SA waterbulletin

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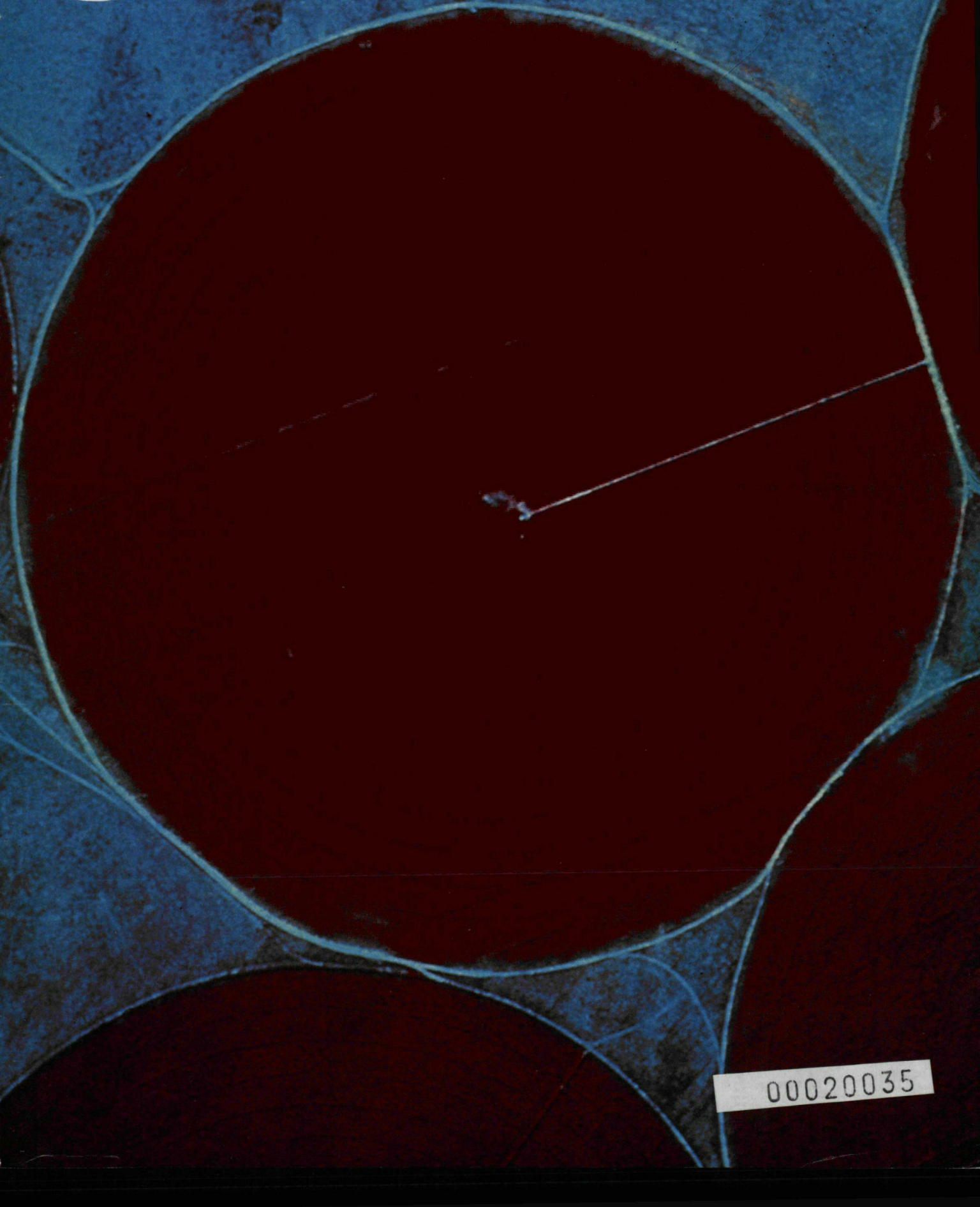


IWPC'S BIENNIAL CONFERENCE AND EXHIBITION

12 – 15 MAY 1987

VENUE:
Elizabeth Hotel
PORT ELIZABETH
(15 May optional)

THEMES:

Principal themes of the conference will include composting, solid wastes, industrial water management, sludge bulking, sewers, chemical phosphate removal, biological phosphate removal, small and rural works, water treatment and supply and pollution studies.

TECHNICAL VISIT

Fish Water Flats – Water Reclamation by reverse osmosis and sludge bulking control by selector technique
OR
Uitenhage sewage and water works.
These optional visits will be completed by lunch time to enable delegates to leave Port Elizabeth in the early afternoon.

EXHIBITION

An exhibition of manufacturers and suppliers equipment will be on show in the Adjoining hall in the Elizabeth Hotel from Tuesday 12 to Thursday 14 May.

REGISTRATION FORM

Name: .....

Address: .....

.....

..... Post Code .....

Telephone No.: .....

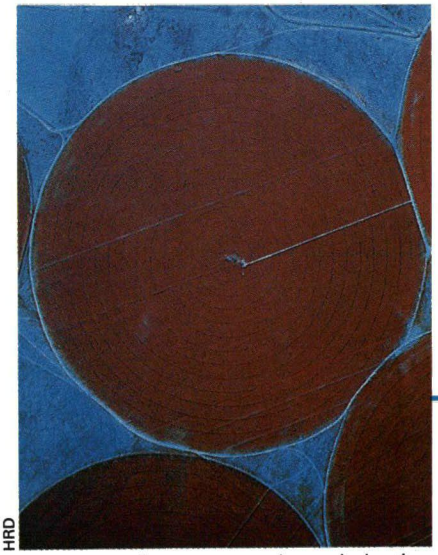
Accompanied by: .....

Full period registration	Member	R250
	Non-member	R300
One day registration	Member	R100
	Non-member	R120
Accompanying ladies' registration (banquet inc.)		R120
Post-conference tour		R 10
Penalty for late registration		plus 20%
Banquet *guests* only		R 60

AMOUNT ENCLOSED .....
(cheques to be made out to: IWPC (Conference)

This form together with fees must be returned *not later than 30 April 1987* to:
The Secretary, P O Box 81249, Parkhurst, 2120

PLEASE NOTE:
Full registration includes papers, transport to and from civic reception, teas and lunches (Monday - Wednesday) and banquet.
One day registration does not include banquet.
Accompanying ladies are very welcome to attend the post-conference tour.



HRD

Large scale center pivot irrigation systems from the air over Nebraska.

SA waterbulletin

VOLUME 13 No 1 FEBRUARY 1987

contents

SA Waterbulletin is a quarterly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organization established in 1971 by Act of Parliament.

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Intekening is gratis. Stof in dié publikasie weerspieël nie noodwendig die oorwoë menings van lede van die WNK nie, en mag hergebruik word met erkenning van die bron.

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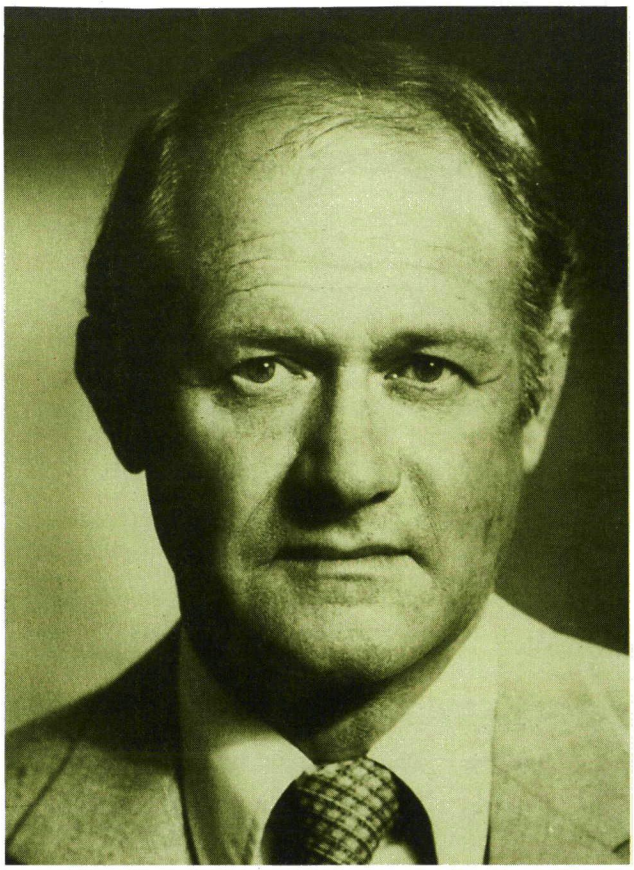


Mr John Wiley, Minister of Environment Affairs and of Water Affairs.

The State President, Mr P W Botha, at the end of last year appointed Mr John Wiley and Mr Japie van Wyk as the new Minister and Deputy Minister of Water Affairs respectively. *SA Waterbulletin* here takes a closer look at the careers of these two distinguished men.

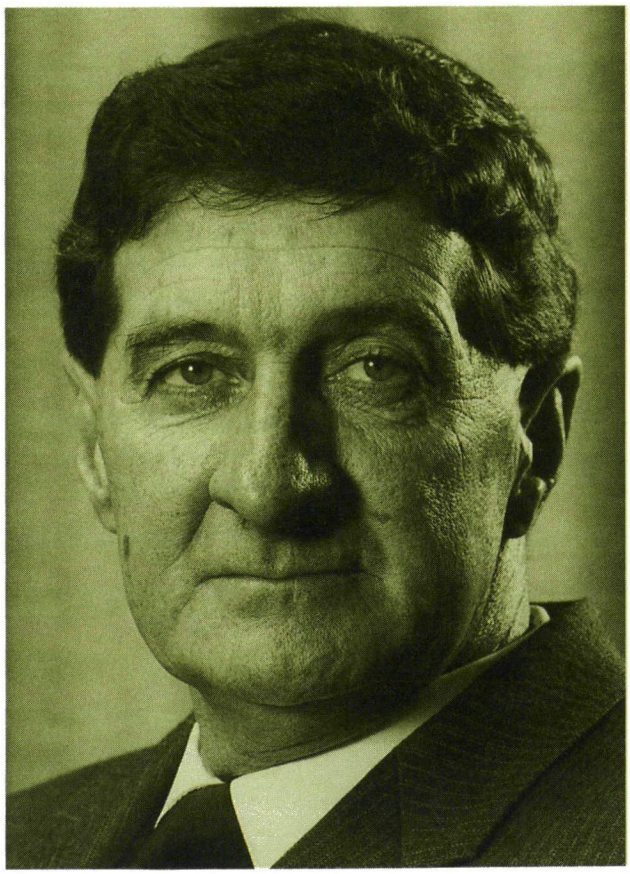
John Walter Edington Wiley was born on 7 February 1927 at St James in the Cape. He was educated at the Diocesan College (Bishops), Cape Town, and after completing the BA degree (Law) at UCT, he obtained a BA (Honours Jurisprudence) and an MA at Oxford University.

Before being elected Member of Parliament for Simon's Town in 1966, he held professional positions as attorney (1954-56) and advocate (admitted in 1963). As MP Mr Wiley has served on various Select Committees such as Pollution, Defence, the Constitution, Fisheries, and Railways and Harbours.

He was appointed Deputy Minister of Environment Affairs and Fisheries in 1982 and Minister of Environment Affairs and Tourism in 1984.

As a cricketer he represented the Western Province in the Nuffield XI, UCT, SA Universities, Oxford and Western Province. He is also keenly interested in private investment, international affairs and nature conservation, and travelling.

Mr Wiley is married to Jeanne Niehaus and has two sons and a daughter from a previous marriage.



Jacob Albertus van Wyk is op 9 Junie 1935 op Grootdrink naby Upington in Kaapland gebore. Hy matrikuleer aan die Upington Hoërskool en verwerf in 1956 'n B.Sc.-graad in landbou aan die Universiteit van Stellenbosch.

Hierna spits hy hom op boerdery toe en word in 1980 as die "Boer van die Jaar" in Noordwes-Kaapland aangewys. Ten tye van sy verkiesing as lid van die destydse Volksraad is mnr Van Wyk dan ook 'n voltydse boer.

Hy dien op talle komitees en rade soos die Suid-Afrikaanse Landbou-unie se Watersakekomitee, die Benede-Oranjerivieropvangbeheergebied-komitee, die Parlement se gekose komitee oor besproeiingsake en die Parlementêre studiegroep: Landbou en Watervoorsiening.

Op sportgebied het mnr Van Wyk veral uitgeblink as rugbyspeler en bokser en het die Universiteit van Stellenbosch in albei hierdie sportsoorte verteenwoordig. Hy stel ook belang in pluimbal en is 'n privaatvlieënier. Mnr van Wyk is getroud en het drie kinders.

◁ *Mnr Japie van Wyk, Adjunk-minister van Waterwese.*

SA Waterbulletin wens dié twee Ministers alle sukses en voorspoed toe met die nuwe verantwoordelikhede wat aan hulle opgedra is.

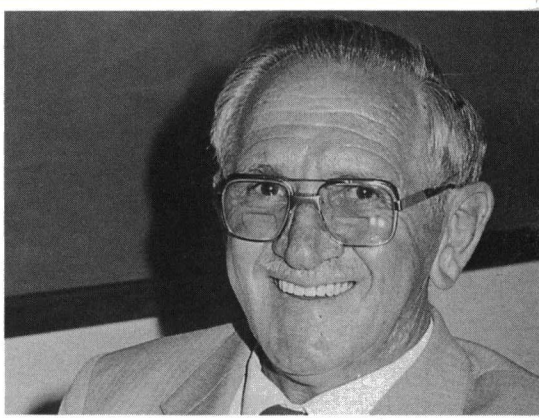
Twee Belgiese wetenskaplikes, die internasionaal bekende biometeoroloog, professor *Ivan Impens,* en die plantfisioloog, *dr Reinhart Ceulemans,* van die Universiteit van Antwerp in België, het Suid-Afrika onlangs besoek. Hulle het na besproeiingsnavorsing in Suid-Afrika kom kyk en die Waternavorsingskommissie onder andere oor navorsing in verband met die doeltreffende gebruik van besproeiingswater geadviseer. Dr Ceulemans is ook aktief betrokke by die WNK se navorsingsprojek oor die verbetering van besproeiingsbestuur deur middel van grondwatermonitering en kennis van die beskikbare waterkapasiteite, wat tans deur die Universiteit van Fort Hare uitgevoer word.

Die foto is by die reënvalsimuleerder van die Navorsingsinstituut vir Grond en Besproeiing (NIGB) in Pretoria geneem. Van links verskyn: mnr Pedro Berliner, NIGB; dr Dries van der Merwe, NIGB; mnr Guy Levy, NIGB; prof Ivan Impens; dr Reinhart Ceulemans; mnr Hendrik Smit, NIGB; en dr George Green, WNK.

▽

Die Universiteit van die Oranje-Vrystaat het onlangs 'n replika van die Coert Steynberg-beeld "Helpende Hand" aan die Waternavorsingskommissie geskenk as 'n blyk van hulle dank en waardering vir die finansiële bystand wat die WNK deur die jare aan die Universiteit verleen het. Op die foto is die hoofbestuur van die WNK besig om die beeldhouwerk te besigtig. Van links: mnr Piet van der Schyff, direkteur: finansies, dr Willie Hattingh, hoofadviseur, mnr Piet Odendaal, uitvoerende direkteur, mnr Hennie Lombaard, direkteur: administrasie, en mnr David van der Merwe, hoofadviseur.

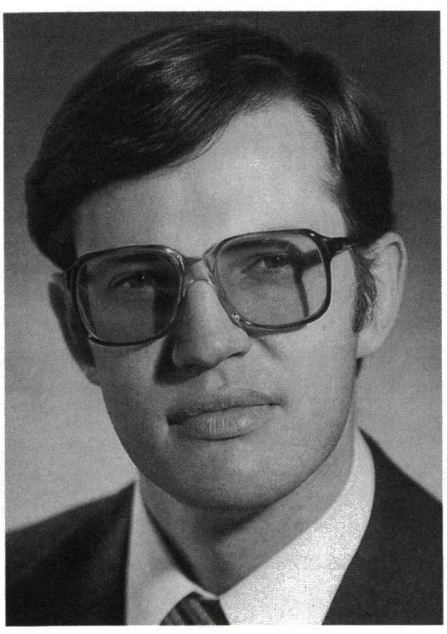
WNK



Dr M C F (Marius) du Plessis, direkteur van die Navorsingsinstituut vir Grond en Besproeiing (NIGB), het op 31 Desember 1986 die tuig neergelê toe hy met pensioen afgetree het. Dr Du Plessis was vir amper 15 jaar hoof van die NIGB en het in dié tydperk die organisasie uitgebou tot 'n toonaangewende, nasionale vakinstituut in die navorsingsveld van grond, water, klimaat en skeikundige dienste, toegerus met van die mees moderne apparaat en toerusting. Hy het op verskeie WNK-loodskomitees gedien en was ook betrokke by die aanvoorwerk van 'n huidige WNK-projek waarin die NIGB die watergebruik en produktiwiteit van gewasse onder toestande van waterstremming ondersoek. Dr Du Plessis word deur dr Derek Scotney van die Departement van Landbou en Watervoorsiening opgevolg.

