ANNUAL REPORT 1979

International Soil Museum - Wageningen - The Netherlands

ISM was born out of an initiative of the International Society of Soil Science, and was adopted by Unesco as one of its activities in the field of earth sciences. It was formally founded on 1st January 1966 by the Government of the Netherlands, upon assignment by the General Conference of Unesco in 1964.

Most of the ISM working funds are provided by the Dutch Ministry for Education and Sciences, and are accountable to the Directorate of Technical Assistance (DTH) of the Ministry of Foreign Affaires.

The constituing members of the Board of ISM are the International Institute for Aerial Survey and Earth Sciences (ITC) in Enschede, the Agricultural University of Wageningen (LH) and the Dutch Directorate of Agricultural Research (DLO).

Advise on the programmes and activities of ISM is given by an Unesco-FAO appointed International Advisory Panel (IAP) and by a Netherlands Advisory Council (NAC).

The financial-administrative responsibility for the working funds and for the permanent staff of ISM rests formally with the Board of Governors of the ITC.

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ISM

International Soil Museum - Wageningen - The Netherlands

CONTENTS

1. INSTITUTIONAL DEVELOPMENTS

1.1 Records of the official opening of ISM

On March 9, 1979, the International Soil Museum, a Centre of Research and Information, was officially opened by Dr. M. Batisse, Deputy Assistant Director-General for Natural Resources and Environmental Sciences of Unesco. About two hundred scientists, administrators and other parties from the Netherlands and abroad attended. On this occasion addresses were delivered by the chairman and representatives of the three institutions cooperating in the Board of Management of ISM, its director, and representatives of the International Society of Soil Science (ISSS), FAO and Unesco.

The chairman of the Board, Mr. R.P.H.P. van der Schans, welcomed the guests and representatives of several national and international institutions and sketched the history and the present organizational set-up of ISM. Dr. W.G. Sombroek, director of ISM since June 1978, gave an outline of its aims and programmes. Prof. A.J. van der Weele, rector of ITC in Enschede - the Netherlands and acting-director of ISM from 1975 to 1978, Prof.Dr. H.C. van der Plas, rector magnificus of the Wageningen Agricultural University and Dr. D. de Zeeuw, director of research of the Dutch Ministry of Agriculture delivered short well-wishing speeches on behalf of the three institutions cooperating in the Board of Management.

Prof.Dr. E. Schlichting, representing ISSS, Dr. R. Dudal of FAO and Dr. M. Batisse of Unesco sketched the relation between ISM and their organizations and the future role ISM could play in the field of soil science. The verbatim record of their speeches is given below.

After the official opening ceremony, which took place in the auditorium of the International Agricultural Centre (IAC) in Wageningen, the participants were shown around the various ISM sections.

The official opening session of ISM in the auditorium of the International Agricultural Centre (IAC) in Wageningen.
Behind the desk the invited speakers and the Board of Management of ISM. From left to right: Prof. Dr. Ir. T. Wormer, Ir. J.B. Ritzema van Ikema, Dr. M. Batisse (Unesco), Prof. Dr. E. Schlichting (ISSS), Prof. Dr. H.C. van der Plas (LH), Prof. Ir. A.J. van der Weele (ITC), Prof. Dr. Ir. G.H. Bolt, Dr. R. Dudal (FAO), Dr. D. de Zeeuw (DLO), Ir. R.P.H.P. van der Schans and Dr. Ir. W.G. Sombroek.

Speech of the representative of ISSS, Prof.Dr. E. Schlichting (''Institut für Bodenkunde und Standortslehre der Universität Hohenheim'', Fed. Rep. of Germany and Chairman of Commission V of ISSS)

Dames en heren, ladies and gentlemen, mesdames et messieurs, meine Damen und Herren,

Ich war präpariert einige Worte in Englisch zu sagen aber wegen des internationalen Karakters dieser Veranstaltung werde ich sie in Deutsch sagen das ich auch verstehe.

Nun, meine Damen und Herren, nach dem Lexikon ist ein Museum ein Muzentempel. Also enthält Sammlungen in Kunst und Wissenschaft. Und das verbinden wir normalerweise mit kunstvollen und alten Gegenstände. Nun ein Bodenmuseum stellt auch Gegenstände aus die sehr alt sind oder sehr alt sein können, aber gleicherweise noch aktiv sind. Es hat also Gegenstände einerseits, die historischer Körper sind und das verbindet sie, die Bodenkunde, mit den allgemeinen Geowissenschaften. Das stelt gleicherweise Segmente aus Landoberfläche aus die ein Metabolismus haben, die also sehr aktiv in das rezente Geschehen eingefasst sind. Das verbindet sie mit der Biologie.

Die Kombination zwischen diesem geowissenschaftlichen und dem biologischen Aspekt ist das Wesen der Ökologie, die ja die Disziplin ist die sich mit den Umwelt - Organismen Wechselbeziehungen beschäftigt. Daher ist sicherlichkeit verständlich zu machen dass den Bodenkunde eine ökologische Geowissenschaften ist, die sich beschäftigt mit der Landschaftgeschichte und der Landschaftökologie. Damit, mit der Vergangenheit und der Zukunft der Menschheit. Diesen letzeren Aspekt hat Herr Sombroek ausgeführt.

Auf der anderen Seite zeigt aber ein Bodenmuseum auch dass diese Objekte der Bodenkunde sehr verschieden sind. Dass also Bodenkundler nicht mit *den* Boden, über *den* Boden arbeiten alsob es den Boden in singular gebe, sondern dass jede Aussage gebunden ist an einen spezielle Boden, an den jeweils untersuchte. Es ist einen Tendenz innerhalb den Bodenkunde zu beobachten dass die Spezializierung und Differenzierung der Methoden soweit getrieben wird dass die Bindung an das Objekt etwas verloren geht. Und das generelle Feststellungen getroffen wurden über dem Boden in singular. Und ich denke für die wissenschaftliche Bodenkunde hat ein Bodenmuseum die Funktion den verschiedenen Spezialisten zuzeigen wo ihre Wurzel sein sollten. Dass sie also von *die* stets ihre Methoden und ihre Aussagen an dieses Object, nämlich den Boden als eine Naturkorper, beziehen sollten. Wir müssen lernen dass die Abstraktion am Ende jeglicher Forschung stehen kann, aber nicht an ihrem Anfang stehen sollten.

Nun, ein Internationales Bodenmuseum zeigt die grosse Varietät der Böden auf der Welt in besondere Masse. Diese Böden sind sehr verschieden, sie werden sehr verschieden karakterisiert und klassifiziert, auch das ist schon kurz gesagt worden. Ein internationales Bodenkunde Museum oder Bodenmuseum hat also ei-

ne ungeheure Aufgabe in Ebene dieser internationalen Korrelation. Damit wir jedenfalls fachlich dieselbe Zunge sprechen wenn wir auch schon verschiedenen nationale Sprachen benutzen. Die Einrichtung dieses Museums ist deshalb sehr zu begrüssen als erste, wenn ich recht unterrichtet bin, wirklich internationale bodenkundliche Einrichtung auf der Welt, weil von der Kenntnis der Böden in den verschiedenen Landschafte deren Erforschung ausgehen sollte.

Die Internationale Bodenkundliche Gesellschaft, die ich hier zu vertreten habe, ist mit dem Internationale Bodenkunde Museum auf verschiedene Weise sehr eng verbunden, wie schon ausgeführt wurde. Ich denke aber dass es insbesondere nötig ist hier den Namen Van Baren noch einmal zu erwähnen weil er einerseits langjährige Generalsekretär dieser Gesellschaft und andereseits energischer Promotor dieses Museums war. Die Internationale Bodenkundliche Gesellschaft dankt der FAO, der Unesco und der niederlandische Regierung für die Einrichtung, für den Unterstützung dieses Museums weil von ihm aus ein Stimulierung der gesamten bodenkundliche Forschung auf der Welt ausgegangen ist und in noch stärkere Masse ausgehen wird. Speziel für den Kommission V der IBG die sich wie die Kommissionen IV und VI mit Böden als Naturkörper beschäftigt und nicht nur mit einzeln Bestandteile oder einzeln Reaktionen ist es für mich eine grosse Freude die Gesellschaft hier bei dieser Eröffnung vertreten zu können.

Und ganz persönlich halte ich, ähnlich wie die Botaniker ihre Wissenschaft, die bodenkundliche Wissenschaft für eine "Scientia amabilis" und nicht nur das, sondern auch die bodenkundlichen Kollegen auf der Welt für liebenswurdige Leute, für eine grosse Familie. Und wenn man zu einen solchen Familienfest kommt - ich zögere Geburtsdag zu sagen, denn eine Geburtszeit von 12 Jahren ist biologisch nicht ganz verständlich - wenn man zu einen solchen Familienfest kommt, dann soll man auch ein Geschenk mitbringen. Und ich habe von meine Mutter gelernt das man, wenn man Freude machen will mit einem Geschenk, dieses nicht kaufen sondern dies selber machen soll. Und das habe ich getan, aber nicht in Bezug auf diesen Tag, dass muss ich zugeben. Und ich möchte ihn also, Herr Sombroek, ein selbstgemachtes Bodenprofil für das Museum schenken. Es ist international weil es aus Nord-Schweden ist und möchte dem Museum eine erfolgreiche Wirkung in der Zeit seines Erwachsenwerdens und in der Zeit seine Reife wünschen.

Speech of the representative of FAO, Dr. R. Dudal, Director of the Land and Water Development Division.

Mr. Chairman, ladies and gentlemen,

It is my great pleasure to convey to you the greetings and best wishes of the Director-General of FAO, Mr. Edouard Saouma on the occasion of this formal opening of the International Soil Museum. FAO has been involved with the creation of the museum since its early beginnings. FAO's interest in soils work relates to its scientific and research aspects but is essentially geared to the resource aspects. Indeed soils are the main resource for agricultural production and for feeding the world. I will therefore refer to soils not just as a research topic but rather stress the need of better knowledge of our soils in terms of feeding the populations of the future.

There are 4.2 billion people today and there will be 6 billion, or more, in the year 2000. That is about 20 years from now, it is almost tomorrow. It is the time which was needed to bring the International Soil Museum into being, indicating the gestation period which it takes to implement important projects. During that period agricultural production will need to be increased by 60% and will have to be derived from the soil resources of the world.

It was a matter of concern years ago that although inventories had been made of the coal reserves, of oil reserves, of gold reserves, of iron reserves no inventory had been made of the world's soil resources. It was in 1954, a quarter century ago already, that FAO in cooperation with Unesco and the International Society of Soil Science conceived a plan to prepare an inventory of soil resources of the world. It took years before the plan materialized but in 1961 an agreement to prepare a Soil Map of the World was reached between the three organizations concerned. It took 18 years to be completed. I am very pleased to inform you that the world coverage is now completed and was presented for the first time at the International Congress of Soil Science last June in 1978. I would like to stress that this achievement was the result of genuine international cooperation and that the map is in that sense unique because it was based on contributions from many soil scientists all over the world.

The idea for the International Soil Museum was closely linked to the Soil Map of the World Project. It is significant that the same parties involved, Unesco, ISSS and FAO are present here today only a few months after the completion of the Soil Map of the World to participate in the opening of the International Soil Museum.

I believe that the Museum will be a depository of the spirit of the Soil Map of the World. When we completed our first draft Dr. Guy Smith who is with us here said at the last meeting of the Advisory Panel "If the only result of the Soil Map of the World had been to bring people together as it has done, it would already have been an achievement". This is exactly what should be continued in the framework of the International Soil Museum. This dialogue among people, this acquiring and

exchanging of experience, this need for knowing each other better to understand each other's approaches to classification is most important. Indeed, although we have made progress over the last 20 years the gaps between different schools of thought in the field of soil science and of soil classification especially, are still tremendous. Now that the Soil Map of the World has been completed it could be used as a tool for further discussion and dialogue which the International Soil Museum could most appropriately stimulate and keep alive.

The Soil Map has a weakness that we all have, it is aging. As a result of aging it becomes progressively less precise and less pertinent. Some sheets which were published as early as 1969 were based on material which is now 15 years old. I feel that an updating is very necessary, I think, here again that the International Soil Museum could play a role, in cooperation with Unesco and FAO, in building up and collecting the necessary material for improving the Soil Map of the World and maintaining an up to date record of resources which are so important for the future of mankind.

I would like to join those who have paid tribute to Prof. F. van Baren, whose foresight in the 1950's was at the beginning of the creation of the Soil Museum. I would also like to pay tribute to the younger colleagues of Prof. van Baren who, when he became very ill and at the time of this passing away, carried his plan and his project to the days of its full implementation and ensured the continuity until the appointment of a full-time director.

The Soil Map of the World and the International Soil Museum prove one thing, that to implement projects of this nature financial resources are important but may not be the most important factor. What is essential, is motivation, perseverence and endurance qualities which we find are these of the staff on the International Soil Museum. In addition they have youth, energy and competence, which augers well for the future of this institution. It was said that the program which has been put forward would induce the authorities concerned to fund and support it. There is a saying that belief moves mountains. The belief and the perseverence of the Museum's staff may not need to move mountains but should be able to move sponsors to support their program. I should like to ensure them that we in FAO will continue and strengthen our support to the Museum in which we believe as a project that can serve mankind and the developing world especially.

Thank you, Mr. Chairman.

Speech of the representative of Unesco, Dr. M. Batisse, Deputy Assistant Director-General for Natural Resources and Environmental Science.

M. le Président, Mrs. les Recteurs, Mesdames, Messieurs.

Il n'est guère de satisfation plus grande que celle de voir aboutir une idée á laquelle on est profondément attaché et à la réalisation de laquelle on a eu le privilège de participer. C'est donc pour moi une joie très vive de venir aujourd'hui à Wageningen inaugurer officiellement le Musée International des Sols et de vous renouveller, au nom du Directeur-général de l'Unesco, le témoignage de l'intérêt et de l'appui que notre Organisation porte à cette passionnante entreprise.

