

Mdu P.

S4 waterbulletin

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HYDROLOGY

Sedimentation threatens Northern Natal estuaries

BESPROEIING

Navorsers ontwikkel gerekenariseerde stelsel vir besproeiingsbestuur

WASTEWATER

New WRC research reports available on biological phosphate removal

00020077



UNIVERSITY OF PRETORIA

Department of Civil Engineering Two-day course on **WATER RESOURCE ANALYSES**

Date: 23rd and 24th November, 1989
(immediately after the SANCIAHS/
LSSA/SAICE symposium)

Venue: University of Pretoria.

Course leader: Prof WJR Alexander.

Purpose: The purpose of the course is to present participants with the latest information on water resource development and management procedures in general, with emphasis on microcomputer applications. The mornings will be devoted to lectures, and the afternoons will be available for practical applications in the microcomputer laboratories (or at home or back at the office!).

Cost: R400 per person payable to the University of Pretoria.

The computer programs and a training manual will be available from about 1st October.

The course notes will be issued at the start of the course.

To register, please complete the registration card in this Bulletin.

Programme

INTRODUCTION

- ☐ Rainfall, climate and hydrological processes
- ☐ Introduction to hydrological statistics
- ☐ Reconstruction of historical records: deterministic methods
- ☐ Reconstruction of historical records: statistical methods
- ☐ Generation of synthetic records

YIELD ANALYSIS

- ☐ Specification of water yield
- ☐ Sequential analysis methods
- ☐ Non-sequential analysis methods

SYSTEM ANALYSIS AND OPTIMIZATION

- ☐ Multiple criteria decision making
- ☐ Linear and dynamic programming
- ☐ Direct mathematical optimisation
- ☐ Numerical simulation
- ☐ Engineering economics
- ☐ Optimum economic phasing of water resource development projects

COMPUTER PROGRAMS

The following computer programs will be provided:

- ☐ **Statistical analyses**
 - Linear regression
 - Multiple linear regression (conventional and stepwise)
- ☐ **Generation of data sets**
 - Deterministic methods (Pitman model)
 - Statistical methods (Monte Carlo models)
- ☐ **Yield analysis**
 - Firm yield (single reservoir)
 - Economic yield (single reservoir)
- ☐ **System analysis**
 - Linear programming
 - Dynamic programming (phased economic development)
 - Numerical simulation

HOW TO GET THE MOST FROM THE COURSE

The length of the course has been reduced to two days which means that participants will have to spend additional time on their own to get maximum value from the course.

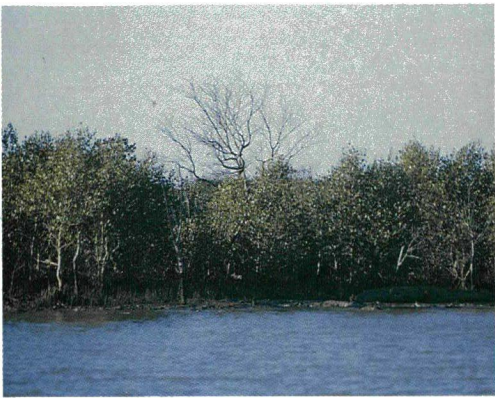
Here are some suggestions.

Obtain and study a copy of the publication Management of the Water Resources of the Republic of South Africa (Afrikaanse weergawe beskikbaar) from the Department of Water Affairs, Private Bag X313, Pretoria 0001.

The lectures and course notes will concentrate on practical applications. The text book Water Resources Systems Planning and Analysis by Loucks, Stedinger and Haith (Prentice Hall, 1981) is strongly recommended for those who would like to develop their theoretical knowledge further. This book is not available in South Africa but can be ordered through van Schaik's bookstore, PO Box 724, Pretoria 0001. Tel (012) 21-2441. The estimated cost is R283 plus R66 if delivered by airmail, plus GST.



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Cover:
Mangroves at St Lucia estuary (WRC)

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Die Waternavorsingskommissie het onlangs tydens 'n geselligheid in Pretoria van die WNK se uitredende voorsitter dr JP Kriel afskeid geneem. Dr Kriel was lid van die Waternavorsingskommissie vanaf die Kommissie se ontstaan in 1971 en voorsitter vir die afgelope vier jaar.

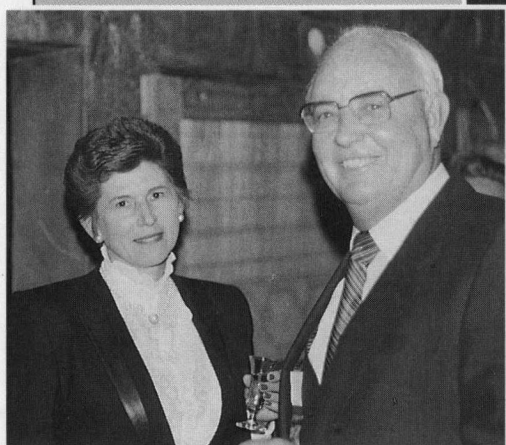


Van links: Mev Hettie Claassens, mnr "Dodo" Claassens, Direkteur-generaal: Departement van Waterwese; mev Hilda Kriel, dr Jacques Kriel, mev Cordelia Odendaal en mnr Piet Odendaal, Uitvoerende Direkteur, WNK.

ONDER: Dr Chris Garbers, President van WNNR, (links) en dr Jacques Kriel.



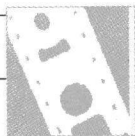
DR KRIEL GROET



Mev Hettie Claassens (links) in gesprek met mnr Johan du Plessis, voormalige Direkteur-generaal van die Departement van Waterwese.



Van links: Mev Gezina van der Merwe, mev Hilda Kriel en mev Joyce van Wyk.



WRC COMMISSIONERS APPOINTED FOR NEW TERM



Mr AJ Raubenheimer

NEW CHAIRMAN

AJ RAUBENHEIMER

Mr AJ Raubenheimer was born in the Vryburg district of the Cape Province. He grew up in the Eastern Transvaal and matriculated at Belfast High School in 1938. He then studied at the University of Pretoria obtaining a B Sc (Agric) degree (1942). He started farming near Nelspruit in 1943.

Since 1954 he has served as chairman for various co-operations and irrigation boards for many years.

In 1966 he was elected Member of Parliament for Nelspruit. He became Minister of Water Affairs and Forestry in 1976. As a member of the President's Council he was appointed chairman of the Planning Committee in 1980 and later chairman of the Committee for Economic Affairs as well. In 1984 he retired from the President's Council to devote himself full-time to his farming.

He has been a member of the Council of the University of Pretoria for many years (1961-1982). He was awarded the honorary citizenship of Nelspruit in 1976. The Order for Meritorious Service was bestowed on him by the State President in 1981.

He enjoys the outdoors and besides farming he likes gardening and is a keen golfer.

Mr Raubenheimer and his wife Charmaine, have five daughters.



Dr WL van Wyk

DR WL VAN WYK

Dr WL van Wyk was born (1923) in the Northern Cape at Vryburg. He obtained the B Sc degree (1945) at the University of Stellenbosch, majoring in geology and chemistry. He was awarded a Ph D degree by the University of Cape Town for his thesis: "Groundwater studies in Natal, Zululand and surrounding areas."

He joined Geological Survey as a junior geologist in 1946. From the start he was involved with geological mapping and groundwater surveys. In 1964 he was appointed assistant-director in charge of Geological Survey, South West Africa.

He headed Scientific Services at the Department of Water Affairs from 1973 till

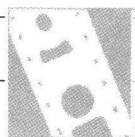
1976. He then was appointed director of Geological Survey (1976 to 1980). Thereafter he was deputy director-general of the Department of Mineral and Energy Affairs until he retired in 1984.

Dr van Wyk has served on several mineral and mining related committees and was amongst other chairman of the SA Diamond Board.

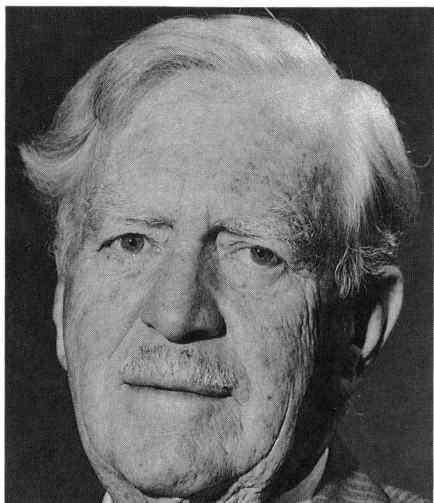
He has presented papers at a number of international and national conferences, mainly on the subject of underground water in southern Africa.

Dr van Wyk has been a member of the Water Research Commission since 1985.

He and his wife Joyce, have three children. He enjoys reading widely and is an enthusiastic golfer.



WRC COMMISSIONERS APPOINTED FOR NEW TERM



Mr Eric Hall

MR EJ HALL

Mr Eric Hall, qualified as an engineer in 1939, obtaining the degree B Sc (Eng) from the University of the Witwatersrand. He obtained the M Sc (Eng) degree from the same university in 1950.

His professional career was with the City Engineer's Department of Johannesburg. He held various positions in the department and was appointed city engineer in 1975. He was associated with projects including the Johannesburg motorway system and the Goudkoppies waste water scheme and purification works.

After retiring as city engineer, Mr Hall joined De Leuw Cather as a director. Presently he is a senior consultant with the company. He is involved in water distribution, solid waste management and environmental impact projects.

Mr Hall is a fellow of a number of professional institutions and has held some distinguished positions amongst these. He has also published over 80 papers on waste disposal, water engineering, municipal engineering and environmental matters.

During World War II he served in the SAEC in East and North Africa as well as Italy.

Mr Hall is a dedicated conservationist and is a member of the Council for the Environment as well as the Ornithological Society of South Africa.

He enjoys bird photography and painting as well as playing bowls in his free time.

Mr Hall and his wife Jean, have two married children.

PROF PD TYSON

Professor PD Tyson was born in Johannesburg (1939) and matriculated at Parktown Boys' School. He studied at the University of the Witwatersrand (Wits), obtaining a B Sc degree with geography and chemistry as majors.

He then became a lecturer at the University of Natal but continued with post-graduate studies at Wits, specialising in climatology. He was awarded a Ph D degree by Wits University for his thesis on topographically-induced wind systems in Natal (1968).

He was appointed professor at Wits in 1969, later becoming dean of the Faculty of Science. Presently he is vice-principal of Wits.



Prof PD Tyson

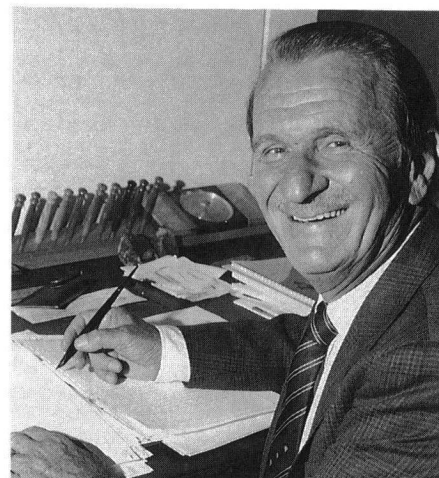
As a highly esteemed scientist, professor Tyson has often been invited to overseas universities as professor and guest lecturer.

He has been director of the Climatology Research Group since 1977 as well as being a member of committees and workgroups on air pollution, desert research and climatic change.

Professor Tyson has published numerous scientific articles and authored two books on Southern African climatology.

Professor Tyson and his wife Jeannette, have a son and two daughters.

Besides a regular game of tennis he enjoys reading and do-it-yourself!



LEFT: Dr Louw Alberts

DR L ALBERTS

Dr Louw Alberts was born (1923) in Port Elizabeth and matriculated there at Grey High School. He then studied at Rhodes University, Grahamstown. He held scholarship throughout high school and university, obtaining degrees cum laude.

He obtained a doctorate in physics at the University of the Orange Free State and continued with post-doctoral studies at the Universities of Amsterdam and Sheffield. He discovered giant magnetostriction in rare earth metals, co-publishing the results with EW Lee.

Dr Alberts was lecturer and professor in physics (1946 to 1970) at the University of the Orange Free State and the Rand Afrikaans University. From 1971 to 1977 he was vice-president of the Atomic Energy Board (now Atomic Energy Corporation). He then was appointed president of the National Institute for Metallurgy (1978 to 1984). Thereafter being director-general of the Department of Mineral and Energy Affairs (1984 to 1987). Presently he is chairman of the CSIR.

He has published extensively in the field of solid state physics, and has written articles on various other subjects including the philosophy of science and mineral economics.

Dr Alberts has participated in many national and international conferences, often by special invitation. In 1980 he was



invited by the Quebec Government to advise on mineral research.

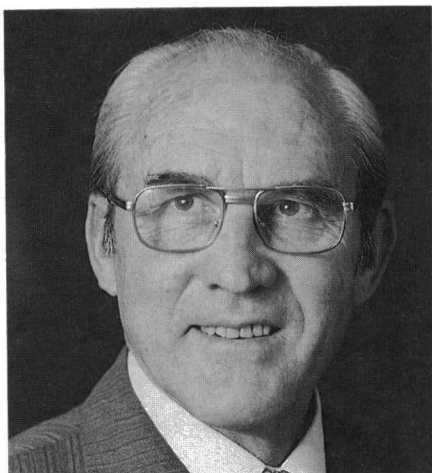
He has been chairman of international as well as national advisory committees and still is a member of science and technology advisory councils.

Several honours have been bestowed on Dr Alberts, by universities and the State President amongst others. He is also a fellow of the British Institute of Physics.

Dr Alberts is well-known as an active christian often speaking at seminars and writing articles addressing topics such as the Bible and science, marriage and family life.

He enjoys hunting and plays bowls whenever he finds time, though not as often as he would like to.

He and his wife Elsje, have three sons and a daughter.



Mr DH Marx

MR DH MARX

Mr DH Marx was born in the Orange Free State in 1922 and matriculated at Grey College, Bloemfontein. Initially he studied at the University of the Witwatersrand but he completed a B Sc degree at Stellenbosch university as well as a B Sc degree in civil engineering at the same university in 1948.

He has been with the City Council of Pretoria since 1949 until his retirement in 1987. Starting as an engineer in the roads and design section, he later became chief engineer and eventually was appointed city engineer (1982). Mr Marx was deputy town clerk (technical) from 1985 until he retired.

During his career as municipal engineer he served on various committees of the CSIR, as well as specification-committees of the SA Bureau of Standards.

He was appointed a member of the Magalies Waterboard by the Minister of Water Affairs in 1983. He has been chairman of this board since 1987.

He is a fellow of the SA Institute of Civil Engineers and also of the Institute for Municipal Engineers of Southern Africa.

Mr Marx and his wife Bettie have three sons and a daughter. All of the sons followed their father in becoming civil engineers.

Mr Marx enjoys doing woodwork and listening to music, piano concerto's in particular, in his spare time and is active in church activities.



Mr GCD Claassens

MR GCD CLAASSENS

Mr GCD Claassens was born (1930) at Worcester and matriculated there at the Boys' High School. Studying at the University of Cape Town he obtained the B Sc (Eng) degree in civil engineering (1952).