SA Waterbulletin wens dr Du Plessis namens die WNK 'n aangename rustyd toe.

WNK



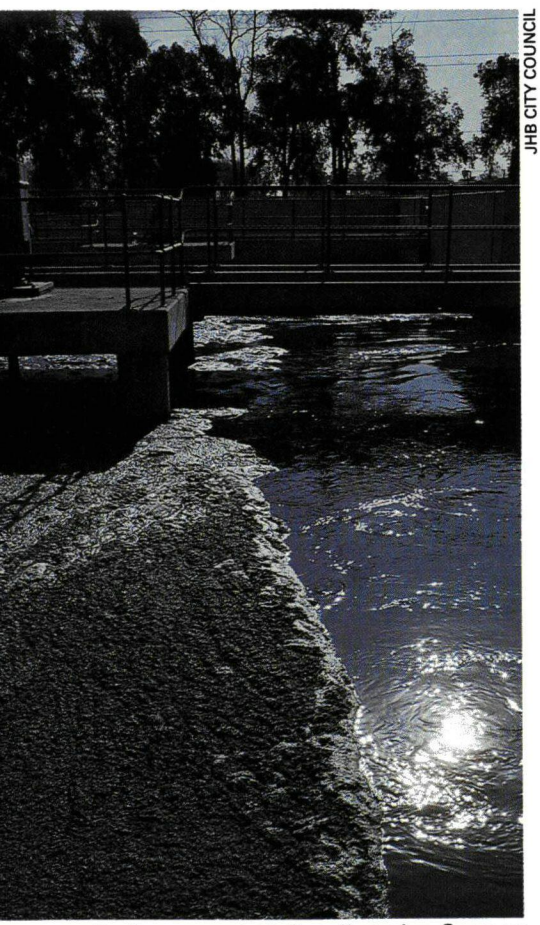
Dr Herman Wiechers, senior adviseur van die Waternavorsingskommissie, wat aan die einde van Januarie 'n pos by die Kamer van Mynwese in Johannesburg, aanvaar het as hoof van die waternavorsingsafdeling in die Kamer se navorsingslaboratorium vir omgewingsingenieurswese.

Dr Wiechers het in Julie 1977 by die Waternavorsingskommissie aangesluit as hoofprojekontwikkelingsbeampte en was hoofsaaklik verantwoordelik vir die navorsingsgebiede rioolwatersuiwering, waterstabilisering en limnologie.

Die daarstelling van 'n aantal rigtinggewende handleidings oor biologiese stikstof- en fosfaatverwydering, chemiese fosfaatverwydering en waterversagting en -stabilisering was enkele van die hoogtepunte van sy dienstyd by die Kommissie.

EXPERIMENTS IMPROVE BIOLOGICAL NUTRIENT REMOVAL AT THE JOHANNESBURG NORTHERN WORKS*

Phosphate removal stability in a five-stage Bardenpho process at the Johannesburg Northern Sewage Works was greatly improved by supplementing the influent COD with fermentation products produced from primary sludge. Optimal performance was achieved by accumulating sludge in the primary sedimentation tanks for 3 to 4 days and elutriating the volatile acids produced by recycle to the influent sewage. Further improvements in phosphorus removal were achieved by eliminating the second anoxic zone and providing endogenous denitrification facilities for returned sludge ahead of the anaerobic zone and diverting the influent sewage to the latter.



JHB CITY COUNCIL

Surface scum at Goudkoppies Sewage Works

Biological phosphate removal sewage treatment plants in South Africa have not always given reliable and satisfactory results. A case in point is the Johannesburg Northern Works which treats a relatively weak sewage. The virtually identical Goudkoppies Plant South of Johannesburg, however, has given consistently reliable results for a number of years.

In August 1983 the Water Research Commission entered into an agreement with the City Council of Johannesburg to investigate the reasons for this discrepancy and to improve plant performance. During the three year duration of the contract the Council has undertaken a number of full-scale investigations, as well as fundamental studies into the problems of biological phosphate removal.

INFLUENT SEWAGE CHARACTERISTICS

Research at the University of Cape Town (UCT), the National Institute for Water Research (NIWR) and elsewhere has highlighted the dependence of phosphate removal mechanisms on the presence of certain minimum concentrations of some readily biodegradable materials including volatile fatty acids. At the Northern Works these volatile fatty acids were produced by fermentation of primary sludge, either in primary sedimentation tanks or off-line in a separate high rate "acid" digester. In both cases a sludge retention time of 3 to 4 days proved optimal, but this may also be dependant on factors such as tank design, sludge characteristics and temperature.

Periodically sludge had to be removed totally from the fermentation area to prevent the unwanted proliferation of methane forming bacteria. The primary sedimentation tank produced far more volatile fatty acids than the off-line digester, which made it the obvious choice.

Although the elutriation of the volatile fatty acids from sludge resulted in an increase in the density of the primary sludge, the digester gas production dropped markedly. The simplest form of elutriation is to recycle a portion of the accumulated sludge to the incoming sewage. Significant improvements in plant phosphate removal were also noted but at the expense of a higher solids and COD load on the bioreactor. Further optimisation of this technique, still needs to be undertaken. Also noticed was a proliferation of filamentous organisms in the bioreactor, possibly as a result of the presence of volatile fatty acids. This phenomenon will also require further investigation.

OPTIMAL USE OF READILY BIODEGRADABLE COD OF SEWAGE (S_{bs})

Research experience in this project identified the need for ensuring that all readily biodegradable material present in the sewage, or subsequently deliberately generated, should be available to promote the growth of phosphate removing bacteria.

To minimise the S_{bs} utilization by denitrification of nitrates in recycled return activated sludge one five-stage 50 M//d module was structurally altered to eliminate the existing Northern

* The final report on this research work – *Enhancement of Biological Phosphorus Removal by altering process feed composition* – is available free of charge from the Water Research Commission, P O Box 824, Pretoria 0001. Telephone: (012) 28-5461.

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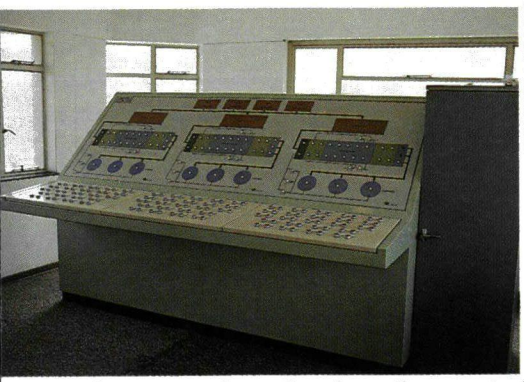
Respirometer



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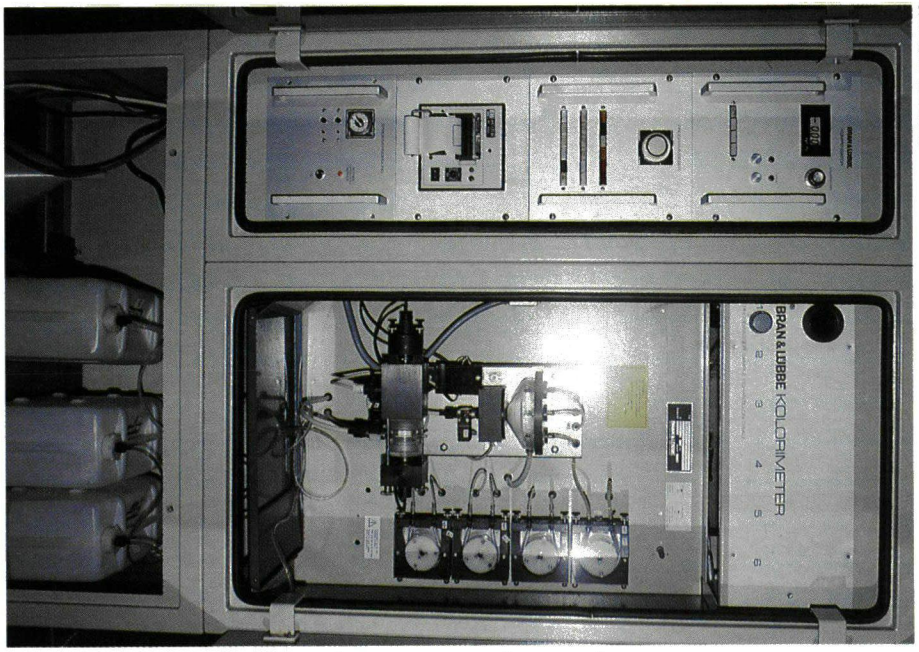
An outstation showing the control panel for Northern Works



JHB CITY COUNCIL

Phosphate concentration monitor

Works second anoxic zone, to recreate it upstream of the anaerobic zone.

Denitrification of the returned activated sludge was achieved by utilising the breakdown products produced by endogenous respiration of the sludge, thus leaving the S_{bs} available in the feed sewage, which was passed to the anaerobic zone for the use of the phosphate accumulating bacteria. It was evident that provided the nitrates in the recycle stream to the anaerobic reactor could be controlled, the feed to both processes had an overriding influence on biological phosphate removal.

Although this mode of operation resulted in a significant improvement in reliability and levels of phosphate removal, it still needs to be proven under wet weather conditions and associated weaker sewages. This also represents a significant departure from the conventional Bardenpho process and may provide an answer to plants experiencing difficulty in maintaining a high level of phosphate removal. The practice of switching off surface aerators to improve denitrification is likely to impair phosphate uptake and encourage the growth of filamentous organisms.

PERFORMANCE MONITORING

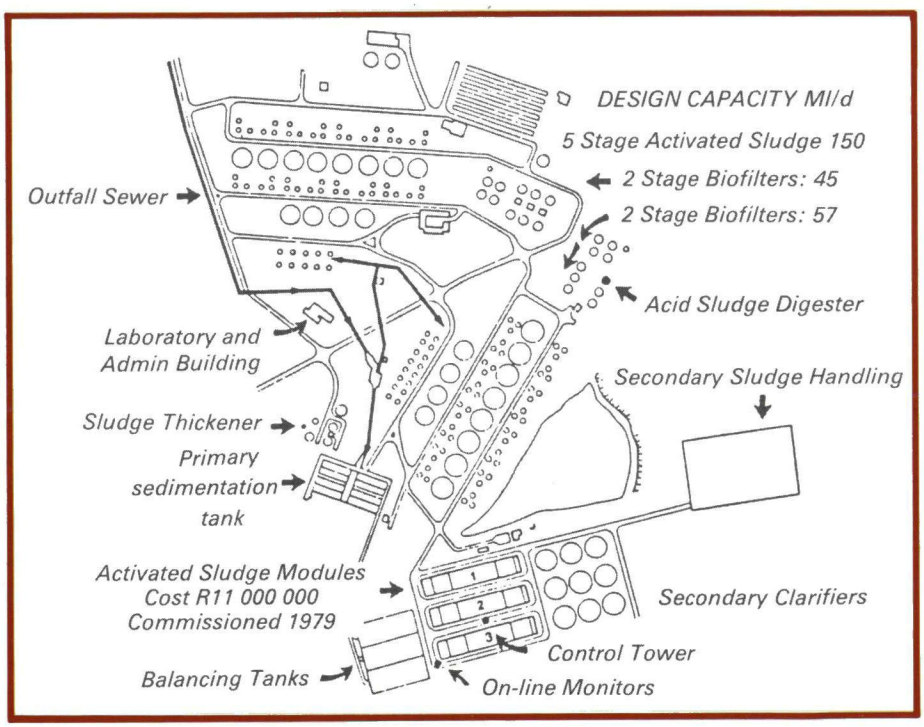
Two commercial on-line monitors for nitrogen and phosphate measurement were installed, and operational problems and costs identified. In 1984 capital costs per instrument were around R30 000. Total monthly running costs for measuring ammonia, nitrate and phosphate continuously, were R756, R535 and R271 respectively.

Variations in oxygen demand in the main aerobic basin highlighted the need to further investigations to evaluate oxygen utilisation rate instrumentation for plant control purposes. A computer controlled instrumentation and data collecting and storage system has been installed. Automatic plant control is a forseeable future development.

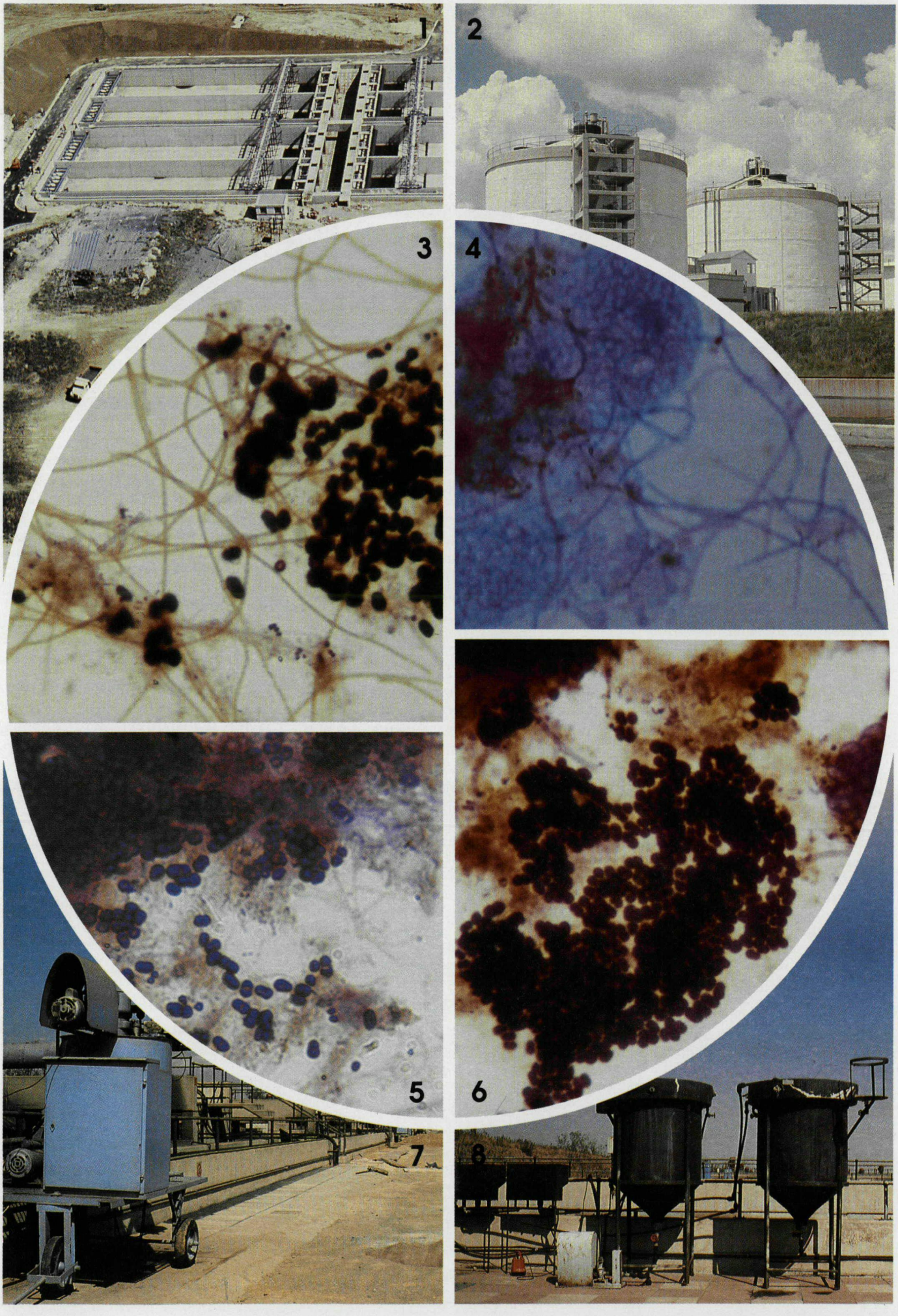
A mathematical model developed by the UCT has been modified to permit its use by non-computer trained staff. This model has been used routinely to determine the optimal solution to plant operational problems, including the identification of a need to increase S_{bs} content. With very little adaptation it is envisaged that this facility could be used for operator training to identify solutions to problems which could arise during plant operation.

OPERATIONAL AND DESIGN ASPECTS

The generation of volatile fatty acids



Layout of the Johannesburg Northern Works



JHB CITY COUNCIL

through the accumulation and recycling of raw sludge, necessitates special consideration to the adequacy and strength of scraper mechanisms settling tanks. High sludge densities generated by this technique may require special facilities for removal.

There are advantages to the endogenous denitrification of secondary clarifier underflow. It appears that plant performance can be further enhanced by providing for plug-flow through compartmentalised anaerobic and anoxic zones. Provision of an unhindered surface path from the reactors to the final clarifiers for scum removal is essential.

The maintenance of an adequate dissolved oxygen level in the aerobic zone, appears to control the proliferation of filamentous organisms. Three-stage plants as opposed to the more conventional five-stage plants, may offer advantages in this regard, as the sludge is constantly exposed to aerobic conditions after leaving the anoxic zone.