Je me souviens avec beaucoup d'émotion d'une conversation - il y a presque exactement 15 ans à l'Unesco - où nous avons prit la décision, avec le Prof. van Baren et le Prof. Kovda, qui malheureusement n'a pas pu être parmi aujourd'hui, d'apporter le soutien actif de l'Unesco à la fondation du Musée. Cette décision allait bientôt être entérinée par la Conférence Générale de l'Unesco. Mais bien entendu tout restait à faire pour que l'idée devienne une réalité, et je voudrais simplement d'un mot rappeler ici tout ce que nous devons à cet égard, dans ces années difficiles de gestation, à l'imagination, à la compétence, au soin et à la tenacité - en un mot à ces vertus si typiquement hollandaises - que notre regretté ami, Ferdinand van Baren a consacrées à la création du Musée.

Il est frappant de constater que si depuis plus de 3 siècles on s'est efforcé de constituer dans de nombreux pays de vastes collections de minéraux, de plantes ou d'animaux, l'idée de rassembler et de classer des échantillons de sols est une idée très récente. Celà montre évidemment que la science du sol est une science relativement jeune, mais en même temps l'évenement que nous célébrons aujourd'hui atteste symboliquement qu'elle a atteint sa plénitude et sa maturité.

Mais, ce qui me parait le plus significatif c'est que, d'une part, ce musée n'est pas un simple musée et que, d'autre part, il aborde les problèmes au niveau international.

Le travaux qui viennent de se dérouler ces deux derniers jours et l'exposé que nous apprenions tout à l'heure du Dr. Sombroek nous montrent bien la perspective résolument dynamique dans laquelle s'engage le Musée qui, tout en jouant pleinement son rôle de collection d'échantillons de sols représentatifs du monde entier, entend en même temps assumer des fonctions complémentaires d'échange d'information, de standardisation, de recherche et de formation. Il s'agit donc d'un musée vivant.

Il s'agit en même temps d'un centre de reférence et d'information à vocation vraiment internationale. On doit ici rendre hommage particulier aux autorités néerlandaises et à tous ceux qui ont joué un rôle dans la mise en place du Musée

d'avoir dès l'abord affirmé cette vocation internationale et d'avoir pris des mesures à la fois effectives et réalistes pour que ce caractère soit assuré. Car il est clair - et les travaux de préparatoires à la Carte Mondiale des Sols l'ont bien montré -qu'il est indispensable d'établir et de développer un language commun pour tous les pédologues du monde, basé dur l'existence de types de sol de référence - language qui bien entendu évoluera avec le progrés des connaissances mais qui évitera la Tour de Babel des nomenclatures que nous avons connue naguère et dont ont souffert et dont souffrent encore de nombreux pays, notamment les pays en voie de développement.

C'est en maintenant cette vocation internationale et cette attitude dynamique que le Musée assurera son plein épanouissement et sa réputation. C'est aussi en maintenant la spécificité de ses fonctions qu'il jouera le rôle le plus incontestable et le plus incontesté. Cette spécificité devrait lui interdire de s'aventurer dans des activités pour lesquelles il n'est pas conçu et pour lesquelles d'autres organisations sont mieux placées que lui. Mais aversement elle devrait lui permettre d'atteindre un fonctionnement harmonieux au centre même des debats et des travaux relatifs à la science du sol dans le monde entier.

A titre d'exemple, et aussi parce que c'est un sujet qui me tient à coeur, je voudrais dire en quelques mots comment pourraient s'articuler certaines activités de base du Musée avec le programme intergouvernemental de recherche que nous poursuivons sur l'Homme et la Biosphère, le programme MAB.

Ce Programme est à présent solidement implanté sur le terrain. Quelques 94 Comités Nationaux du MAB sont en activité. Dans plus de 600 sites des recherches écologigues intégrées se déroulent dans le cadre du MAB. Quelques 150 réserves de la biosphère ont été désignées pour exercer des fonctions de recherche et de surveillance continue ainsi que pour assurer la conversation des resources génétiques et la formation de spécialistes.

Ces sites de recherche et des réserves de la biosphère couvrent tous les types d'écosystèmes depuis la toundra subpolaire jusqu'aux zones arides ou aux forêts tropicales humides. Les situations naturelles, aussi bien que toute la gamme des modifications agricoles, forestières apportées par l'homme, sont représentées dans ces sites de recherche et dans ces réserves de la biosphère.

L'épanouissement opérationnel du Programme MAB et le développement renouvellé du Musée International des Sols après son transfert dans ses batiments définitifs, permettent d'envisager l'établissement de relations en quelques sorte symbiotiques entre le MAB et le Musée.

En premier lieu, les réserves de la biosphère offrent une occasion unique de recueillir un échantillonage très représentatif de monolithes du sol, correspondant à toutes les principales régions écologigues et biogéographiques de la planète, ainsi qu'aux différents types pédologiques et de substrat. Les monolithes provenant de ces sites, qui pourraient être recueillis grâce à l'intervention et à l'intérêt des milliers de chercheurs, qui sont dans les projects du MAB, seraient donc accompagnés de toutes les informations spécifiques permettant de les situer dans le contexte de telle ou telle ecosystèmes. En outre, étant donné le statut des réserves de la biosphère comme sites de conservation à long terme, il existera toujours une possibilité de répérage des conditions des sols et de contrôle après de très nombreuses années.

Ainsi, le Musée International des Sols pourrait compter sur tout un réseau de correspondants pour compléter sa collection de monolithes et pour jouer une fonction dynamique, puisqu'à chacun de ces spécimens de collection correspondraits une situation réelle, une situation ''suivie'' de recherche et de développement sur le terrain.

Du point de vue du Programme MAB, l'étude uniforme de ces monolithes donnerait la possibilité d'accroître le niveau de comparabilité des recherches entrepises dans le programme, qui seraient donc basées sur une classification en quelque sorte standardisée et une interprétation comparable des types de sol. Cela offrirait la possibilité d'évaluer avec une plus grande précision dans quelle mesure les résultats de recherches peuvent être extrapolés à d'autres conditions écologigues et d'édaphiques.

D'un point de vue plus géneral, comme l'a souligné à l'instant mon ami Rudy Dudal, cette symbiose entre la Programme MAB et le Musée International des Sols produirait une nouvelle génération de données sur les sols du monde qui fournirait des éléments de révision et de mise à jour de la Carte mondiale des Sols, notamment en réexaminant la validité des choix de sols dominants qui ont servi de base à la carte.

Enfin, un échantillonnage complet de cette nature placerait le Musée dans une situation unique en ce qui concerne les possibilités de formation de chercheurs engagés dans telle Programme et le Musée serait alors le témoin visuel et permanent de tout ce qui peut se rencontrer sous la surface d'une forêt ou d'une prairie et illustrerait la diversité des situations qui, dans la taxonomie des sols, n'est pas plus réduite que dans la taxonomie des plants ou celle des animaux.

Ces quelques réflexions Mr. le Président illustrent le prix que nous attachons à l'Unesco tout comme à la FAO à un fonctionnement dynamique du Musée et l'importance spécifique qui doit être la sienne dans l'organisation et l'avancement des connaissances sur la nature et l'évolution des sols de notre planète, ces sols dont - on ne le repétera jamais assez -dépend la survie des hommes.

Aujourd'hui donc nous assistons à l'installation définitive du Musée, qui va lui permettre de prendre un nouvel essor. Cette installation se fait dans un cadre hautement approprié, dont la réputation internationale est bien connue, celle du complexe de recherche et d'enseignement agricoles de Wageningen. En même temps, le Musée conserve ses liens avec cette autre organisation prestigieuse, l'ITC, dont les installations sont aujourd'hui à Enschede et avec laquelle nous sommes heureux d'entretenir des relations étroites, notamment en ce qui concerne les études intégrées du territoire. On ne pouvait à mon avis souhaiter pour le Musée une meilleure formule que celle qui résulte de ce double patronnage et de ce choix de son emplacement.

Sous de tels auspices et avec l'appui constant et généreux du gouvernement néerlandais, avec la collaboration croissante de pédologues de tous les pays, je suis certain que le Musée se prépare à un grand avenir. Cet avenir, c'est celui d'une liaison étroite et sans ambiguité entre la science et le développement, dont est beaucoup questions ces temps-ci à l'occasion de la prochaine conférence des Nations Unies qui ce tiendra à Vienne en Août prochaine sur la science et la technologie au service de dévéloppement. Plus sans doute que la plupart des spécialistes d'autres

disciplines, les pédologues savent que leur science est au service des hommes et de tous les hommes. Le Musée International des Sols est un outil de choix qui est mis à leur disposition pour qu'ils puissent continuer à travailler dans cette noble direction.

Merci.

From left to right Dr. R. Dudal (FAO-respresentative and IAP member), Dr. A.M. Osman (ACSAD and IAP member for the Near East) and Ir. R.P.H.P. van der Schans (Chairman of the ISM Board of Management), visiting the exhibition hall (''pedonarium'').

1.2 Meetings of the ISM Advisory Bodies

1.2.1 International Advisory Panel.

On the occasion of the opening, the International Advisory Panel (IAP), established by Unesco to support ISM scientifically, met on March 7-9. Ad-hoc IAP participants were: Dr. C.S. Holzhey for North America, Dr. R. Herrera for South America, Prof. G. Aubert for Western Europe, Prof. V.A. Kovda for Eastern Europe, Dr. S. Peirera-Barreto for Africa, Dr. A.M. Osman for the Near East, Dr. R.S. Murthy for Asia, Dr. L.D. Swindale for Australasia and the CGIAR Institutes, Dr. R. Dudal for FAO and Dr. F. Fournier for Unesco.

The meetings resulted in the following conclusions and recommendations:

1. The International Panel discussed the present and future programmes of ISM during sessions of March 7-9 at Wageningen. Remembering that it was 7 years since the Panel met, we congratulate the ISM and the Dutch Government on the impressive progress that has been made, and on the implementation of many proposals from the 1972 Panel meeting.
2. The Panel notes with satisfaction the creation of the Board of ISM, the Netherlands Advisory Council and the recent appointment of a distinguished scientist, Dr. Wim G. Sombroek, as full-time director of the ISM. The Panel considers it desirable that the ISM staff develop an international character, realizing that this may require greater international budgetary support.
3. The Panel discussed the activities as listed in the working paper presented by the ISM staff, emphasizing that, with the limited staff available, clear priorities should be established. We recommend that through further support from the Dutch government and other national and international agencies the staff be enlarged in order to increase the involvement in these very important activities.
4. In the course of deliberations the Panel arrived at a consensus on priorities to be established.
   The core of the program is the soil monolith collection. Around this core program, the following activities are listed.
   - Top priority should be given to completion of a base-line set of monoliths, giving due attention to soil classifications; geographic representation; ecological coverage; biosphere reserves; virgin status; quality and diversity of data from the collection site including soil, land use and other site data; map units; and regional problem areas, for example the Sahel.
   - To improve the interpretation of analytical data in the monolith collection, the Museum should play a more active role in stimulating interlaboratory comparisons of key analytical procedures used in the major soil classification systems.
   - The Panel recommends establishment of a complete collection of soil and supporting maps with country-wide of regional coverage.
     The ISM should collect, in as much as possible, large scale maps illustrating the soil patterns in areas where monoliths are collected. It is not recommen-

ded that a comprehensive collection of larger scale map be collected by ISM. It is recommended that ISM established and maintain a reference system to such maps.
- With a view to placing the various collected soils into the major soils classification systems, and to create a facility in which visitors may most effectively use the collection, the Panel recommends that ISM staff remain active in international soil correlation and classification activities.

5. The Panel underlines the role of ISM in training visitors and guestworkers, in providing basic information for development work, and in providing a facility for guest researchers.
6. The Panel recommends that ISM, in cooperation with FAO and Unesco, be active in updating the FAO-Unesco Soil Map of the World.
7. The Panel gives support to ISM cooperation with the Unesco Man-and-Biosphere program (MAB) with special reference to characterization of soils in biosphere reserves.
8. The Panel does not endorse the initiation of ISM programs related to soil pollution.
9. Much of the research and other ISM activities will be published in existing technical journals to ensure wide distribution. Hence, the Panel recommends the establishment of a single ISM technical publication series. Soil monolith information should be prepared in a simplified manner for handout to visitors. Photographic slides could be made available at a price.

In conclusion the International Panel wishes to state its wholehearted appreciation to the ISM staff, and to all those involved in making the Panel meeting possible and for associating the meeting with the ISM opening ceremony. The Panel requests the Directors-General of Unesco and FAO to continue to support the ISM.

1.2.2 Netherlands Advisory Council

The Netherlands Advisory Council (NAC) met twice in 1979. On March 8 there was a joint meeting with the International Advisory Panel (IAP). On this occasion the NAC commented on the IAP discussions held the previous day. Subjects during these discussions were the various aspects of the soil monolith collection, the building-up of a map collection, the laboratory research and standardization of methods and the ISM publication series. Subsequently ISM's possible involvement in inventorizing of virgin soils c.q. the documentation of soil changes, and the assessment and monitoring of soil pollution were discussed.

The second meeting of the NAC was held on December 13. Discussions focussed on the difference of opinion between the IAP and the NAC with respect to the publishing activities of ISM; the soil monolith collection and monolith documentation; the aim and set-up of the laboratory exchange programme (LABEX); the soil maps documentation; and ISM's participation in the collection of virgin soils in cooperation with Unesco (Man and Biosphere Programme).

2. REVIEWS AND ARTICLES

Soils of the Amazon region and their ecological stability

W.G. Sombroek

Paper originally presented at the Joint Meeting of the British Society of Soil Science and the Royal Geographic Society, 10-11 April 1979 in London, U.K., on "The characteristics of soils of the humid tropics and their potential for intensified crop production".

Abstract

The recuperative capacity of the Amazon forest has lately been much debated, in view of plans for large-scale agricultural settlement in the area. Fears are being expressed that the whole of the Amazon region will turn into a desert of white sand and/or massive laterite rock. A precise characterisation of the main soils and a monitoring of the vegetational changes taking place is therefore wanted.