He joined the Department of Water Affairs in 1953. In the course of his career he has had part in several large projects of the Department. The PK le Roux dam and Fish River tunnel were under his supervision as chief engineer (construction) for Water Affairs.

In 1984 he became deputy director-general and in 1987 he was appointed director-general for the Department of Water Affairs.

Mr Claassens is a fellow of the South African Institute of Civil Engineers and serves on a number of commissions and boards in the waterfield. He is chairman of the Permanent Water Commissions of Venda and Ciskei.

Mr Claassens and his wife Hettie have three sons. He enjoys reading, gardening and doing some woodwork as well as fishing and a little golf for relaxation.

DR AJ HEYNS

Dr AJ Heyns was born in the district of Calvinia in 1925. He studied at the University of Stellenbosch receiving a BSc degree in 1946. He continued with postgraduate studies in botany at the same university.

In the early 1960's he studied in Britain obtaining a Ph D degree from the University of London in 1964 for his thesis on fungicidal activity in certain organo-sulphur compounds.

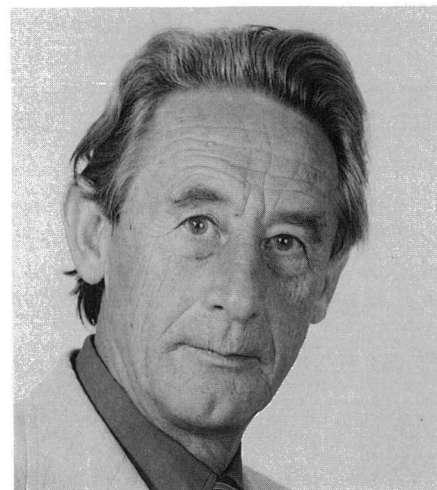
In 1950 he joined the Fruit and Fruit Technology Research Institute as an assistant professional officer, eventually becoming deputy director in 1970. During this period his research included various diseases of pome and stone fruit.

He served as director for the Horticultural Research Institute from 1974 till 1984. Thereafter he was appointed to the directorate of the Department of Agriculture and Water Supply. Presently he is the superintendent-general of the Department.

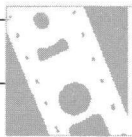
Dr Heyns has published numerous articles and reports in his field of research. He has been on a number of tours abroad looking at plant improvement schemes and investigating co-operation with overseas scientists. Dr Heyns presently is a member of the Scientific Advisory Council, as well as the senate of the Foundation of Research Development.

He and his wife Madeleine have two children, a son and a daughter.

Collecting first-day covers is one of his many interests.



Dr AJ Heyns



Die stadsraad van Boksburg het tydens 'n middagete in die burgemeester se ontvangslokaal 'n finale verslag oor chemiese fosfaatverwydering aan die voorsitter van die Waternavorsingskommissie, dr JP Kriel, oorhandig. Die verslag spruit uit navorsingswerk wat die stadsraad onder kontrak met die WNK by hulle Vlakplaats-rioolwerke uitgevoer het.

In sy bedankingstoespraak het dr Kriel Boksburg geloof vir hulle ondernemingsgees en kundigheid. Hy het gesê Boksburg is vanweë hierdie navorsing tans 'n leier in Suid-Afrika op die gebied van chemiese fosfaatverwydering, 'n proses wat veral by rioolwatersuiweringswerke met biologiese filterbeddings gebruik word. Meer as vyftig persent van Suid-Afrika se rioolwatersuiweringsaanlegte het nog biologiese filterbeddings in werking wat die belangrikheid van hierdie fosfaatverwyderingsproses beklemtoon, aldus dr Kriel.



BO: Die stadsingenieur van Boksburg, mnr Hannes Langeveldt, (links) oorhandig die finale verslag getiteld "Evaluation and optimisation of full-scale chemical phosphate removal in biological sewage treatment processes" aan die voorsitter van die Waternavorsingskommissie, dr JP Kriel.



ONDER: Van links: Dr Herman Wiechers, Kamervan Mynwese, mnr Charles Kroon, assistent-stadsingenieur van Boksburg en mnr Hennie Basson van die stadsraad van Boksburg.

Mnr Beyers de Klerk, burgemeester van Boksburg, (middel) en mnr Johan Coetzee, stadsklerk, (tweede van links) saam met die outeurs van die verslag, mnr WV (Bill) Alexander (heel links) van die ingenieursfirma, Scott en De Waal en mnre Hennie Basson en Dries Louw, beide van die stadsraad van Boksburg. =



POSTCARD

Postage
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**Mrs Tineke van der Schyff
c/o Water Research Commission
P O Box 824
PRETORIA
0001**

BOOK ORDER

Complete and return to the Water Research Commission, P O Box 824, Pretoria 0001.

Please send:

..... copy/copies of: *Two-year study on the enhancement of biological phosphate removal by altering process feed composition (plant and laboratory studies)* by D W Osborn, L H Lötter, A R Pitman and H A Nicholls (WRC Report No 137/2/89).

..... copy/copies of: *Two-year study on the enhancement of biological phosphate removal by altering process feed composition (metabolic control mechanisms)* by L H Lötter (WRC Report No 137/3/89).

..... copy/copies of: *Evaluation and optimisation of full-scale chemical phosphate removal in biological sewage treatment processes* by A S Louw, H J Basson, W V Alexander (WRC Report No 159/1/88).

..... eksemplaar/eksemplare van: *Die ontwikkeling van die nodige apparaat en programme vir die monitor en bestuur van besproeiing* deur W P J Wessels, W H Steyn en N de W du Toit (WNK Verslagnr. 102/1/87).

Name

Address

Telephone No Postal Code

Signature Date

Two-day course on **WATER RESOURCE ANALYSES**

Please complete and mail the card to the address shown overleaf.

Tick (✓) the relevant paragraph box.

- ☐ I will probably attend the course. Please keep me informed.
- ☐ Please register me for the course and send me the training manual and computer programmes as soon as they are available. A cheque for R400 is enclosed. (This is fully refundable prior to the despatch of the training manual and computer programmes. Thereafter R150 is refundable if the course is cancelled or notice of non-attendance is received at least two weeks before the start of the course.)

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Organisation

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Please make out your cheque to the University of Pretoria.

Fax: (012) 43-3589. Tel: (012) 420-2978.

REGISTRATION CARD

**Mrs Nellie le Roux
Department of Civil Engineering
University of Pretoria
PRETORIA
0002**

Insert to SA Waterbulletin June/July 1989

SA moniteringstelsel vir besproeiing ontwikkel

Navorsers aan die Universiteit van Stellenbosch het met finansiële steun van die Waternavorsingskommissie apparaat en programme vir die monitor en bestuur van besproeiing ontwikkel.

Die navorsers, mnr WPJ Wessels, WH Steyn en N de W du Toit, sê in 'n finale verslag wat die WNK oor die projek vrygestel het, die doel met die navorsing was die ontwikkeling van 'n gerekenariseerde stelsel wat die besproeiingsboer in staat sal stel om op 'n gereelde basis die daaglikse besproeiingsbehoefte van die gewas onder besproeiing te bepaal, 'n besproeiingsprogram op te stel om aan die behoefte te voldoen in soverre die kapasiteit van die besproeiingstelsel dit toelaat, en om vas te stel of die gewenste grondvogregime in die wortelsone gehandhaaf word sodat regstellings gemaak kan word, indien nodig.

Volgens die verslag het navorsers van die Universiteit se Departement Siviele Ingenieurswese en die Instituut vir Elektronika, 'n stelsel ontwikkel waarmee evapotranspirasie op grond van outomaties ingesamelde weerdata bereken en saam met gemoniteerde reënval en besproeiing gebruik word om daaglikse grondvogtekorte te bereken. Die programmering van besproeiing word volgens die grondvogtekorte, voorspelde daaglikse evapotranspirasie, en die kapasiteit van die besproeiingstelsel uitgewerk. Grondvogdata word outomaties met behulp van tensiometers en kapasitansiesensore verkry ten einde vas te stel of die verlangde grondvogregime in die wortelgebied gehandhaaf word. Volledige rekords van besproeiing en weerdata word op 'n magnetiese skyf gehou.

Die navorsers sê die resultate wat behaal is, dui daarop dat dit moontlik behoort te wees om 'n bevredigende moniteringstelsel in Suid-Afrika te kan vervaardig met behulp van elektroniese onderdele en ander apparate wat tans algemeen in die handel verkrygbaar is, en deur sekere onderdele hier te vervaardig. Die nodige rekenaarprogramme kan ook plaaslik ontwikkel word terwyl 'n boer die stelsel maklik sal kan uitbrei om 'n besproeiingstelsel outomaties te beheer.

Afskrifte van die verslag, getiteld Die ontwikkeling van die nodige apparaat en programme vir die monitor en bestuur van besproeiing (WNK-verslag nr 102/1/87) is gratis beskikbaar by die Waternavorsingskommissie. Om 'n eksemplaar te bestel, voltooi asseblief die poskaart in hierdie Bulletin.

Pogings op die gebied van ingenieurswese om die doeltreffendheid van waterverbruik in besproeiingsboerdery te verhoog, het tot dusver in Suid-Afrika hoofsaaklik gegaan oor die bekamping van verliese van besproeiingswater in aanvoerstelsels. Op hierdie gebied word ongetwyfeld sukses behaal waar balanseerdamme en besproeiingskanale van waterdigte voerings voorsien word. Besproeiingsingenieurs lewer ook 'n bydrae deur voortdurende pogings om toe te sien dat goeie ontwerpe vir besproeiingstelsels gebruik word. Hierdie navorsingsprojek was egter daarop gemik om nuwe metodes en toerusting vir die bestuur van 'n besproeiingstelsel te ontwikkel. Dit moet 'n besproeiingsboer in staat kan stel om die beste moontlike gebruik te maak van sy besproeiingstelsel en beskikbare water deur optimum watertoedienings te maak. Hiermee word bedoel dat die besproeiingsprogram sodanig moet wees dat die maksimum gewasopbrengs per eenheid water verbruik, onderhewig aan praktiese beperkings, behaal kan word. Die doel kan slegs bereik word indien water in voldoende hoeveelhede met geskikte tussenposes toegedien word om in die behoeftes van die gewas te voorsien, sonder om te veel water aan wegsyfering en ander verliese te verloor.

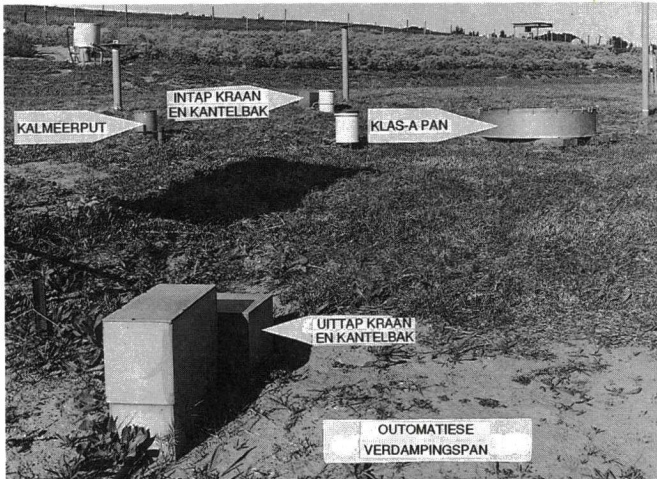


WERKING

Die stelsel vir die monitor en bestuur van besproeiing wat ontwikkel is, funksioneer soos volg:

In die begin word 'n beraming van die grondvogtekort in die wortelsone van die gewas gemaak op grond van grondvoglesings. Data oor die volgende weersfaktore word daarna op 'n

daaglikse basis gebruik om die potensiële evapotranspirasie te bepaal: totale inkomende sonstraling, lugtemperatuur, natboltemperatuur en windspoed. Verdamping uit 'n klas-A verdampingspan word ook gemeet en geregistreer met die oog daarop dat dit as 'n alternatiewe maatstaf van potensiële evapotranspirasie gebruik kan word. 'n Gewasfaktor, gebaseer op die tipe en groeistadium van die betrokke gewas, word gebruik om die werklike evapotranspirasie as 'n breuk van die potensiële evapotranspirasie te bereken. Indien besproeiing waargeneem is (met behulp van 'n vloeiometer) word die netto besproeiing bereken deur 'n aanname te maak oor die verliese aan afloop en verdamping tydens besproeiing. Die grondvogtekort



aan die einde van die dag word vervolgens bereken deur die evapotranspirasie by te tel en die netto besproeiing af te trek van die grondvogtekort aan die einde van die vorige dag. Indien die resultaat van hierdie berekening 'n negatiewe syfer is, word die netto besproeiing verminder sodat die grondvogtekort nul word. Die laasgenoemde vermindering word in sodanige gevalle as 'n verlies aan wegsyfering gereken. Indien reën waargeneem is op die betrokke dag, word die gedeelte van die reën gelyk aan of minder as die grondvogtekort (nadat die besproeiing, indien enige, vir die dag ingereken is) as effektiewe reën gereken. Hierna word die finale grondvogtekort aan die einde van die dag bereken deur die effektiewe reën ook van die grondvogtekort af te trek. Op hierdie wyse word 'n sintetiese rekord van grondvogtekort vir elke onderafdeling van die besproeide grond gehou. Rekords word ook gehou van alle bruto sowel as netto besproeiings, totale en effektiewe reënval en potensiële sowel as werklike evapotranspirasie.

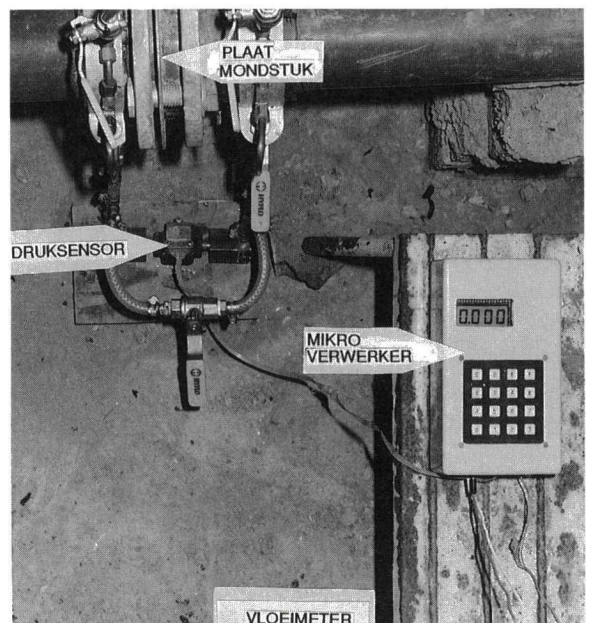
REKENAARPROGRAM

'n Rekenaarprogram vir die bestuur van die besproeiingstelsel is as deel van die navorsingsprojek ontwikkel. In hierdie program word die berekende grondvogtekort vir elke onderafdeling van die besproeiingsgrond gebruik om te voorspel wanneer die maksimum toelaatbare grondvogtekort op elke perseel bereik sal word. 'n Voorspelde tempo van waterverbruik, gelyk aan die gemiddelde besproeiingsbehoefte oor die afgelope vyf dae, word gebruik vir die doeleindes van die voorspelling. 'n Besproeiingsprogram word op grond van die beskikbare tyd en die kapasiteit van die besproeiingstelsel uitgewerk om elke perseel so na as moontlik aan die berekende datum waarop die grondvoglimiet bereik sal word, te besproei. Indien die kapasiteit van die besproeiingstelsel op 'n bepaalde tydstip te klein is om aan die volle



besproeiingsbehoefte te kan voldoen, word die tydstip en hoeveelheid van besproeiing vir elke perseel aangepas sodat op elke perseel dieselfde persentasie van die beraamde grondvogtekort aangevul sal word.