Various process configurations experimented with at the Northern Works were shown to have very little effect on the sludge settling characteristics which suggests that some external factors, which may include temperature and dissolved oxygen concentration appear to play a controlling role.

The entrainment of air in the underflow return system should be minimised, thus preventing facultative anaerobes from utilising some of the S_{bs} prior to its entry to the anaerobic zone where it is required as a substrate for phosphorus accumulating bacteria. This will prevent flotation effects and the formation of scum in the main bioreactor. Such scum or froth may be stabilised by polymers produced by the phosphate accumulating bacteria.

Special attention needs to be given to the final handling and disposal of phosphate-rich sludges as these tend to leach phosphate when they stand, and they may be more difficult to dewater an dry.

FINANCIAL CONSIDERATIONS

At the Northern Works, biological filter plants using chemical addition for phosphate removal and activated sludge plants, incorporating nutrient removal, exist side by side. For various reasons, a direct cost comparison of these two systems was abandoned in favour of a desk study in which a four-stage Bardenpho process was used as a base, and to which a number of phosphate removal options were added.

The introduction of an anaerobic zone, with sewage characteristics modification, to a standard four-stage denitrifying Bardenpho process, incurred an additional cost of 1,6c/k/. The alternative removal of phosphate by chemical means in a four-stage plant involved an additional cost of 2,5c/k/. To retro-fit chemical dosing equipment to a two-stage biological filter plant, was calculated to add 7,6c/k/ to treatment costs. It therefore appears that the biological removal of phosphate is the more cost effective option.

MICROBIOLOGICAL STUDIES

Severe bulking sludge problems have been experienced, particularly during the winter months, with *Microthrix parvicella* being identified as the causative organism. Bacterial population studies indicated a dominance of *Acinetobacter* in aerobic zones, with *Aeromonas punctata* predominating in the anaerobic zone. Sludge fermenting in the primary sedimentation tanks was found to contain large numbers of the latter species, but in "acid" digesters, *Klebsiella oxytoca* predominated. Degradation of the typical *Acinetobacter* clusters was noted as a precursor to plant failure with regard to phosphate removal.

Biochemical studies were undertaken to provide an insight into intracellular activity, particularly with regard to substrate uptake and conversion. Monitoring two bacterial storage products, viz polyphosphate and polyhydroxybutyrate, revealed the dependence of the metabolic reactions involved on process conditions such as nitrate levels in the anaerobic zone and sewage volatile fatty acids levels.

Investigations into the intracellular metabolism of *Acinetobacter spp* have allowed the University of Cape Town researchers, in collaboration with the Johannesburg staff, to propose a biochemical model for phosphate removal in the activated sludge process. This has made a significant contribution to the understanding of the mechanism of enhanced phosphate removal and has resulted in a refinement of the UCT generalized activated sludge mathematical model.

FUTURE RESEARCH

During the period of this contract, a number of areas have been identified that require further research to arrive at conclusive results. With regard to full-scale plant studies the researchers believe further experience for at least one year should be obtained regarding the generation of volatile fatty acids in the primary sedimentation tanks and the more effective use of the readily biodegradable substrate produced through the removal of nitrates present in the underflow from the secondary clarifiers by endogenous denitrification.

1 *Primary sedimentation tanks at Northern Works*

2 *A view across the primary sedimentation tanks to the sludge digesters at Northern Works, where the fermentation of sludge took place and where acids were generated and leached into the activated sludge tanks*

3 *Polyhydroxybutyrate in cells of the Northern Works anaerobic zone*

4 *Cluster of cells surrounded by polysaccharide – Northern Works aerobic zone*

5 *Cells containing polyphosphate inclustors in Northern Works aerobic zone*

6 *Cluster of polyphosphate containing cells – Northern Works aerobic zone*

7 *Respirometer*

8 *Settling tanks ahead of the automatic continuous online monitors*

STRETCHING SA's LIMITED WATER RESOURCES

VISITING ISRAELI PROFESSOR RECOMMENDS A TOTALITARIAN APPROACH TO INTEGRATE SOUTH AFRICA'S GROUNDWATER AND SURFACE WATER DISCIPLINES.

Prof Arie Shimshom Issar, Head of the Water Resources Center at the Jacob Blaustein Institute of Desert Research of the Ben Gurion University of the Negev at Sede Boker, Israel, felt a need for the promotion of an interdisciplinary approach to water research and planning as well as international co-operation between the water scientists and engineers of Israel and RSA.

Professor Issar was brought to South Africa as a joint venture by the Department of Water Affairs (DWA) and the Water Research Commission (WRC), to undertake an hydro-geological tour of the RSA.

The purpose of the tour was to visit hydrological and geo-hydrological projects currently being undertaken and to advise and comment on analysis techniques, to assist with the identification of future research needs and to advise on how best to co-operate with and exploit overseas expertise.

A full programme of visits, discussions and field tours was prepared by the WRC and DWA, commencing in the Western Cape, progressing up the coast to Natal and into the Kalahari and Karoo groundwater areas. In addition a half day tour to the dolomite aquifers south of Pretoria was also undertaken.

In the Western Cape, Prof Issar visited both the Breede and Berg River catchments and was particularly helpful in the Poesjenels River basin where his theories on the application of natural isotope analises was seen as a major contribution.

One of the aims which still has to be achieved under this project is a *quantitative hydrochemical model* with which it will be possible to quantify the contribution of each source of water and salinity in the valley as well as to forecast quantitatively future developments. To reach this aim, however, the available data is inadequate due to the fact that the chemical character of the various contributions in the hydrochemical flow-chart cannot be distinguished one from the other. For this purpose "finger-print" tracers have to be used such as, for example, the environmental isotopes of oxygen and carbon, and, indeed, the preliminary survey carried out demonstrates that the 180 isotope data has the potential to clarify, as well as to quantify, the hydrochemical processes which take place in this valley.

MARIETTA THERON

To elucidate the value of isotope determinations, Prof Issar plotted ^{180} values against TDS and his deductions from the resulting figure were most enlightening to the project team and visitors alike.

TABLE MOUNTAIN SANDSTONES: AN AQUIFER?

Boreholes drilled into the Table Mountain Sandstones (TMS) have been known to yield vast quantities of water.

Low oxygen 18 values show that this water came from more elevated regions. Tritium data indicates that the water is not young. If the carbon 14 data confirms this observation, then, from a regional hydrogeological point of view, the Table Mountain Sandstones should be considered as a regional aquifer, the water of which is confined by the Bokkeveld Series which can be regarded as an aquitard or a leaky-aquiclude.

The TMS aquifer could be developed as an additional water resource of high quality and high storage capacity. Prof Issar believes it is worthwhile to invest more in order to ascertain this assumption.

Of major concern in the Breede River valley is the mobilization of salts resulting from irrigation farming in the catchment.

It is quite clear that the Bokkeveld Series are the main contributors to the salts, but the spatial distribution of these contributions are not well known. Part of the salt originates in the soils, especially in soils newly ploughed, and partially through direct discharge of artesian saline water from fractures into the saturated zone and from there into the river channel. The complexity of the flow and thus the salination system through the Bokkeveld and soils, is known and the question to be answered

is whether detailed knowledge is essential for the understanding of the general hydrochemical regime. The solution of this complex problem may be of interest to the soil scientist but not to the hydrologist who is interested in the ratio between the input and output of salts in the valley.

GENERAL SALINATION MODEL

Everyone is fully aware of the fact that salination processes are taking place in this catchment and many observations point to the conclusion that these processes are cumulative and the quantities of salt produced by the return flow from the irrigated fields are going to be an important factor in the salt balance of the Breede River catchment. Thus a water management plan for the river is envisaged, and the quantitative aspects of these processes have to be forecast and monitored. This calls for an investigation of the main tributaries which donate water to the Breede River. It seems that two or three "river types" such as the Poesjenels and Hex Rivers can be investigated in more detail, while the rest classified accordingly and investigated superficially. Such a management plan is essential at a rather early stage of the development of the water distribution project as it will enable decision making regarding the role of the river bed as a supply and/or drainage canal. The situation now is that the double role that the river bed plays, costs a certain amount of water which is used for flushing out the accumulating salts.

This amount is going to grow parallel to the increase in salt content. At a certain point, a decision will have to be taken whether a division between the supply system and drainage system is not more economical than the flushing method. All this, should be regarded as a long range programme to be developed stage by stage. The complexity and level of precision and certainty will increase from each stage to the next.

For this purpose, Prof Issar suggests a research team comprising a hydrogeologist, a modelling hydrologist and a hydrochemist.

THE BERG RIVER SYSTEM

In this region salination phenomena are caused by the Malmesbury shales which underlie most of the area.

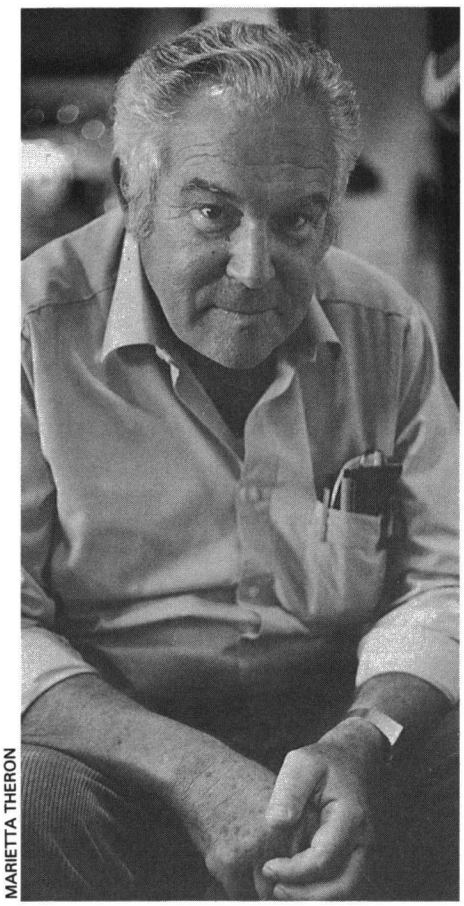
These salination processes and especially the flow of the water in the fractured Malmesbury slates and shales are of importance not only to the problem of salination of the soil but also for the future development in the Atlantis aquifer. It might be that there exists, at present, a delicate balance between the fresh water in the sands of the Atlantis aquifer and the underlying saline water in the fractured Malmesbury slates and shales. This delicate balance could be changed if the Atlantis aquifer is further developed.

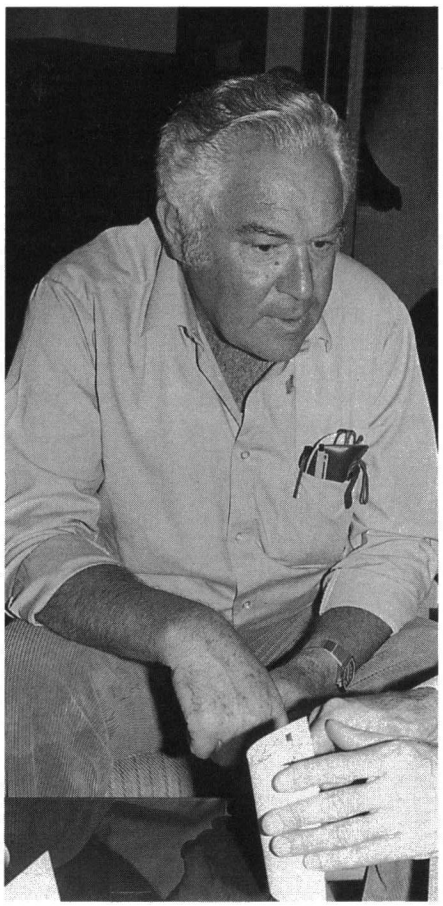
Prof Issar therefore felt that research in the *Sandspruit basin* should put more emphasis on the groundwater phenomena, involving sampling and monitoring of the boreholes in the region and the chemical as well as isotopic analysis of the surface, shallow and deep water resources.

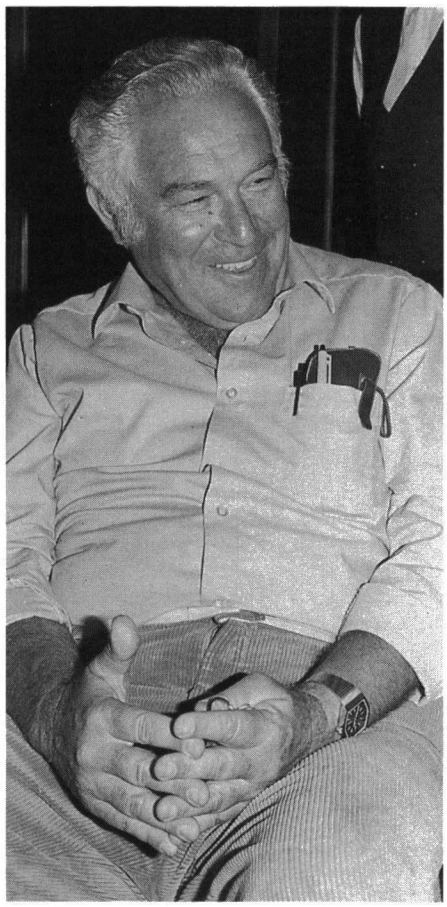
The Atlantis aquifer should be regarded as a long range manageable reservoir to extract and store water in the framework of a regional long term water supply plan to the Berg River and Western Cape region. Thus the protection of the recharge area by declaring it a national park should be considered.

WESTERN KALAHARI REGION

Prof Issar also had some far reaching





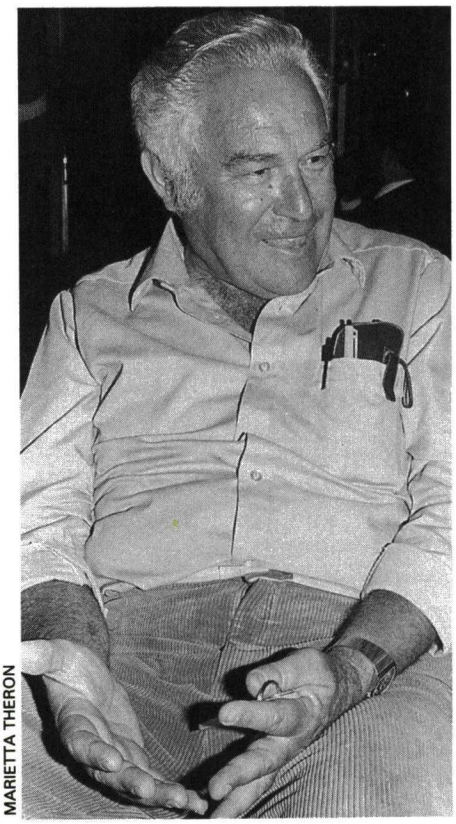


MARIETTA THERON

ideas regarding this region. As the fresh water resources are limited to lenses recharged by river floods, any scheme to supply water from these lenses, on a regional basis, would demand a substantial change in the water rights law of the country, or the purchase of vast stretches of property under which fresh water is found. On the other hand saline water seemed to be abundant under most of the region.

As the basic demands of this region have been answered by the pipeline project, and therefore no pressure of time exists, this region can now be used for non-conventional methods to solve local problems. One such method which might warrent further investigation could be a pilot project to demonstrate desalination by R.O., or even solar distillation, especially in the salt pans where saline water lies just below the surface of the pan. Sun area is large, salt and water are unlimited and maybe they could be brought together to form a suitable project. Prof Issar's experience has shown that if there is no major cost for space, then solar distillation approximates the cost of conventional desalination of seawater.

He also suggested initiating a research programme to investigate the use of saline water for the irrigation of forage crops which can be utilized as sand binding vegetation.



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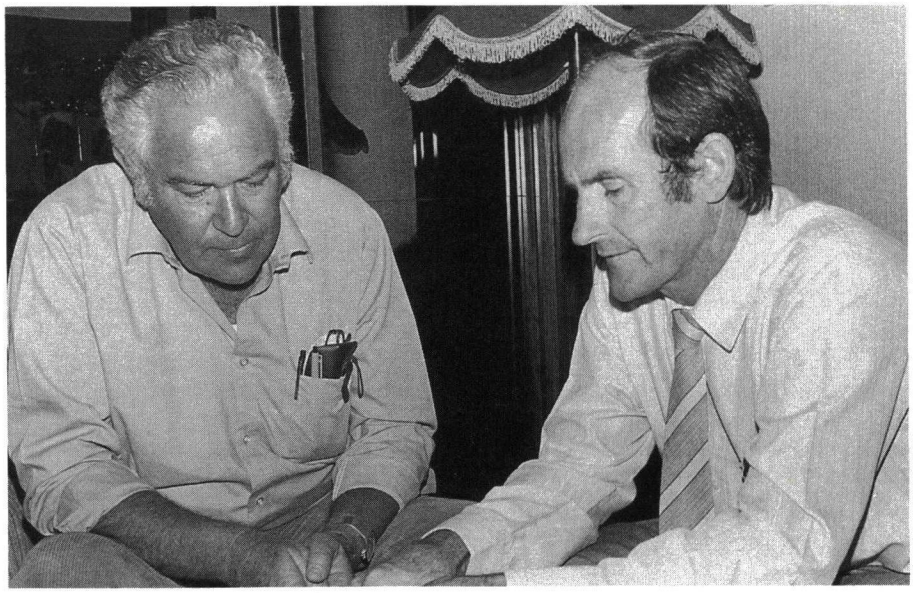
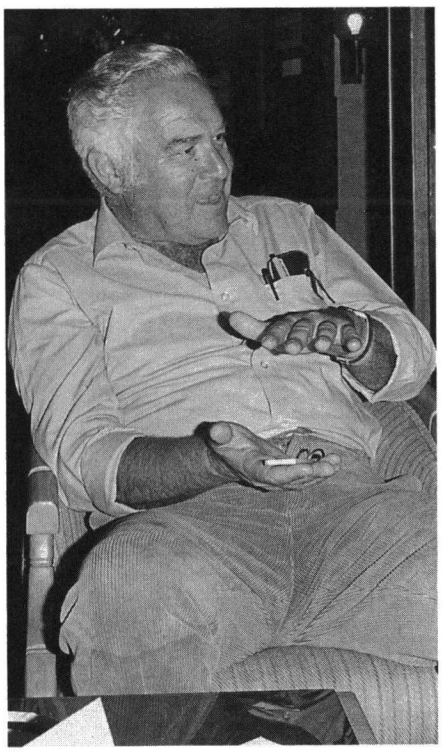


MARIETTA THERON

Professor Arie Issar (left) and Mr Charles Chapman, WRC.