The well-drained upland soils (orthic to xanthic ferralsols, and ferric to orthic Acrisols mainly) support high forest, also those with concretionary laterite or ironstone. The forest re-establishes itself after occasional agricultural occupation of the shifting cultivation type, unless the fallow periods become too short.

Sizeable level areas exist however with imperfectly drained soils (plinthic Acrisols or gleyic Podzols) that support only savannah forest or savannah vegetation (bush thicket, bushland, bushed grassland or open grassland). Agricultural occupation of these areas, accompanied by large-scale burning and drainage, may transform at least some of these areas irreversibly into bare white sand plains or poor grassy plains with indurated laterite.

A sketch is given of the physiographic position and the expanse of these soils of precareous ecological balance.

1. Introduction

In the last decennium, the interest in the future of the Amazon forest region of South America has revived. In the South American countries concerned (the Guyanas, Venezuela, Colombia, Peru, Bolivia and especially Brazil) the physical human occupation of the region has captivated the imagination and spirit of enterprice of both the Governments and the peoples.

A substantial number of highways traversing the region are either already constructed or are on the planning board. Agricultural occupation, preceded by large-scale forest clearing, is stimulated by Government agencies, often with the notion that the soils concerned should be quite fertile.

In the world-at-large, however, and more in particular in the United States of America and Western Europe, an academic and popular pre-occupation with the global conservation of the human environment has made scientists and environmental activists alike wary of the effects of such a drastic intervention in the ecological balance of the immense region (more than 5 million km2). Fears are expressed about upsetting of the world's supply of oxygen or the level of carbon-dioxide in the atmosphere, and there is concern for the future of what is left of the Amerindian tribes. Also the notion prevails in these circles that the region would turn either into inpenetrable laterite rock or into sterile white sand ..... on which any recuperation of the forest vegetation would be impossible and agricultural settlement an utter failure (cf McNeil, 1964; Goodland and Irwin, 1974). Recently, these ar-

guments are voiced in the countries concerned as well.

In the following, the origin and validity of the contrasting views on the soil conditions of the Amazon region will be reviewed (see also Bennema, 1975).

The data for this paper were collected by field observation and literature study during a three-years stay of the author in the eastern Brazilian part of the region, on an Brazilian Government/FAO joint programme of forest inventory (cf. Sombroek, 1966); on his participation in a FAO roving seminar on land evaluation for the region as a whole (cf. Beek et al., 1973); and on a review of recent literature. In the context of the latter, special mention should be made of the great effort of the Brazilian Government towards a systematic inventory of the natural resources of its Amazon region, with the help of airborne radar. The programme of mapping, at scale 1:1.000.000, has just been completed (Projeto Radam, volumes 1 to 15, 1972-1978). It yields an enormous amount of new data, that in part necessitates a drastic modification of earlier generalizing statements.

A similar programme of radar-based mapping is now underway for the Amazon parts of Colombia (Instituto Geográfico Augustin Codazzi), Peru (Oficina Nacional de Evaluacion de Recursos Naturales) and Venezuela (Ministério del Ambiente y de los Recursos Naturales Renovables).

2. The well-drained soils

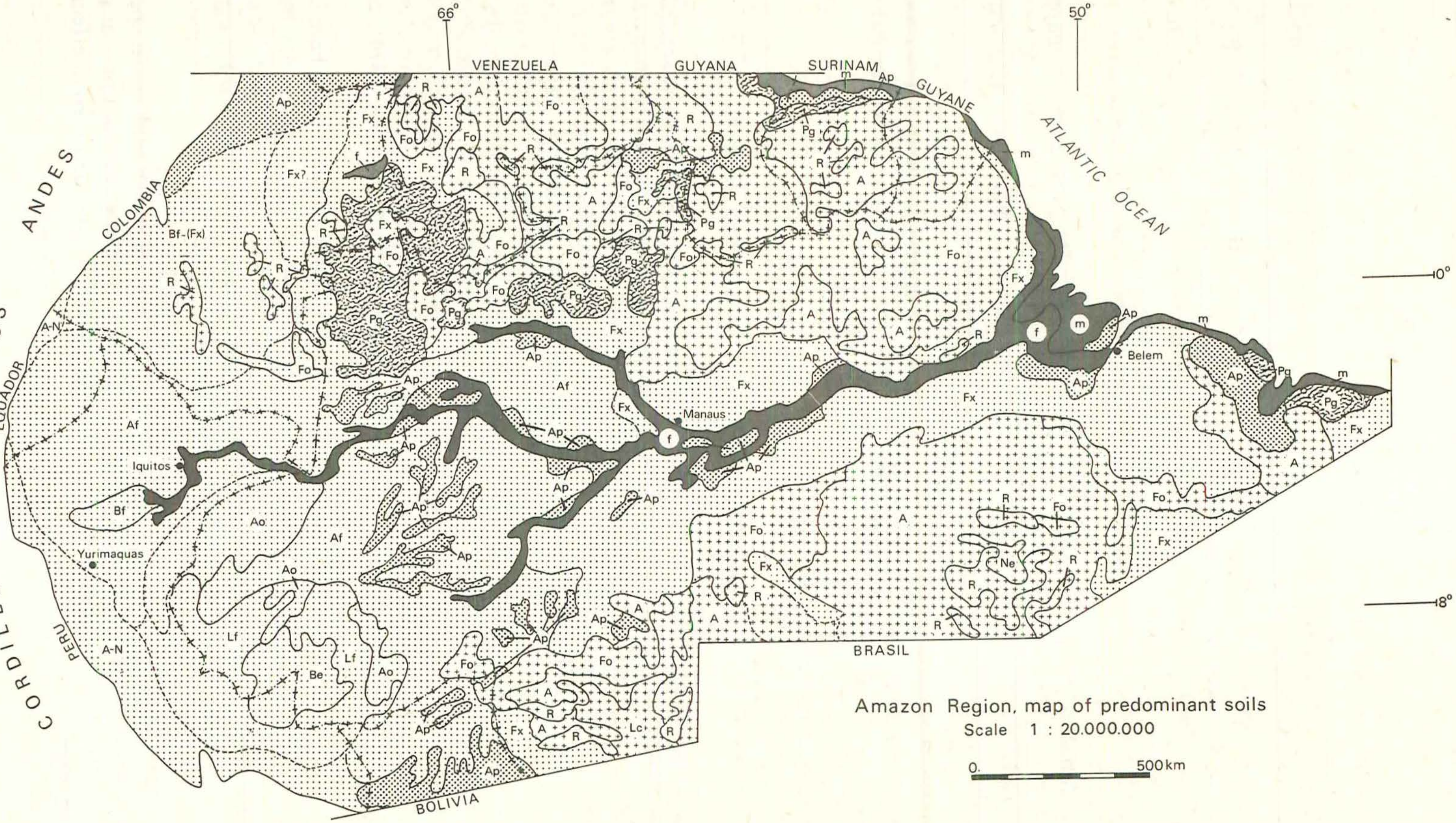
2.1. Soils of the central sedimentary part of the Amazon region *).

It has been shown (Sombroek, 1966) that the great majority of the soils of the axial part of the eastern Amazon region, the so-called Planicie with its Late-Tertiary and Pleistocene kaolinitic sediments, are quite uniform. They are deep, well drained, very acid, yellowish brown, friable and porous throughout; they vary in texture from loamy sand to heavy clay but lack any definite textural change within the individual profile (no ''argillic B-horizon''). The clay fraction consists largely of kaolinite, with minor percentages of iron oxides (2-8%) and near absence of aluminium oxides. These characteristics do qualify the soils as ''lateritic'' in older geographic and pedologic literature (e.g. Marbut, 1932). More recently they have been named Latosolo Amarelo Distrófico in the Brazilian system of classification (Camargo et al., 1979), as **xanthic Ferralsols** (FAO/Unesco, 1974), or as Haplorthox (U.S. Soil Taxonomy, Soil Survey Staff, 1975).

Chemically, the soils are very poor. This not only because of a low base saturation (20% or so) but also because the cation exchange capacity of the clay fraction is very low (CEC of 2-5 meq/100g clay: ''low-activity clay''). Most of the available plant nutrients are in fact linked with the organic matter, which is for a good part concentrated in the topsoil. It varies from 1 to 3% C over 5 to 30cm depth, depending on the texture of the soil and the vegetative cover.

The soils sustain a closed-canopy forest of several stories and mixed species composition. The one-time removal of the forest by felling and burning, for peasant farming of the shifting cultivation type, has no serious detrimental effect on

*) The soils of the recent floodplains, occupying only 1 to 2% of the total acreage, will not be discussed in this paper.



Amazon Region, map of predominant soils
Scale 1 : 20.000.000

Legend of the soil map of the Amazon Basin at scale 1:20,000,000, by W.G. Sombroek, ISM

SHIELD AREAS*

well drained soils:

- R Rock-outcrops; Regosols/Lithosols; Cambisols, shallow phase
- A Acrisols, undivided
- Fo orthic Ferralsols
- Ne eutric Nitosols
- Lc chromic Luvisols

*(crystalline and older sedimentary rocks)

AMAZON SEDIMENTARY BASIN

well drained soils:

- Fx xanthic Ferralsols, with ferralic Arenosols
- Af ferric (ferralic) Acrisols
- Ao orthic Acrisols
- Lf ferric Luvisols
- Bf ferric Cambisols (to Ferralsols)
- Be eutric Cambisols
- A-N Acrisols and Nitosols, undivided

imperfectly drained soils:

- Ap plinthic Acrisols associated plinthic soils

- Pg gleyic Podzols and albic Arenosols

poorly drained soils:

- f floodplain soils, undifferentiated
- m coastal hydromorphic soils, undifferentiated

Note: A 1:5,000,000 draft soil map of the same area as shown above, but with many more details, can be consulted at ISM. It may become part of the master copy for the eventual updating of sheet IV 1 of the 1971 FAO/Unesco Soil Map of the World.

the recuperative capacity of the vegetation. With fallow periods of 15 to 20 years, the regrowths is apparently able to recycle the nutrients washed down into the soil profile after the burning. Only when the fallow periods become too short over several decennia, as in the Bragantina zone near Belém, a serious impoverishment may develop, resulting ultimately in anthropogenic shrub savannah.

Permanent cultivation with sustained yields is also possible, if perennials and a groundcover, or regular manuring, are taken as essential components in the cropping system (see also Bennema, 1977; Van Wambeke, 1978). The success of the establishment of permanent pastures, or rather rangelands, is less obvious; bush control is difficult at the start, and fertility depletion, structure decline and mineral imbalances in the cattle will occur in the long run (Sutmöller et al., 1963). Through planting of special grasses (*Brachyaria sp*) and regular fertilizing with rock phosphate these problems may be overcome.

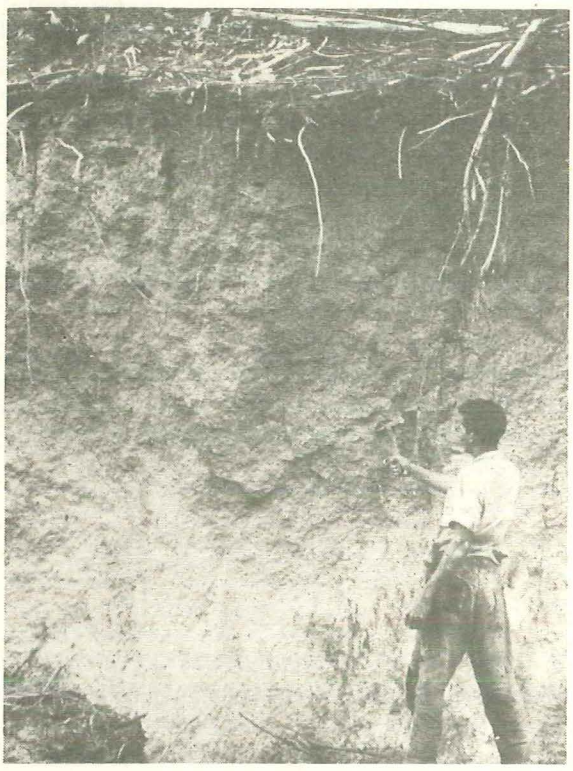
A portion of the above soils contain ironstone (''petroplinthite'' or ''laterite gravel''), either from the surface downwards or as distinct layers at varying depth. In contrast to the situation elsewhere, notably West-Africa, this ironstone does normally not occur as massive sheets, but consists of discrete concretions of varying size and form, in-between friable earth of the nature as described above. The ironstone is considered to be a fossil material, dating from periods with imperfect drainage of flat land surfaces.

Also these soils (Solos Concrecionários Lateriticos indiscriminados, Distróficos) have normally a forest coverage and do not turn into massive sterile rock upon its removal. In fact, some of these soils are chemically less poor than their non-concretionary associates. Only where rainfall is marginal - e.g. at the northbank of the Lower Amazon and in Eastern Amapá - the lower net moisture storage in the soil as a result of the stoniness may lead to quicker establishment of man-induced savannah.

It should be mentioned that in the southwestern Brazilian and adjacent Bolivian and Peruvian parts of the sedimentary area the soils are less poor chemically, more silty and at the same time less well drained (Projeto Radam, Volumes 12 to 15; Sanchez and Buol, 1974). There, many subsoils have in fact the characteristics of an argillic B-horizon with either low or high activity clays, and the classification changes accordingly to: Podzólico Vermelho-Amarelo, álico, atividade de argila baixa (Brazilian), **ferric Acrisol** (FAO), or Paleudult (US Soil Taxonomy) or to: Podzólico Vermelho-Amarelo, álico, atividade alta (Brazilian), **orthic Acrisol** (FAO), or Tropudult (US Soil Taxonomy). In Acre State of Brazil, even high-base-status soils occur: Podzólico Vermelho-Amarelo, eutrófico (Brazilian), **ferric Luvisol** (FAO), or Tropudalf (US Soil Taxonomy). The textural change in these soil profiles is often quite definite, and the subsoil rather dense, even plinthic in part. The denseness of the subsoil may be the reason that they have an open-forest coverage rather than a closed-canopy one.