Die waargenome grondvogdata kan soos volg aangewend word om die verlangde grondvogregime te verkry en te handhaaf: Indien die bereik van die voginhoud van die wortelsone te laag of te hoog bevind word, moet die gewasfaktor wat vir die berekening van evapotranspirasie gebruik word, opwaarts of afwaarts respektiewelik aangepas word totdat die gewenste resultaat bereik word. Indien die boonste gedeelte van die wortelsone te veel uitgedroog raak teen die einde van die besproeiingsiklusse terwyl die onderste gedeelte so nat bly dat die afwaartse beweging van grondvog uit die wortelgebied uit meer as byvoorbeeld 5 persent tot 10 persent van die evapotranspirasie beloop, moet die toegelate grondvogtekort voor besproeiing verminder word. Op die wyse sal die frekwensie van besproeiing sowel as die gemiddelde voginhoud van die boonste gedeelte van die wortelsone toeneem terwyl die gemiddelde voginhoud in die onderste gedeelte sal afneem, met 'n gevolglike vermindering in wegsyferingsverliese. Indien die onderste gedeelte van die wortelsone egter te veel uitdroog, sal groter besproeiings met 'n laer frekwensie die probleem regstel.



DIE STELSEL

Daar is besluit om die stelsel so modulêr moontlik te hou en sodoende die uitbreikbaarheid en herkonfigureerbaarheid van die stelsel nie te strem nie. Daar is ook gepoog om gebruik te maak van 'n verspreide intelligensiestelsel, sodat die betroubaarheid en deurvoervermoë van die stelsel nie sal afneem wanneer die stelsel vergroot word nie. 'n Verdere voordeel wat hieruit geput kon word, is dat verwerkingseenhede op mikrorekenaarsvlak gebruik kon word. Dit beperk die koste van sodanige stelsel tot 'n groot mate, aangesien dit nie nodig sal wees om duur kragtiger rekenaars (mini-rekenaars) te gebruik nie.

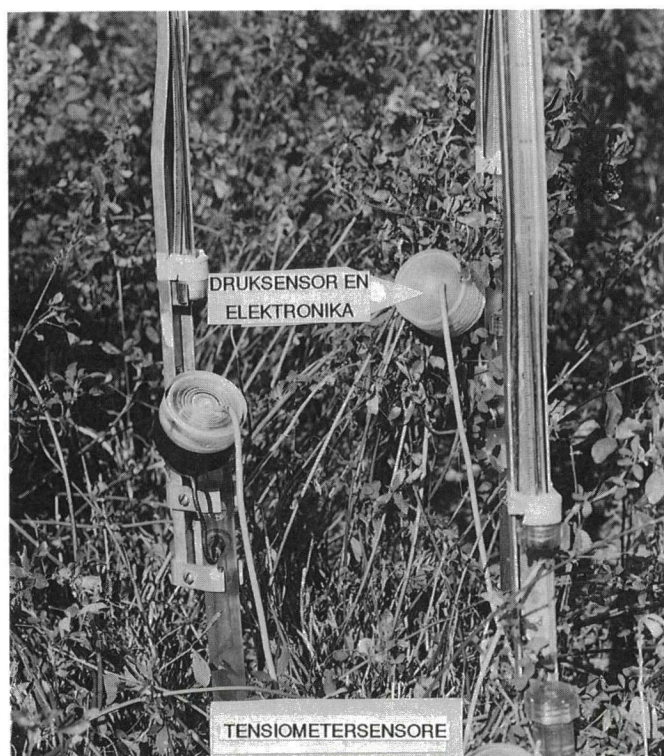
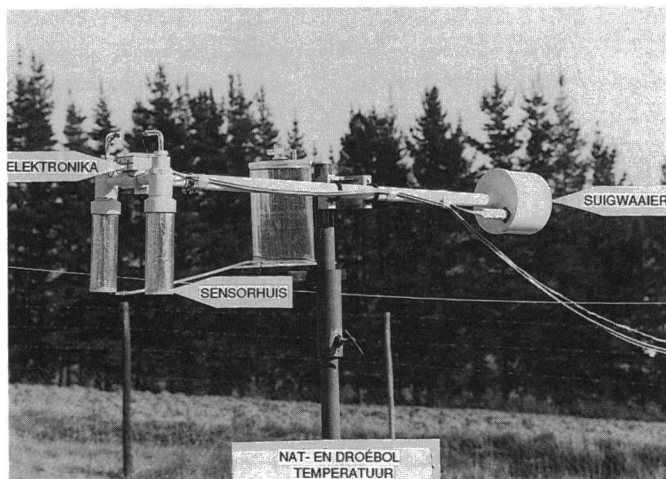
Die totale stelsel is verbind deur middel van seriële enkelpaar kabel waarop alle kommunikasie geskied. Daar is gebruik gemaak van 'n meesterslaaf beginsel van kommunikasie, deurdat die sentrale verwerkingseenheid alle kommunikasieaktiwiteite aktiveer en die slaafeenhede slegs hierna geleentheid het om status op data terug te rapporteer.

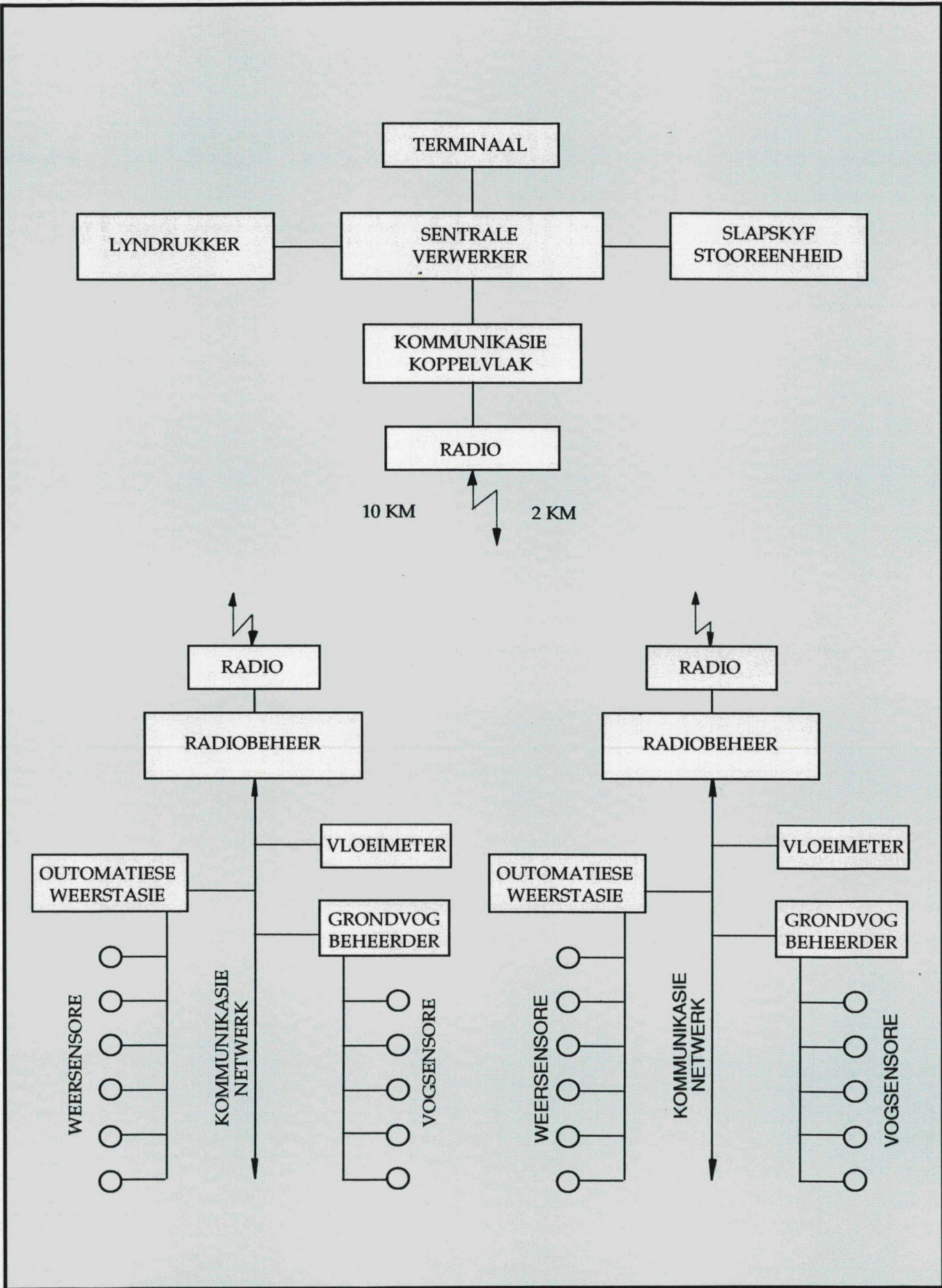


Die kommunikasiekanaal kan ook waar nodig (as gevolg van geografiese probleme, ens), onderbreek word en vervang word met 'n radioskakel. Dit is ook wel so toegepas in die geïmplementeerde stelsel. 'n Langafstand radioskakel bied ook die moontlikheid om 'n aantal stelsels vanaf 'n enkele sentrale punt te bedien, byvoorbeeld in 'n besproeiingskema situasie.

Hierdie toepassingsmoontlikheid sal die stelsel ook meer aantreklik maak as gevolg van laer koste, omdat elke substelsel nie nodig het om sy eie, relatief duur, sentrale verwerker te besit nie.

'n Blokdiagram van die stelsel soos geïnstalleer op die Welgevalen en Rust-en Vrede proefpersele naby Stellenbosch word getoon in Figuur 1. (Sien bladsy 12)





Studies show how to enhance biological phosphate removal



Councillor Koos Roets, mayor of Johannesburg, presents the final report on the enhancement of biological phosphate removal to Mr Piet Odendaal, Executive Director of the Water Research Commission (left). Mr Odendaal said the research findings were of great value to Johannesburg and the improvements in effluent treatment technology could translate into meaningful financial benefits.

The Water Research Commission has recently released two final reports on the enhancement of biological phosphate removal by altering process feed composition.

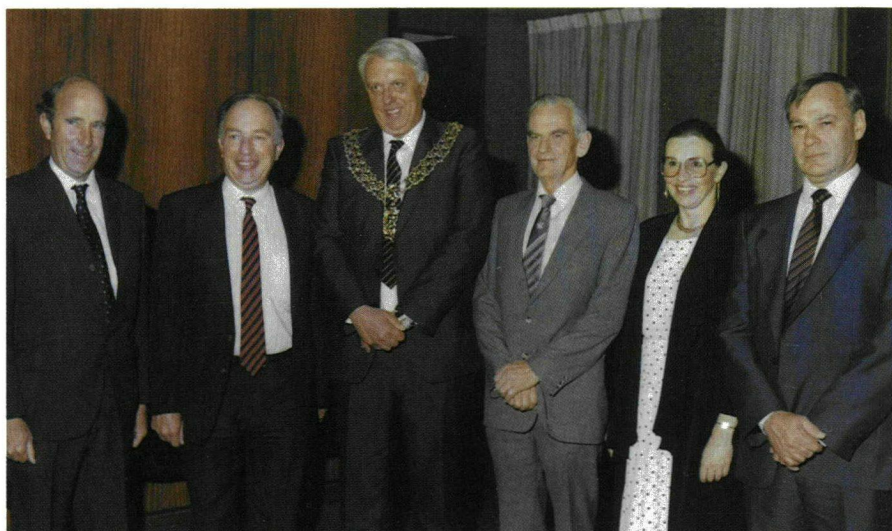
The reports which are based on a two year study funded by the Water Research Commission and carried out by Johannesburg's city health and city engineer's departments, were presented to the Executive Director of the WRC, Mr Piet Odendaal, at a function in Johannesburg by the mayor of Johannesburg, Councillor Koos Roets.

The reports summarise the research results of plant and laboratory studies and metabolic control mechanisms of the biological phosphate removal process at Johannesburg's Northern and Bushkoppie Works.

The researchers, DW Osborne, LH Lotter, AR Pitman and HA Nicholls, say the aim of the research work was to:

- ☐ improve elutriation of readily biodegradable compounds from primary sedimentation tanks to achieve optimum use of this process
- ☐ minimise the mass of nitrate entering the anaerobic zone
- ☐ monitor oxygen utilisation rates (OUR) and oxidation reduction potentials (ORP) in the plant to optimise power consumption
- ☐ develop less labour intensive and more accurate methods of determining volatile fatty acid levels
- ☐ confirm postulates contained in the bio-chemical model of biological phosphorus removal experimentally
- ☐ consolidate on-line effluent monitoring
- ☐ incorporate new design features in plant modifications.

Copies of these reports are available on request from the Water Research Commission. To order, please complete the postcard in this Bulletin.



After presenting the report on the enhancement of biological phosphate removal to the Executive Director of the Water Research Commission, Mr Piet Odendaal (right) the mayor of Johannesburg, Councillor Koos Roets, (centre) poses with the authors of the report. From left: Mr Harold Nicholls, Mr Tony Pitman, Mr Dave Osborne and Dr Lauraine Lötter.

Research into and development of biological nutrient removal from sewage in South Africa over the last twelve years, with much of the work being sponsored by the Water Research Commission, has resulted in significant advances in understanding the process and its successful application in practice. This knowledge has been transferred to user agencies such as consulting engineers and local authorities by way of presentations at local and international conferences, working group discussions and a comprehensive information document on the Theory, design and operation of nutrient removal activated sludge processes, published in 1984 and available from the Water Research Commission.

The factors responsible for and controlling phosphate removal from sewage have been identified and to a limited extent quantified. The more important are the composition of the sewage, the bacterial species which remove the phosphate and the process reaction conditions, the first named being the most crucial. Parameters of importance are the quantity of short chain organic compounds, such as acetic acid, present in sewage as well as the relative proportions of carbon to nitrogen and phosphorus.

Mathematical models relating phosphate removal to the above parameters have been developed and found to give conservative estimates of the phosphate removal experienced in practice.

PROCESS FEED COMPOSITION

Experience at the Johannesburg Northern Works which makes use of both the five and three-stage Bardenpho Process, has shown that the continuous and reliable removal of phosphates to the required standard of 1 mg o-P/l, is critically dependent on having an adequate supply of readily biodegradable COD present in the influent to the anaerobic zone.

Mr Piet Odendaal presents a WRC tie to the recently retired Chief Scientific Officer of the Johannesburg City Council, Mr Dave Osborne. Mr Odendaal lauded Mr Osborne for his invaluable contributions to the South African Water industry and said he was the driving force in the Council who initiated and managed the agreements between Johannesburg and the WRC over the last ten years.