CONCLUSION

In wrapping up his observations, prof Issar commented that a major obstacle to the implementation of many of the above suggestions will be the lack of young, well-trained hydrologists and geohydrologists, equipped with the latest instrumentation and techniques with which to build the necessary models. The conceptual modelling and quantity modelling will be done by people of different disciplines.

The conceptual model will require more the approach of the geologist, thinking in a three dimensional, visual manner – i.e. how the water flows from surface to the outlet, while the quantity modeller will be more an abstract type of thinker. Seldom do you find these two types in one person. Therefore, an interdisciplinary team approach is called for to consider a region as a whole. The route is, firstly the brain storming, followed by the conceptual modelling, followed by the quantitative model, then the planning procedure, etc. It is important that the above process should be done around a table and not by only one discipline using other disciplines in an advisory capacity.

To achieve the objective, prof Issar proposed a need for a change in the attitude of the planning engineers towards groundwater by seeing groundwater not as a secondary factor, but as an essential part of the water cycle and thus of the water plan. As stated previously, this can only be achieved by forming interdisciplinary research and planning teams as well as by the undertaking of a national programme of scientific meetings in which interdisciplinary subjects like salination processes, water resources management schemes etc. are discussed.

It is also clear that the RSA will need more hydrogeologists, especially modellers, in order to promote groundwater development. For this purpose it will be necessary to promote a special programme to educate a generation of young hydrologists and hydrogeologists equipped with the most advanced tools for water research and modelling.

To this end a bi-national programme of co-operation between Israel, who has reached a very advanced stage of its water resources development, and the RSA could be highly advantageous.

The organization of S.A. – Israeli special-task-teams or working groups, to deal with problems which need the know-how of Israeli scientists could also be organised through the programme of scientific co-operation.

Dr Willie Hattingh, hoofadviseur van die Waternavorsingskommissie is verlede jaar deur die *Water Treatment Scientists Association* van Ciprus genooi om 'n referaat by 'n konferensie oor die hergebruik van behandelde rioolwater te lewer. Die konferensie het in die Palm Beach Hotel naby Larnaca in Ciprus plaasgevind en is deur ongeveer 60 afgevaardigdes bygewoon. Dr Hattingh vertel meer van sy besoek aan dié interessante eiland.

CIPRUS steek by SA kers op

Die persone wat verantwoordelik is vir watervoorsiening en sanitasie op Ciprus het onlangs die *Water Treatment Scientists Association* gestig, en hulle reël jaarliks 'n konferensie oor die een of ander aspek van waterbehandeling. 'n Aantal oorsese sprekers word genooi om hulle toe te spreek oor die tema van die konferensie en op hierdie wyse word oorsese kundigheid oorgedra na hulle gemeenskap. Die hele doel van dié konferensies is dus om op die hoogte te kom met die jongste stand van kundigheid oor die aspek wat bespreek word. Daarom aanvaar die organiseerders ook om die genooide sprekers se kostes tydens die konferensie te dra, uitgesonderd die reiskoste na en van Ciprus.

By hierdie spesifieke konferensie oor die hergebruik van water het daar ses oorsese sprekers afkomstig van Groot-Brittanje, Wes-Duitsland, die Republiek van Suid-Afrika, Israel en Egipte opgetree en elk het 'n oorsig van die hergebruik van water in hulle onderskeie lande gegee. Die waarde van die konferensie het gelê in die geleentheid wat daar met vraetyd aan die afgevaardiges gebied is om meer pertinente inligting te kry. Dit was opvallend dat daar nie 'n enkele plaaslike spreker was om die probleme waarmee Ciprus te doen het, te skets nie.

INDRUKKE

'n Deel van Ciprus is gedurende 1974 deur Turkye beset en hierdie besetting word vandag nog volgehou onder die wakende oog van die VVO. Daar bestaan 'n skerp skeiding tussen die Turkse deel van die land (40 persent) en die Griekse deel, soveel so dat geen beweging oor die skeidingslyn plaasvind nie.

Die hoofstad Nicosia is net soos Berlyn verdeel en die twee gemeenskappe is geskei. Hierdie besetting sorg vir veel bitterheid en skep ook groot ekonomiese probleme. Die deel van Ciprus wat vir toerisme ontwikkel is, lê in die Turkse gebied – daarom is die owerhede nou besig om die Griekse deel vir toerisme te ontwikkel. Hoewel die besetting maar net 40 persent van die oppervlakte verteenwoordig, is dit egter 70 persent van die ekonomiese potensiaal van die land.

Die bevolking van 650 000 bestaan uit ongeveer 80 persent Grieksprekende en 20 persent Turksprekende Cipriote. Die ongeveer 520 000 Grieksprekendes is in vyf stede saamgetrek omdat 'n groot deel van die land bergagtig is. Toerisme verteenwoordig ongeveer 50 persent van die land se buitelandse valuta. Om hierdie rede vind 'n mens dat die hotelle langs die suidkus nuut en op die oorsese besoeker gerig is.

Die land beskik oor geen standhoudende riviere nie en is aangewys op die opgaring van water gedurende die reënseisoen en op grondwater. Ciprus het ook die afgelope reënseisoen nie normale reënval gehad nie en ondervind dus ernstige watervoorsieningsprobleme.

Daar bestaan op die oomblik geen stedelike rioolbehandelingswerke in die land nie. Die rioolwater word of deur middel van septiese tenks, gevolg deur sypelriole, of 'n suigtenkdiens of 'n inhuise behandelingsaanleg behandel. Dit beteken dat geen behandelde riooluitvloeisels beskikbaar is vir hergebruik nie. Daarom was daar groot belangstelling in Suid-Afrika se houding teenoor waterherwinning en -hergebruik.

Die hotel waarin ons tuisgegaan het, beskik oor 'n uiters vernuftige behandelingstelsel vir sy rioolwater. Dit bestaan uit 'n verlengde belugtingsgeaktiveerdeslykaanleg wat onder een van die grasperke se oppervlakte versteek is. Dit bevat twee belugtingsbakke waarvan net een gedurende die afseisoen benut word. Die behandelde water word besink, deur sand gefiltreer, ontsmet en na 'n opgaardam – wat ook ondergronds is – en die blad van die tennisbaan vorm – gepomp. Van hierdie tenk word die water deur 'n geaktiveerde koolstofaanleg gestuur waarna die finale water gebruik word vir besproeiing van die tuine op die terrein. Op dié wyse word die water wel hergebruik maar glad nie vir besproeiing van groentegewasse nie.

Hoewel die stelsel goed werk, het 'n mens tog bedenkinge oor die feit dat die behandelde water nie beter benut word nie, veral in so 'n droë land.

Opsommend dus was die besoek baie interessant omdat Ciprus ten opsigte van watervoorsiening 'n groter probleem as Suid-Afrika in die gesig staar en kon die RSA en Israel die noodsaaklikheid van die hergebruik van water en die voor- en nadele van so 'n gebruik deeglik onder die Cipriote se aandag bring.

Regaining lost ground

Up to about 1970, South Africa was amongst the leaders internationally in the field of anaerobic digestion. Since then South Africa lost ground to the extent where industry have found it necessary to import this technology at high cost. The lost ground must be regained and a symposium on anaerobic digestion, last year, was therefore most appropriate and timely to foster progress in this direction. Dr G G Cillié, Professor T J Britz and Mr W R Ross report on the proceedings.

The symposium on anaerobic digestion was held at the University of the Orange Free State, Bloemfontein during the period 22-24 September 1986. It was organised jointly by the Department of Microbiology of the University and the National Institute for Water Research of the CSIR. The objective of the symposium was to assemble engineers, scientists and operators for a comprehensive review of the various disciplines in the field of anaerobic digestion. Emphasis was placed on the state of the art, recent research results and the need for further research. The symposium was attended by 150 delegates and the 35 papers and 14 poster papers presented are available as proceedings from the secretariat at the University of the Orange Free State.

REVIEW OF PAPERS

Three overseas guest speakers shared their wide experience and in-depth knowledge of fundamental issues as well as their valuable expertise with the delegates. Professor R E Speece from the USA gave his impression of two recent international conferences held in Brazil and Holland. His comments regarding the relative merits of high rate digesters (60 kgCOD/m^3.d) as against simple open unheated earth digesters with loadings of only 1 kg/m^3.d, but with high reliability and cheap operation were indeed thought provoking. Professor Speece also referred to the use of flotation as an alternative to vacuum filtration for separation of active biomass from the effluents of high rate digesters. These unit processes as well as cross flow microfiltration warrants intensive evaluation in situations where pellet formation cannot be relied upon to ensure efficient separation of biomass.

Dr. E. Senior from Scotland stressed the importance of anaerobic digestion as a source of energy and correctly identified the circumstances and conditions where anaerobic digestion can and should be used in the field of waste-water treatment and even solid waste disposal. In general it would seem that anaerobic digestion is applicable to the strong organic wastes with COD greater than 5 000 mg//, but it should always be followed by aerobic treatment to effect the final polishing. Dr. Senior also reported on the interaction between various bacterial species and this together with the valuable contributions by the research group of the Department of Microbiology of the University of the Orange Free State pointed to an in-depth understanding of the mechanisms involved. This work together with that of the University of Cape Town researchers and the NIWR promises positive results.

Dr. C. Prévot from France described the four systems currently in vogue for anaerobic digestion it was interesting to learn that notwithstanding the spectacular advances which had been achieved overseas, the Suedzucker Mill in Germany was conservatively designed for a load of 11 kgCOD/m^3.d which is of the same order as achieved locally.

Papers from the RSA related several success stories and demonstrated the economics, reliability and applicability of anaerobic digestion in treating strong industrial wastes. The use of anaerobic digestion for petro-chemical wastes, was of particular interest.

From the joint discussions, it was clear that improved loading rates could be achieved by maintaining optimum concentration of biologically active sludge in the reactor. This of course pivots on efficient retention or alternatively recycle of biomass i.e. pellet formation or physical separation of solids. The factors responsible for pellet formation obviously require further intensive study.

Yet another aspect which requires urgent attention is that of energy production via methane gas. Anaerobic digestion produces energy whereas all other purification processes use energy, hence its usefullness in a world which is rapidly depleting its sources of energy. However, the papers presented indicated various problems and pitfalls which still have to be overcome.

THE NEED FOR COMMUNICATION

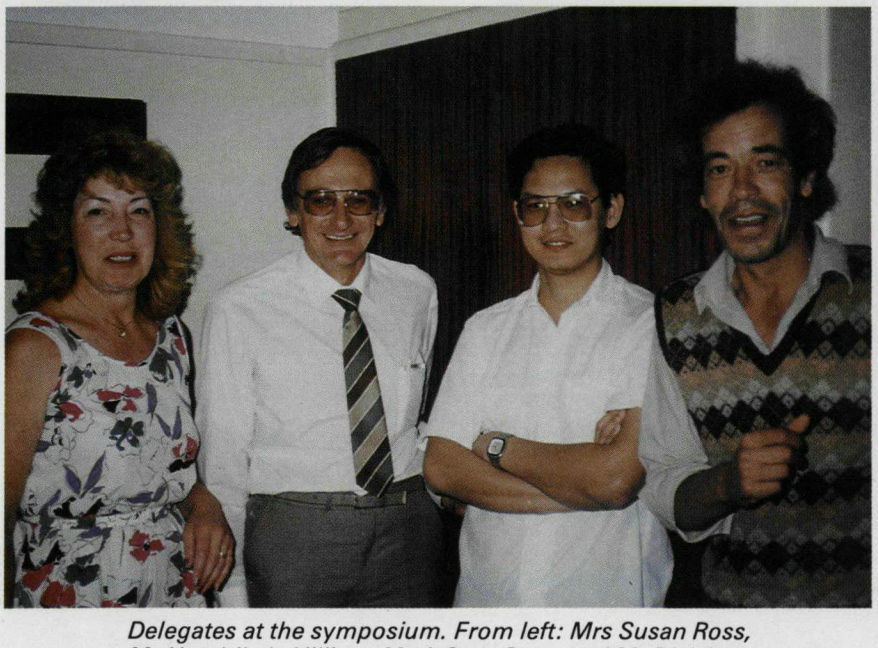
The panel discussion vividly demonstrated the value of communication and exchange of ideas. There is indeed a dire need for close co-operation between for instance the various universities, the NIWR of the CSIR and various research groups of industry. This symposium has certainly been most appropriate to focus attention on the value of communication. In this regard it was probably long overdue. As a first step in this direction it was decided that a regular newsletter be issued to all interested parties.

THE FUTURE

This symposium identified several aspects of fundamental research, of design and of process technology which require further study. The current Organising Committee was asked to co-ordinate and collate such activities and to consider the establishment of a permanent association or working group for anaerobic digestion.

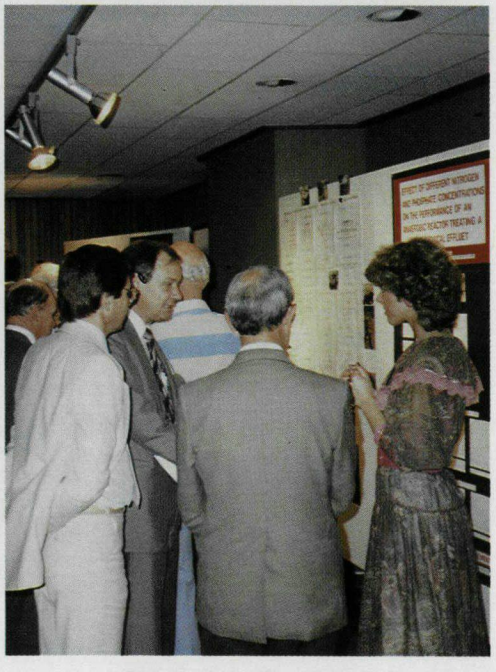
This symposium has gone a long way in promoting interest and confidence in the anaerobic field. It can be considered the beginning of a new era in the development and application of anaerobic digestion in South Africa.

Tea time at the anaerobic symposium



B ROSS

Delegates at the symposium. From left: Mrs Susan Ross, Mr Hendrik de Villiers, Mr A Sam-Soon and Mr Dick Loewenthal.



Discussion of posters

ANAEROBIC DIGESTION SYMPOSIUM: PROCEEDINGS SEPTEMBER 1986: BLOEMFONTEIN

This publication incorporates the 32 papers and 12 poster papers that were presented at the symposium.