Some of the soils in the Western Fringe area of the sedimentary basin, though deep, show little textural differentiation. They may be rich, like in the Acre State of Brazil: Cambissolo eutrófico (Brazilian), **eutric Cambisol** (FAO), or Eutropept (US Soil Taxonomy). Others are rather poor, like in Colombia: **ferralic Cambisol** (FAO), or oxic Dystropept (US Soil Taxonomy).

1. The undulating to rolling landscape of the eastern axial part of the Amazon region, with well-drained soils of the xanthic Ferralsol type and a closed-canopy high forest coverage.
(Belém-Brasilia highway; photo T.H. Day).



2. A profile of a xanthic Ferralsol under high forest, showing the absence of any distinct horizonation. Note the concentration of organic matter and most of the roots in the uppermost part of the top soil, just below the litter layer
(Santarém area of Brazil).

2.2 Soils of the northern and southern edges of the Amazon region

At the northern and southern edges of the Amazon basin older sedimentary rocks as well as gneisses, schists and the like of the crystalline shields are at the surface. The soils in there areas are more varied in their characteristics. Some are quite comparable to those of the axial part, for example the deep soils developed from (granitoid) gneisses: Latosolo Vermelho-Amarelo, álico (Brazilian), **orthic Ferralsol** (FAO), or Haplorthox (US Soil Taxonomy). Others are physically rather similar but have a different mineralogic composition of the clay fraction - much higher percentage of active iron oxides - due to a richer parent material like dioritic crystalline rock, basalts or ferro-magnesian rich sedimentary rocks. These so-called Terra Roxa Estruturada (Brazilian), or **eutric Nitosol** (FAO) and rhodic Paleudalfs (US Soil Taxonomy), occur for instance in sizeable expanse along the Transamazon highway (Falesi, 1972), in the Upper Xingú area and in Rondônia. Usually however they occur in minor patches only. The soils are much sought-after for both peasant farming and the growing of exacting perennials like cocoa.

Recent Radam mapping has revealed that the predominant soils of the crystalline basement areas are the moderately deep soils with a subsoil that is less porous and heavier textured than the topsoil (argillic B-horizon). Some of them are nearly as poor chemically as the soils of the axial part of Amazonia: Podzolico Vermelho-Amarelo, álico, atividade baixa (Brazilian), **ferric Acrisol** (FAO), or Hapludult (US Soil Taxonomy). Others have a clay fraction of higher cation exchange capacity: Podzolico Vermelho-Amarelo, álico, atividade alta (Brazilian), **orthic Acrisol** (FAO), or Tropudult (US Soil Taxonomy).

In strongly dissected parts the soils may be quite young and/or shallow: **Cambisols**, shallow phase, **Lithosols/Regosols** (all FAO), and associated bare rockoutcrops.

With the exception of the latter ones, all of the soils on the northern and southern edges of the Amazon basin may contain layers of ironstone, but all support a forest coverage. The species composition is often quite different from that in the central part of the region. Also the physiognomy of the forest may be different. The Acrisols in particular have often a low timber volume due to the predominance of creepers, climbers and bamboo species (''floresta aberta'', ''cipoal'' or ''tabocal''). None of these soils, however, lack the capacity for forest regeneration after agricultural occupation, unless climatic conditions happen to be marginal (dry season of 4-6 months). Preliminar indications are that the establishment of rangeland on these soils can be quite succesful (Falesi, 1976).

3. Imperfectly drained soils

In the sedimentary part of the region, two main types of imperfectly drained soils are encountered. It will be shown that their precareous ecological qualities are in fact the source of the doomsday prophecies mentioned in the introduction.

3.1 Groundwater Laterite soils.

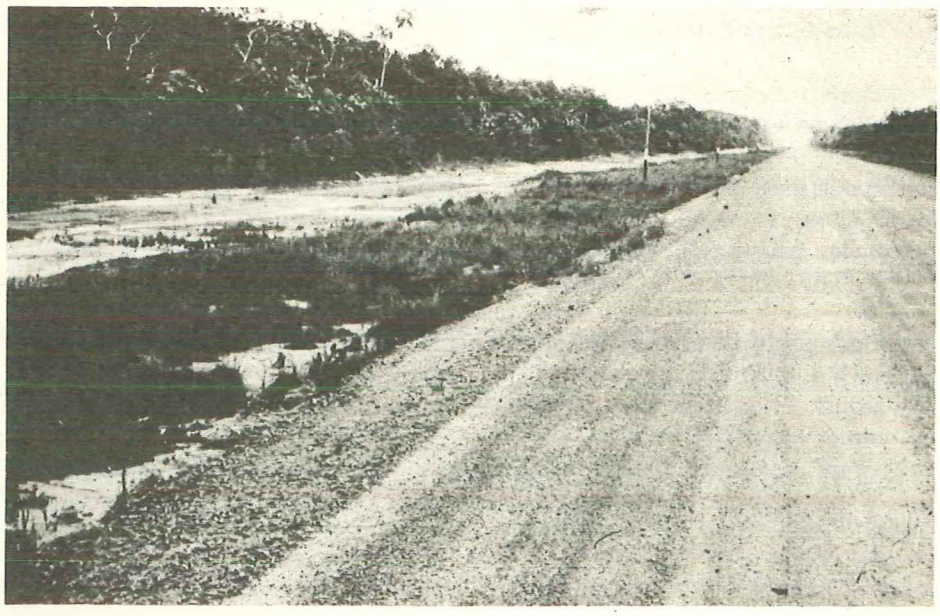
These are essentially intermittently imperfectly drained and strongly weathered soils, developed on more or less clayey parent material. The profile consists of a relatively light textured topsoil (A horizon) over a relatively heavy textured subsoil (B horizon), usually with a clear transition. The A horizon contains a light coloured subhorizon (A2 or E) and the B horizon consists of compact material with prominent, coarse and abundant mottles of reddish colour in a white or light grey matrix. The centres of the red mottles are usually hardened and at the transition zone between the A and the B horizons a thin layer if discrete concretions may occur. Upon exposure to open air for several seasons, the mottles become irriversibly hardened to slag-like material. This constitues the ''plinthite'' of the U.S. Soil Taxonomy. Size, shape and arrangement of the mottles varies with the nature of the parent material and of the groundwater movement, but in the axial part of Amazonia it is usually discrete, vesicular or fine reticulate. In the lower part of the B horizon and in the underlying C horizon the mottling may become vague or even absent (''pallid zone'' of the laterization theories). The structure of the A horizon is weak - often with a sealed surface layer - and that of the B horizon is usually weak to moderate medium subangular blocky; clayskins are commonly present, though faint and partly desintegrated.

The base saturation of the profile is low throughout, and the chemical activity of the clay minerals usually low to very low (CEC less than 10 meq/100g clay). These minerals consist of kaolinite and sesquioxides (gibbsite, goethite, haematite), the latter usually in minor percentages; they are therefore ''lateritic'' in the old sense of the word, with SiO_2/Al_2O_3 molar ratios of about 2.0. A number of profiles with analytical data are given by Day (1961), Sombroek (1966), Vieira et al. (1971) and in the Brazilian Projeto Radam reports: the examples range from profiles in their most developed form (''low phase'') to those in the initial stages of plinthitization. There can be no doubt that a ''lateritic'' type of soil formation is involved, while at the same time clay (and iron-) illuviation has taken place. Clay destruction in the A2 horizon may be involved as well.

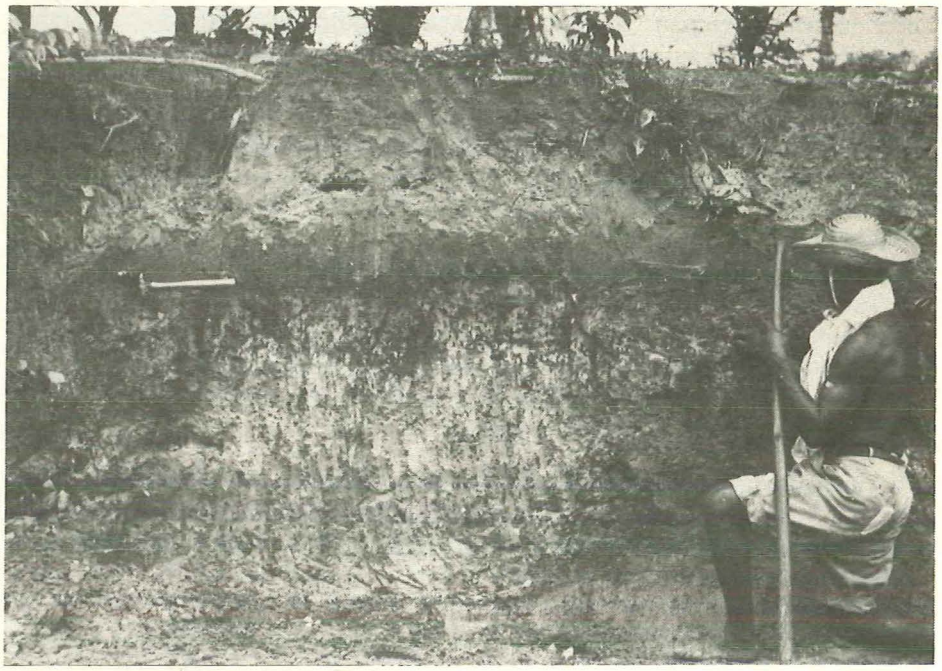
The soils are the true ''Groundwater Laterites'' in the sense of Marbut (1936). This is still maintained in the Brazilian classification as ''Laterita Hidromórfica, álica, de atividade baixa''. In the FAO/Unesco terminology they are lumped with the Acrisols **(plinthic Acrisol)**, in a manner comparable to their placing in the U.S. Soil Taxonomy system (oxic Plintaquult).

The soils have developed extensively on low-lying terraces along the Lower Amazon, the Solimoes and the lower portions of their tributaries. They also occur on flat interfluves, notably in the Juruá-Madeira area. A shallow and seasonably oscillating groundwater table and not too sandy sediments seem to be perequisites for their formation. The acreage is estimated to be between 2 and 5% of the total Amazon region. Outside the forest they are found as well (northern part of Roraima-state of Brazil; part of the Llanos Orientales of Colombia)*).

*) In the western fringe area of the Planicie (Peru, Colombia) the flat interfluves may also have such strongly mottled subsoils. Their clay mineralogy is however less kaolinitic, and they do not harden upon exposure (''pseudo-plinthite''; Sanchez and Buol, 1974).



3. The flat interfluve landscape of the central axial parts of the Amazon region, with intermittently imperfectly drained soils of the plinthic Acrisol type and a shrubby low forest coverage. (Humaitá-Manaus highway).



4. A profile of a plinthic Acrisol under an open shrub savannah (''campo''), showing the clear transition from the bleached E horizon to the strongly mottled plinthitic B horizon. On this particular site a thin spodic horizon is forming just above the plinthite zone, at the height of the hammer (Marajó area of Brazil).

The vegetation consists either of a poor and low type of forest, often with predominance of palm species like *Oenocarpus* and *Iriartea*, or of shrub- and even open grass savannah (''campo''), the latter usually in the central parts of the terrains affected.

The local population has learned that arable farming is not feasible on these soils. Some of the savannah terrains are grazed but the carrying capacity is very low. If this grazing would intensify and expand, by burning down the surrounding low forest and by artificial drainage, then the soil may dry out till greater depth, and substantial sheet erosion may take place. It is in such a situation that large-scale irreversible hardening of the plinthite of the original subsoil may take place. Erosion, hardness and low fertility, in conjunction, would then turn these terrains into some form of badlands. Only a new cycle of soil formation, after a lowering of the hydrologic base level of the Amazon region as a whole, would be able to turn the hardened soils very slowly into well drained concretionary but friable soils, where forest can re-establish itself.

3.2. Groundwater Podzols

These are more continuously imperfectly drained soils, developed on sandy sediments. The profiles are characterised by a subsurface horizon (A2 or E horizon) of strongly variable thickness - from 20 cm to well over 2 m - consisting of light grey to white sand or loamy sand of single-grain structure; this is underlain by a subsoil (B horizon) that is homogeneously or banded dark brown to black, has a texture that is little or no heavier than of the overlying layer (loamy sand to sandy loam), but has a firm consistence or even cementation and a low permeability and penetrability. This hard-pan, which has some accumulation of humic substances and of sesquioxides (Bh or Bhs), may be continuous or show a very irregular pattern, to the extent that in places it may be completely absent. The lower subsoil (C horizon) is usually a light brown non-cemented sand. Throughout the profile the base saturation is very low and the aluminium saturation high. Examples of profile descriptions can be found with Vieira and Filho (1961), Klinge (1965), Sombroek (1966) and the Brazilian Projeto Radam reports (especially no's 8, 11 and 14).

The podzolisation process is obviously the predominant agent of soil formation. In most profiles the spodic B horizon contains free aluminium oxides rather than free iron oxides, which makes the soil a Lowland Tropical Podzol or Groundwater Humus Podzol of early classification systems. In the present day Brazilian system they are called Podzol Hidromórfico (álico, distrófico), with FAO they are **gleyic Podzols** and in the U.S. Soil Taxonomy they belong to the Tropaquods.

The bleached sand layer may be so thick that any spodic B horizon is beyond reach with normal field probing equipment. In that case the denomination Areias Quartzosas Hidromórficas Distróficas (Brazilian), **albic Arenosol** (FAO), or Tropaquent/Quartzipsamment (US Soil Taxonomy) is often given *).

*) It should be mentioned that very deep white-sand soils are also found on excessively drained instead of imperfectly drained sites. Such soils occur, usually as small patches, within upland areas with deep sandy soils of ferralitic weathering, i.e. Areias Quartzosas Distróficas/ferralic Arenosols/oxic Quartzipsamments. They are known as White-sand Regosols or Giant Podzols (**albic Arenosol** or albic Quartzipsamment) and their vegetative cover is little different from that of the associated soils: mixed high forest of relatively low timber volume, or shrub savannah (''cerradao'') where rainfall conditions are marginal.