If the feed has an adequate concentration of readily biodegradable substances in particular, anaerobic fermentation products such as volatile fatty acids (VFA), phosphorus removal has a good chance of success. Sewage having a total COD of about 500 mg/l, a VFA content of greater than 70 mg/l as acetic acid and readily biodegradable substances of greater than 120 mg/l, has been successfully treated in the Johannesburg three and five-stage Bardenpho plants, to give an effluent having very low concentrations of both orthophosphate (less than 1,0 mg o-P/l) and total nitrogen (less than 5,0 mg N/l).

The production of volatile fatty acids either by fermentation in the primary sludge tanks, or by the fermentation of primary sludge in high rate anaerobic digesters operated in a batch mode, is examined. In both cases it was necessary to maintain a sludge retention time (SRT) of three to four days and to ensure that the VFA's produced were not converted to methane.

High rate digesters were found to produce roughly equal quantities of acetic and propionic acid, whereas more acetic than propionic acid was produced in the primary sedimentation tanks (PST's). Furthermore the mass of total volatile fatty acids produced in the off-line digesters was far less than that produced in the PST's, where the more desirable acetic acid predominated.

Fermentation of sludge in the PST's became the routine method for VFA production. The VFA's produced by this process tend to remain adsorbed to the sludge under hydraulically static conditions and must be elutriated into the liquid phase if they are to serve any useful purpose in the activated sludge reactor.

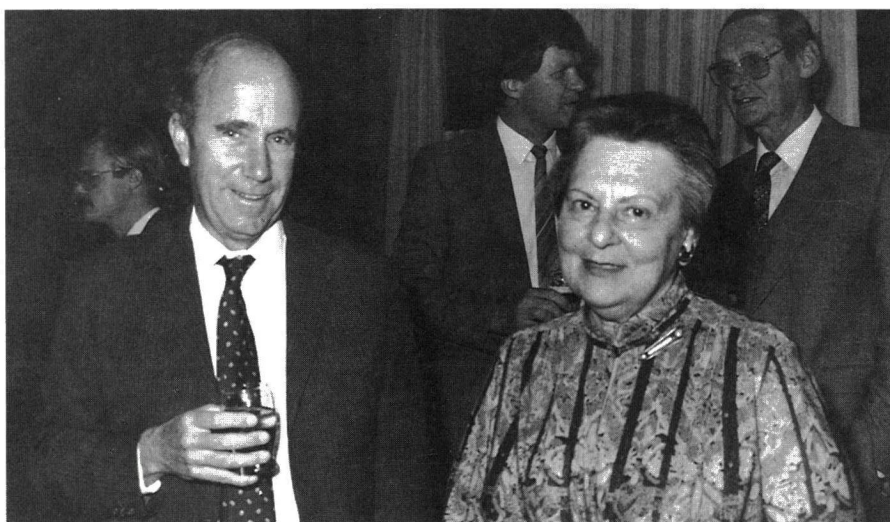
A number of elutriation regimes incorporating recycling of the sludge back to the inlet of the sedimentation tanks, were examined. Phosphate removal was improved by this procedure. However, consistent compliance with the effluent standard was not achieved. Intermittent air lancing of the sludge in the PST's combined with recycling was found to give very good results.

During summer, the best results were obtained when sludge was accumulated for 24 hours, airlanced for 30 seconds three times during the next 24 hours, and finally stored for a further 24 hours. The effect of the lower winter temperature on the above procedure, still requires investigation. Raw sludge gravity thickeners with elutriation facilities can also be used for this purpose.

DENITRIFICATION

Experience in Johannesburg (and elsewhere), has shown that when dealing with predominantly domestic sewage containing limited amounts of naturally occurring readily biodegradable substrate, it is essential to limit the presence of nitrates in the anaerobic zone to an absolute practical minimum. This will ensure that the readily biodegradable substrate is made available to phosphorus accumulating bacteria and is not utilised by denitrifying bacteria.

To assist in achieving this objective, one 50 Ml/d module at the Northern Works was converted to three-stage operation by eliminating the second anoxic zone. The original anaerobic zone was enlarged however, and compartmentalised in such a way that the returned sludge could be



held and denitrified under endogenous conditions (i.e. no sewage added), in the first few compartments. This modification became known as the Johannesburg Process. The successful operation of the plant under these conditions is highly dependent on having a sludge with a low SVI, thereby permitting high concentrations of returned sludge to be held in the newly created anoxic zone ahead of the bioreactor. Under such circumstances, the concentration of denitrifiers is likely to be about twice that present in conventional anoxic zones. The modification appeared to confer additional stability on the biological removal of phosphorus over an extended period.

Experience in Johannesburg has shown that up to 10 mg N/l nitrate can be removed from the return sludge in such a zone at retention periods varying between 0,5 and 2,0 hours.

Mr Harold Nicholls (left) and Mrs Leah Melmed

AERATION

It has been demonstrated that aeration has a marked effect on nutrient removal processes. Aeration levels should be such to maintain DO levels of at least 2 mg/l throughout the aerobic stages. This is particularly necessary at the initial entry to the aerobic zone, as phosphorus uptake is extremely rapid at this point. Excess aeration toward the end of the aeration zone should be avoided however, as excessive nitrification will occur, and increase the denitrification requirements of the process.

Experience in Johannesburg has shown that the rectangular aerobic zones in nutrient removal plants are not as completely mixed as was first thought, despite the large volume of mixed liquor being recycled through them. Semi-plug flow conditions can exist in these zones, leading to a distinct respiration rate profile along their length. Such zones should therefore have a tapered aeration system with more aeration capacity available at the inlet, than at the outlet of the zone.

ON-LINE MONITORING

The monitoring of effluent phosphate levels on-line has proved useful in the comparison of different process configurations. These data will also be utilised to calculate chemical dosage where this is required to achieve compliance with the effluent standard.

A number of methods of collecting and processing the data from on-line analysers were investigated.

The prediction for the future is that a number of Programmable Logic Controllers (PLC's) will be placed at strategic points in the plant to collect data from monitors. The data will be accessed and processed by a central computer, which will provide the plant manager with up-to-date operational data.

MICROBIOLOGICAL STUDIES

Microthrix parvicella and filament types 0041 and 0092 were identified as the main causative organisms in scum formation and sludge bulking in the Northern Works activated sludge plant. Bulking caused by these organisms can be controlled by adequate aeration. Bulking problems have never been experienced at the diffused air plants at the Bushkoppie Works. Different types of filaments were observed in this

plant, as compared to Northern Works. *Acinetobacter spp* dominated the phosphorus removing organism population in the aerobic zones under the test conditions applied.

The effect of microbial metabolism on effluent phosphate levels can be readily monitored by microscopic evaluation. While microscopic evaluation provides a useful tool for the general health of the plant, it is not suitable as an absolute operating parameter.

Comparison of different media for the isolation of activated sludge show that these give varied population compositions, as is expected. It is therefore, not possible to compare the population studies of some researchers when different media have been used. The technique currently being used is beneficial in the study of the effects of operational changes on bacterial population.

A new identification system, namely, the Microbact Identification System, was shown to be more species specific and cost effective than the API system, and is now used routinely with a separate oxidase test.

These preliminary results have indicated that the phosphate releasing capacity test has potential as an easy, inexpensive technique, to predict deterioration in phosphorus removal.

Further work is required to ensure that this method can be utilised successfully in practice. This could provide a useful tool in supplementing biological removal with chemical addition.

BACTERIAL METABOLISM

A number of hypotheses incorporated in the current biochemical model of enhanced biological phosphate removal from activated sludge, were evaluated experimentally during this study. The main hypothesis, namely, that the process is controlled by intracellular metabolite levels rather than genetic selection, was found to hold.

The studies also showed that *Acinetobacter spp*, as an example of a polyphosphate bacterium, possessed strategies to absorb substrate under one unfavourable situation (i.e. anaerobic), and to use the stored substrate as an energy source under a second unfavourable situation (i.e. lack of external carbon), to absorb other essential nutrients like phosphate. The necessity for adequate aeration was also emphasized by these studies.

DEVELOPMENT AND REFINEMENT OF TECHNIQUES

During the execution of the Contract, methods for the routine monitoring of plant response parameters such as volatile fatty acids and readily biodegradable substances had to be refined. While these two parameters were successfully determined during the Contract period, some further requirements are required.

In attempts to gain further insight into the mechanism of enhanced biological phosphate removal, techniques were modified for the analysis of activated sludge mixed liquor. Subsequently, polyhydroxybutyrate was successfully determined in mixed liquor.

Attempts to determine activated sludge energy levels by analysis for ATP were unsuccessful.

Methods were successfully developed for the routine determination of volatile fatty acids and polysaccharides in sewage and activated sludge samples. A method for the determination of polyphosphate chain length was investigated, but which proved more difficult to use on activated sludge than anticipated, and requires further work.

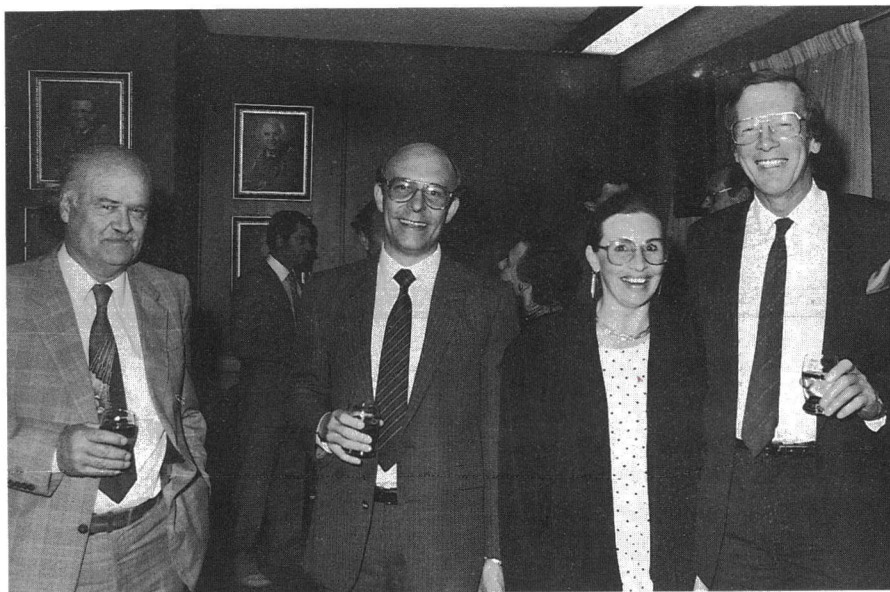
FUNDAMENTAL STUDIES: CHEMICAL AND BIOLOGICAL PHOSPHATE REMOVAL

In situ chemical precipitation as a removal mechanism in the activated sludge system has long been a controversial issue. These studies have shown that under conditions prevailing in Johannesburg plants, this is not a significant factor.

The efficient nitrification in the Johannesburg plants precludes the accumulation of ammonia which could serve as a nutrient for filamentous growth, and the correlation between nutrient levels and SVI values was not observed.

The additional effort and cost involved in the chemical analysis of extracellular polysaccharide compared to microscopic evaluation, is not warranted, as the former technique does not provide a more sensitive indicator of plant performance than the latter.

A satisfactory phosphorus fractionation procedure has been developed by the Division of Water Technology of CSIR, which will allow a more accurate estima-



From Left: Mr DP Marais, Mr G Offringa, Dr L Lötter and Dr J Barnard

tion of different biological phosphorus forms. These data will be useful in refining the biochemical model of the process.

Dehydrogenase activity is relatively easy to determine and its potential use in controlling aeration could be investigated.

A method for the routine determination of alkaline phosphatase activity in activated sludge has been developed.

FINANCIAL ASPECTS

A 50 000 Ml/d four-stage Bardenpho process with primary sedimentation and flow balancing, was used as a base for a paper study, to which a number of phosphate removal options were added. The cost of each option was then calculated, assuming the same unit electricity and chemical costs.

The introduction of an anaerobic zone and sewage character modification involves an additional cost of 1,60 c/kl, while the phosphate removal by chemical addition would incur an additional cost of 2,47 c/kl.

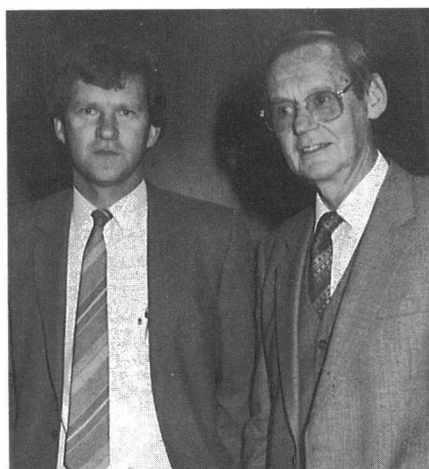
In contrast to the above, the retrofitting of chemical dosing equipment to a two-stage biological filter plant, would involve an additional 7,62 c/kl.

Although these figures may serve as a useful guide in decision making, they cannot be seen in isolation. Each individual situation must be evaluated on its own merits, taking other relevant factors into account. For example, the scrapping of a biological filter unit which has not been fully amortised, may not be an economical proposition.

MATHEMATICAL MODELLING

Until recently, the use of the general activated sludge model developed by the University of Cape Town, was confined to people with access to a mainframe computer. During this study, the model equations have been successfully applied to a spread sheet, used in conjunction with a micro-computer.

The use of this technique has permitted the sophisticated UCT model to become available to wastewater plant management staff, enabling them to observe the effect of a change in one parameter on other parameters, including effluent quality. This allows staff to make operational decisions with far greater confidence.



Mr J Duvenage (left) and Mr PGJ Meiring.

Sedimentation – A threat to Natal estuaries

Excessive sediment in both the Umhlatuze and Umfolozi rivers is adversely affecting the estuarine ecosystems and wildlife at Lake St Lucia and Richards Bay. At Lake St Lucia the original mouth has been blocked completely with sediment deposits. While at Richards Bay the whole estuary is in the process of silting up.

The WRC recently invited an overseas authority on river dynamics, Prof Gessler from Colorado State University, USA, to visit these areas. Prof Gessler was accompanied by Natal Parks Board and WRC officials as well as SA Waterbulletin.

Estuaries are transition zones between fresh water and marine habitats. The mixing of fresh and sea water in estuaries brings about a nutrient rich ecosystem (ecological system), which is unique rather than merely transitional. Nutrient rich organic material of terrestrial origin is deposited and accumulated here, providing an abundant food supply.

In particular estuaries serve as nurseries for coastal marine life. Here young marine life finds protection and a generous supply of food, going out to sea only when fully grown.

Very often these estuaries sustain endemic species of plants and other wildlife not found elsewhere. Lake St Lucia and Richards Bay estuary are such estuaries. On and around these estuaries an abundance of wildlife is found, the birdlife being particularly prominent.

A unique form of vegetation is found both at St Lucia and Richards Bay. Mangrove trees and mangrove swamps are a dis-

An Estuary ... is a semi-enclosed coastal body of water which has a free connection with the open sea; it is thus strongly affected by tidal action, and within it seawater is mixed (and usually measurably diluted) with freshwater from land drainage.

(Odum, 1971)



A young mangrove tree growing in the intertidal zone at Richards Bay sanctuary. Note the sticklike aerial roots surrounding the tree.

tinctive part of tropical and subtropical coastal shallow water ecosystems. These unusual trees are sparsely distributed along the Natal coast, as far south as the Transkeian estuaries.