1986: 400 pages
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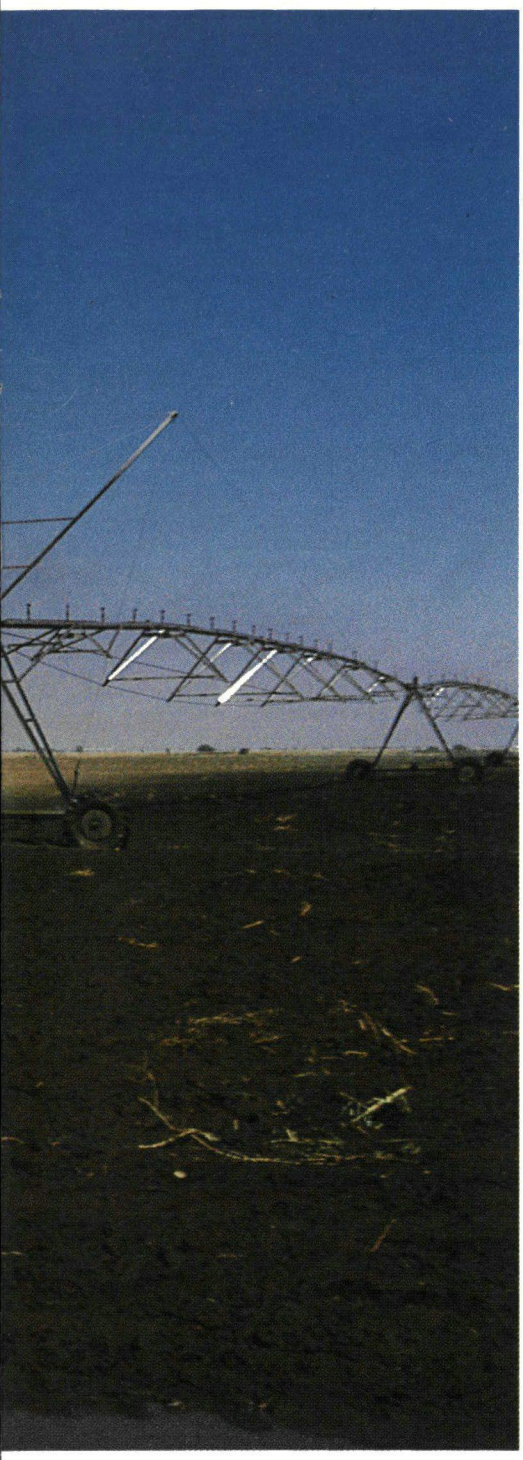
AVAILABLE FROM:

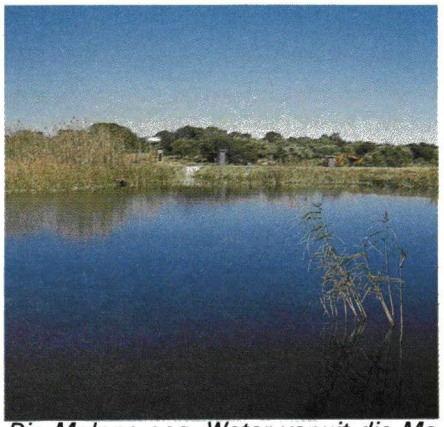
Prof T J Britz, Department of Microbiology, University of the Orange Free State, P O Box 339, Bloemfontein, 9300. South Africa. Telephone: (051)-4012676.

MODELLE ONTWIKKEL VIR DIE BESTUDERING VAN SA AKWIFERE

Grootskaalse besproeiing van winter- en somergewasse vind uit die Grootfontein-kompartement plaas. △

Die Groottontein-oog in Wes-Transvaal waar water vir Mafikeng en Mmabatho onttrek word. Die oog vorm deel van die Grootfontein-kompartement tussen Lichtenburg en Mafikeng - tans een van die hoogs benutte dolomietakwifere in Suid-Afrika. Die Instituut vir Grondwaterstudies (IGS) aan die UOVS het in 1985 met WNK-fondse 'n wiskundige model van die Grootfontein-kompartement opgestel wat die fisiese toestande in die akwifeer volgens bestaande inligting beskryf. ▷





Die Molopo-oog. Water vanuit die Molopo-oog Staatswaterskema word gebruik om die onttrekking van water by die Grootfontein-oog aan te vul.

Die Instituut vir Grondwaterstudies (IGS) aan die Universiteit van die Oranje-Vrystaat het onlangs die resultate van hulle navorsing oor die toepaslikheid van grondwatermodelle as 'n hulpmiddel by die bestudering en evaluering van Suid-Afrikaanse akwifere in die vorm van 'n finale verslag gepubliseer. Dié navorsingsprojek is deur die Waternavorsingskommissie gefinansier en in samewerking met die Departement van Waterwese uitgevoer. Dit het vier jaar geduur en was daarop gemik om die praktiese benutting van modelle in grondwaterstudies te bevorder deur die daarstelling van toepaslike modelle vir Suid-Afrikaanse omstandighede asook om Suid-Afrikaanse kundigheid op hierdie gebied tot stand te bring.

Die navorsers sê dat rekenaarmodelle reeds die afgelope tien jaar in oorsese lande gebruik word om grondwatersisteme te bestudeer en te evalueer. In lande soos Israel, Holland, Frankryk en die Verenigde State is die gebruik van grondwatermodelle reeds 'n algemene verskynsel en sedert 1970, toe die eerste digitale grondwatermodelle die lig gesien het, is 'n groot verskeidenheid modelle met toenemende kompleksiteit en akkuraatheid ontwikkel.

Die navorsers sê die nut van grondwatermodelle is tweërlei. Ten eerste word modelle dikwels en met groot sukses gebruik as 'n geohidrologiese tegniek waardeur meer inligting oor die fisiese toestande van die grondwatersisteem bekom kan word. Met behulp van tydige maar eenvoudige modelle kan leemtes in geohidrologiese ondersoeke suksesvol geïdentifiseer word. Sodoende kan die veldpersoneel geohidrologiese inligting met 'n groter mate van sekerheid op strategiese punte genereer. Indien daar nie van modelleringstegnieke gebruik gemaak word nie, ontstaan die vraag dikwels gedurende geohidrologiese ondersoeke of daar reeds voldoende inligting gegenereer is om die sisteem in sy geheel te kan beskryf.

Tweedens word modelle ook heel dikwels gebruik om voorspellings ten opsigte van die reaksie van die sisteem tydens benutting te maak. Sulke modelle is egter relatief skaars. Die kombinering van vloeimodelle met 'n optimale benuttingsprogram van 'n besondere akwifeer is 'n aspek wat selfs in oorsese lande nog nie met baie sukses toegepas is nie. Dit behels gekompliseerde stelselontleding deur middel van nie-lineêre programmering en numeriese analise. Tans geniet hierdie tipe modelontwikkeling voorkeuraandag in oorsese lande waar intensiewe grondwateronttrekking plaasvind.

In Suid-Afrika bestaan daar verskeie geohidrologiese sisteme waar geohidrologiese modelle 'n belangrike inset ten opsigte van 'n beter begrip van die hidrouliese toestande kan maak.

Die klem in die pasafgehandelde IGS-navorsingsprojek het geval op die ontwikkeling en die toets van digitale grondwatermodelle in drie gebiede met verskillende tipes akwifere. Die drie gebiede waarvoor elkeen 'n eiesoortige model ontwikkel is, was die Sishen-gebied in Noordwes-Kaapland met 'n sekondêre gefragmenteerde harde rots-akwifeer, die Atlantis-gebied in Wes-Kaapland wat oor 'n primêre kusakwifeer beskik en die Krokodilrivierstelsel in Noord-Transvaal met 'n ongekonsolideerde alluviale akwifeer in wisselwerking met die rivierstelsel.

Die projek was die eerste fase van modelleringsproses wat bestaan uit die daarstelling van 'n geskikte numeriese model wat die fisiese toestande in elk van die drie gebiede kan beskryf en bestaande inligting is gebruik. Die tweede fase se mikpunt is om 'n objektiewe metodologie te ontwikkel waarmee voldoende data ingesamel kon word om die betrokke grondwaterstelsel in die toekoms met 'n model te kon bestuur.

VERSLAG

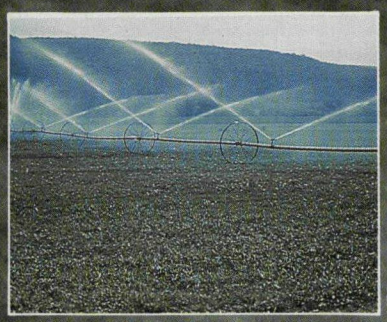
Volgens die finale verslag was die navorsers se modelleringsoefeninge uiters suksesvol gewees. Die modelle wat in die loop van die projek ontwikkel is, is nadat hulle aangepas is, reeds vir 'n wye verskeidenheid probleme in ander gebiede aangewend, soos o.a. die Omaruru-delta, Richardsbaai, Vaalputs, Grootfontein,en in die mynbou-industrie.

Die modelle het bewys dat hulle uiters nuttig is vir die opleiding van geohidroloë en sal vir opleidingsdoeleindes via die Rekensentrum vir Waternavorsing in Pietermaritzburg beskikbaar gestel word.

Die opvolgfase van die projek naamlik die insameling van nog data wat deur die modelleringstudies geïdentifiseer is, sal by al drie studiegebiede plaas vind. By die Atlantisakwifeer is daar tans ook 'n nuwe IGS-navorsingsprojek aan die gang wat deur die Waternavorsingskommissie gefinansier word. Dit handel oor die modellering van grondwatergehalte in die Atlantisakwifeer.

Afskrifte van die finale verslag getiteld *Die toepaslikheid van grondwatermodelle as 'n hulpmiddel in die bestudering en evaluering van Suid-Afrikaanse Akwifere,* kan gratis bestel word vanaf die Waternavorsingskommissie, Posbus 824, Pretoria. 0001.

IRRIGATION IN THE USA



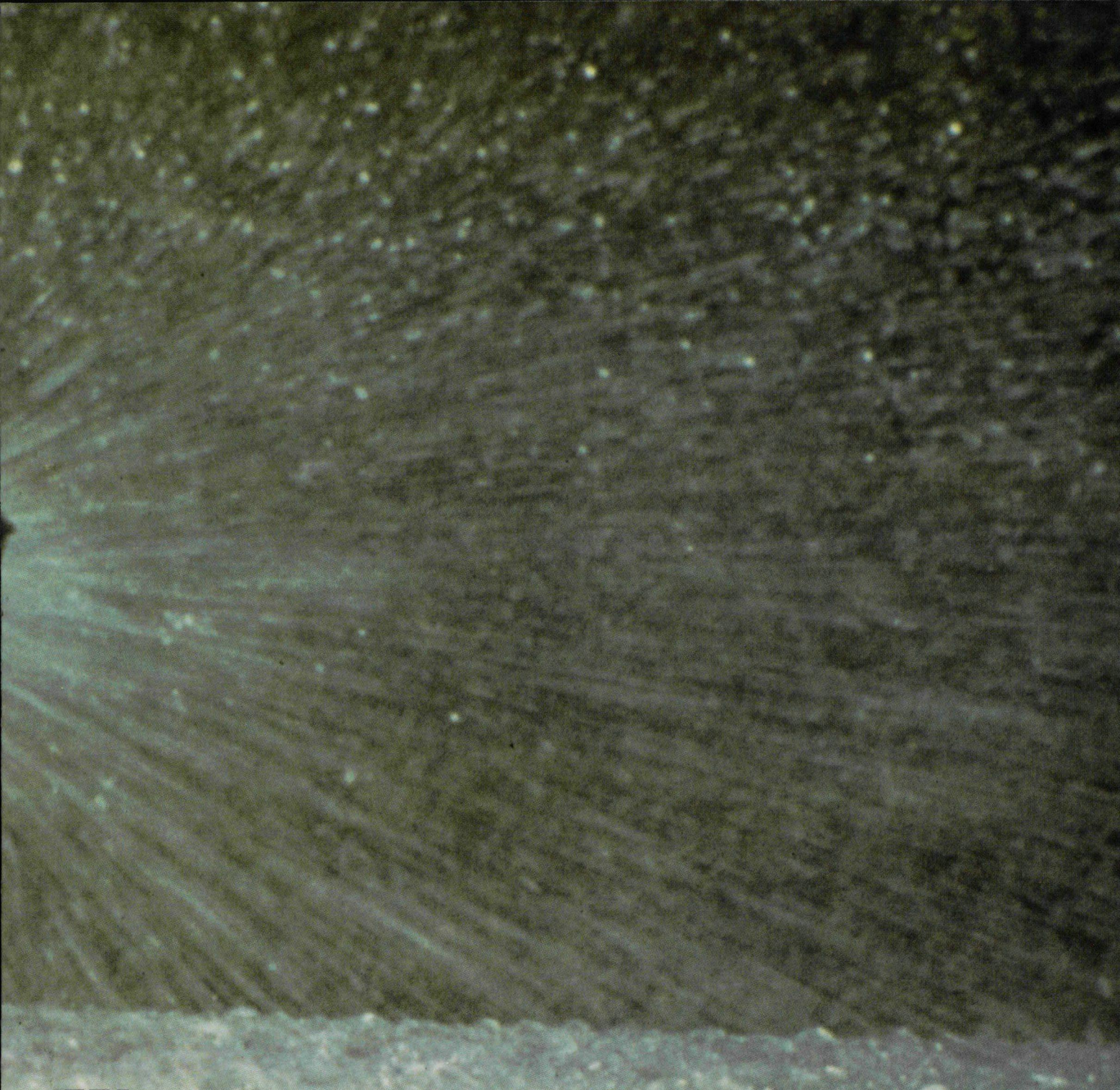
HRD

DMS

by
Derrick M. Oosterhuis*

Water is the most limiting factor in crop production in the USA, and the use of irrigation is increasing rapidly with nearly seven million acres under irrigation. The efficient and economic use of water in agriculture is, therefore, becoming a prime factor in agricultural management, and scientists and farmers are striving to improve irrigation practices and obtain a clearer understanding of how plants use water and respond to shortages. A wide range of irrigation systems are used with sprinkler types, in particular the center pivot, becoming increasingly popular.

*Agronomy Department, University of Arkansas, Fayetteville, AR 72703
Dr Oosterhuis used to work on WRC projects at SIRI before emigrating to America.



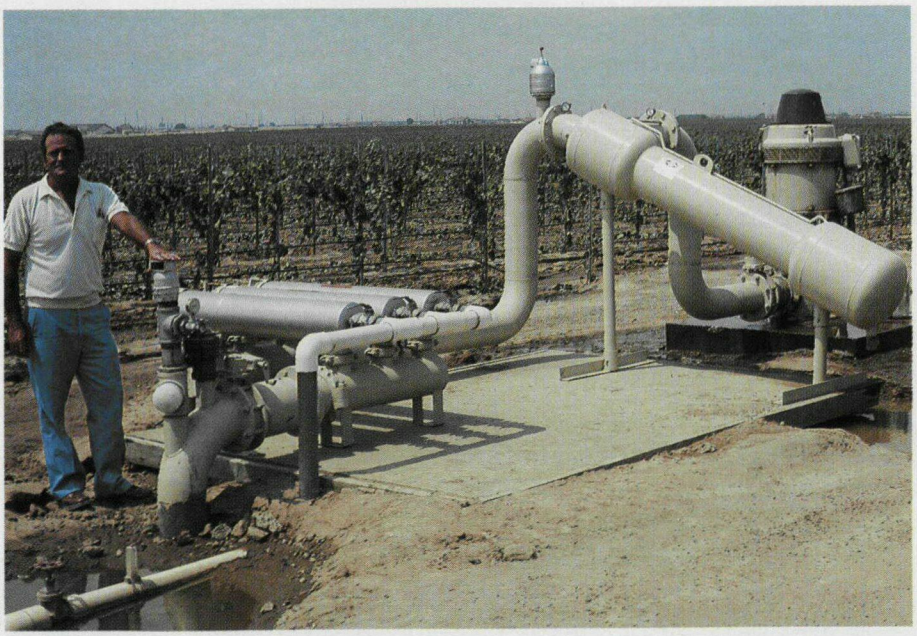
Water is critical to plant growth and development, and shortages during time of drought result in yield reductions and sometimes in plant death. There is a relatively simple reason for using irrigation and conducting research on plant water use: Man's existence, which depends on plant growth, becomes threatened when drought or water stress severely decreases plant productivity. Paradoxically, water is the earth's most abundant compound, yet the lack of fresh water is the most important single factor limiting plant productivity and crop yields throughout the world. In most circumstances the natural rainfall limits the amount of growth or number of crops that can be grown in a year. Storing rainfall and runoff and tapping underground reservoirs of water have traditionally been important ways of increasing crop productivity in many areas of the world, but usually at tremendous costs in terms of human activity, energy inputs, and capital investment.

A total of 61 686 842 acres was irrigated in the USA in 1984 not including turf and ornamental nurseries. Of the total acreage, 84 per cent was located in 17 Western States, with California, Nebraska and Texas being the biggest with over 42 per cent of the total in the USA. The use of irrigation in the USA is increasing by about 300 000 acres a year. The total number of farms in the United States in 1983 was 2 370 000 with an average size of 437 acres giving a total of 1 035 000 000 acres being utilized for farmland. Hence, only a very small percentage of the farmland in the USA is actually being irrigated.

Irrigation is by far the largest consumer of water today and probably always will be.

JRM

Drip irrigation in a vineyard in California showing the pump and filter system and an irrigated grape plant.



JRM

‘Irrigation accounts for approximately 80 per cent of the total water consumed today in the United States.’

Thus, in the last decade or so there has been a growing concern about irrigation water use efficiency and related conservation practices. While the reasons for achieving improvements in irrigation water use efficiencies are varied, the consensus is that irrigation water is not being used wisely in some cases and that waste should not be condoned in a country of increasing water demands, both agricultural and urban. Many people feel that irrigated agriculture offers numerous opportunities for conservation or savings of water that could meet all the future demands for additional agricultural production as well as allow for other uses in growing industries, municipalities, and recreational needs. There are obviously many challenges and opportunities for today and the future for all involved with irrigation to improve and optimize irrigation technology and associated practices.