5. Aerial view of the landscape of the northern part of the Amazon region, showing white-sand savannahs on the flat interfluves areas, with continuously imperfectly drained soils of the gleyic Podzol or albic Arenosol type.
(Upper Rio Negro area of Brazil-Venezuela).

6. A profile of a gleyic Podzol under a low but dense shrub vegetation (''caatinga''), showing the thick bleached sandy E horizon. At the bottom left a part of the irregular hardpan of transported humic substances and sesquioxides.
(Maracassumé area of Brazil; photo T.H. Day).

The soils have developed on low-lying terrains with sandy parent materials. These terrains may be either flat to slightly concave interfluves, or narrow low river terraces and abandoned riverbeds. The latter ones may be flooded but then with river water without any load of sediment. Such rivers carry in fact often "black" water, because of the presence of fulvic acids originating from other Podzol areas (cf. Sioli, 1965 et seq.).

Based upon the experience in the eastern part of Amazonia, it was believed until recently that the sites with such Groundwater Podzols are small and scattered only, constituting a pedologic rarety (less than 0,5%). The new radar-bases mapping has however shown that the interfluve Podzol areas are very common and extensive in the upper Rio Negro area of Brazil, the adjoining parts of Venezuela and Colombia, and the middle reaches of the Rio Branco drainage system. Averaged over the whole northwestern section of the forested Amazon region, about 20% of the total land surface may be concerned. It is not unlikely that locally deep and strongly developed Groundwater Laterite profiles are concerned (the "low phase"), in the bleached sandy E horizon of which podzol formation is taking place as a secondary process.

The natural vegetation of the Groundwater Podzol areas is either a savannah-forest or a savannah, but with a physiognomy and species composition that is different from the vegetation of the Groundwater Laterite soils. The savannah-forest type can be a closed-canopy low forest of about 15 m high, consisting of dense stands of thin trees of many different species but with dominance of e.g. *Micandra spruceana* (Euphorbiaceae) or *Eperua leucantha* (Caesalpinaceae); this is the so-called "tall Amazon caatinga" (Klinge, 1978). The vegetation may also consist of shrubs with interspersed high trees, the so-called "low Amazon caatinga".
The savannah type, called "campina" or "campina-rana", consists of shrubs, palmlets and small trees, alternating with patches or irregular strips of a bare white sand-surface.

Many variants occur, related not only to topographical-hydrological gradients, but also to different degree of past human (Indian) influence. The Brazilian Radam Project mapping team has grouped all these special vegetation types together as "campina-rana" (with a subdivision into "arbórea densa", "arbórea aberta", "arbustiva" and "gramineo-lenhosa").

Detailed studies on the ecology of the Podzol areas are going on in the Unesco/IUFRO Man-and-Biosphere pilot project area of San Carlos de Rio Negro, in the Amazon province of Venezuela (Herrera, 1977; Klinge, 1978).

Because of the extremely poor soil qualities (extreme sandiness, hard-pan occurrence, shallow groundwater) the agricultural value of these terrains is nil.

If nevertheless their specific vegetation is destroyed by large-scale slashing and burning, either purposely or accidentally, then there is little chance for recuperation. The nutrients released from the ash are quickly washed down in the soil profile, cannot be held by the mineral soil and are drained off to the rivers. Mechanical surface clearing would expose the white-sandy mineral soil rightaway. In both cases the result would indeed be a whitesand "desert", albeit a marshy one.

4. Conclusions

The great majority of the lands of the Amazon region has well-drained soils of the Ferralsol or Acrisol type, that may or may not contain hard lateritic materials. These soils support a mixed high forest vegetation which can re-establish itself after agricultural occupation of the shifting cultivation type, unless fallow periods are taken too short. The soils have also a fair suitability for adapted forms of permanent agriculture.

A minor but significant portion of the land has imperfectly drained soils of the Groundwater Laterite type (plinthic Acrisols) or the Groundwater Podzol type (gleyic Podzol). These soils support various forms of poor savannah-forest or savannah proper. Their agricultural value is very low. If neverheless large-scale destruction of the natural vegetation on these terrains would take place, then there is a fair chance that they will turn into barren laterite surface or white sand ''deserts'', on which any substantial vegetation regrowth is very difficult.

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3. ACTIVITIES OF THE SECTIONS

3.1 Soil monolith collection and exhibition

3.1.1 Present status

Following the recommendation of the Netherlands Advisory Council (NAC) at its meeting of December 1st, 1978, work was concentrated on a selected number of soils. Mostly on the basis of soil genesis and classification, 62 monoliths representative for large areas in the world were chosen and put on display.

A total of 60 Soil Information Sheets (SIS) have been prepared to accompany the soil monoliths in the exhibition hall; they are available for visitors to the ISM. In 1979 about 5000 SIS have been distributed. However, a number of the SIS is not yet fully documented with all analytical data; this will be completed in 1980. As recommended, the leading theme for the present first selection of monoliths is on soil genesis and classification, based upon the FAO-Unesco Soil Map of the World and the USDA Soil Taxonomy.
At the exhibition some attention is also given to such aspects as land use and soil problems.

A few new soil monoliths were received from Canada, collected by local soil scientists. About 30 soils are still in boxes and not yet impregnated. Also a large part of the collection of Canadian soils acquired in 1978, needs new impregnation. In total about 350 monoliths are now in stock at ISM, in various degree of preparation. They originate from:

Countries	Numbers	Countries	Numbers
Australia	33	Namibia	11
Belgium	2	Netherlands	15
Botswana	7	New Zealand	5
Canada	21	Nigeria	14
Colombia	1	Norway	3
Czechoslovakia	8	Romania	11
Denmark - Greenland	2	South Africa	20
Fed. Rep. of Germany	17	Spain	18
Finland	5	Sweden	17
France	11	Syria	4
Ghana	4	Thailand	13
Greece	14	Turkey	13
Hungary	20	USSR	10
Ireland	11	West Samoa	5
India	30	Yougoslavia	3
Italy	8	Zambia	10
Malaysia - Serawak	10		

3.1.2 New acquisitions

For the collection of new profiles and supporting data contacts have been established with soil scientists of the following countries:

Australia: From the collection of Australian profiles a number of data are still missing. However, some valuable new contacts have been established and recently new data and information have been received.

Canada: ISM bought 19 Canadian monliths, which were assembled at the occasion of the 11th International Congress of Soil Science in 1978. There are deficiencies in the information on the site, the soil, the environmental conditions, photographs, etc.

Through correspondence it has been tried to get this information, as well as samples of a number of soils. Lately, these efforts have yielded some results. Also two Canadian profiles were collected by Agriculture Canada in Vancouver, B.C.; they arrived together with bulk samples, micromorphological samples, photographs, analytical data, etc.

U.S.A.: In the years to come the Soil Conservation Service, U.S. Department of Agriculture, will prepare a collection of 28 soils. The first soil profiles and relevant documentation are due to arrive soon.

U.S.S.R.: An important addition to the ISM collection is a series of soils from the USSR, taken for the 1st International Congress of Soil Science, held in 1927 in the U.S. The collection was under the care of the Soil Conservation Service, U.S.A., but it has now been agreed that it will be shipped to ISM for preparation and exhibition. These soils have not been on display since 1927 and have been kept in the original wooden boxes. The amount and quality of supporting information is still largely unknown.

West Samoa: Through personal contacts 5 monoliths were collected. A number of data and information as well as samples of one soil are still missing. Recently, some information on the soil, the site and laboratory data were received.

Belgium, Cameroon, Ghana, Italy, Kenya, Poland, United Kingdom, Venezuela: Discussions with soil scientists from these countries have been held on bringing together collections of soils for the ISM. The plans are in various stages of implementation. It is expected that in 1980 soils will be collected in Italy, Kenya and Poland. This will be partly done by local soil scientists and partly by ISM staff. The soils were selected by the ISM in close cooperation with the local soil scientists.

3.2 Laboratory

3.2.1 Analytical work

The main task of the laboratory this year consisted of completing the analyses of the monoliths collected for the inauguration exhibition. Part of this collection were "new" profiles, i.e. consisting of samples which had to be analyzed comple-

tely, whereas work on the other part entailed completion of earlier work or repetition of dubious analyses. The main lag was in the X-ray diffraction and X-ray fluorescence analyses (elemental analyses) which have not been carried out prior to 1975.

Mineralogical analysis of the sand fraction was started this year and some 40 samples have been completed. Apart from the latter, analyses on the exhibition collection will be completed by the end of this year while the X-ray work has virtually caught up with the other analyses in general, i.e. analyses on profiles not selected for the present exhibition.

3.2.2 Research

Because of the amount of routine analytical work, the time available for research was limited. Yet, a few topics received some attention:

- after several comparative experiments it was decided to adopt the Piper ''rapid titration method'' to determine carbonate in soils. This is an easy and rapid method applicable in any laboratory and without special equipment. Its main disadvantage is the inaccuracy in the low carbonate content range (below 1%) but this inherent in many other methods.
- the procedure for determining exchangeable acidity was modified.
- the use of DMSO (dimethylsulfoxide) to improve differentation between kaolinite and chlorite is being tested.
- a computer programme was written to speed up calculation of particle size analysis results.
- a HP 9825 A desk computer was acquired for, amongst other things, processing X-ray fluorescence data. Interfacing of this machine and the programming was achieved in cooperation with the Dept. of Soil Science, Agricultural University, Wageningen.
- for the determination of soil moisture characteristics (pF-curve) attention was focussed on the individual pressure cell for each ring sample (tempe cell). Based on the commercially available ''Soil Moisture Corp'' cell a new versatile cell was designed. A series of 12 cells was specially manufactured. Testing is in progress and the results look promising.

3.2.3 Comparison of methods, procedures and results of laboratory analysis for classification purposes

On recommendation of the 2nd International Soil Classification Workshop held in Malaysia and Thailand in 1978 and of the International Advisory Panel to ISM (1979*), with the technical support of the Royal Tropical Institute (KIT) in Amsterdam, a project has been undertaken to cross-check, correlate and possibly standarize laboratory methods for soil characterization as used in the various parts of the world.

A circular letter has been sent to 18 selected laboratories (see appendix B) as an invitation to join an exchange scheme of laboratory procedures and data (LABEX Programme). No reaction has been received yet from two (Hawaii and Indonesia). All others have enthousiastically accepted the invitation and the first bat-

*) See 4.2 of the IAP's recommendations.

ches of samples together with procedures and data have arrived already at ISM. The Royal Tropical Institute has generously agreed to carry out the work on our side entailing for the time being the determination of charge characteristics (base saturation, CEC, exchangeable acidity) and particle size analysis on some 175 samples.

It is essential that there will be agreement on the adopted procedures between KIT and ISM on the one hand and the USDA/SCS Lincoln National Laboratory (Dr. Holzhey) on the other. Contacts have been made to that end. A wide variety of bulk samples which will act as reference samples to be distributed by ISM are presently being collected by the Kenya Soil Survey (Dr. W. Siderius) in Kenya. It is hoped that analytical work can start by March/April 1980.

3.3. Micromorphology

3.3.1 Technical section

The preparation of the thin sections is carried out at the laboratory of the Netherlands Soil Survey Institute (head: Dr. A. Jongerius) by a technician of ISM. There is a close cooperation with the technician of the Soil Institute and there are material contributions to the laboratory. In the past, a new vacuum pump, a microscope and various minor equipment has been purchased by the ISM. In 1979 a grinding machine for the preparation of rock thin sections was installed at the expense of the ISM. There is a regular contribution of lacquer, oil and glassware.

In 1979 about 200 thin sections have been prepared bringing the total collection to approximately 1600. These comprise mostly samples belonging to the monolith collection. Other samples are those of special pedological interest.

3.3.2 Scientific section

The main purpose of micromorphological investigations as performed at ISM is to detect, elucidate and verify processes active in the soil, with the ultimate goal to classify the soil and predict its behaviour. Up to the present most of the thin sections of the collection have been investigated only superficially, mainly for the purpose of provisional classification.

In 1979 thin sections of 60 profiles in the exhibition hall have been studied in more detail. Photomicrographs, including a short explanatory text were made, showing the most relevant features of each profile. The aim is to demonstrate the use of micromorphology to those who are unfamiliar with it. So far, thin sections of approximately 40 profiles have been studied into more detail. Simultaneously an attempt was made to develop a system to describe the thin sections. In contrast to the above mentioned short explanatory text, these descriptions are intended for those who have a reasonable knowledge of micromorphological terminology and concepts. The main concern at the moment is to arrive at a scheme which can be accepted, at the least understood, by the trained student on micromorphology. In order to achieve this, the ISM keeps abreast with the ISSS Advisory Group on Descriptive System which is at present engaged in the preparation of such a system. A meeting of this Advisory Group was held recently at the Soil Survey Institute at

Wageningen (12-16 November 1979) and at the occasion the Group paid a visit to the ISM.

A detailed description of the thin sections of 6 profiles was presented for criticism. It is now attempted, by incorporating the ideas and decisions of the group, to come to a standardized method of description.

3.3.3 Collaboration with India

On the occasion of the 11th Congress of the International Society of Soil Science in June 1978 in Edmonton (Canada) the Director of ISM and the Director of the National Bureau of Soil Survey and Land Use Planning, Nagpur, India considered the possibility of collaboration of the institutes with a view of establishing a micromorphological laboratory in India and the training of one or two Indian soil scientists in micromorphology. The immediate need for micromorphology data on Indian soils has arisen in the context of the country hosting the 12th International Congress of Soil Science in February 1982. It is the intention of the National Bureau to publish a handbook of benchmark profiles at that time which should also include a micromorphological characterization of the soils. At present in India there is no micromorphological laboratory and scientists specialized in micromorphology are not available.

A project entitled: ''Micromorphological Analysis and Characterization of Benchmark Soils of India'' has been formulated and is now awaiting the final approval of the Dutch Goverment. The costs amount to Dfl 650,000, allowing the training of two Indian soil scientists, technical assistance for the establishment of a laboratory and training staff, equipment, and advance preparation and analysis of soil samples of benchmark soils in Holland. ISM and the Netherlands Soil Survey Institute (Stiboka) would cooperate on the project from the Dutch side.