Mangroves are the only trees that tolerate the salinity of seawater and the anaerobic muds and silts on which they grow. Specialised aerial roots (pneumatophores), rising upward from the mud, provide the mangrove root systems with the necessary air. (Lenticells on the root surface function like pores that allow gaseous exchange of oxygen and carbon dioxide). Mangroves develop a shallow but quite extensive root system. The mangrove roots reduce tidal currents and protect the estuarine coast from excessive erosion. Extensive deposits of mud and silt around and between these upward rising roots may eventually cause the formation of islands or an extended estuarine coastline.

These mangrove roots, regularly flooded by the tides, create a special habitat for some of the estuarine life.

Amphibious fish, crabs and molluscs are the characteristic "mud-dwellers" of the mangroves swamps of southern Africa. These mud-dwellers are very well adapted to living in this half-wet, half-dry environment.

The little Mudskipper (*Periophthalmus* sp.) is one of the fascinating inhabitants of the

mangrove swamps. This unusual little fish is amphibious when fully grown and often sits on exposed mangrove roots and stems. It is insectivorous and commonly found at the seaward fringe of the mangroves and along puddles and waterways in the swamps.

Crabs are common in the mangrove swamps. Their numerous burrows in the mud amongst the mangrove roots indicate their abundance. Fiddler crabs (*Uca* spp.) are brightly coloured and very active on the muds. They are amphibious and feed on the plankton in the surface mud.

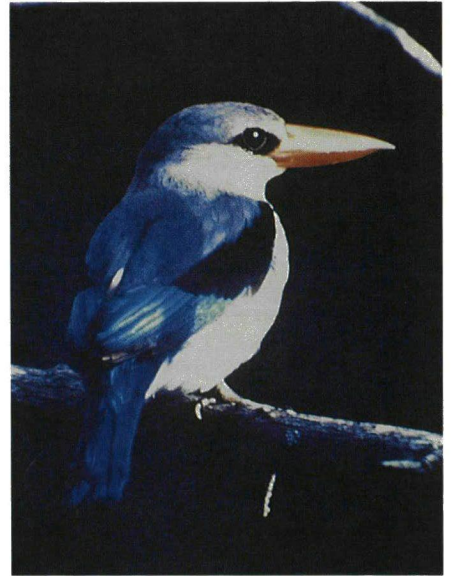
The sesarmid crabs (*Sesarma* and *Ilyograpus* spp.) are less colourful and shyer, preferring shaded areas less inundated by the tides.

A few mollusc species with tough, hard shells are also found among the mangroves.

The rare Mangrove Kingfisher is regarded as virtually exclusive to mangroves and estuarine habitats. This brightly coloured bird feeds mainly on small crabs and insects.

Other kingfisher species and herons are frequently found within these estuarine habitats at Richards Bay and St Lucia.

However, these estuaries with their unique wildlife features are clearly experiencing the influence of man and his activities.



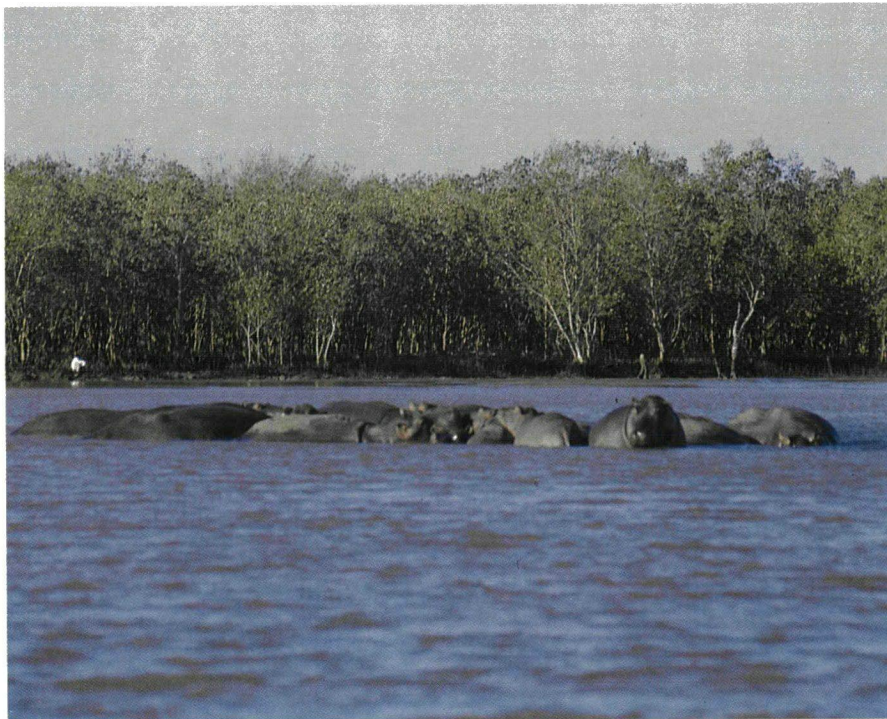
The rare mangrove kingfisher
(Photo: Geoff Lockwood).



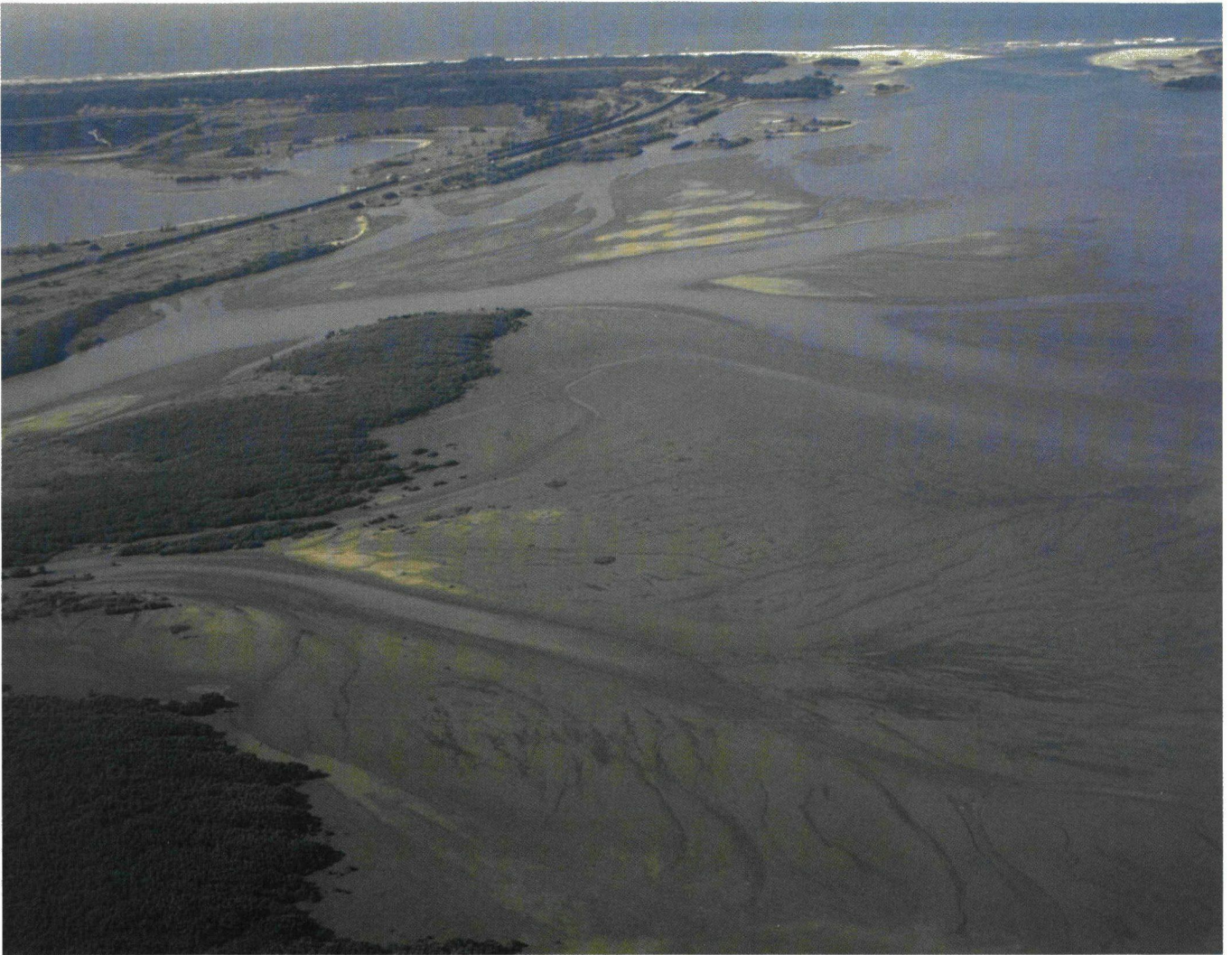
Two Mudskippers, one with a raised dorsal fin, sitting on a mangrove root. (Photo: Duncan Butchart).



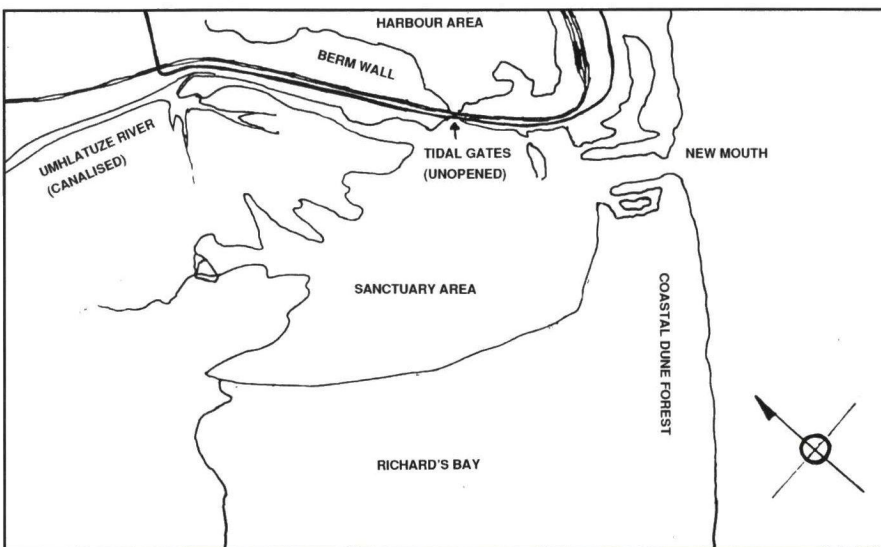
A sesarmid crab on the mud amongst mangrove roots
(Photo: Duncan Butchart).



BELOW: Hippos and mangroves (in background) at St Lucia.



Richards Bay sanctuary. The extent of sedimentation is clearly visible in this aerial view at low tide. To the left large stands of mangroves can be seen. The berm and just a corner of the harbour area can be seen in the top left corner. A railway and road run across the berm.



Disruption of the finely balanced ecological systems of nature cause unforeseen problems.

RICHARDS BAY

At Richards Bay part of the original large estuary has been converted into a deep water harbour. In the mid 1970's a berm was constructed across the estuary, dividing the estuary into the harbour on the one side and what is now known as the sanctuary on the other side. Fresh water flows into the sanctuary from the Umhlathuze river. The new opening to the sea was made for the sanctuary-estuary as the berm cut off the sanctuary from the original opening to the sea. The original opening is now being used as the harbour opening to the sea. The new mouth for the sanctuary-estuary was dredged through the dune system to allow seawater influx and tidal flow into the sanctuary area. There

is no major inflow of fresh water into the harbour as the Umhlatuze river flows into the sanctuary.

The Umhlatuze river has been canalised and carries quite a heavy load of sediment into this area. The sediment input, however, has been cut off from the harbour by the berm dividing the original estuary. The full load of sediment is now deposited in the sanctuary area. The extent of sedimentation and shallowness of the sanctuary is clearly visible on the aerial photo of the sanctuary.

Presently there are lovely stands of mangroves along the greater part of the estuarine coastline. The shallow, salty water of this estuary on the subtropical north coast of Natal being their specific type of habitat. New mangroves are establishing themselves on the newly created shallow and partly exposed mud banks in the estuary. These mud banks are the result of the huge amount of silt and sediment brought down by the Umhlatuze river and deposited in the sanctuary area.

It is believed that with the current rate of silting and sedimentation the sanctuary will eventually be silted up and become an extended land area with very little estuarine habitat left. The mangroves and their unique habitat will be lost to some other form of wetland.

Estuaries or an estuary mouth silting up is detrimental to the wildlife, as well as marine life, depending on this type of habitat as breeding ground and nurseries.

FARMING PRACTICES

A major factor contributing to the heavy silt and sediment load in Natal rivers is agricultural practices. Crops are planted on flood plains of the rivers and almost up to the river banks. This aggressive farming practise releases, rather than retains sediment. Riverine forest and vegetation have been destroyed, and along with the trees the stabilising effect of their root systems on river banks has also been removed. The only naturally effective anti-erosion factor along stream and river banks is the roots of well-established trees growing on the banks. The natural vegetation of riverbanks, river plains and swamps stabilises the soil and retains silt and sediment brought down by the rivers.

Not only Richards Bay sanctuary is being affected by agricultural practices but Lake St Lucia has also suffered from the results of agricultural practices.



Sugarcane farming next to the Umhlatuze river.



The meandering Umfolozi river, near St Lucia. Forested coastal dunes are visible in the background. The channel in the foreground is manmade.



The Umfolozi river channelised. Crops farmed here are mainly sugarcane.