The efficient and economic use of water in agriculture is becoming prominent in agricultural management. The concept of water efficiency, which refers to the crop yield divided by the water used to produce it (evapotranspiration of the crop area) is becoming more widely used. Needed to improve water use efficiency is a clear understanding of how plants use water and respond to shortages. A great deal of scientific research is being expended into irrigation technology and water management, as well as into soil-plant-water relations and understanding how plants respond physiologically to drought. Knowledge gained is being used in breeding programs for more resistant plant types and for maximizing water use efficiency through improved agronomic and irrigation practices.

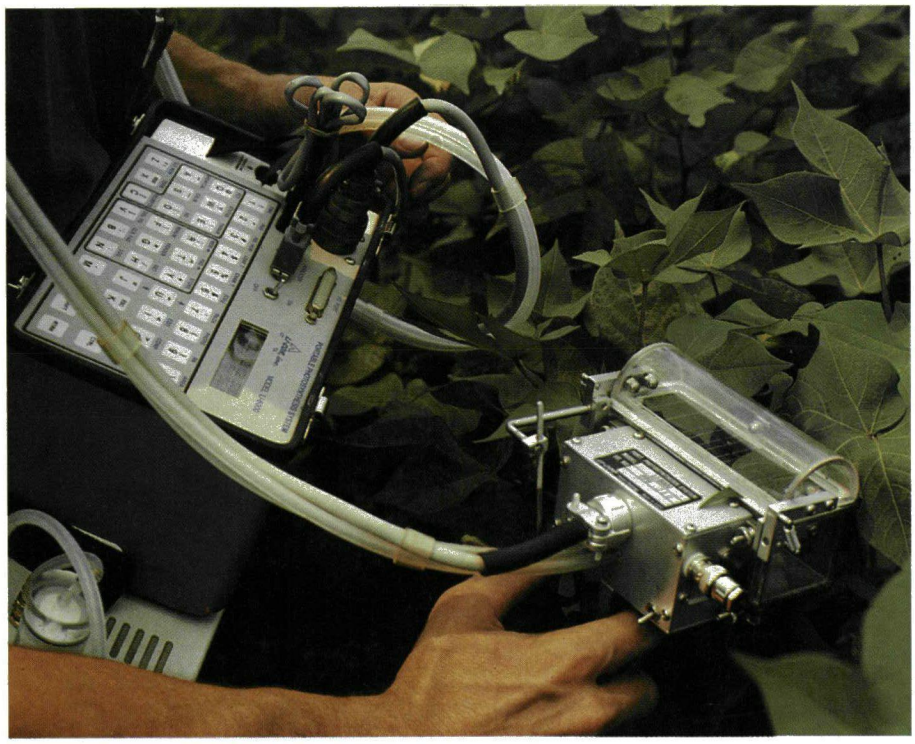
Correct irrigation scheduling is vital for maximizing water use efficiency, for controlling crop growth, and for optimum yield and economic returns. Some people consider that in order not to waste water it should be applied only when the plants are under drought stress, although some yield reduction could possibly have occurred by the time plant stress can be easily seen.

> It is really the first signs of water stress that need to be taken into consideration in irrigation scheduling.

This is an active area of research, and plant physiologists are investigating means for detecting the onset of water stress before it is visible. Some success has been achieved using canopy temperature, stomatal resistance, leaf water potential, and leaf movements. The use of tensiometers to monitor soil water status has been increasing in popularity in recent years. Understanding the physiological changes that occur as plant water stress increases and being able to detect these changes as early as possible before any significant adverse effects on plant growth or yield have occurred, are of particular importance in managerial decisions and when limited supplementary irrigation is available.

The main irrigation systems used include sprinkler and gravity types. The sprinkler systems include: center pivot, boom, gun, hand move, solid set, tow line/side roll/lateral, traveller, and drip/trickle types. The gravity systems include: gated pipe direct from source, open ditch/siphon tube, underground with valves, and flooding from ditches. Sprinkler irrigation is becoming increasingly popular, particularly on the large irrigation systems, and is used on about 36 per cent of the total irrigated acreage. The main sprinkler type used is the center pivot system which makes up more than half the sprinkler irrigated acreage. Nebraska has about three million acres under center pivot irrigation. The most popular gravity system is the open ditch with siphon tube and the gated pipe direct from the source. California, the state with the most irrigation (over 10 million acres), has 3.6 million acres of open ditch/siphon irrigation and 3.2 million acres of gated pipe type of irrigation.

New ideas in sprinkler irrigation along with reintroduction and acceptance of older ideas include linear-move systems, corner-watering center pivots, low pressure systems, improved sprinkler heads and other accessory equipment, automation, and better management of water and chemical application. In addition, sprinkler systems have also been used for environmental modification, such as crop cooling or prevention of cooling and the application of waste water. These developments and modifications have been the results of continued research with the principal objective of improving the overall sprinkler irrigation efficiencies and reducing the energy requirement of irrigation systems. Accessory equipment includes new flowmeters, more accurate flow control and pressure regulators, and the increased use of improved plastic compounds in sprinkler heads.



Portable photosynthesis apparatus to measure cotton leaf CO_2 uptake and stomatal resistance as an indication of plant productivity in irrigation studies.

Rising energy costs, high employment costs and general inflation, particularly in areas depending upon high-cost water, have increasingly reduced profit margins. However, without irrigation food prices would definitely increase. Measuring the benefits of irrigation to consumers in a market economy is extremely difficult. Irrigation ensures a wide choice of food and a year round supply.

Agricultural crops are irrigated in both arid climates, where rainfall would not support crop growth, and in more temperate areas where rainfall usually supports or is adequate for crop growth. Uneven rainfall distribution in temperate areas often necessitates the use of supplementary irrigation. For obvious reasons, irrigation has been practiced mostly in the arid West and Mid-west and to a lesser extent in the Mississippi Delta areas. However, periods of water stress often occur in midseason in the humid south central and south eastern USA, and the interest in irrigation in these areas is increasing. At a recent workshop of experts in plant water stress in California, it was suggested that the return from extra irrigations may be greater in the conventionally non-irrigated more humid areas in the Southeast of the country than in the arid West.

The USA contains vast agricultural areas with a great diversity of climate, and, therefore, of farms and farming systems. A large variety of crops, pastures, vegetables, and fruit trees are irrigated in the USA depending on geographical location. The Midwest, for example, caters mainly to the irrigation of corn, soybeans, and, to a lesser extent, wheat and sorghum. For example Nebraska irrigates almost 5 million acres and Kansas over 1 million acres of corn. Pastures and hay are irrigated fairly widely but particularly in Montana (2 026 464 acres), California (1 686 000 acres), Oregon (1 256 000 acres), Wyoming (1 413 600 acres), and Idaho (1 420 000 acres). Citrus and vegetables are irrigated mainly in California and Florida. Cotton is irrigated predominantly in the arid Southwest with Texas irrigating 2 200 000 acres and California irrigating over one million acres. California probably has the greatest range of crops, fruit and vegetables under irrigation, including 700 000 acres of vineyards, and also has the biggest assortment of irrigation systems.

In conclusion, irrigation constitutes an integral part of agricultural production in the United States with a great diversity of crops, pastures, fruits, and vegetables being irrigated. Many different types of irrigation systems are used with the popularity of sprinkler-type systems increasing. However, lower profit margins and the increasing demand for water necessitate the optimization of all irrigation practices and the continual improvement of irrigation technology.

Council for Scientific and Industrial Research

National Institute for Water Research

South African Chapter of the International Society for Ecological Modelling

Dear Colleague

I have for six years been a member of the International Society for Ecological Modelling (ISEM) and found it an excellent forum for keeping up to date with international modelling activities in the aquatic field. However, locally there seems to be much less awareness of each other and communication between ecological modellers. I had the opportunity to discuss the activities of ISEM and the lack of local communication between modellers with Dr Bernard Patten, University of Georgia, Athens, Georgia, during his recent visit to South Africa. He suggested that we should consider the formation of a South African Chapter of ISEM.

ISEM has the object of facilitating the international exchange of ideas, scientific results, and pertinent knowledge, as well as the application thereof, within the general area of ecological and environmental modelling.

Currently, a significant proportion of good scientific work in this expanding field is not published in international journals, and is thus apt to be lost to the wider profession, being merely printed or duplicated as internal reports, theses, etc., that are generally not known outside of a limited and often small circle of concerned scholars.

Towards remedying this deficiency, the Society publishes a quarterly journal, which contains summaries of such materials as are otherwise not easily available, and also information as to where they may be obtained. In addition, there will be abstracts providing information on sources of data, on model construction, on computer programmes, on equations used in the models, and also indications of sources of further information.

The Society sponsors or co-sponsors conferences, workshops, and training courses, to advance the development of ecological and environmental modelling. Every second year, it organizes a state-of-the-art meeting on ecological modelling.

Arrangements have been made for members to obtain reductions in the cost of books, software and subscription rates of relevant journals that are published by major international scientific publishers.

ISEM has made arrangements with Elsevier to have Ecological Modelling as the Society Journal. The annual fee for membership of the Society is US $30 excluding and US $80 including subscription to Ecological Modelling. As far as I am aware, reduced fees are available for student members of the Society.

I thought it worthwhile to establish if there is enough local interest in forming a South African Chapter of ISEM. If you are interested, I would like you to either call me or fill out the form below and return it to me as soon as possible.

Dirk Grobler

SPECIALIST RESEARCHER
National Institute for Water Research, CSIR
P O Box 395
PRETORIA 0001
Tel. (012) 869211 x 2255

YES I am interested in becoming a member of ISEM and the formation of a South African Chapter of ISEM.

Name: ..... Title: .....
Organization: .....
Address: .....
.....
..... Postal Code: .....
Tel. No.: Code ..... No. .....
Field of interest: .....
.....
.....
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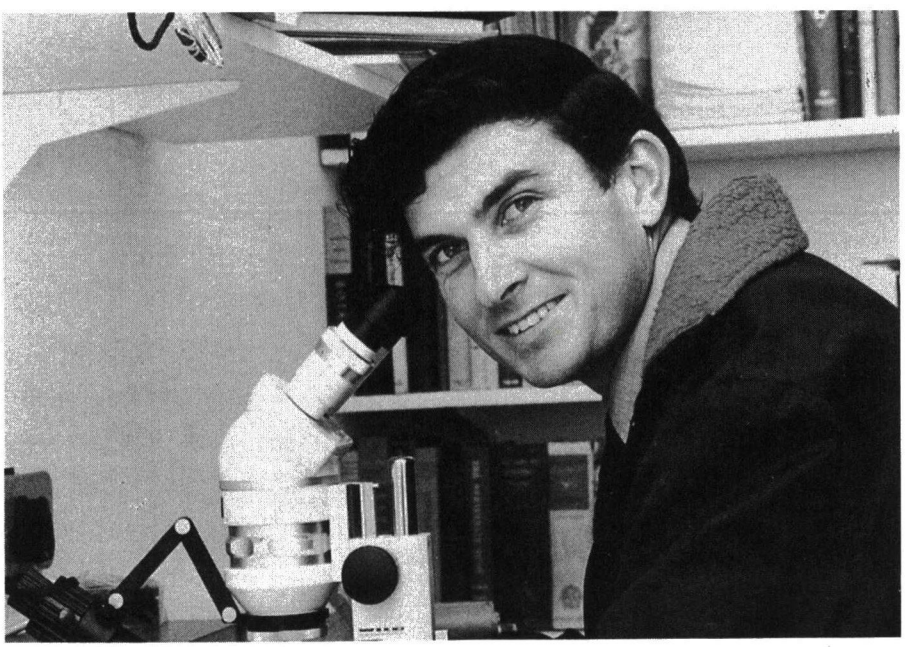
AKKERSDYK STUDIOS

Dr Frik Schutte, of the Water Research Commission recently obtained a Ph D degree from the University of Cape Town. The subject of his thesis was a study of the feasibility of reverse osmosis in water reclamation applications. His contributions on practical aspects include a definition on the potential roles and applications of reverse osmosis in South Africa and an evaluation of the economic viability and technical feasibility of the process. Fundamental studies focused on equilibrium and transport phenomena in the transmembrane transport of organic solutes. These fundamental studies were conducted at the Rensselaer Polytechnic Institute, Troy, New York, where he spent twelve months as a visiting research scholar.

Frik Schutte was born in Vryburg in 1945 and it was there that he matriculated in 1962. A university career at the Potchefstroom University for Christian Higher Education saw the award of the B Sc degree in 1966 and the B Sc (Hons) and M Sc degrees in Industrial Chemistry in 1967 and 1968 respectively. After experience with the CSIR National Institute for Water Research, three years in industry and a post at the Vaal Triangle Technikon he moved to the University of Pretoria in 1975 to join its Water Utilization Engineering unit. Appointment in the Water Research Commission followed and in 1981 he was given his present post as Senior Adviser responsible for co-ordinating and furthering the national research effort in desalination, potable water treatment, water reclamation and dry cooling.



"NATURAL" LEAK

A 'Natural spring-fed creek," which supplied Pittsburgh area residents with water for more than 20 years, was found to be a leak from a broken main in a facility which received water from the city on a flat-rate basis. According to a report in *AWWA Mainstream* (9/86), a firm specializing in leak detection found the problem as it investigated pressure difficulties reported by a local fire department. The underground main had split in two in a brickyard, where buried bricks provided easy drainage. The water, found to be leaking one million gallons a day, emerged from a hillside below the break and travelled through woods to an interstate highway.

WETLANDS STUDY WINS ENVIRONMENTAL AWARD

The winner of the Sappi fiftieth anniversary environmental study tour is Dr George Begg, a senior ecologist and environmental planner from Durban.

Over forty entries were received by the sponsors and Dr Begg wins R8 000 which he will use to study the topic of the entry further.

His entry, which had to cover some aspect of water, was titled *Towards placing the hydrological significance of wetlands in perspective.*

Dr Begg intends to visit the United States of America for discussions on wetlands and the strategies that are being used there to manage these areas more effectively.

The judges were Mr Keith Cooper, director of conservation for the Wildlife Society, Dr D F Toerien, chief director of the National Institute of Water Research and Mr P J le Roux, chief director of environmental conservation at the Department of the Environment.

GECHLOREERDE WATER NIE GEVAARLIK VIR MENSLIKE GESONDHEID

Die drink van gechloreerde water hou geen gevare vir die mens se gesondheid in nie, sê 'n komitee van die Departement van Gesondheid en Sosiale Veiligheid in Brittanje.

Dié komitee wat gemoeid is met die mediese implikasies van lug-, grond- en waterbesoedeling, het die afgelope 18 maande die moontlike gesondheidsgevare van neweprodukte as gevolg van chlorering van drinkwater ondersoek. Hulle het die betrokke data oor epidemiologie, dierlike karsinogeniteit en mutageniteit bestudeer en in hulle verslag tot die gevolgtrekking gekom dat daar geen geldige rede bestaan om te beweer dat die inneem van die neweprodukte as gevolg van die chlorering van drinkwater wat, volgens die huidige prosesse behandel en gechloreer is, die risiko van kanker in mense verhoog nie.

Die Komitee sê die verandering van chloreringsprosesse wat hulle doeltreffendheid oor baie jare bewys het of die vervanging van chlorering met ander ontsmettingsmiddels is nie nodig nie. Hierdie gevolgtrekking kan gemaak word in die lig van die beskikbare data oor kankerepidemiologie, dierlike karsinogeniteit en mutageniteit met betrekking tot die chloreringneweprodukte in drinkwater. Water Bulletin 31086

RAINMAKING THEORY

Bacteria may be involved in rainmaking, according to research being, done at Montana State University. Plant pathologist David Sands' work leads him to hypothesize that the moisture in rain causes bacteria to grow on plants. The bacteria then are swept up into the atmosphere where they become the nuclei of rain drops. When the rain lands on plants, it begins the cycle again.

In test fields of barley, Sands and graduate student D. Georgakopoulos were trying to remove *Pseudomonas syringae* bacteria because it causes some leaf damage. It kept returning, however, despite pesticides and other management techniques. The scientists then turned to precipitation as a source and ended up catching the bacteria while holding out a petri dish from an airplane. Associate professor of meterology James Heimbach took some of the bacteria and put it in a machine that maintains an artificial cloud. He found "definitely some nucleating ability" from some of the bacteria, according to a report in *Crops and Soils* (10/86).

The bacteria is now being captured in initial precipitation, which is the only part of a rainstorm where *P. syringae* is found. It is then grown to see if it conforms to this "precipitation cycle" theory. Sands and Georgakopoulos are also working with a computer model developed to take into account how fast the bacteria grows on plants and, given updrafts during a storm, how the bacteria can be expected to travel.

Sands said that bacteria levels may be inadvertently raised and lowered depending on the varieties of crops that are planted, which in turn would change weather patterns. Speaking about current genetic experiments to create ice-minus bacteria, Sands said that rather than fight frost damage, ice-minus bacteria instead may cut back the amount of rain that an area receives.

Water Newsletter 311086

SUBMISSION OF NEW RESEARCH PROPOSALS TO THE WRC

In order to enable the WRC to plan in good time for its 1988 budget, it would be appreciated if organisations could submit to the WRC any research proposals they may have in mind, before *30 June 1987* for preliminary consideration.

