free from human influences (Verstappen, Vink, I. S. Zonneveld, J. I. S. Zonneveld).

Another reason for the growth of interest in the landscape is that in the overpopulated Netherlands urbanisation and industrialisation are gradually causing large scale alterations in the countryside. “Typical Dutch historical landscapes” have acquired a rarity value. Furthermore, urbanisation, road building and industrialisation cause landscape-ecological disturbances. It seemed a worthwhile undertaking to study this landscape in more detail, paying attention to its physiognomy, its natural and “cultural” history and its ecological links, and to map it in detail (cf. PIKER, 1969; ZONNEVELD, 1971; DE VEER, 1977; WEISS, 1977; and I. S. ZONNEVELD, 1977).

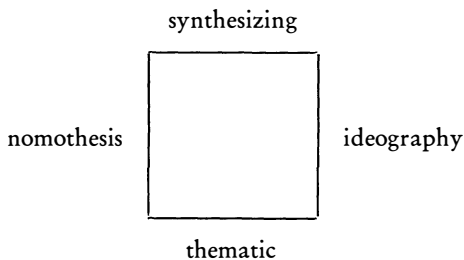
The landscape approach therefore seemed to satisfy both a scientific and a social need. It widened the scope for applied physical geography not only in the Netherlands but particularly in the developing countries where the exploitation of natural resources and the development of agriculture are so important (see also VINK, 1968, 1975; and VEEN, 1976). Effective town and country planning needs both ecological information and polythematic surveys; the latter must be more than merely a compilation of data and views and should be based on thorough knowledge of existing relationships and equilibria.

It would not be fair if geography monopolised the field in landscape-ecological research. Other disciplines, such as for instance biology, geology and town and country planning, are involved as well. But clearly geography with its specific interest in the spatial aspects of ecology must be part of this research. Physical geographers realise that—from the point of view of scientific development and practical application—in the landscape ecological “team” vegetation geography, soil geography, hydrology, geomorphology and climatology must all be represented. At present applied physical geography is to quite a large extent landscape-ecological in character (see I. S. ZONNEVELD, 1977). It is interesting to compare these facts with the ideas of HARD (1973).

#### *Nomothesis, ideography, synthesis and the monothematic approach*

During the last 20 to 30 years there has been some discussion as to whether geography is (or should be) nomothetic or ideographic and whether synthesis is

preferable to the study of separate themes; from the foregoing one can see that physio-geographical research in the Netherlands has borne each of these stamps at one time or another. It is true that there have been "shifts" in emphasis over the years and some geographers have tended more to one approach than others. But such shifts are unlikely to lead to geography bearing one special label. Nomothesis and ideography must exist side by side. There is no doubt that an ideographic description of one particular subject (e.g. a specific *cuesta* in S. Luxemburg) is a necessary contribution to a clear nomothetic study of the development of *cuestas* in general. And likewise, as was ascertained previously, a (mono)thematic study, for instance of a local hydrological situation, can serve as part of the fundamental research required for a (polythematic) landscape-ecological study. The four concepts mentioned are neither contradictory nor mutually exclusive. Overlaps and combinations are possible. The links between the concepts can perhaps be best indicated by means of a square:



Each side of the square represents one of the concepts or principles in a more or less absolute form. On the left we have "nomothesis" which has to do with the formulation of laws on the basis of observations and a (large) number of analogous phenomena; this is the realm of the reproducible experiment where predictions can be made on the basis of laws that have been established. On the right we have ideography, where the emphasis is on the description of individuals and the reconstruction of developments, each being regarded as a separate entity. The bottom of the diagram is the realm of the thematic approach, the study of systems at a "low" level of integration. As one moves upwards one comes to more complicated systems which in their turn may incorporate more themes. One can say that there is an increasing degree of synthesis. (One could conceivably make the diagram 3-dimensional. Then one could put side by side in the third dimension at the bottom a number of themes which would merge with each other "upwards" towards more highly integrated systems).

One can fit into this square investigations that are carried out within the framework of (physical) geography. Monothematic e.g. geomorphological work fits in at the bottom, and research connected with the

regional, geomorphological description of a certain area (in the form of a geomorphological map) belongs to the bottom right; to the bottom left belongs an investigation into the formation of, for instance, meanders or pinnacle snow performed with the help of laboratory experiments or data collected during field-work. The study of a *cuesta* in S. Luxemburg, mentioned above, would be found at the right hand side of the diagram. The main emphasis of the study of the general question as to how *cuestas* are formed belongs much further to the left.

The more integrated the study, the higher up it should be in the diagram. The study of a natural landscape will be fairly high up, and the study of a "cultivated" landscape higher still. Although one encounters in geographical literature many regional (thus ideographic) landscape-studies which fit into the diagram somewhere at the (top) right, landscape study that is more general and nomothetic in character belongs to the top left of the diagram.

