

Irrigation contract for Sovenga:

PIVOT, SCHEDULING STUDIED

'The adequacy of the Republic's water resources in years to come will largely depend on what savings can be achieved in irrigation farming.' This was said by Mr David van der Merwe, chief adviser at the Water Research Commission, when he signed a contract on behalf of the chairman of the WRC with the University of the North.

The research contract was officially signed at Sovenga on 26 June 1984 and pertains to a project entitled: 'Practical scheduling of irrigation in the Northern Transvaal'. The project will be undertaken on behalf of the Commission by the University of the North in collaboration with members of the Pietersburg Agronomy Study Group, the local agricultural extension office, the Division of Agricultural Engineering and Vetsak Irrigation in collaboration with the Noord-Transvaalse Koöperasie.

Mr van der Merwe said that the importance of irrigation research could not be overstressed since 75% of all South Africa's water resources were taken up by agriculture. He said that he welcomed the decision to involve farmers and farmers' study groups right from the start of the research programme which would establish scientific irrigation scheduling methods best suited to the irrigation practices of the region.

'It has been of great concern to us in the Commission that often

valuable irrigation research results, invariably obtained at great expense, do not make an impact on irrigation practice,' he said. 'By involving farmers directly, the chain of communication between the researcher and the farmer has been shortened — a very important requirement for successful technology transfer.'

Three departments of the University, viz Plant Production, Soil Science and Agricultural Economics will team up to undertake the project which will involve an investigation of the applicability of irrigation scheduling methods in the on-farm situation; the promotion of the use of scientific scheduling methods by involving farmer study groups in the research programme; and establishing scheduling criteria for automated linear and centre pivot irrigation systems.

It is generally agreed that centre pivot systems tend to lead to excessive water use by crops. At the same time, however, the frequent light applications often do not meet the water requirements of the crop, resulting in a steady depletion of moisture reserves from the deeper soil layers.

The crop often is left extremely vulnerable and even a short interruption of the irrigation programme due to breakages may cause com-



Mr David van der Merwe (centre), chief adviser at the WRC, and Prof PC Mokgokong (left) rector of the University of the North, sign the irrigation research contract whilst Prof MP Burgers, dean of the Faculty of Agriculture, looks on.

(To page 2)

☐ in
bulletin

● Technology transfer . . . 3, 4, 5 ● NATSURV . . . 6 ● Surface hydrology . . . 8 ● Grondwatervorsing . . . 11 ● Vloedbesproeiing en skedulering . . . 14 ● Graskarp in Germistonmeer . . . 16 ● Water Amendment Bill . . . 21 ● New books . . . 28 ● Equipment . . . 29 ● Water treatment in Switzerland . . . 32 HYDRO REPORTS . . . NEED ANY? Check insert!

00020111

SOVENGA

(From page 1)

plete crop failure. Any improvement in the management guidelines for these systems that would reduce or prevent such occurrences would therefore result in a tremendous boost towards more efficient usage of irrigation water.

In accepting the first instalment of the funds being made available by the Water Research Commission, the rector of the University, Prof PC Mokgokong said that the project could contribute a great deal towards more efficient use of one of the country's most strategic natural resources.

He said that the project was a truly collaborative effort and that it was bound to yield good results.

Professor M Burgers, the project leader, welcomed guests to the University and also stressed that the collaboration would benefit all involved in the project.



Some of the principals engaged in the irrigation research project inspecting the soil of the experimental site. From left: Messrs Ben Seyffert (heading irrigation at NTK), Dick Coetzee (NTK's Pietersburg branch), Prof Tienie Burgers (dean of Faculty of Agriculture), Messrs A Coetzee (heading VETSAK Irrigation), Dave Hickerson (Velmont International — Valley Irrigation Systems, USA), Dr George Green (senior adviser, WRC) and Messrs David van der Merwe (chief adviser, WRC) and Hennie Lombaard (director of administration, WRC).

Water technology seminar:

FRENCH EXPERTS SPEAK

Techniques developed by a number of French and USA companies in the fields of water exploration, management and treatment were presented at a joint seminar in Pretoria early in July. The seminar, *Some new advances in water technology*, was arranged jointly by the Water Research Commission and the French South African Trade Development Corporation (FRANSA).

Speakers from France and the USA provided the latest information on two different themes, namely water resources management and water supply control on the one hand, and water and effluent treatment on the other. The sessions were chaired by South African scientists and engineers.

In opening the seminar, the chairman of the Water Research Commission, Dr MR Henzen, said that the water technology and expertise of some of the world's most prominent water research countries were not very well known in South Africa's water industry. This was probably due to language problems. Enough was known, however, for South Africans to be

aware that high quality research and development of water technology were in progress in France.

Dr Henzen also said that one rarely had the occasion of meeting one's water research colleagues

from abroad and exchanging new ideas on advances in water technology. For these two reasons it had been decided that great benefit could be derived from a joint seminar.



Speakers at the FRANSA/WRC seminar with some of the organisers: From left: Dr J Gaillard, Dr G Dassonville, Mr Pierre Alla (all France), Mr RM Ahlgren (USA), Mr PE Odendaal (chief adviser, WRC), Mr H Castelnau (FRANSA), Dr E Siwertz (France), Dr MR Henzen (chairman, WRC), Dr P Roberts (senior adviser, WRC), Dr Y Richard and Mr F Fiessinger (both France).