In order to save any unnecessary effort, submissions should only include essential information, i.e.:

- ☐ Title
- ☐ Short resume of motivation and modus operandi (about 2 pages)
- ☐ Proposed duration of contract
- ☐ Estimated budget (for each year: salaries, other current expenses and capital costs).

Will you please, in compiling the essential information, liaise with the WRC as our advisers can give guidance in this connection.

The WRC will look at all the submissions together on a priority basis and you will be informed as soon as possible whether further negotiation is justified.

In cases where further negotiations are required, detailed submissions are necessary. The WRC's responsible advisers shall personally contact the staff concerned at the different organisations in order to discuss the format and content of the detailed submissions and possible further clearance procedures, before the submissions are finally and formally considered at a meeting of the WRC.

Please address all correspondence to the Executive Director.

MAARTEN SCHALEKAMP AWARD

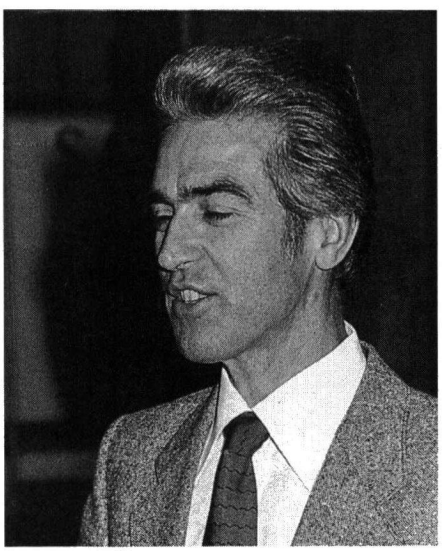
Maarten SCHALEKAMP, Dr. sc. techn. h.c. ETH Zurich, during his presidency of IWSA from 1982 to 1984, has given the Association a truly world-wide dimension.

His concern and his involvement in the improvement of drinking water supply throughout the world was aimed particularly at those parts of the world most in need of adequate and reliable drinking water supply.

For this purpose he initiated actions of the IWSA with the motto *"Safe Water For All"*.

To show the high esteem of the IWSA for the outstanding merits of Maarten SCHALEKAMP in the world of drinking water supply in general and within IWSA in particular, the Executive Board has decided, at its meeting of 28th May 1986 in London, to establish the 'Maarten Schalekamp Award', the first to be adjudged at the 17th world congress in 1988 in Rio de Janeiro, Brazil.

WRC



REGULATIONS

Article 1 : Object

The International Water Supply Association has created the 'Maarten Schalekamp Award' to motivate young engineers and scientists currently involved in drinking water practice or in research in the field of water supply.

Article 2: Prizes

Two first prizes of 1 000 Pounds Sterling will be awarded on the occasion of the world congresses. One prize will be awarded to a practical paper, one prize will be awarded to a research paper.

The laureates will be invited as guests to the IWSA world congress at which the prize will be awarded. Travel and sojourn expenses will be paid by IWSA.

Article 3: Papers

Papers to be submitted must be original both in content and publication; scientifically relevant and useful in the field of drinking water supply, and may relate to:

- water management
- water treatment
- water quality and health
- water transport and distribution
- sludge treatment in potable water plants
- engineering and design in water supply.

Five copies of the papers must be submitted to the Secretariat of the Association, 1, Queen Anne's Gate, London SW1H 9BT, before 1st December 1987. Manuscripts should be typed single spaced on good quality white paper 210 x 297 mm (A4) or nearest equivalent size. Figures and tables should be accurate, clear and well set out.

Article 4: Official Languages

Papers can be submitted in English or French, the official languages of IWSA. A summary in English and French must be provided.

Article 5: Candidacy

Candidates must be citizens of a country, which is a corporate member of IWSA, and be involved in drinking water supply or in research in this field. Papers describing relevant engineering practices of current interest, or dealing with technical innovations, can be submitted.

Article 6: Award Jury

The selection of the successful paper will be carried out by an independent jury of international experts with special qualifications in water supply science and technology and under the chairmanship of the Chairman of the IWSA Scientific and Technical Council. The jury reserves the right to withhold either prize if the standard submitted is not satisfactory.

The decision of the jury will be final and without appeal.

Article 7: Publication

The International Water Supply Association will acquire the copyright of the manuscripts of the laureates, to be published in one of the IWSA publications to ensure the widest possible readership.

UNDERGROUND SEWER PIPE LOCATOR

A unique set of equipment called TRACKA is being used by several South African municipalities and local industries to pinpoint the exact position and depth of non-metallic underground pipes.

The equipment consists of a battery-operated transmitter which is attached to the end of normal sewer rods and pushed down the pipe, and a small, portable receiver which the operator uses to locate the exact position of the underground transmitter. The unique aspects are that the transmitter is designed for the rough, dirty and wet conditions of a sewer, and that the receiver is designed to respond only to the transmitter and produces a clear signal when in the proximity of the transmitter. An adjustable amplifier on the receiver allows it to signal the presence of the transmitter at depths varying from 20 centimeters to 6 meters. When using the equipment, the operator first walks around with the amplifier turned to maximum, and finds the general area in which the transmitter is lying. He then turns the amplifier down and narrows the area until the position of the transmitter is pin-pointed to a spot of 20 cm diameter or less.

The procedure for locating the transmitter takes less than 10 minutes, compared with the hours and days which might be required to dig trenches. Moreover, the damage which is caused by digging trenches across roads, through gardens and through the concrete floors of buildings and the subsequent cost of making good, can make the cost of locating a blockage or break in a pipe very expensive.

Enquiries: Peter Rothenberg (Pty) Ltd, P O Box 2471, Johannesburg. 2000, Telephone (011) 786-2952.

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Insert to SA Waterbulletin February 1987

BOOK ORDER

Please supply

..... copy/ies of: SOFTENING AND STABILIZATION OF MUNICIPAL WATERS
By R E Loewenthal, HNS Wiechers and G V R Marais

..... copy/ies of: GUIDELINES FOR CHEMICAL PHOSPHATE REMOVAL
FROM MUNICIPAL WASTE WATERS
Edited by Dr H N S Wiechers
Contributors: Dr K E U Brodisch, NIWR, Mr A S Louw and
Mr H J Basson, Town Council of Boksburg and
Mr N C Thirion, formerly of the Town Council of Pretoria

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CSIR Conference Centre – 17 and 18 August 1987

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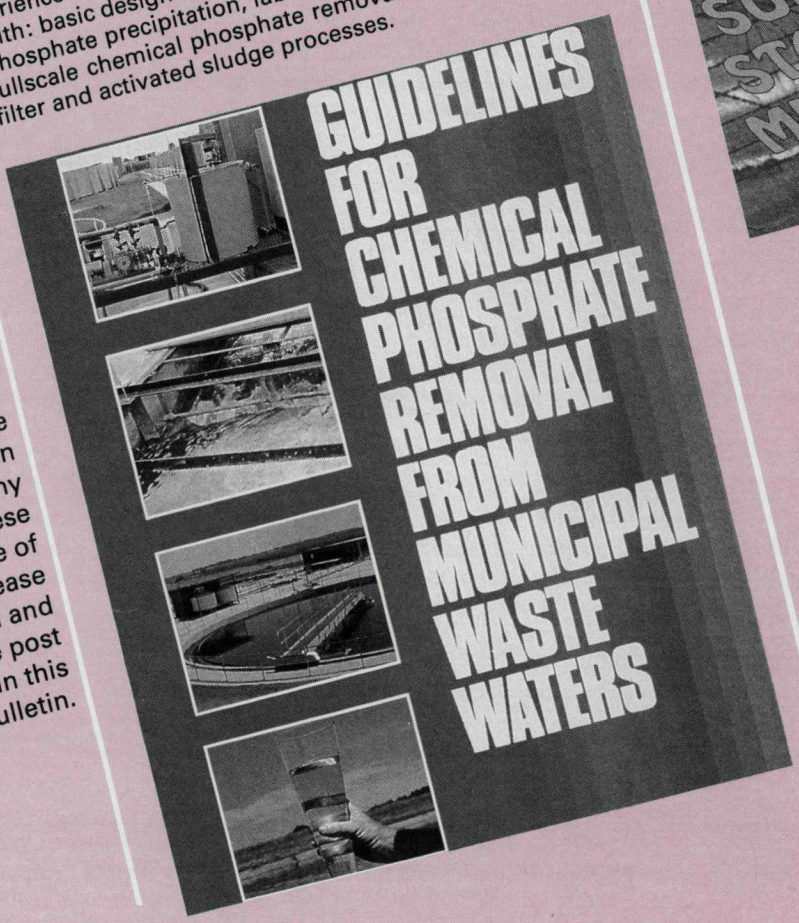
New WRC Reports just published

GUIDELINES FOR CHEMICAL PHOSHATE REMOVAL FROM MUNICIPAL WASTE WATERS

EDITED BY DR H N S WIECHERS
CONTRIBUTORS ARE DR K E U BRODISCH, NIWR, MR A S LOUW AND MR H J BASSON, TOWN COUNCIL OF BOKSBURG AND MR N C THIRION, fORMERLY OF THE TOWN COUNCIL OF PRETORIA.

This publication is intended for use by local authorities, mines, peri-urban councils and consulting engineering firms. The level of presentation assumes that the reader has had tertiary training and/or considerable experience in the field of waste-water treatment. It deals with: basic design considerations, the theory of chemical phosphate precipitation, laboratory test procedures, and fullscale chemical phosphate removal in both biological filter and activated sludge processes.



Should you be interested in obtaining any one of these reports free of charge, please fill in and return the post card in this Bulletin.

SOFTENING AND STABILIZATION OF MUNICIPAL WATERS

BY R E LOEWENTHAL, HNS WIECHERS AND G V R MARAIS

This monograph is aimed at the chemist and designer in the water industry. It gives guidelines for the softening and stabilization of municipal waters as well as detailed background information. Some worked examples, to demonstrate the practical application of the guidelines, are included.

RIVER FLOW MODELLING AND FORECASTING

Edited by D A Kraijenhoff, Department of Hydraulics and Catchment Hydrology, Agricultural University Wageningen, The Netherlands and J R Moll, Delft Hydraulics Laboratory, Emmeloord, The Netherlands.

River flow forecasts are needed for various purposes within the framework of river basin management activites; they are needed and implemented in practice.

Methods for producing forecasts, however, are usually developed in the theoretical environment. There is an old and arrogant saying among theoreticians: 'today's practice is yesterday's theory.' Many examples in this textbook will show that this is not necessarily true, although examples where it does apply can also easily be found.

The objective of this book, which features contributions from an international team of leading hydrologists, is to narrow the gap between theory and practice and to minimize the time delay between the development and implementation of useful new methods. This textbook tries, therefore, to present to the practicing engineer only those new techniques which may be useful for the solution of practical problems.

This book will be useful in any graduate course on hydraulic and water resources engineering and physical geography.

1986 384 pages
Price £38,95
ISBN 90 277 2082 7

Available from Elsevier Sciences Publishers, P O Box 211, 1000 AE Amsterdam, The Netherlands.

THE ROLE OF THE OCEANS AS A WASTE DISPOSAL OPTION

Proceedings of the NATO Advanced Research Workshop, Vilamoura, Portugal, April 24-30, 1985.

Edited by G Kullenberg, Department of Physical Oceanography, University of Copenhagen, Denmark.

The papers included in this volume deal with aspects of marine sciences, engineering, ecology, freshwater research, economy, legislation and public perception. Separate overviews cover examples of new waste disposal problems and the options available to deal with them; the problem of discovering effects of waste disposal of various kinds in ecological systems characterised by very different variance distributions as a function of frequency; a suite of management options and policy-making approaches. A presentation of the distribution, production and use of freshwater, sea water and soil resources illustrates the potential of the deep sea as an option for waste disposal.

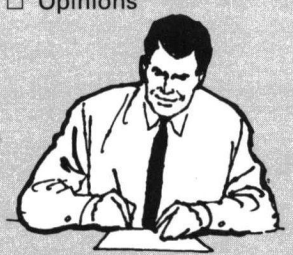
1986 736 pages
Price £76,25
ISBN 90 277 2209 9

Available from Elsevier Sciences Publishers, P O Box 211, 1000 AE Amsterdam, The Netherlands.

DROP US A LINE

SA WATERBULLETIN encourages its readers to send in contributions on water concerning the following:

- ☐ Discoveries
- ☐ On-going projects
- ☐ Completed projects
- ☐ Innovative technologies
- ☐ Brief technical reviews
- ☐ Technical reports
- ☐ Forthcoming events
- ☐ Development news
- ☐ Opinions



Mail your contribution to:
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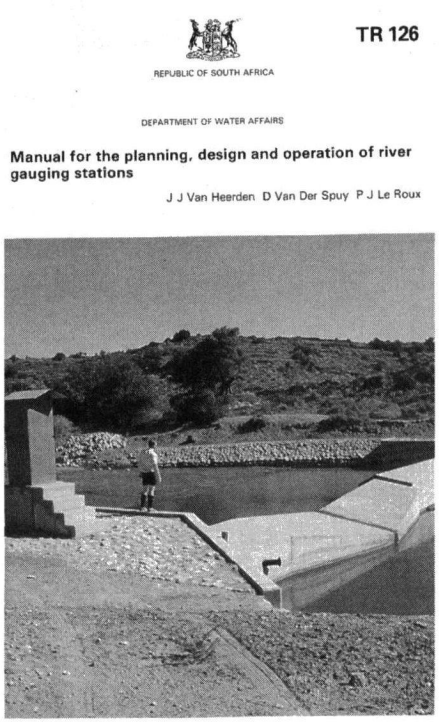
Water Research Commission
P O Box 824 PRETORIA 0001
Republic of South Africa



MANUAL FOR THE PLANNING, DESIGN AND OPERATION OF RIVER GAUGING STATIONS

By J J van Heerden, D van der Spuy and P J le Roux.

Mainly permanent structures are used to measure river flows in South Africa. The aim of this report is to acquaint the reader with the requirements of these structures so as to enable him to design a weir.

This report will also be useful for the evaluation and maintenance of gauging stations. The operation and maintenance of the water level recorders now in use are not covered in this report.

As every gauging structure has its own unique problems, this report merely provides guidelines for the design of a river flow gauging station and should not be seen as a rigid set of rules to be adhered to. For example the design of a weir on a river, where flow over the banks can cause damage, should cater for 100 per cent submergence of the weir before the water level reaches the top of the banks unless this results in an uneconomical structure.

As this report will also be used by persons with no formal understanding of Hydraulics, it will first be necessary to give a short summary of the basics of Hydraulics, especially where it applies to flow gauging.

1986 153 pages
Price R7,77 & GST
ISBN 0 621 10020 X
Technical Report TR 126

Available from the Department of Water Affairs, Manager: Scientific Services, Hydrological Research Institute, Private Bag X313, Pretoria 0001. Contact person: Mrs M Blomerus, telephone (012) 82-1021.

'N EVALUERING VAN DIE FISIES-CHEMIESE EIENSKAPPE VAN DISPERSIEWE GROND EN DIE METODES VIR IDENTIFISERING VAN DISPERSIEWE GROND

Deur F A Gerber

Die dispersieverskynsel is 'n probleem waarmee ingenieurs en grondkundiges al lank al mee gekonfronteer word en die onvermoë om die probleem eenduidig te identifiseer is een van die grootste struikelblokke.

In hierdie ondersoek na dispersie is daar eerstens aandag geskenk aan die teorie en agtergrond wat oor die verskynsel handel. Hieruit het geblyk dat dispersie hoofsaaklik 'n fisiese verskynsel is wat deur talle chemiese en fisies-chemiese eienskappe van die grond veroorsaak word. Aan die hand hiervan kon die meeste afwykings wat voorkom, asook die onvermoë om die probleem eenduidig te identifseer, verklaar word.

Verskeie metodes wat in die literatuur beskryf word, is ondersoek om sodoende te kon vasstel in watter rigting daar na 'n oplossing gesoek moet word. Die ondersoek was eerstens gerig op die toepasbaarheid daarvan in die praktyk en tweedens is na 'n eenvoudige maar doeltreffende metode gesoek wat gebruik kon word om gronde vir damkonstruksie te evalueer.

Die toepassing van die resultate wat uit die ondersoek voortgespruit het, behels relatief eenvoudige prosedures, en die eindresultaat verskaf antwoorde waarmee dispersiewe gronde relatief geïdentifiseer kan word.