In anticipation of the approval of the Dutch goverment the technical staff of the ISM has made a start with the preparation of a number of Indian soil samples. In 1979 the first 87 samples were received. A trained micromorphologist has been temporarily employed (as from September 1979) at Stiboka to examine and analyse these sections.

As soon as the project is approved by the Dutch goverment arrangements will be made to establish a laboratory in India. It is foreseen that a Dutch soil scientist will direct the proper installation of the equipment and train the technical staff.

3.4 Library and map collection

3.4.1 Aims and set-up

The need to establish at ISM a systematic documentation on soil maps and the accompanying technical reports was already discussed and formulated some years ago. However, activities only started in May this year with the temporarily appointment of a new staff member on part-time basis.

The Soil Map documentation is aimed to serve the following main purposes:
- to complement the collection of soil monoliths, by showing the distribution of different soils in each country;
- to form a source of information on its own, not only to soil scientists but also to technical assistance personnel going out to, or already working in developing countries;
- to form a data base for the future updating of the FAO/Unesco Soil Map of the World; for international symposia and workshops, and for international soil correlation/classification activities.

Because part of material is confidential or copyrighted, the collected map material and technical reports can as a matter of rule only be consulted at the premises of ISM. Lending or copying is not allowed, unless by written permission of the Director.

As a first objective it was decided that this documentation should consists of:
- a systematic collection of small maps from each country, and examples of soil maps from countries engaged in systematic (semi-) detailed surveys;
- documentation of information on all existing soil survey publications and soil maps through the collection of catalogues of other soil map collections, national catalogues or cartography indexes, etc.

At the same time, but as a long-term objective, the possibilities are investigated to establish or to cooperate in the establishment of:
- regional bibliographies on executed and/or published soil surveys and soil maps;
- coverage maps, for each country, indicating the geographical extension of the different soil surveys;
- information-storage and retrieval system, possibly computerized, for soil survey reports and maps;
- collections of agroclimatic, vegetation/land use and land evaluation maps to facilitate agrotechnology transfer.

3.4.2 Activities

The present activities centre around the establishment of the Soil Map Collection. A catalogue of all the maps already available at ISM was produced in its most simple form. Maps have been described by their scale, title, publisher, and year of publishing. The catalogue itself has both a regional and a thematic entry. At the same time addresses have been collected of national soil survey institutions and individual soil scientists, and letters, accompanied by a list of the soil maps already present at ISM, are now going out with the request of complementing the ISM documentation. In this respect also the assistance of the Dutch Agricultural Attachés at the different embassies has been sought.

For future possibilities of computerizing the information on soil maps, and in search of an internationally accepted standard description of cartographic material, ISM follows with much interest the research project of the Central Catalogue of Cartography (C.C.K.) in Utrecht, the Netherlands.

The map collection of the Soil Resources Development and Conservation Service, at FAO Headquarters in Rome, has been consulted for information and selections of maps to be transferred to ISM. Major soil resources inventory agencies, like ORSTOM (Bondy, France), ODA-LRDC (Tolworth, U.K.), and USDA/SCS (Lanham, USA) have promised their cooperation.

The possibility of a microphoto archive of the soil maps in our collection, and possibly from other sources, is being studied.

3.5 Education and information

3.5.1 General

In 1979, ISM has received about 2500 visitors from 69 countries. The majority of the visitors was from the Netherlands; about 300 came from abroad.

Compared with 1978, when ISM was visited by about 800 persons, there has been a large increase in the number of visitors. Most probably this has been caused by the publicity which ISM has received at the occasion of its official opening in March. The number of participants in groups increased as well. Also the first so-called "open days" attracted many visitors.

3.5.2 Individual visitors

Most of these visitors, mainly active in some branch of soil science, came from abroad. Their visits were usually arranged beforehand, either trough direct contact or by institutions in the Netherlands, which they were visiting. A large number of unexpected visits were made, especially during the summer season. The individual guests required much time from the ISM staff as they were shown around on individual basis or in very small groups (usually less than 5). Their stay often took about half a day or longer, as they visited all parts of the Museum, including workshop, laboratory, microscope room, library, map collection, etc. They also frequently met with other members of the ISM staff, depending on their interests and specialization. In 1979, ISM received a number of distinguished soil scientists from all over the world. For details see Appendix A.

Several persons visited ISM to prepare for their posting with DTH, FAO or other institutions, or who wished to have special information for publications, term papers, etc.

3.5.3 Group visits

Approximately 1100 visitors came to ISM in groups, mainly from educational institutions (universities, agricultural and technical colleges, high schools, etc.). Most of the groups were Dutch, but ISM also received groups from Germany and France, as well as groups of students attending international courses in the Netherlands (Wageningen, Enschede, Deventer, etc.).

In general, groups spent 2 to 3 hours at the Museum, in which time an outline of the history and programme of ISM and a lecture in soil science (introductory or specialized) were given, followed by a tour along the display of monoliths.

A number of groups visited ISM one or more days for instruction purposes. These visits also required much time of the ISM staff because of preparation (displaying selected soil monoliths, giving lectures on classification systems, etc.) and, occasionally, discussion of special topics.

3.5.4. "Open day" visits

After the official opening of ISM in March, a few "open days" were organized, during which the Museum was open to the public.

The first one was set on March 10, immediately after the official opening. Four introductory lectures were held throughout the day and all parts of the building could be visited. This day, advertized in local newspapers, was a great success. The number of visitors was estimated between 300 and 350 and the visits concentrated around the lecturing times as announced in the advertisements. The three following "open days", organized on the first saturday of the month, showed a rapid decrease of interested people. It then was decided not to continue the series but to search for a new formula, e.g. two "open days" per year, on the occassion of new, thematic exhibitions.

3.5.5. Special visits

On the occasion of the official opening of the new ISM premises, the International Advisory Panel and the Netherlands Advisory Council were welcomed (see 7.2 and 7.3 for the memberships). During sessions on March 7-9 both advisory bodies discussed the present and future programs of ISM and visited the various departments of the building.

4. TRAVEL AND MISSION REPORTS

Staff members of ISM have attended several meetings, congresses and courses. Only the more important events are mentioned. Dr. Sombroek's participation was usually in his dual capacity as Director of ISM and Secretary-General of the ISSS.

4.1 OECD-DAC meeting on Laterite Research in Developing Countries, Paris, France. Participant: W.G. Sombroek.

With permanent delegates and/or technical assessors from most other OECD countries, a discussion was held on the various meanings of laterite and the status of research on laterite in the field of soils and agriculture, construction (roads, buildings), mining exploration (raw metals), and hydrology.

One of the proposals concerned the establishment of a working group for the inventarisation, through literature review and questionnaires, of the existing knowledge on the agricultural aspects, as a basis for any further action by OECD. It was tentatively proposed that the Secretariat of such a working group be at ISM. Soon, however, it became clear that funds for such an undertaking would have to come from one of the member countries rather than from OECD itself. The matter was therefore temporarily dropped.

Definite action in any field of laterite research was left open pending the results of the forthcoming International Meeting on Laterisation Processes in Trivandrum, India (December 1979). A second informal meeting would then probably be called, and a large-scale conference is under consideration as well.

4.2 Joint Meeting of the British Society of Soil Science (BSSS) and the Royal Geographical Society (RGS) on "The characteristics of soils of the humid tropics and their potential for intensified crop production", London, U.K. Work Visits to the ODA - Land Resources Developments Centre (LRDC) at Tolworth Tower. Participant: W.G. Sombroek.

At the London meeting, a paper was read on "Soils of the Amazon region", which generated a lot of interest. The Amazon paper is publised in this Annual Report, since the BSSS/RGS have no intention to publish the meeting's papers. At LRDC the discussion centred on a) map collection and b) participation in the ISM laboratory exchange programme (LABEX). ISM is on the mailing list for LRDC publications and copies of older publications have been forwarded.

4.3 UNEP expert meeting on methodology for desertification assessment and mapping, Geneva, Switzerland. Participant: W.G. Sombroek.

In joint discussions between soil scientists, geomorphologists and agro-economists/sociologists, a first draft was prepared on the identification and quantification of desertification indicators, and a recommendation for mapping procedure was drawn up.

Probably a similar meeting of the experts will be held in 1980, on the basis of an elaboration of the working papers of the above meeting by Dr.H. Dregne of USA (UNEP consultant). Mapping and evaluation probably will be carried out by FAO, with UNEP funds. Pilot field projects in several affected countries, such as Mali, are foreseen.

4.4 Conference on "Priorities for alleviating soil related constraints to food production in the tropics", Los Baños, Philippines. Participant: W.G. Sombroek.

The meeting was organized by the International Rice Research Institute (IRRI) of Los Banos and Cornell University of Ithaca N.Y.

A thorough review of soil-related constraints was given on the basis of a good number of technical papers. Discussions resulted in a proposal to create an International Board for Soil Resources Management, in which ISM would probably be closely involved.

A provisional steering committee was created to follow-up the recommendations, to prepare a "Los Banos declaration" on international research needs, and to seek international funding.

4.5 NATO course on advanced chemical methods for soil and clay minerals research, Urbana-Campaign, U.S.A. Participant: L.P. van Reeuwijk.

A number of advanced analyzing techniques in soil research, viz. the new Mössbauer spectroscopy, neutron scattering, X-ray photoelectron spectroscopy or electron spectroscopy (ESCA), nuclear magnetic resonance (NMR) and electron spin resonance (ESR) is increasingly used. Unfamiliarity with these techniques however makes literature poorly accessible and the results difficult to interpret. Therefore, this course was organized for soil scientists and mineralogists.

The lecture notes of this course will be published shortly by the organizers as a textbook.

4.6 Annual meeting Soil Science Society of America (SSSA), Fort Collins, U.S.A. Participants: W.G. Sombroek and L.P. van Reeuwijk.
Work visits to Lincoln, Washington and Lanham, U.S.A. Participant: W.G. Sombroek.

At the SSSA annual meeting - which was combined with meetings of the American Society of Agronomy (ASA) and the Crop Science Society of America (CSSA) - an evening talk was given on ISM. The meeting had over 3000 participants and very many papers were presented. Several useful contacts for ISM were established. A one-day field excursion was made in the surroundings of Fort Collins (mountains and plains). Field examination of soils also took place during the overland travel across the Great Plains to Lincoln, going from the traditional range belt, through the wheat belt to the corn belt.

The Lincoln National Laboratory was visited under guidance of its Director, Dr. Steve Holzhey. Arrangements were made for the exchange of methods the ISM

LABEX programme; a list was compiled of about 30 monoliths of representative soils of the USA to be collected for ISM by the various State Soil Scientists under the coordination of Dr. Holzhey.

In Raleigh the Soils Department of the University was visited (Head: Prof. S. Buol), as well as the State Soil Survey Organisation (Head: Dr. H.J. Byrd). This was followed by field examination of typical North Carolina soils, with special attention to the soils with low-activity clays.

At the USDA - SCS Headquarters in Washington D.C. discussions were held with the Assistant Administrator for Soil Survey, Dr. Klaus W. Flach and other officials. Agreement was reached on the shipment to ISM of the 1927 Russian soil monolith collection, and on the forwarding of US soil reports and reconnaissance soil maps. Also the need for a soil monolith exposition at one of the musea of the Smithsonian Institute in Washington was discussed.

At the World Soil Geography Office in Lanham, the Russian monolith collection was inspected, and the Office's soil map collection viewed (Dr. A.C. Orvedal). Talks on soil classification history were held with Dr. R. Simonson.

At the World Bank's Head Office in Washington the prospects for an International Board for Soil Resources Management were reviewed with Dr.J. Coulter, Scientific Advisor to the CGIAR Secretariat.

4.7 DBG Meeting "Bodenentwicklung und Landnutzung in Mittelgebirge und Vorland", Freiburg, Fed. Rep. of Germany. Participant: D. Creutzberg.

The congress was attended by 320 soil scientists from 14 countries. Approximately 150 papers were presented, dealing with subjects regarding all seven commissions. Five excursions were organized, centering around the mountainous region of SW. Germany and N. Switzerland. Two of these excursions were attended.

4.8 Meeting on "Project de classification des sols (ORSTOM). Discussions with Unesco, Paris, France. Participant: W.G. Sombroek.

The first approximation of a new world-wide applicable scheme of soil classification as prepared by an ORSTOM working group (Dr. Ségalen a.o.), was discussed and criticsed. Participants included Prof. R. Tavernier from Ghent and Prof. A. Herbillon from Louvain-la-Neuve, Belgium.

Discussions were held with Dr. F. di Castri and Dr.F. Fournier of Unesco's Division of Ecological Sciences, mainly on financial and organisational aspects of the posting of three Dutch associate experts ecological sciences (soils) at the Unesco Regional Offices in Nairobi (Africa), Montevideo (Latin America) and Djakarta (SE. Asia). Their duty would include the compilation of soils information on the MAB biosphere reserves in these regions. ISM would provide the technical and scientific backstopping.

4.9 20th FAO Conference, Rome, Italy. Participant: W.G. Sombroek.

Discussions were held with Dr. Dudal (FAO) and Dr. Fournier (Unesco) on forthcoming international meetings (on elaboration of a World Soils Policy; on an international reference base for soil classification), and with Dr. A. Pécrot (FAO), on soil maps collection. The 20th FAO Conference was attended and possible support for the FAO-ISM ''Updating of the Soil Map of the World'' programme was discussed.

4.10 Consultancy for the Directorate for Technical Assistance (DTH) of the Netherlands Ministry of Foreign Affairs to Kenya Soil Survey Project, Nairobi, Kenya. Participant: W.G. Sombroek.