LAKE ST LUCIA

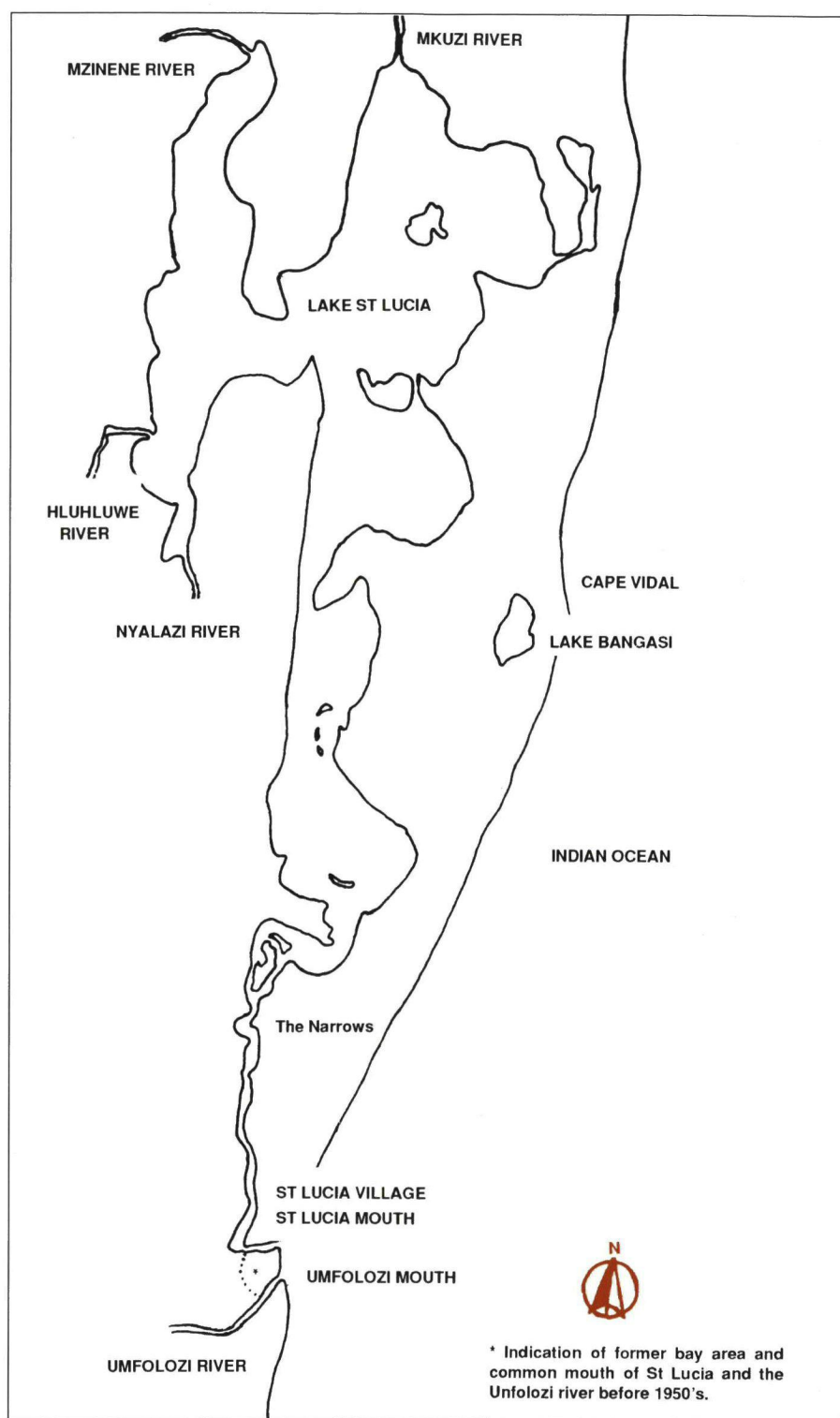
Lake St Lucia is the largest estuarine system in Africa. The lake is some 60 kilometres long with an average depth of less than one metre. St Lucia is a valuable ecosystem in terms of conservation, recreation, tourism and the economy.

The lake supports aquatic life and an abundant bird population, including fish eagles, pelicans, flocks of flamingoes and spoonbills as well as wild geese and many other bird species. Nyalas, reedbuck and warthog, amongst others, inhabit the area surrounding the lake. Hippos and crocodiles thrive in the lake. Large stands of mangroves are present in the lower reaches of the lake towards the estuary mouth. The estuary plays an important role in providing for a bounteous fishlife offshore.

Lake St Lucia needs both seawater and fresh water to sustain its rich wildlife. The sea influences all parts of the lake and some four rivers flow into the system at various points. The Umfolozi river used to be part of the system but as a result of sedimentation it no longer is. This change has a definite impact on the estuarine system during periods of drought.

During periods of extreme drought the lake becomes hypersaline. As a result of a high evaporation rate the water level of the lake tends to drop below sealevel and seawater flows into the lake. As evaporation continues salinity increases. In the upper reaches of the lake salinity increases to as much as three times the salinity of seawater. Most of the wild life cannot tolerate such salt concentrations. Animals, birds and fish move out of the system under such conditions, but when exposed to hypersalinity the plantlife dies off. The *Phragmites* reedbeds surrounding a large part of the lake can withstand drought but if their roots are flooded by hypersaline water they die. Plantlife takes a long time to recolonise after salinity levels have dropped.

Until the early 1950's Lake St Lucia and the Umfolozi river shared a common mouth. During dry periods a sandbank would form, shutting the river and estuary off from the sea. The river then flowed into the lake. Thus fresh water entered the lake system counteracting the effect of evaporation by diluting the salty water of the lake. Periods of hypersalinity are thought to have been less frequent and less severe.



In the early 1950's this changed when enormous amounts of sand and sediment were deposited in the common mouth of the river and the estuary, blocking the whole area.

The sand and sediment came from the Umfolozi catchment areas. The Umfolozi flats (i.e. the river floodplain and swamp) were drained for sugarcane farming. The

river was channelled in the process, disrupting the sediment retaining nature of the swamp. The river then deposited the sediment in the common mouth area.

Sediment from the catchment areas is the result of loss of wetlands, overgrazing and poor farming practices. Overgrazing causes erosion when rainwater carries off the denuded soil to the rivers, thus loading the



rivers with sediment. Not only is valuable soil lost and the ecology of these areas adversely affected, but the sediment is inevitably deposited elsewhere thus also affecting another ecosystem.

With the common mouth area completely blocked, new but separate mouths were dredged for the river and the estuary. The river flowing out to sea keeps its mouth open, but the estuary, not having the strong outflow of the river, now tends to become blocked with sediment from the ocean. The Natal Parks Board has the estuary mouth dredged continually to keep it open and to allow the inflow of seawater and marine life necessary to maintain the ecological equilibrium of the lake.

Extraction of water from the rivers for irrigation purposes also affects the ecosystems of Richards Bay sanctuary and Lake St Lucia. It causes a reduction of fresh water inflow, which is a vital part of these estuarine systems.

Sedimentation in estuaries is a symptom resulting from bad management of inland catchment areas as well as the loss of wetlands in the ecosystem of rivers. Rivers are dynamic transport systems in nature. When soil enters this transport system it is inevitably carried downstream and deposited elsewhere.

In the river ecosystem swamps and swamp vegetation act as filters which retain sediment. When swamps are drained and the rivers canalised, sediment is carried further and deposited elsewhere, be it at sea or in the quiet waters of an estuarine bay.

It has happened at St Lucia and is happening at Richards Bay. These estuaries are suffering from the myopia of man, disrupting nature's systems, without restraint. Scientists are monitoring and trying to manage these situations as best they can. Once lost, these estuaries and their wildlife can never be restored.

ABOVE: Lake St Lucia: birds and a reedbed on an island. Note the forested coastal dunes separating the lake from the sea in the background.

Reference: Odum, Eugene P. 1971. Fundamentals of Ecology. Third edition. WB Saunders Company, Philadelphia.

AQUATIC ECOTOXICOLOGY FOR ENVIRONMENTAL PROTECTION

- WHAT'S IT ALL ABOUT?

by Andrew C Jarvis

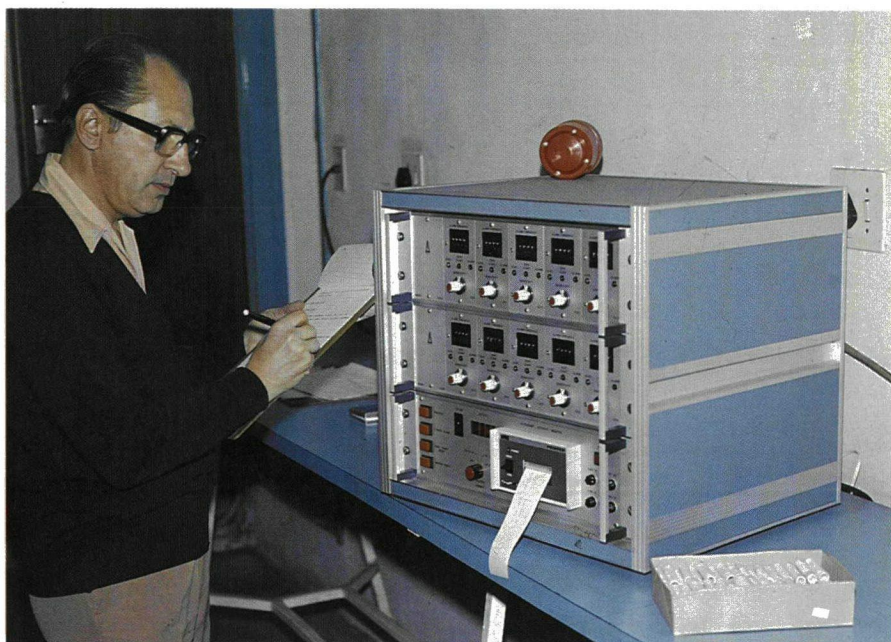
WHAT ARE ECOTOXICOLOGY AND THE AIMS OF ENVIRONMENTAL TOXICITY TESTS?

Aquatic ecotoxicology is a multidisciplinary and applied science that examines the adverse effects of chemical pollutants on the living organisms in our lakes and rivers. The goals of ecotoxicology are to:

- ☐ identify chemicals that impair water quality and are detrimental to the environment and aquatic life;
- ☐ predict chemical concentrations that are either safe, or concentrations at which negative impacts occur to plants and animals;
- ☐ support water resource managers in the setting of water quality standards and the safe allocation of effluent discharge loads;
- ☐ form part of any monitoring system aimed at protecting the quality of our open waters where chemical pollution is possible.

Aquatic ecotoxicology tests examine the toxic effects of chemicals on aquatic organisms. These toxic effects may be severe (acute effects) such as lethality or mortality, or these effects may be sublethal (chronic or subchronic effects). Sublethal effects are less obvious, but can have serious consequences such as failure to produce viable offspring, or may promote detrimental and irreversible changes to the organisms physiology, histology and behaviour. These deleterious effects on

24-SA Waterbulletin Junie/ Julie 1989



The Division of Water Technology, CSIR, has experience and facilities for the toxicity testing of portable and other waters.



The effects of chemical pollution can be lethal on aquatic organisms.

aquatic populations can reduce their ability to compete and survive and so may upset the ecological equilibrium and reduce the species diversity of our aquatic systems. Aquatic toxicity tests can tell us when a body of water is 'safe' or 'clean enough' for its intended use. In terms of criteria for environmental protection this means safe for the naturally occurring flora and fauna.

WHAT ARE AQUATIC POLLUTANTS AND WHERE DO THEY COME FROM?

Potentially harmful or toxic substances can enter the aquatic environment from a number of sources. Direct or point sources include discharges of domestic sewage and a variety of industrial effluents. Pollutants also enter surface and underground waters indirectly (nonpoint sources) via runoff from urban and industrial areas, leachate from domestic and toxic waste dumps and mining operations, accidental spillages, atmospheric deposition (acid rain), and through the release of agricultural chemicals, pesticides and herbicides (biocides).

Pollutants entering our water resources are either inorganic or organic in chemical nature. Inorganic pollutants typically include acids and alkalis from industrial and mining sources, nitrogen and phosphorus which lead to eutrophication, metals in various dissolved or bioavailable forms, and other industrial by-products and wastes such as cyanide and sulphite. The variety and types of organic pollutants are increasing annually as a result of man's activities. Over 2000 organic anthropogenic compounds have been detected in water supplies as our analytical techniques become more sensitive. Many of these, particularly the hydrocarbons, halogenated compounds and biocides, are known to produce adverse effects.

Hydrocarbons arise from oil and fuel products and their incomplete combustion. They can accumulate, especially in sediment, and can be carcinogenic (e.g. polycyclic aromatic hydrocarbons). The halogenated hydrocarbons may also be carcinogenic (e.g. chloroform arising from chlorination) and may accumulate in aquatic organisms. Of particular concern is the release of polychlorinated biphenyl (PCB) which is both toxic and very persistent in the aquatic environment. Biocides exist in a wide variety of forms. They enter the water as

runoff from agricultural land, crop spray drift, careless spillage and disposal of pesticide and herbicide containers, or as runoff and effluents from biocide manufacturing industries. Many biocides, particularly the chlorinated hydrocarbons (e.g. both DDT and dieldrin) are persistent in the environment, can accumulate within organisms (bio-accumulation), and may be concentrated along the food chain (biomagnification).

The toxicity of a chemical compound is a function of its concentration and the duration of exposure of the aquatic organism. Information about the biological processes and mechanisms affected and the local conditions prevailing during exposure is also important. Similarly, the properties of the chemical compound can provide insights into the pathways of the aquatic environment through which the compound will move, the part of the ecosystem at risk of greatest exposure, and the toxicant's form and bio-availability (dissolved, adsorbed or incorporated and accumulating in the biota).

The long term toxicity of a chemical is also a function of its persistence and ability to accumulate in the aquatic environment. Chemicals may be transformed by biotic and abiotic processes and so their persistence may be expressed as a 'half-life'. Once incorporated into aquatic organisms the chemical may also accumulate in the organisms tissue and be excreted at varying rates. This excretion rate can also be expressed as a 'half-life' of persistence within the organism or tissue.

WHAT ARE THE INFORMATION REQUIREMENTS AND OBJECTIVES OF ECOTOXICITY TESTS?

Ecotoxicity testing is crucial in providing the information required for protecting the aquatic environment from harmful discharges. A measurement of toxicity most frequently encountered in laboratory toxicity testing is the concentration (dose) - response relationship between the toxicant and the test organisms. In establishing this relationship the three basic components to be assessed are the quantity or concentration of the toxicant, the duration of exposure and the severity of the effect or response. This relationship is the central concept in aquatic environmental toxicology and is based on the assumption

of direct causality between the chemical and the observed effect, and between the response and the chemical concentration.

The duration of exposure of an organism to a toxic chemical may be short (acute) or long (chronic). During acute exposure tests the chemical may be delivered in a single dose or as multiple doses within a short period. Chronic and subchronic tests generally use low concentrations of chemicals with continuous or periodic exposure over a longer duration. These tests can cover the organism's entire reproductive cycle, or may involve the early life stages of the organism (embryo-larval or egg-fry tests).

The early developmental stages and young of many organisms are often more susceptible than adults to toxicants, usually due to their underdeveloped excretion and detoxification systems. This sensitivity of early life stages is often overlooked so the full impact of chemical agents on the aquatic environment can be underestimated unless early life stage tests are performed. Furthermore, some chemicals may be highly selective in the type of cells or tissues that they harm, or they may even be species-specific in their selective activity. This selectivity can limit the predictive values of some single-species toxicity tests by invalidating the extrapolation of results to other species.

The severity of the response over a defined duration in toxicity tests is generally a function of the concentration of the test chemical. Usually there is also a threshold value at a particular concentration below which no harmful response will be observed (the no-effect-level). At high chemical concentrations the mortality or lethality of a toxicant over a specific time is another criterion used for toxicological evaluation by short-term or acute tests. These tests are used to determine that concentration at which 50 per cent mortality of the test population occurs within a specific duration (LC50). This is often the starting point when determining the toxicity of a new chemical to aquatic organisms. When an effect other than mortality is examined, such as behavioural or physiological changes, then the EC50 or median effective concentration is measured.

As indicated above, a variety of toxicity tests can be used to evaluate the harmful effects of chemicals on aquatic organisms. The information that these tests provide can be used to assess the level of environmental 'safety' of a toxicant based on the associated risks judged to be acceptable.

CURRENT TOXICITY TESTS

A member of standard toxicity tests exist that answer a variety of questions. To be accepted by the scientific community, these tests must be realistic in toxin concentration and exposure duration, and should be sensitive and repeatable in different laboratories. The tests should also be sensitive to the effects of a range of chemicals on a variety of test organisms.