1986 137 bladsye
Prys R9,57 & AVB
Tegniese verslag TR 123
ISBN 0 621 10023 4

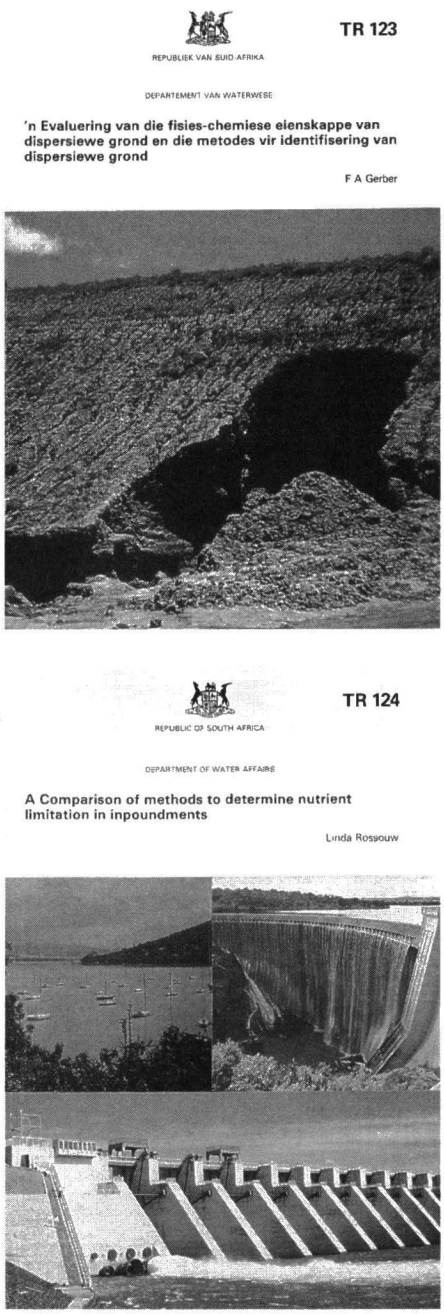
Verkrygbaar vanaf die Departement van Waterwese, Bestuurder: Wetenskaplike Dienste, Hidrologiese Navorsingsinstituut, Privaatsak X313, Pretoria 0001, Kontakpersoon: mev M Blomerus, telefoon (012) 82-1021.

A COMPARISON OF METHODS TO DETERMINE NUTRIENT LIMITATION IN IMPOUNDMENTS

By Linda Rossouw

Because of the scarcity of water in South Africa, impoundments are subjected to many uses. A single body of water may be used for the supply of potable and irrigation water and for recreation. A consequence of the shortage of water is that waste water (eg sewage and industrial effluents) must be returned to natural water courses in order to supplement supplies which results in a rapid deterioration of the water quality. Perhaps of greater concern than the quantity of available water is the rapidly deteriorating water quality which might limit water use.

Eutrophication, after mineralisation, poses the biggest water quality problem for South Africa. The enrichment of water bodies with plant nutrients (phosphorus and nitrogen) results in man-induced eutrophication and is associated with increased biological productivity and reduced stability of aquatic ecosystems.



The over-abundant growth of algae and water plants, following upon eutrophication, causes the many problems like increased water treatment costs, taste and odour problems in drinking water, and the deoxygenation of hypolimnetic waters, aesthetic problems, interference with recreational use of impoundments, health problems such as skin irritation and gastro-enteritis, loss of livestock due to the consumption of toxic algae, and the interference with irrigation, eg *Cladophora* growing in irrigation canals.

In order to plan future water resources development effectively and to manage existing water bodies, the impact of nutrient enrichment on impoundments must be understood and quantified. Nutrient control strategies are usually directed at phosphate control.

Determination of the limiting, or potential limiting nutrient is, therefore, essential. On the assumption that the same nutrients which limit the growth of phytoplankton would also limit the growth of higher plants, especially floating macrophytes (this assumption is supported by the stress on nitrogen and phosphorus as growth-limiting nutrients for macrophytes,) this study only deals with the identification of algal growth-limiting nutrients.

Algal growth is not only dependent upon nutrients but also light and temperature. The latter two are not amenable to practical control measures and, therefore, nutrient control is the only practical eutrophication control strategy. Successful nutrient control is dependent upon the ability to identify the primary growth-limiting nutrient. The author investigated different methods to identify algal growth-limiting nutrients in impoundments.

The following criteria were selected to evaluate the different methods:

- The ability of the methods to indicate actual or potential nutrient limitation.
- The ability of the method to show the onset of nutrient limitation.

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Technical Report TR 124
ISBN 0 621 10022 6

Available from the Department of Water Affairs, Manager: Scientific Services, Hydrological Research Institute, Private Bag X313, Pretoria, 0001. Contact person: Mrs M Blomerus, telephone (012) 82-1021.

IWPC

The biennial conference and exhibition of the Institute of Water Pollution Control (SA Branch) will be held in Port Elizabeth from 12 to 15 May 1987.
Enquiries: The Secretary, IWPC, P O Box 81249, Parkhurst, 2120.

WATER AND SANITATION

An international conference on water and sanitation in developing countries – "So What's New?" will be held in San Juan, Puerto Rico from 26 to 29 May 1987.
Enquiries: American Society of Civil Engineers, 345 East 47th Street, New York, NY 10017, USA.

STABILIZATION PONDS

A conference on recent research on wastewater treatment in waste stabilization ponds will be held in Lisbon, Portugal, from 22 to 25 June 1987. Papers invited.
Enquiries: Professor D D Mara, WSP-Lisbon 1987, Department of Civil Engineering, University of Leeds, LS29JT, England.

ICHTHYOLOGY

An international conference on the alternative life history styles of fishes and other organismes will be held at Rhodes University in Grahamstown from 20 to 25 June 1987.
Enquiries: The Conference Secretary, 1987 Life History Conference, J L B Smith Institute of Ichthyology, Private Bag 1015, Grahamstown, 6140. South Africa.

WATER QUALITY

The first IAWPRC international symposium and exhibition on systems analysis in water quality management will be held in London, UK, from 30 June to 2 July 1987.
Enquiries: Dr M B Beck, Watermatex 87, IAWPRC, 1 Queen Anne's Gate, London, SW1H9BT, England.

FRESHWATER ECOSYSTEMS

An international conference on the biomanipulation of natural and artificial freshwater ecosystems will be held at Lake Kinneret, Tiberias, Israel, from 2 to 7 August 1987.
Enquiries: The Organising Committee, International Conference on Freshwater Ecosystems, P O Box 3190, Tel Aviv 61031, Israel.

IUGG 1987

The 19th general assembly of the International union of Geodesy and Geophysics will be held at the University of British Columbia, Vancouver, Canada, on 9 to 22 August 1987.
Enquiries: Conference Secretariat, c/o Venue West, 801-750 Jervis St., Vancouver, B.C. Canada V6E2A9.

HYDROLOGICAL SCIENCES

A symposium combining the Biennial Symposium on the Ground Water Division of the Geological Society of Southern Africa and the third National Hydrological Symposium of the South African National Committee for the International Association of Hydrological Sciences (SANCIAHS) will be held on 6 to 9 September 1987 at Rhodes University in Grahamstown.

Second circulars and registration forms are available from the Organising Committee, Hydrological Sciences Symposium, Department of Geography, Rhodes University, P O Box 94, Grahamstown, 6140.

DESALINATION

The 3rd world congress on desalination and water reuse organised by the International Desalination Association (IDA) will be held in Cannes, France, from 14 to 17 September 1987.
Enquiries: Mrs Lucie Cohen, Societe de Chimie Industrielle 28 rue Sanint-Dominique, 75 007, Paris, France.

OZONE

The 8th ozone world congress will be held from 15 to 18 September 1987 in Zurich, Switzerland, Papers and posters invited.
Enquiries: International Ozone Association, Swiss Committee, c/o Wasserversorgung Zürich, Hardhof 9, Postfach, CH - 8023 Zürich. Telephone: 01/435-2111, Telex: 822060.

PROTECTION OF PIPES

The 7th international conference on the internal and external protection of pipes will be held in London, England from 21 to 23 September 1987. Papers invited.
Enquiries: Lorraine Grove, Conference Organiser, 7th Pipe Protection, BHRA, the Fluid Engineering Centre Cranfield, Bedford, MK43 OAJ, England.

AGROHYDROLOGY

An international Symposium on recent developments in agrohydrology will be held in Wageningen, the Netherlands from 29 September to 1 October 1987.

The topics, introduced by keynote speakers, will be:

- Effects of drainage on crops and farm management
- Water conservation and water harvesting
- Hydrology of nature reserves
- Re-use and disposal of drainage water from irrigated areas

Enquiries: IAC Bureau OCC, P O Box 88, 6700 AB Wageningen, The Netherlands.

PHOSPHATE REMOVAL

An international specialised conference on biological phosphate removal from wastewaters will be held in Rome, Italy, from 5 to 7 October 1987.
Enquiries: Dr R Ramadori, IAWPRC International Specialised Conference, IRSA-CNR, Via Reno 1, 00198 Rome, Italy.

OFF-FLAVOURS

The second international symposium on off-flavours in the aquatic environment will be held in Kagoshima, Japan, from 12 to 16 October 1987. Papers are invited.
Enquiries: Professor T Motohiro, Faculty of Fisheries, Kogishima University, 4-50-20, Shimoarata, Kagoshima 890, Japan.

GROUNDWATER CONTAMINATION

An international conference on groundwater contamination: use of models in decision-making will be held in Amsterdam, the Netherlands, from 26 to 29 October 1987.
Enquiries: TNO Corporate Communication Department, P O Box 297, 2501 BD The Hague, The Netherlands.

MOUNTAIN CATCHMENTS

A jubilee hydrology symposium with the theme "Fifty years of mountain catchment research in South Africa" will be held in Stellenbosch from 11 to 13 November 1987.
Enquiries: Department of Environment Affairs, P O Box 727, Pretoria 0001 or phone Mr D L Owen at (012) 28-7120.

S·Y·M·P·O·S·I·U·M

MODELLING OF AQUATIC SYSTEMS

OBJECTIVES

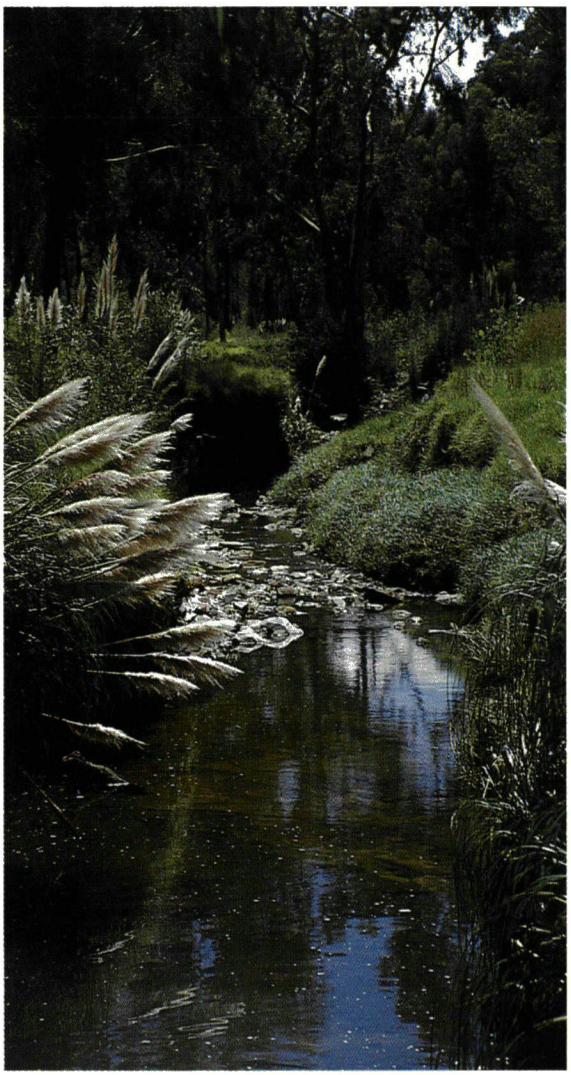
To encourage interaction between all limnologists, hydrologists, water resource planners and managers currently involved in, or interested in, the development or use of models of aquatic ecosystems and resources.

To assess the current status of aquatic modelling in South Africa.

To present delegates with the array of models available for the science and management of water resources.

To identify areas requiring additional attention.

To encourage co-operation.



WHO SHOULD COME

Anyone involved in research management, planning or utilization of our freshwaters.

AUSPICES

The symposium will be held under the joint auspices of the Committee for Inland Water Ecosystems, the Limnological Society of Southern Africa and the South African National Committee for the International Association of Hydrological Scientists.

DATE

Monday 17th – Tuesday 18th August 1987.

VENUE

CSIR Conference Centre.

COSTS

The registration fee will be R70 which will include morning and afternoon teas, lunches and a social function on the evening of 17th August.

PRELIMINARY REGISTRATION

If you are interested in attending or participating in this symposium, please complete and return the registration card in this Bulletin.

FORMAT OF PROGRAMME

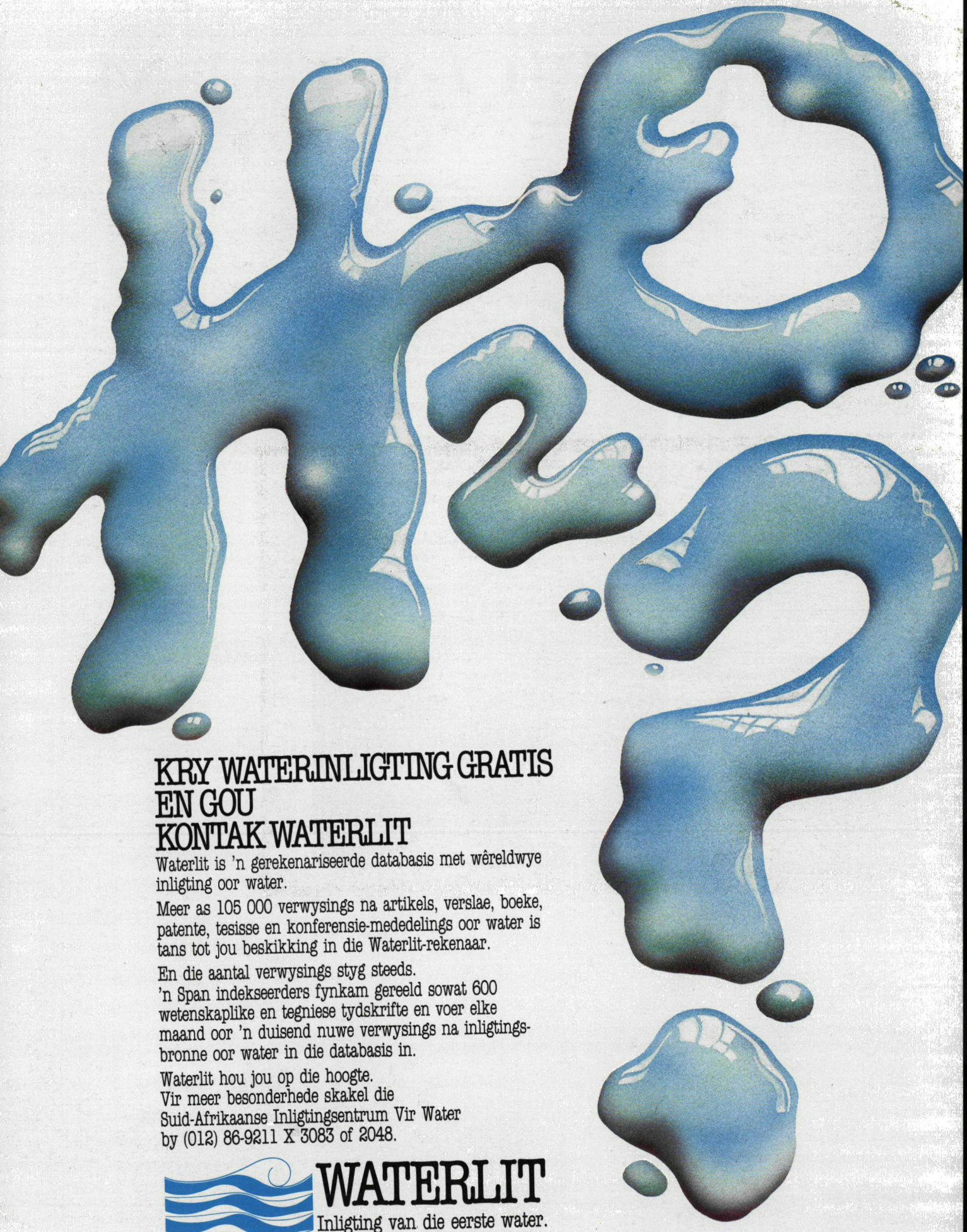
Papers and posters will be welcomed on matters relating to the development and use of models relevant to water resource management. The programme will be split into the following sessions:

- ☐ Models of ecosystems and aquatic environments: development and application
- ☐ Development and testing of models for the extension of water quality and quantity data
- ☐ Development and testing of models for the assessment of the impact of land use and management on the quality and quantity of river run-off
- ☐ The use of micro-computers in aquatic resource modelling and management
- ☐ Sensitivity, error analysis, and calibration and verification of models
- ☐ Application of models in water resource management and operations

ENQUIRIES

Miss M Robbertse
Ecosystem Programmes
Foundation for Research Development
Council for Scientific and Industrial Research

PO Box 395
Pretoria
0001



KRY WATERINLIGTING GRATIS EN GOU KONTAK WATERLIT

Waterlit is 'n gerekenariseerde databasis met wêreldwye inligting oor water.

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'n Span indekseerders fynkam gereeld sowat 600 wetenskaplike en tegniese tydskrifte en voer elke maand oor 'n duisend nuwe verwysings na inligtingsbronne oor water in die databasis in.

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