Obviously there is little point in trying to allot definite positions in the diagram to physical geography as it once was and as it is today. It is true that there have been some fundamental shifts in emphasis. For instance, recent research is sometimes more markedly nomothetic than most research was years ago. The thematic interest in fundamental research, lower down in the diagram, has not flagged. Thematic research on the ideographic side as well as on the nomothetic side of the diagram can be used to discover ways and means of making an ecological study of more integrated systems.

#### *Contact with social geography*

In general contact between physical and social (or human) geography (as distinct from historical geography) cannot be said to have yielded very exciting results. And one would hardly have expected this to happen, given the situation in the Netherlands. When Geography was officially divided by Academic Statute into two branches, one belonging to the physical and the other to the social sciences, the former continued to concentrate on the relief of the landscape, whereas the other, unhampered by the methods of the natural sciences, could study man firstly in relation to nature, next in his relations with the (partly man-made) environment, then in his striving for prosperity and more recently man's spatial behaviour pattern.

This type of social geography had little need for contact with physical geography, which aimed primarily at explaining the formation of mountain ranges and peneplains. When, later on, other things such as soils were studied, social geography had become so estranged from any concepts relating to the natural environment that there was no longer any point of contact. In fact the gap was constantly widening; as

a result of continued technological progress nature's role seemed to be becoming less and less important and was now hardly of interest in geographic studies of highly developed, industrialised and urban areas.

However, the last few years have seen a growth of environmental awareness and people are beginning to realise that physical geography is not concerned simply with the explanation of causal relationships but that it also evaluates the functional role of natural factors in the ecological system to which man belongs. (In this connection the following extract from a recent publication by VAN PAASSEN (1976, p. 325) is interesting. Writing about the work of Hägerstrand, he says: "Recently he stressed the 'physical' perspective of geography in a specifically radical and *for some social geographers disturbing way*: geographers should aim to cast light on life and living conditions in such a way 'that human activity can be seen as part of nature'"\*). Clearly then, it is because of the "great technological demands" that natural limits are being reached and/or exceeded and the "subjection of nature to man" makes it essential that man should at least know the consequences of his actions, consequently not only in terms of costs and budgeting but also in terms of the unexpected results of the disturbance of natural equilibria. In recent years there have been signs that social and physical geographers have interests in common in the field of environmental studies. This fact makes the establishing of working links desirable in any study of problems in highly industrialised countries as well as in developing areas. It is neither necessary nor desirable to revive the old "unitary" geography ("Einheitsgeographie") in which one person had to know all about the whole landscape and study both the physical and the socio-economic problems; it is possible to speak of a working association in which the division of tasks is clearly defined. In geography, which involves studying earth inhabited by man and discovering situational relationships, the social geographer concentrates on man as an inhabitant of the earth's surface and on society's structures and spatial processes; the physical geographer concentrates on the natural relationships on the earth, the dwelling place of mankind. In many instances situational relationships can only be properly understood if one is constantly aware of the relationship between man and the place where he lives. Therefore the best and the most useful type of geography nowadays is one that involves a team of geographers each of whom is a specialist in his own field and is able to make a contribution to the solution of common problems.

\*) Italics by J.I.S.Z.

The original Dutch text (cf. Geogr. Tijdschrift. N.R. XI, p. 160-168) was translated into English by Miss S. M. McNAB.

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## NEUERE VERSUCHE DER BESTIMMUNG DER PRIMÄRPRODUKTION DER WÄLDER UND FORSTLICHER ERTRAGSPOTENTIALE

5 Abbildungen und 3 Tabellen

HANS-WILHELM WINDHORST

*Summary:* Recent attempts at evaluating the primary productivity of forests and at estimating their economic potential

The paper shows that the results of the International Biological Program concerning the primary productivity of the biosphere have not found appropriate acknowledgement so far in geographical research. The author demonstrates that it is necessary to get a better insight into these problems not only for exact estimations of the possibilities of wood production in the specific forest formations but also for securing the food supplies especially in the developing countries. After explaining the various methods of measuring the primary productivity, several models of biologists, silviculturists, and geographers are compared. It is shown that it is almost impossible to compare these models

in detail, as they are constructed from different points of view and are based on different schemes for distinguishing forest formations. Nevertheless an attempt is made to develop a new model estimating the potential productivity of the forests of the earth. From this synopsis it can be seen that the production potential of the tropical rain forest is often over-estimated. This is especially dangerous because of the specific ecological situation of the humid tropics. If the developed countries do not bring in their knowledge in using these forests without destroying the ecosystem, far-reaching ecological as well as economic problems have to be expected. Selective exploitation as it is practiced now will have the effect that by the year 2000 no more primary forests in the tropics will be available for timber production.