This consultancy was carried out to finalize the draft exploratory soil map and legend of Kenya, as aftermath of a previous assignment. In addition, several matters were discussed with the following organizations:

- Kenya Soil Survey: collection of bulk sample for the ISM laboratory exchange programme (LABEX) and soil monolith collection in 1980
- ICRAF (Dr. K.F.S. King, Dr.R. Contant): project proposal on research of the structure of tropical lowland forests by the Department of Foresty, Agricultural University, Wageningen
- IPAL (Dr. H. Lamprey) and Uneso Regional Office: posting of an associate expert soil science to the African MAB Programme, and cooperation on soil studies in the Mount Kulal arid lands research area of Northern Kenya
- UNEP (Dr. J. Høgel, Prof. Dr. R. Olembo, Prof. I.P. Garbouchev): ISM Programme, desertification inventory missions and UNEP world soil policy meeting
- Research Division of Kenyan Ministry of Tourism & Wildlife (Mr.S. Taiti): follow-up of WOTRO soil and vegetation studies in Tsavo National Park, Kenya.

4.11 Map collection mission FAO Headquarters, Rome, Italy. Participant: A. de Sitter.

This mission was carried out in order to study the map collection of AGL at FAO. A perusal of all the soil maps, present in the collection, was carried out. References to interesting maps were noted. Double and/or triple copies of maps were made available and sent to ISM. Additional copies, to supplement what was already present at ISM, of Soil Bulletins, World Soil Resources Reports, Conservation Guides and Irrigation and Drainage Papers were collected as well.

5. INTERINSTITUTIONAL RELATIONS

5.1 International relations and activities

5.1.1 Unesco

Agreement has been reached with the Direction for Technical Assistence (DTH) of the Netherlands Ministry of Foreign Affairs and Unesco on the financial and organizational details of the posting of three Dutch associate experts ecological sciences (soils) at the Regional Offies for Science and Technology of Unesco in Montevideo (Latin America), Nairobi (Africa) and Djakarta (Southeast Asia). Their duty will be to support and coordinate the soils work (especially soil identification and mapping) of all MAB biosphere reserves in the areas with technical and scientific backstopping of ISM. Where necessary extra field work will be carried out. The programme as a whole should result in a uniform reporting on the soil conditions in these reserves, as one of the essential elements for the assessment of the areas on their representativiness for major ecosystems in the tropics and subtropics. In addition, soil monoliths will be collected for ISM by the associate experts. These soils will serve as a ''virgin soils'' reference base.

5.1.2 FAO

Frequent contacts with officers at FAO Headquarters, Rome, Italy, have been maintained in 1979. This has resulted, among other things, in the transfer of duplicate or triplicate soil maps to the ISM Soil Map Collection and an agreement in principle for cooperation between FAO and ISM in updating the Soil Map of the World.

5.1.3. International Society of Soil Science (ISSS).

ISM houses the Secretariat of the ISSS since 1978 when at the International Soil Congress in Edmonton, Canada, the Director Dr. W.G. Sombroek was elected Secretary-General (on honorary basis). The constituents of the ISM Board - the International Institute for Aerial Survey and Earth Sciences (ITC), Agricultural University Wageningen (LH) and the Division for Agricultural Research of the Dutch Ministry of Agriculture and Fisheries (DLO) - have undertaken to provide financial support for the extra administrative facilities needed at ISM for the proper functioning of the ISSS Secretariat.

Mr. J.H.V. van Baren, as book review editor, prepared most of the texts for the section ''New Publications/ Nouvelles Publications/ Neue Veröffentlichtungen'' of the ISSS Bulletin.

Dr. O.C. Spaargaren assisted the Secretary-General in many ways, especially with the print preparation of the biannual ISSS Bulletin.

ISM staff members are taking part in the activities of the following subcommission and working groups: Subcommissions B, Micromorphology (D. Creutzberg), Working Group DS, Desertification (J.H.V. van Baren and W.G. Sombroek) and Working Group PP, Paleopedology (W.G. Sombroek and O.C. Spaargaren).

The Internationaal Soil Museum in Wageningen, the Netherlands.....seat of the International Society of Soil Science as well.

5.1.4 Correlation of soil classification systems

The ISM staff has been active to keep abreast of the new developments in international soil classification:

- The collection of publications and documents pertaining to all national soil classification systems is actively pursued.
- ISM is represented in each of the four international committees on revision of certain parts of the US ''Soil Taxonomy'' to make it more suited for application in the tropics and subtropics (ICOMLAC, ICOMOX, ICOMAND, ICOMMORT). The director has moreover been invited to become a member of the steering committee for the new USDA/SCS-USAID programme on ''Soil Management Support Services'', which has the revision of Soil Taxonomy as a major component.
- Contacts have been established with the group of ORSTOM soil scientists that have recently prepared a first approximation to a new international system of soil classification. For the first time, a francophone system is proposed that contains diagnostic properties and horizons with quantified limits as building stones (modelled as much as feasible to those of Soil Taxonomy). A different combination of these elements has however resulted in a completely new

system, with a radically new terminology. The point-de-départ is worldwide rather than an elaboration of the situation in one country or continent.
- Most important from the point of view of ISM, a new initiative is developing for refining and subdividing (with a third level category) the units of the FAO/Unesco Soil Map of the World legend. For May 1980 a meeting is planned in Sofia, convened by FAO, Unesco and ISSS, where the principles and the organisational aspects of such an effort will be discussed. Leading soil scientists from France, the U.S.A., and the U.S.S.R. have pledged their cooperation.

5.1.5 Others

Through personal memberships ISM has relations with the following professional Societies:

a) soil science societies
- Soil Science Society of America (SSSA)
- British Society of Soil Science (BSSS)
- Soil Science Society of Brazil
- Belgian Soil Science Society
- Deutsche Bodenkundliche Gesellschaft (DBG)
- International Society of Soil Science (ISSS)
- Soil Science Society of the Netherlands (NBV)

b) other societies
- Classification Society of the United Kingdom
- Royal Geological and Mining Society of the Netherlands
- Geologische Vereiniging (of the Federal Republic of Germany)

5.2 National relations and activities

ISM is in close contact with several soil science and agricultural institutions in the Netherlands and is represented in a number of scientific working groups in the field of environmental sciences.

5.2.1 Institutes

The institutes with which more or less regular cooperation in maintained are:

- Agricultural University (LH), Wageningen
- International Agricultural Centre (IAC), Wageningen
- International Institute for Aerial Survey and Earth Sciences (ITC), Enschede
- Netherlands Soil Survey Institute (Stiboka), Wageningen
- Royal Tropical Institute (KIT), Amsterdam

Three staff members of ISM lectured at ITC in the following topics:
- soil genesis and classification (with exercises) - Soil Taxonomy: 18 lecture hours (D. Creutzberg)

- FAO-Unesco Soil Map of the World (with exercises): 14 lecture hours (J.H.V. van Baren)
- physico-chemical aspects of soil formation: 28 lecture hours (L.P. van Reeuwijk).

The total time involved amounted to 4 man-months. This time has been compensated by ITC through enabling ISM to employ an extra staffmember on a temporary basis (Mr. A. de Sitter); see 7.4.

5.2.2 Working groups

ISM is represented in the following working groups:

- Aard Wetenschappelijk Onderzoek Nederland (AWON), Werkgemeenschappen Geochemie en Fysische Geografie en Bodemkunde;
- Wetenschappelijk Onderzoek van de Tropen (WOTRO), Werkgemeenschap Biologisch en Aardwetenschappelijk Onderzoek (East Africa, Sahel);
- Nederlandse Gespreksgroep Kleimineralen.

6. PUBLICATIONS

In 1979 the following publications were printed and made available for distribution:

ISM Technical Paper nr. 1: Procedures for the collection and preservation of soil profiles.
ISM Technical Paper nr. 3: A new suction apparatus for mounting clay specimens on small-size porous plates for X-ray diffraction.
Note: ISM Technical Paper nr. 2, dealing with soil and landscape photography is still in preparation.

To mark the inauguration of the ISM, articles on the aims and programme appeared in many daily, weekly and monthly publications in the Netherlands, and furthermore, in the ISSS Bulletin, ITC Journal, NUFFIC Bulletin and Unesco's Nature and Resources.

In September 1979 O.C. Spaargaren obtained a Ph.D. from the University of Amsterdam on his thesis ''Weathering and soil formation in a limestone area near Pastena (Fr., Italy)''.

6.1. Technical Paper 1. Procedures for the collection and preservation of soil profiles. J.H.V. van Baren and W. Bomer 23 pp.

A growing number of institutes, universities and highschools are collecting soil monoliths or have plans to do so in the near future.

These collections are built up for a variety of reasons and serve several purposes. Over the years the ISM received many requests for advice on taking and impregnating soil profiles, their transport, exhibition and storage. Since 1972 over 700 mimeographed booklets on taking and impregnating soils have been distributed.

The present Technical Paper is an extended version of that booklet. It presents the procedures for the collection and preservation of a variety of soils in the form of lacquer peels (impregnated in the field) and monoliths (impregnated indoors). It lists the tools, equipment and materials, including the lacquers used and some alternatives and has also sections on packing and transport, and the display and storage. Six pages of photographs illustrate the work involved step-by-step.

6.2. Technical Paper 3. A new suction apparatus for mounting clay specimens on small-size porous plates for X-ray diffraction. L.P. van Reeuwijk 4pp.

This note describes a suction apparatus developed in order to use small-sized porous plates as sample carrier the X-ray diffraction of the clay fraction.

About a hundred of these suction devices are now in use in various laboratories.

6.3. Ph.D. Thesis. Weathering and soil formation in a limestone area near Pastena (Fr., Italy). O.C. Spaargaren. 191 pp.

This thesis deals mainly with the (chemical) weathering of and soil formation on Cretaceous limestone and dolomitic limestone in South-Central Italy. Based on mineralogical and chemical analyses of some limestone samples, theoretical weathering models were calculated at a number of partial CO_2 -pressure ranging from $10^{-3.52}$to $10^{-0.80}$ bar. The results of these calculations were compared with the chemical composition of water samples (liquid phase) and the mineralogy of the soils (solid phase). The results show that the theoretical composition of the weathering residues (''soils''), being kaolinite and''residual'' dolomite agrees rather well with the actual mineralogical composition of a number of soils, especially those on dolomitic limestone.

Disagreement between the theoretical and actual mineralogical composition, viz. the presence of muscovite/illite in the soils, could be explained from admixture with allochtonous material (airbone volcanic dust) or appeared to be related to physical properties of the soil material.

At the end a synthesis of the landscape evolution and soil-forming processes during the Quaternary is given, based on a number of geological, geomorphological and pedological observations in the survey area.

This thesis has also been published as Publication nr. 30 of the Laboratory for Physical Geography and Soil Science of the University of Amsterdam.

7. PERSONNEL

7.1 ISM Board of Management

Members of the Board of Management were on December 31, 1979:

- Prof. Dr. Ir. G.H. Bolt, Chairman Netherlands Advisory Council.
- Prof. Dr. L. van der Plas, Agricultural University Wageningen.
- Ir. J.B. Ritzema van Ikema, International Institute for Aerial Survey and Earth Sciences (ITC), Enschede.
- Ir. R.P.H.P. van der Schans, Division for Agricultural research, Ministry of Agriculture and Fisheries, Wageningen (Chairman)
- Prof. Dr. Ir. T. Wormer (personal member).

7.2 International Advisory Panel

The International Advisory Panel (IAP) met for the third time (after 1967 and 1972) on the occasion of the offical opening of ISM in March 1979 (see 1.1). Members of the IAP on December 31, 1979, were:

- Prof. Dr. G. Aubert, ORSTOM, Bondy, France.
- Dr. F. di Castri, Unesco, Paris, France.
- Dr. R. Dudal, FAO, Rome, Italy.
- Dr. S. Holzhey, USDA-SCS, Washington, USA.
- Dr. R. Herrera, IVIC, Caracas, Venezuela.
- Prof. Dr. V.A. Kovda, Moscow State University, Moscow, USSR.
- Dr. R.S. Murthy, National Bureau of Soil Survey and Land Use Planning, Nagpur, India.
- Dr. A.M. Osman, ACSAD, Damascus, Syria.
- Dr. S. Pereira Berreto, ORSTOM, Dakar, Senegal.
- Dr. L.D. Swindale, ICRISAT, Hyderabad, India.

7.3 Netherlands Advisory Council

Members of the NAC on December 31, 1979 were:

- Dr. Ir. K.J. Beek, International Institute for Land Reclamation and Improvement (ILRI), Wageningen.
- Prof. Dr. Ir. J. Bennema, Department of Soil Science and Geology, Agricultural University Wageningen.
- Prof. Dr. Ir. G.H. Bolt, Department of Soils and Fertilizers, Agricultural University Wageningen (Chairman).
- Dr. Ir. J.C. Dijkerman, M.Sc. Course Soil and Water, Agricultural University Wageningen.
- Prof. Dr. Ir. A. van Diest, Royal Netherlands Society of Agriculture, Wageningen.

- Dr. Ir. Th.J. Ferrari, Institute for Soil Fertility, Haren.
- Prof. Dr. Ir. D. Goosen, International Institute for Aerial Survey and Earth Sciences (ITC), Enschede.
- Ir. B. van Heuveln, State University of Groningen
- Dr. F. Kadijk, Laboratory for Soil and Crop Testing, Oosterbeek.
- Prof. Dr. Ir. F.R. Moormann (personal member)
- Ir. A. Muller, Royal Tropical Institute, Amsterdam.
- Ir. J.C. Pape, Soil Science Society of the Netherlands, Wageningen.
- Dr. Ir. J.J. Reynders, State University of Utrecht.
- Dr. Ir. J. Schelling, Soil Survey Institute (Stiboka), Wageningen
- Drs. J.F.Th. Schoute, Free University, Amsterdam
- Prof. Dr. Ir. A.P.A. Vink, Laboratory for Physical Geography and Soil Science, University of Amsterdam.
- Ir. W. van Vuure, Division for Agricultural Research, Ministry of Agriculture and Fisheries, Wageningen.
- Dr. Ir. G.P. Wind, Institute for Land and Water Management Research (ICW), Wageningen.