Toxicity screening tests exist that rely on enzyme or microbial organisms to non-specifically detect the presence of high concentrations of hazardous substances. This provides us with a warning of unsafe conditions. These rapid response tests can either be carried out directly in the field or in the laboratory and they can provide answers within minutes or hours. These screening tests can then be followed by more sensitive single-species tests which determine acute, chronic, or early life stage effects. Such single-species tests can provide a lot of information on lethal and sublethal effects of both the chemical concentration and exposure duration on the test organisms (cause and effect relationships). These LC50 and EC50 tests are usually carried out using a fish such as trout or an invertebrate such as *Daphnia*. Although single-species tests are very valuable they do not account for variations in response and the adaptations that occur in natural populations; nor do they simulate the complex interactions between species and their variable environmental conditions. Multispecies and ecosystem toxicity tests address these limitations of the single-species test.

Using laboratory microcosms or isolated natural ecosystems such as ponds, the influences and interactions of both the biota and the physical conditions are more realistically simulated by multispecies and ecosystem tests. However, due to the complexity of biotic and abiotic interactions and the number of uncontrolled variables present, the results often require complex interpretation and the tests are difficult to standardize and reproduce.

Biomonitoring systems have been developed which can continuously provide information on the presence or absence of hazardous substances. A continuous and automatic biomonitoring system has been developed locally. This system relies on the physiological and behavioural responses of sensitive fish. When toxins are present and the fish become stressed, this electronic system gives us an immediate warning of dangerous pollution levels by recording changes in the respiration rate,

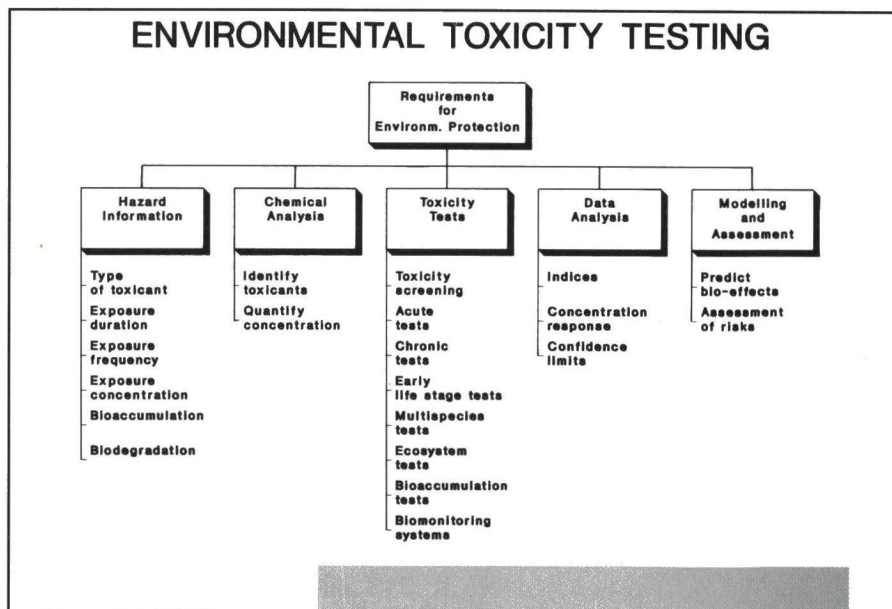
heartbeat rate or movement patterns of the fish. Such systems have already been employed by some local industries to continuously monitor and control their effluent discharges into rivers.

For environmental toxicity tests to be appropriate and to give meaningful results, the test organisms used must also be appropriate. These organisms should be widely available and of uniform genetic make-up, previously well-studied, routinely used and reared in many laboratories, and they should be adequately sensitive to a broad range of toxins. In multispecies and ecosystem tests the test organisms should also be representative and ecologically important in the local ecosystem under question. The toxicity tests performed should also be uniform and adhere to standard procedures so that replication is possible and comparisons may be made with published information. Such accurate and standard procedures are important for the acceptance of test results by the courts when disputes are contested and legal action is being taken, or when

products require registration, or permits for waste discharge are required and environmental impact assessments are required. The Division of Water Technology, CSIR, has experience and facilities for the toxicity testing of potable and other waters and also possesses the extensive scientific expertise necessary for interpretation of results and assessment of environmental impacts.

The fact that potable water must be safe for human health is never questioned, but what is 'safe enough' for our open waters and the wildlife that they support? An environmental toxicity testing service can provide answers to questions concerning safe levels of chemicals in waste discharges or the likely impacts of accidental chemical spills that can threaten our natural aquatic ecosystems.

It is important to remember that 'conservation' is recognized as a 'legitimate user' of water. Therefore, the commonly-used concept of 'safe' levels of pollutants requires careful development. |||



Environmental toxicity testing

Aquatic ecotoxicology tests are usually carried out using fish



ADDRESSES OF SANCIAHS MEMBERS



DROP US A LINE

The secretary will welcome contributions for this page from SANCIAHS members

The Secretariat of SANCIAHS maintains an address list of registered members, mainly for the purpose of mailing relevant information to them.

The last time that information was mailed to members a large number of letters have been returned to us marked: "Left, return to sender".

It would be appreciated if anyone could help us locate these members if at all possible.

Mr D Brough
PO Box 8509
EDENGLLEN
1610

Mr AC Johnstone
Webb & Partners
PO Box 1856
DURBAN
4000

Miss IM Masche
Department of Water Affairs
Private Bag X13193
WINDHOEK
9000

Mr AH Wright
Gold Fields of South Africa
PO Box 723
MARBLE HALL
0450

Mr HJ Lubbe
Nampak Liquid Packaging
PO Box 1911
EAST LONDON
5201

Mr CAJ Burger
Knight, Dames & Moore
PO Box 1076
RIVONIA
2128

Mr R Robertson
Murray, Biesenbach & Badenhorst
PO Box 509
GRAHAMSTOWN
6140

Mr TM Curtis
PO Box 450
PRETORIA
0001

Dr GN Bakkes
Institute for Groundwater Studies
University of the OFS
PO Box 339
BLOEMFONTEIN
9300

Mr G Grundling
NUCOR (Pelindaba)
Private Bag X256
PRETORIA
0001

Mr RJLC Drews
NIWR
CSIR
PO Box 395
PRETORIA
0001

Mr HNF Pells
c/o Development Bank of SA
PO Box 784433
SANDTON
2146

Mr CN Waller
SASISCO
PO Box 78642
SANDTON
2146

To prevent this state of affairs I want to appeal to members to notify the secretariat of any changes of address when you move.

ARE YOU INTERESTED IN WATER MATTERS?

Registration forms to become a member of SANCIAHS are available at the secretariat. Registration is free!

We are interested in the following categories of members:

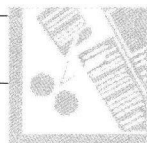
- ☐ Student
- ☐ Teacher/lecturer
- ☐ Full-time research officer
- ☐ Practising hydrologist
- ☐ Hydrological technician
- ☐ Manager
- ☐ Retired but interested
- ☐ Hydrology a minor component of your job

FOURTH HYDROLOGICAL SYMPOSIUM 20-22 NOVEMBER 1989, PRETORIA

It gives me pleasure to announce that Prof DH Pilgrim of the School of Civil Engineering, University of New South Wales, Australia has accepted an invitation to be our guest speaker. He is an expert on floods and was Editor-in-chief of the publication: "Australian Rainfall and Run-off, a guide to flood estimation".



From your secretary,
Hugo Maaren



AQUATIC ECOSYSTEMS

RESEARCH OPPORTUNITIES IN THE KRUGER NATIONAL PARK

The water resources of some of the perennial rivers draining eastwards through the Kruger National Park (KNP) into Mocambique are barely adequate to meet existing demands. Of concern at present, is the issue of allocating water in a rational manner to the numerous economic user sectors within these catchments. The KNP, one of the world's foremost conservation areas and an important contributor to the country's tourist industry, is recognised as one of these user sectors to which water must be allocated. However, the managers of water resources have recognised that South African knowledge and expertise in assessing minimum flow requirements of river systems is at present far too limited for concrete decisions to be made on water allocations to the KNP rivers as demands for water increase.

In March 1987 the Department of Water Affairs convened a workshop at which the water requirements of the KNP were discussed. The workshop concluded that relationships between water availability and ecosystem quality and functioning were almost completely lacking. It was therefore motivated that a cooperative multidisciplinary research programme should be urgently initiated. A small group of specialists subsequently met to develop a document which incorporated the philosophy, goals and objectives of such a programme.

A document containing a programme framework was submitted to the executives of certain Government and statutory agencies (Water Research Commission, Department of Water Affairs, Department of Environmental Affairs, National Parks Board and CSIR) who unanimously supported the concept of initiating a full-scale research programme on assessing the water requirements of the KNP. This notice announces to the South African scientific community details of the developing programme as a means of soliciting input and support from interested parties.

GOALS OF PROGRAMME

To develop the means to predict the impact on KNP river systems of changing flow regimes and water quality as the

basis of a protocol for managing the allocation of water for ecological purposes.

OBJECTIVES

- ☐ Define and evaluate scientific information pertinent to the allocation of water to the Kruger National Park
- ☐ Develop the appropriate expertise for managing water allocation for ecological purposes
- ☐ Develop and maintain the necessary inter-institutional cooperation and communication
- ☐ Define and initiate research in priority areas
- ☐ Secure and make recommendations on funding requirements
- ☐ Ensure the appropriate documentation of research findings

PROGRAMME STRUCTURE AND ADMINISTRATION

The programme is coordinated by a committee of executives of the Foundation for Research Development, Department of Water Affairs, Department of Environment Affairs, National Parks Board and the Water Research Commission.

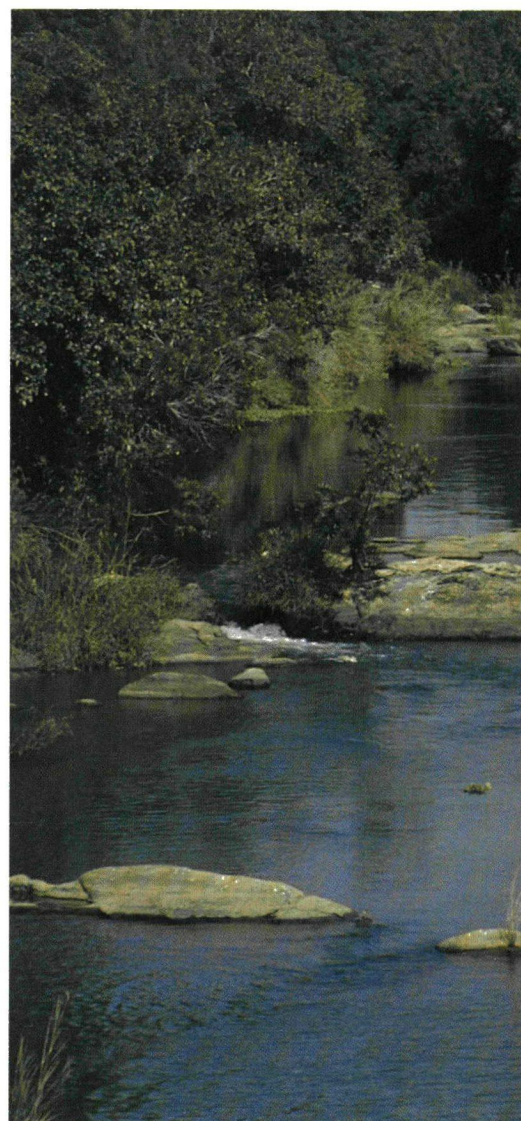
It is managed by a working group of specialists. The working group will be concerned with planning the programme, implementing management actions and coordinating activities. The group will meet on a regular basis as needed.

RESEARCH PRIORITY AREAS AND OPPORTUNITIES FOR SCIENTISTS

The working group, following suggestions made by a wider community of scientists, has compiled a list of some thirteen research priority areas. These are as follows:

Water availability

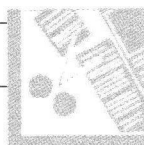
- ☐ Evaluation of groundwater resources within the KNP



- ☐ Evaluation of historical discharges for rivers flowing into the KNP.
- ☐ Development of relationships linking catchment rainfall, discharge and channel processes.
- ☐ Evaluation of the hydrological network.

River characteristics

- ☐ Assess the physical characteristics of each river, viz morphology, sediment type and geology.
- ☐ Assess the habitat structure of the riparian zone and the probable response of riparian communities to changing river flow regimes.
- ☐ Record the structure and composition of the invertebrate and vertebrate fauna associated with the riverine environment.



- ☐ Assess the habitat requirements of key invertebrate and vertebrate fauna associated with the riverine habitat and identify species which require further study.
- ☐ Identify the key processes and their probable response to changes in flow and quality.

Water quantity requirements

- ☐ Assess the total consumptive and non-consumptive biotic water requirements.
- ☐ Assess the proportion of water required for evapotranspiration, evaporation, soil moisture and deep ground water recharge.

Water quality

- ☐ Assess the existing water quality characteristics of KNP rivers and evaluate the current monitoring system.
- ☐ Assess the potential impact on the quality and quantity of water entering the KNP from various categories of human activities in the catchment.

For further information please contact:

**Dr P Reid, Programme Manager,
Water Research Commission,
PO Box 824, PRETORIA, 0001, RSA**

ANNOUNCEMENT:

SOUTHERN AFRICAN SOCIETY OF AQUATIC SCIENTISTS

The Limnological Society of Southern Africa has recently metamorphosed into the Southern African Society of Aquatic Scientists in order to attract a wider membership which will embrace both estuarine and marine aquatic scientists.

The mandate to broaden the base of the Society came from the Jubilee Annual General Meeting held at the University of Pietermaritzburg during July 1988. Since then, the Executive Committee of the Society has altered the Constitution of the Society, has canvassed limnological membership and has received very positive support for this change in direction.

The broadened Society has the potential to represent the interests of limnologists, hydrologists, estuarine and marine scientists, as well as aquaculturists and water resource managers. In addition, the Society is in the position to act as a vehicle for exchange of information between aquatic scientists and managers throughout Southern Africa.

The Society is there to act on your behalf, no matter the degree of salt in your ecosystems!

JOIN US

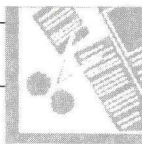
The Executive Committee encourages all marine, estuarine, and inland waters ecosystem researchers, aquaculturists, hydrologists, water resource managers, and water resource engineers to join us in the formation of a vigorous and active Society which speaks in one voice for the continued development of sound research and management of Southern Africa's aquatic resources.

The current Executive of the Society resides in the Department of Zoology, University of Cape Town, Rondebosch, 7700.

Please write to the Honorary Secretary at this address applying for membership which will entitle you to Southern African Journal of Aquatic Sciences, a regular Bibliographic compilation and all rights of membership.

Join us now as we take this new direction!

PROFESSOR BR DAVIES
University of Cape Town
EXECUTIVE PRESIDENT



TUKKIES WOEL MET AFVALWATERNAVORSING

Die Afdeling Waterbenuttingsingenieurswese van die Departement Chemiese Ingenieurswese is op 'n breë front besig met projekte vir die verbetering van uitvloeiselkwaliteit, herwinning van grondstowwe uit afvalwaters en die meer sinvolle hergebruik van water. Die personeel, prof At Pretorius, prof Hans van Leeuwen, mnr Johann Botha en hulle nagraadse studente doen veral navorsing op biotegnologiese en fisies-chemiese behandeling van afvalwater en op waterherwinning. Die projekte word finansieel deur die Waternavorsingskommissie, plaaslike owerhede en die nywerheid gesteun. Beide professore is deur die stigting vir Navorsingsontwikkeling geëvalueer en vind ook toenemende steun uit hierdie bron.