7.4 ISM Staff

7.4.1 Present Staff

On December 31, 1979 the ISM Staff members were:

Director	:	Dr. Ir. W.G. Sombroek
Soil curator	:	Drs. J.H.V. van Baren
Micromorphologists	:	Drs. D. Creutzberg
		Ing. R.O. Bleyert
Head of Laboratory	:	Dr. Ir. L.P. van Reeuwijk, M.Sc.
Documentalist	:	Ir. A. de Sitter (part-time)
Educational officer	:	Dr. O.C. Spaargaren
Laboratory Analysts	:	J.R.M. Huting
		A.J.M. van Oostrum
		R.A. Smaal (seconded by ITC)
Technicians:		
- impregnation, technical services	:	W. Bomer
- photography and drawing	:	W.C.W.A. Bomer
- thin section preparation	:	J.D. Schreiber
Internal administrator	:	J. Brussen
Clerical staff	:	Mrs. G.J. Giesen-Peters
		Mrs. P.C. van Leeuwen
Service staff	:	Mrs. J.C. Jonker-Verbiesen
		Mrs. J. Nijhuis-Möller
External administrator	:	Managing Director, ITC, Enschede

7.4.2 Mutations in Staff

The following staff members left ISM during 1979:

- Mr. H.R. Renaud, who joined the Museum in the early days of its existence (retired). He took care of purchasing and internal administration, was responsible for a part of the accounts and organized the library and map collection, slide collection, and soil profile documentation. Although not a professional photographer, he managed to become an expert in all phases of black and white and colour photography.
- Mrs. A.E. Aalderink-Jellema, who joined in 1977 as receptionist, telephone operator and typist (resignation). She organized the sale of slides, books and maps.

The following persons joined ISM during 1979:

- Mr. A. de Sitter, a soil scientist who has been a FAO Soil Survey and Land classification expert for seven years. Initially he worked with the "Projet de Développement Hydro-agricole du Sud du Liban" covering the largest part of Southern Libanon. His next assignment was with the Land and Water Use Planning Project in Mozambique. His task at ISM is centered around the establishment of the documentation of soil maps reports for each country.
- Mr. J. Brussen, formerly with the Department of Financial and Economic Affairs, Agricultural University Wageningen, takes care of purchasing and internal administration. He is also responsible for part of the accounting and daily management of the library and map collection.

7.5 Guest workers and trainées

One foreign guest worker enjoyed the hospitality of ISM: Mr. N. Mahmood from Malaysia, being a student at ITC, carried out analyses for his M.Sc. thesis. During 6 weeks he worked under guidance of the laboratory staff.

Hospitality has also been given to Mr. W. van Wijngaarden (the Netherlands), who was at ISM throughout 1979, elaborating the data of his field work in the Tsavo National Park, Kenya. This research study is to result in a Ph.D. thesis, to be defended at the Agricultural University Wageningen.

APPENDIX A List of visitors from abroad over 1979.

Official representatives of international organisations:

M. Batisse (Unesco)
R. Dudal (FAO)
M. Farkas (UNEP)
F. Fournier (Unesco)
I.P. Garbouchev (UNEP)
A.M. Osman (ACSAD)
J. Hogel (UNEP)
E. Schlichting (ISSS)
L.D. Swindale (ICRI)

Visitors per country

Afghanistan
A.R. Azizi
M.Q. Yusafi

Argentina
L. Serna

Australia
J.W. McGarity
T.R. Paton

Austria
M. Webner

Bangladesh
A.W. Chowduri
A. Haque
M.M. Hossain

Belgium
J. Batardy
C. Belmans
O. Cogels
D. Gabriëls
R. Gervain
T. Heickmans
G. Stoops
R. Tavernier

Benin
D.D. Gbaguidi

Botswana
G. Staring

Brazil
R.J. Kirchheim
P.C. Molina
C. Nascimento
R.A. de Souza
H.H. Suiguino

Burma
K.S. Htum
Nyan Tun
Soe Saing

Cameroon
G. Aelterman
G.W. van Barneveld

Canada
G.J. Beke
E.E. Mackintosh

Costa Rica
U.B. Cortis

Curacao
G.E. Jonis

Cyprus
C. Photiou
Chr. Tschiattalos

Czechoslovakia
S. Matueen
P. Sletfelova

Denmark
R. Kjorgaord
P. Kungsten
L. Larsen

Ecuador
M. Wambigi

Egypt
M.A. Abdelkalik
A. El Araby
M.A. Omata
S.A. Saad

Ethiopia
T. Giselassie
R. Portegies Zwart

Fed. Rep. of Germany
C. Albers
U. Babel
A. Bechthoff
H. Bohme
B. Bzinwigs
R. von Fabrisch
T. Gaul
A. Gerards
Z. Gracinin
H. Graf von Reichenbach
T. Hampe
K.H. Hartge
P. Hausam

Fed. Rep. of Germany (cont'd)
H. Klinge
R. Kuilenburk
H. Mengenthaler
E. Muttert
R. Nusee
N. Pölster
U. Rath
H. Reck
J. Schöne-Warnefeld
D. Schröder
R. Schwarz
U. Steinhardt
L. Stössger
B. Ulber
H. Ulm
M. Voigt
B. Volk

France
G. Aubert
S. Bonnamy
P. Coudiu
N. Federoff
P. Gegout
M.C. Girard
A. Klein
C. Lacombe
V. Larsonneau
M. Lhoucine
M. Pelville
P. Perrin
H. Rey
P. Schwarz
P. Simon
S. Tible
V. Vergés
C. Wesam
C. Wuert

Ghana
R.D. Asiamah
J.M. Hutchison
D. Kyeboah
K. Nyalemegbe

Greece
G. Nakos

Hungary
J. Percir
M. Szinay

India
D.R. Bhumbla
S.K. Dey
M. Singh

Indonesia
M. Al-Jabri
M. Prajitno
A. Rahaya
J. Sukanto
Y. Sukra
Z.W. Wiboura

Iraq
H.K. Aziz
S.S. Hussain
S. Kasal
S.B. Katib
K.R.A. Rahman

Ireland
J. Curry

Israel
P. Haldberg

Italy
L. Venello

Ivory Coast
J.H. Bruin

Jamaica
J.J. Scholten

Japan
E. Nioh
M. Ogiso
K. Sato
N. Sekiya

Jordan
G. Tuffaha

Kenya
S. Cobb
H. Kangu
C.J. Mbara
E.N. Mugai
E.M. Muriuki
K. Njoroge
P.R. Otieno
J.P. Rakwach
H. Wanbiji
A.W. Wanjala

Lesotho
R.L. Ntokoane

Liberia
P. Korvah
W.J. Veldkamp

Malaysia
R. Kamandin
Tan Swee Tian

Mexico
M. de Laurdes
S.R. Maples
M. Padrio
G.H. Silva
C.A. Valdez
M.M. Vermeersch

Mozambique
M. Kaufman
M. Konstapel
M. van Mourik

Nepal
M. Bahadur

New Zwaland
K.F. O'Connor

Nigeria
W. Adebayo
T.I. Ashaye
T.A. Bello
J.V. Do
N.C. Ildabackie
T. Kobho
F. Mouteauguole
M. Salihu
A.A. Suelioni

Norway
S. Pederson

Pakistan
M. Athar
M.K. Mahmood
M. Tahir Saleem

Papua New Guinea
S. Mea

Peru
J.G. Chuquiure
M. Mendoza

Philippines
M.M. Agua
L.N. Bautista
A.L. Belda
M. Buyem
G. de Guzman
G.R. Ipac

Poland
S. Kowalinski

Portugal
J.C. Martinis
E. Portella

Romania
G. Tumariu

Ruanda
P. van der Zaag
C. van der Zaag

Senegal
S. Pereira Barreto

Sierre Leone
A.S. Ndanema
L. Touber

South Korea
Lee-Tai Soo
Kai-doo Kun

Spain
J. Aquilar
G. Paneque

Sri Lanka
M. Dharmawardene
K.S.C. de Fonseka
P. de Fonseka
S. Gnanakuma
R.M. Kularatna
J. Paulsay
S.U. Siviwardare

Sudan
M.O. El Karouni
E.G. Mussa
P. van Blom
M. van Noordwijk

Sweden
M. Jühl

Syria
W.H. Daoud
R. Rizk

Tanzania
S. Kachima
I.K. Kullaya
S. Msahi
E. Mwambazi
C. Nyeupe
B.B. Olomi
H.T. Veldhuizen
M. Verweij

Thailand
V. Daorerk
P. Hemmadhun
E.F. Senirang Na
E.F. Ahydhaya
R. Sorchurai

Trinidad
R. Sanlandy

Turkey
Y. Bilginer
U. Dinc
M. Göksu
C. Kikermay

Uganda
M.A. Bekunda

Upper Volta
J. Buursink
M. Jordans
I. Oubda
A. Vermeer

U.K.
R. Brown
P. Bullock

U.K. (cont'd)
I. Canthers
D. Dent
P.A. Dinkerson
C. Edwards
E.A. Fitzpatrick
M.J. Goss
S. Le Girce
E.G. Hallsworth
B. Kerry
J.R. Lofty
D. Mackney
C. Murphy
P.F. Perce
M. Ragg
A. Thomasson

U.S.A.
M. Guthrie
C.S. Holzhey
H. Ikawa

U.S.A. (cont'd)
D. Mauat
D.L. Mokma
C.J. de Mooy
R.D. Muncan
H. Scheckner
P. Scheckner
G. Smith

U.S.S.R.
T. Tursina

Venezuela
W. Franco
R. Herrera
W. Peters

Yugoslavia
G.L. Antonović
P. Ivanović

Appendix B. Participants in the ISM Programme on Laboratory Methods and Data Exchange (LABEX)

Australia

CSIRO, Division of Soils, Davies Laboratory
Pte Bag, Townsville, QLD 4810, Australia.
(Liaison-officer: Dr. Gavin Gillman)

Belgium

Lab. v. Fysische Aardrijkskunde
en Bodemstudie
Geologisch Instituut, RUG
Krijgslaan 271
B-9000 Ghent, Belgium.
(Liaison-officer: Prof. Dr. C. Sys)

Brazil

SNLS-EMBRAPA
Rua Jardim Botânico, 1024-Gávea
22460 Rio de Janeiro, RJ, Brazil
(Liaison-officer: Dr. A.F. de Castro)

Cameroun

Inst. of Agric. & Forestry Research
Centre for Perennial Crops, Ekona
PMB 25, Buea, Cameroun.
(Liaison-officer: Dr. J.M. Menyonge)

Colombia

Inst. Geografico "Augustin Codazzi"
Laboratorio de Suelos
Carrera 30, no. 48-51
Bogota, Colombia.
(Liaison-officer: Dr. Carlos Luna Zambrano)

France

Services Scientifiques Centraux
O.R.S.T.O.M.
70-74, Route d'Aulnay
93140 Bondy, France
(Liaison-officer: Dr. P. Pelloux)

Germany (BRD)

Ordinariat für Bodenkunde
Universität Hamburg
Von Melle Park 10
2000 Hamburg 13, BRD
(Liaison-officer: Dr. D. Goetz)

India

Nat. Bur. of Soil Survey & Land
Use Planning
Seminary Hills
Nagpur - 440 006, India.
(Liaison-officer: Dr. R.S. Murthy)

Indonesia

Director Soil Research Institute
Jalan Juanda 98
Bogor, Indonesia
(Liaison-officer: Dr. D. Muljadi)

Japan

Tropical Agriculture Research Center
Min. of Agric., Forestry & Fisheries
Yatabe, Tsukaba, Ibaraki,
300-21 Japan.
(Liaison-officer: Dr. Yutaka Arita)

Kenya

Kenya Soil Survey, National Agricultural Laboratories
P.O. Box 14733,
Nairobi, Kenya
(Liaison-officer: Mr. F.N. Muchena)

Malaysia

Analytical Services, Dept. of Agric. H.Q.
Jalan Swettenham
Kuala Lumpur, Malaysia
(Liaison-officer: Mr. Lim Han Kuo)

New Zealand

Soil Bureau, DSIR
Private Bag, Lower Hutt, New Zealand
(Liaison-officer: Mr. L.C. Blakemore)

Nigeria

I.I.T.A., PMB 5320
Ibadan, Nigeria
(Liaison-officer: Dr. A.S.R. Juo)

Syria

The Arabic Center for the Studies of Arid Zones and Dry Lands (ACSAD)
P.O. Box 2440
Damascus, Syria
(Liaison-officer: Mr. J.O. Job)

U.K.

Tropical Soils Analysis Unit, LRDC
Min. of Agric., Fisheries & Food
Block A, Government Office
Coley Park, Reading RGI 6 DT, England
(Liaison-officer: Mr. J.A. Varley)

U.S.A.

Lincoln National Laboratory
Soil Conservation Service
Room 393, Federal Bldg, U.S. Courthouse
Lincoln, NE 68508, .U.S.A.
(Liaison-officer: Dr. C.S. Holzhey)

Dept. of Agronomy & Soil Science
College of Tropical Agriculture
3190, Maile Way
Honolulu, Hawaii 96822, U.S.A.
(Liaison-officer: Dr. James A. Silva)

Venezuela

Seccion Suelos
CENIAP, MAC
Maracay 200, Venezuela
(Liaison-officer: Dr. A.V. Chirinos)

LIST OF ISM PUBLICATIONS

Technical Paper 1: Procedures for the collection and preservation of soil profiles (J.H.V. van Baren and W. Bomer). 23 pp.

Technical Paper 2: The photography of soils and associated landscapes (J.M. Ragg and D. Creutzberg) (in preparation)

Technical Paper 3: A new suction apparatus for mounting clay specimens on small-size porous plates for X-ray diffraction (L.P. van Reeuwijk). 4pp.

AIMS OF ISM

- to serve as a documentation centre on soils of the world - through its collection of soil monoliths and reports and maps on land resources with emphasis on the developing countries

- to improve methods of soil analysis - through research and international correlation with emphasis on soil characterization and classification

- to transfer specialized information - by lecturing and by publishing on the collected materials and on research data, and by advising on the establishment of national or regional benchmark soil collections

- to stimulate and contribute to new developments in soil genesis and classification, soil mapping and land evaluation - through active participation in international scientific working groups