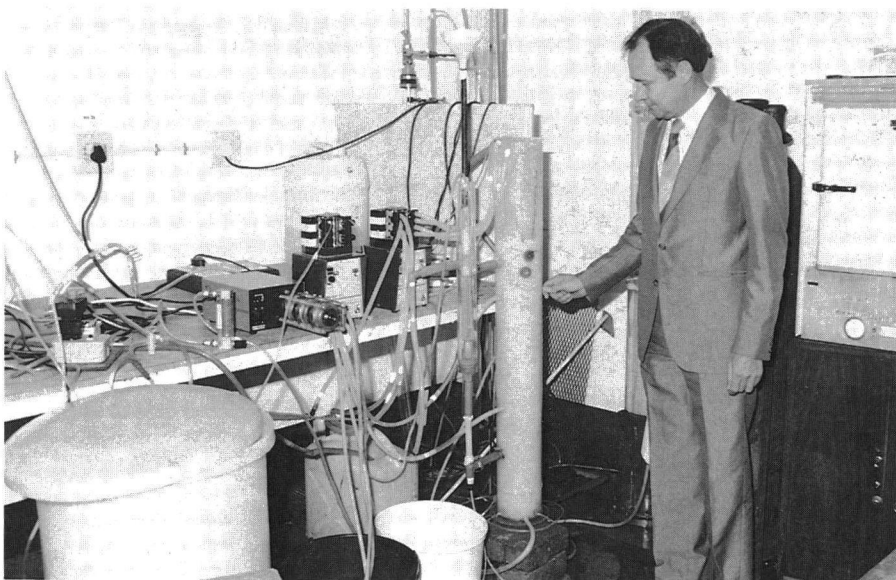
Daar word heelwat navorsing gedoen op die herwinning van proteïene uit afvalwaters. Fisiese seleksiemetodes, soos siwwe, maak dit moontlik om die fungus *Geotrichum*, met 'n hoë proteïeninhoud te kweek op oliesintese- en papier- en pulpafvalwaters terwyl daar gewone suiwing van die afvalwater plaasvind. Suiker- en ook ander afvalwaters gaan nog as moontlike voedingsbron vir proteïenproduksie ondersoek word. Proteïenproduksie op oliesinteseafvalwater word reeds nou op 'n R1 miljoen loodsaanlegprojek ondersoek.

FOSFAATVERWYDERING

Die Afdeling doen tans ook navorsing oor die verbetering van rioolsuiweringsprosesse. Fosfaatverwydering met behulp van elektrolities geproduseerde ferri-ione word ondersoek. Dit lyk na 'n baie ekonomiese proses en lei nie tot 'n soutvrag soos die gebruiklike ferrichloried of -sulfaat nie. Daar word ook 'n ondersoek gedoen na fosfaatverwydering met kalk in 'n korrelbedreaktor en na grondliggende verbeterings in suurstofoordrag gedurende belugting. 'n Volskaalse ondersoek na slykuidtydingsbeheer met osoon en waterstofperoksied gaan gedurende 1990 aanpak word.

AFVALWATER

Daar word sterk klem gelê op nywerheidsafvalwatersuiweringsprojekte wat in sa-30-SA Waterbulletin Junie/ Julie 1989



mewerking met die nywerheid aangepak word. Behalwe die reeds genoemde proteïenherwinning word daar ook gekyk na verbeterde fisiese skeidingsprosesse vir nywerheidstoepassing. Chemiese oksidasieprosesse met chloor, osoon en waterstofperoksied word ondersoek en in 1990 word waterbestuur en afvalwatersuiwing in die sorghumbierbrouerye onder die loep geneem.

Die toenemende watertekorte en die ongunstige waterbalans in die land kry ernstige aandag deur die betrokkenheid van die personeel by waterherwinningsprojekte. Voorts word aandag gegee aan verbeterde herbenutting van water in stedelike gebiede deur 'n uitgebreide lessenaarstudie en rekenaarmodellering van dubbele verspreidingsstelsels.

PUBLIKASIES

Die navorsingsuitsette van die Afdeling Waterbenuttingsingenieurswese oor die afgelope twee jaar word gereflekteer in die elf publikasies in internasionale vaktydskrifte en die tien referate wat by plaaslike en internasionale konferensies gelewer is. Die personeel ontvang ook gereeld uitnodigings vir samewerking vanuit die buiteland en hulle publikasies wek belangstelling uit alle oorde.

BEURSE

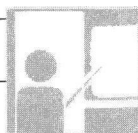
Deesdae is ruim beurse vir voltydse studie taamlik maklik bekombaar en daar is in die volgende jaar se projekte R25 000 per jaar

Prof At Pretorius kyk na een van die eksperimente wat in die laboratorium van die afdeling Waterbenuttingsingenieurswese by Tukkies uitgevoer word.

vir die betaling van elke voltydse magisterstudent begroot en meer vir doktorsale studente. Daar is nog een of twee projekte waarop daar posisies vir voltydse studente vakant is en belangstellendes moet so gou as moontlik vir professor WA Pretorius skakel (telefoon (012) 420-2198) of professor J van Leeuwen (telefoon (012) 420-2291). Studente wat self projekte wil voorstel, is ook baie welkom alhoewel dit nie altyd moontlik sal wees om op kort kennisgewing finansiering op dieselfde grondslag as die ander projekte te verkry nie.

HONNEURSGRADE

Die afdeling plaas 'n groot klem op gerigte opleiding op die honneursvlak en 'n persoon moet normaalweg reeds 'n honneursgraad agter sy of haar naam kan skryf alvorens toelating tot die navorsingsprojekte verkry kan word. Persone met 'n B Sc of B Ing graad sal ook oorweeg word op die voorwaarde dat die vakkursusse wat deur die afdeling aangebied word bygewoon en geslaag word alvorens die M-graad toegeken word. Meer inligting oor die vakkursusse wat aangebied word, is vervat in die brosjure wat in hierdie uitgawe van die SA Waterbulletin ingesluit is.



SOUTHERN AFRICA

SANCIAHS

The 4th South African national hydrological symposium will be held in Pretoria from 20 to 22 November 1989.

Enquiries: Mr Stefan Kienzle, Department of Water Affairs, Hydrological Research Institute, Private Bag X313, Pretoria 0001, RSA.

Tel. (012) 821100x 207

SAMSIG

A symposium organised by the South African membrane separation interest group on all aspects of membrane separation will be held at the Karos Wilderness Hotel from 22 to 24 November 1989.

Enquiries: Dr OO Hart, Water Research Commission, PO Box 824, Pretoria 0001

ANALYTICA '90

The first national symposium on analytical science - Analytica 90 - will be held from 18 to 23 March 1990 in Pretoria. The theme will be: Analytical technology in a developing South Africa.

Enquiries: The Chairman, Analytica '90, Department of Chemistry, University of Pretoria, Pretoria 0002, RSA. Tel. (012) 4202515.

IRRIGATION

A South African Irrigation Symposium will be held from 4 to 6 June 1991, at the Elangeni Hotel in Durban.

Enquiries: The organising Committee: Irrigation Symposium, PO Box 824, Pretoria 0001.

OVERSEAS

WATER SUPPLY

An international conference and exhibition on water supply and treatment: World Water '89 Congress, will be held from 14 to 16 November 1989 in London, UK.

Enquiries: Institution of Civil Engineers, 1 Great George Street, London SW 1 P 3 AA, UK.

TECHNOLOGY EXHIBITION

The third Asian Water Technology Exhibition '89 will be held in Kuala Lumpur, Malaysia from 27 to 30 November 1989.

Enquiries: International Conferences and Exhibitions Ltd, 29 Dering Street, London W1R9AA, UK.

EFFLUENT TREATMENT

A conference on effluent treatment and waste disposal will be held in Leeds, England, from 3 to 5 April 1990.

Enquiries: Conference Section, Institution of Chemical Engineers, 165-171 Railway Terrace, Rugby CV21 3HQ, England.

HYDRAULICS

The third international conference on hydraulic engineering software - Hydrosoft '90 - will be held in Boston, USA from 3 to 5 April 1990.

Enquiries: Liz Newman, Computational Mechanics Institute, Ashurst Lodge, Ashurst, Southampton SO4 2 AA, UK.

WATER TREATMENT

The first joint IAWPRC/IWSA conference will be held in Jönköping, Sweden from 24 to 26 April 1990. The theme will be: coagulation, flocculation, filtration, sedimentation and flotation in water and wastewater treatment.

Enquiries: Joint Specialist Group, International Water Supply Association, 1 Queen Anne's Gate, London SW1H 9BT, UK.

WASTEWATER

An international conference and exhibition concentrating on water and wastewater technology will be held in Barcelona, Spain, from 24 to 27 April 1990.

Enquiries: The organisers: Water and Wastewater '90, PO Box 125, Scotch Plains, NJ 07076, USA.

IRRIGATION

The 14th International Congress on Irrigation and Drainage will be held from 29 April to 4 May 1990 in Rio de Janeiro, Brazil.

Enquiries: The Secretary, International Commission on Irrigation and Drainage (ICID) 48 Nyaya Marg, Chana Kyapuri, New Delhi 110 021, India.

WASTE DISPOSAL

The IFAT 90-International Trade Fair for Waste Disposal will be held in Munich, FRG, from 22 to 26 May 1990.

Enquiries: Munchener Messe- und Ausstellungsgesellschaft, mbH, Messeglade, Postfach 12 10 09, D-8000 München 12, FRG.

WATER RESOURCES

The 8th international conference on computational methods in water resources will be held in Venice, Italy, from 11 to 15 June 1990.

Call for papers on modelling of groundwater, surface water dynamics, water quality, sedimentation, resource optimisation and computers.

Enquiries: Prof G Gamloti, Dipartimento di Metodi e Modelli Matematici, Università degli Studi, Via Belzoni 7, 35 131 Padova, Italy.

WATER RESOURCE SYSTEMS

A symposium on water resource systems application will be held in Winnipeg, Canada, from 12 to 15 June 1990.

Enquiries: International Symposium on Water Resources Application, Civil Engineering Department, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada.

IAWPRC

The IAWPRC's Biennial '90 international conference and exhibition on water pollution control will be held in Kyoto, Japan, from 29 July to 3 August 1990.

Enquiries: IAWPRC Biennial '90, 1 Queen Anne's Gate, London SW 1H 9 BT, England.

GROUNDWATER MODELLING

An international conference on calibration and reliability in groundwater modelling will be held in the Netherlands from 3 to 6 September 1990.

Enquiries: Modelcare 90, P O Box 30424, 2500 GK, The Hague, the Netherlands.

SAMSIG SYMPOSIUM

SA MEMBRANE SEPARATION INTEREST GROUP

The SA Membrane Separation Interest Group (SAMSIG) will hold its 1989 symposium at the Karos Wilderness Hotel from the evening of 21 November 1989, leaving after lunch on 24 November 1989. Official registration for the symposium is through Rennies Travel.

Tel: (012) 325-3800, fax (012) 323-2351, PO Box 1550, Pretoria 0001. A token attendance fee of R5 is payable at the symposium.

For additional information please phone Mrs Ralda de Wet, Water Research Commission (Tel: (012) 330-0340).

A meet and greet function will be held as from 19:30 on 21 November 1989.

WEDNESDAY, 22 NOVEMBER 1989

08:00-08:45 Registration

SESSION 1: CHAIRMAN: Mr GR Botha

08:45 - 09:00: Welcome and announcements: Mr PE Odendaal, Water Research Commission

09:00 - 09:30: Desalination needs in the RSA: Mr SAP Brown

09:30 - 10:00: Everything you wanted to know about membranes but were afraid to ask: Dr RD Sanderson

10:00 - 10:30: Tea/coffee

SESSION 2: CHAIRMAN: Dr EP Jacobs

10:30 - 11:00: Current membrane applications in the RSA - a resume': Prof CA Buckley

11:00 - 11:30: The role of the consultant: Mr GR Botha

11:30 - 12:00: Membrane systems design: Mr K Treffry-Goatley

12:00 - 12:30: The effect of manifold configuration on the performance of cross-flow filtration systems: Mr GE Rencken

12:30 - 14:00: Lunch

Afternoon free

SESSION 3: CHAIRMAN: Dr HNS Wiechers

18:00 - 18:30: Membranes in the chlor-alkali industry: Mr C Nice

18:30 - 19:00: Shopping for the right membranes: Dr EP Jacobs

19:00 - 20:30: Dine and Wine Poster session and product exhibit

THURSDAY, 23 NOVEMBER 1989

SESSION 4: Supplier's Forum: CHAIRMAN: Mr JAC Cowan

08:00 - 08:20: FilmTec: Mr B Trotter

08:20 - 08:40: Explochem: Mr K Treffry-Goatley

08:40 - 09:00: Portals: Mr TM Collins

09:00 - 09:20: Membratex: Mr DJC Nel

09:20 - 09:40: KMS: Mr M Kilaney

09:40 - 10:00: Novel methods of funding and operating of high-tech water and waste-water treatment plants: Mr EL Choritz

10:00 - 10:30: Tea/coffee

SESSION 5: CHAIRMAN: Mr GW Lok

10:30 - 11:00: Fluid dynamics in porous tubes: Mr VL Pillay

11:00 - 11:30: Preferential fouling - dynamic and supplementary coatings: Dr AJ van Reenen

11:30 - 12:00: Hydrous zirconium (IV) oxide and zirconium-poly-electrolyte membranes on porous stainless steel supports - the effect of modified substrate pore size on the flux and rejection characteristics of the membranes: Prof FG Neytzel-de Wilde

12:00 - 12:30: Membrane desalination of service mine water from gold mines: Dr HNS Wiechers

12:30 - 14:00: Lunch

Afternoon free

SESSION 6: Applications: CHAIRMAN: Prof CA Buckley

18:00 - 18:20: Smithchem: Mr DS Rosie

18:20 - 18:40: De Beers Industrial Diamond Division: Mr PJ Metcalf

18:40 - 19:00: Eskom: Messrs JD Aspden and DA Swanepoel

19:00 - 19:20: Atomic Energy Corporation: Mr S Kruger

19:20 - 21:00: Braai

FRIDAY, 24 NOVEMBER 1989

SESSION 7: CHAIRMAN: Mr GW Lok

08:00 - 08:30: Membrane systems and applications: Dr RD Sanderson

08:30 - 09:00: The prototype tubular filter press at Umgeni Water's HD Hill Water Works: an analysis of process data accumulated over more than two years: Mr GE Rencken

09:00 - 09:30: Die gebruik van ultrafiltrasie en tru-osmose in die suiwelbedryf: Mr AP Potgieter

09:30 - 10:00: Membrane treatment of abattoir effluents: Mr JAC Cowan

10:00 - 10:30: Tea/coffee

SESSION 8: CHAIRMAN: Dr RD Sanderson

10:30 - 11:00: Dynamic membranes for treating wool scouring effluents: Mr CH Steenkamp and Mr RB Townsend

11:00 - 11:30: Treatment of a fertilizer manufacturing process effluent with electrodialysis reversal: Mr JJ Schoeman

11:30 - 12:00: Future of SAMSIG: Group discussion

12:00 - 12:15: Summing Up: Mr PE Odendaal

12:15 - 14:00: Lunch