Code for manure handling published

A Code of Practice for the handling of manure from intensive animal feeding units has been published by the Water Research Commission in collaboration with the Department of Agriculture.

The authors are Mr JW Funke, Water Research Commission, and Messrs JG Knoesen and JC Venter of the Division of Agricultural Engineering, Department of Agriculture.

The objective of the "Code" is "to provide sufficient background information and to show alternative solutions for the economic handling of large volumes of manure under local South African conditions".

According to the foreword intensive animal feeding units have become a vital link in ensuring a uniform rate of animal production for the world's growing meat markets.

"These units will grow in size and number and tend to be established at the perimeters of cities and large towns in order to take advantage of market proximity. This fact, unfortunately, aggravates the problems associated with the generation of large quantities of animal wastes at these units: waste quantities can range from 11 t per year per tonne of animal body mass for sheep to 33 t per year for dairy cattle or pigs.

"Apart from the obvious odour and health problems, these wastes, if improperly managed, can be a serious source of water pollution, especially in South Africa with its limited water supplies. Effective waste management is, therefore, not only a matter of con-



cern to agriculture generally, but also to water supply authorities specifically.

"For these reasons the Water Research Commission and the Department of Agriculture collaborated in the production of this "Code of Practice". The content is based on an extensive literature review, a study of overseas experience and a survey of local practice. Special attention is paid to the

selection of safe and economic practices which are valid for South African conditions. A basic tenet is that waste management should be an important element in the integrated planning, design and operation of intensive animal feeding units."

Copies of the "Code" are available from the Chairman, Water Research Commission, PO Box 824, Pretoria 0001.

Guide: the true facts!

(In the May 1984 edition of *SA Waterbulletin* the omission of several lines of type caused a news item on *Surface water resources of South Africa* to become an omelet instead of the hash it was meant to be! The true story follows).

A Guide and Addendum to the *Survey* have been published by the Water Research Commission in terms of the consultancy with Professor DC Midgley.

The Guide leads users through the *Survey* and provides information on its uses and possible pitfalls. The Guide and Addendum also provide extensive information on alternative methods of solving water resources problems. The *Survey*, published in 1981, provides a means of making water

resource development decisions as well as information for performing economic and sensitivity analyses. It provides information on the degree to which available water resources could be safely exploited and demonstrates methods for handling many of these and similar problems in this field.

As the *Survey* is now out of print the WRC is considering a reprint and an estimation of demand for this and other reports from the now defunct HRU is required. Our readers' attention is drawn to the Demand Questionnaire in this issue of *SA Waterbulletin*.

The Guide and Addendum are available from the Chairman, Water Research Commission, PO Box 824, Pretoria 0001.

TECHNOLOGY TRANSFER



TEGNOLOGIEOORDRAG

The latest developments in water and effluent management techniques being developed by a firm of consulting engineers on behalf of the Water Research Commission for the fishing industry were recently demonstrated to the industry and the various authorities involved at an open day organized by the Water Research Commission at Suid-Oranje Visserye in St Helena Bay.

Effluent management:

UF SYSTEM DEMONSTRATED

In the guide issued at the demonstration the consulting engineers, Binnie and Partners, say that their work on effluent management, carried out with WRC funding, has shown in the past that while dissolved air (DAF) systems provide an effective clarification technique, these systems are prone to overloading by the very high strength effluent fractions arising for example from dry off-loading (i.e. dry off-loading bloodwater). Conversely, membrane or ultrafiltration (UF) systems have been found to be effective in separating and concentrating such high strength effluent sources, but become very costly plants in full scale if a large volumetric throughput is required.

Combining these two observations therefore, the logical development which is being implemented in the current phase of the effluent management project is to treat the high-volume but less polluted streams (e.g. wet off-loading effluents and cannery fluming effluents) by DAF processes, and to treat the relatively low-volume but very high-strength pollutant sources (e.g. dry off-loading bloodwater, and stickwater) by suitable membrane (UF) processes.

The overall configuration of the pilot plants is that all feeds to the plants except stickwater are screened and then fed to one or other of the two containers comprising respectively the DAF and UF pilot plants.

The screen being used is of the static tangential wedgewire type and has replaceable screens of 0,25/0,50/0,75/1,0 mm apertures. Cleaning of the screen surface when necessary has been carried out manually with cold water from a hand-held hose. In full-scale application, the cleaning system

would consist of a fixed or portable spray system, with steam or hot water addition if desirable.

The DAF plants previously used on the project have been circular, with a central feedwell. This type of plant has been found to be susceptible to solids carry-over in the final effluent at high loading rates. Accordingly, a rectangular pilot plant DAF unit has been prepared for the latest series of trials.

In this plant, the feed is introduced into a baffled inlet compartment at one end of the rectangular flotation cell. The flotation effect achieved by de-pressuring an air-saturated sidestream, and allowing the nascent micro-bubbles to admix with the feed solids to give an overall buoyancy to the air/solids conglomerates, carries the conglomerates to the surface of the flotation cell. A flight and chain scraper system then propels the floated sludge over a beach and into a sludge collection chute and hence out of the flotation unit. The clarified effluent gravitates over an adjustable out-flow weir for discharge.

Alternatives

The DAF pilot plant has been set up to allow three alternatives for pressurising (air saturation at high pressure) in the saturator. These are (a) pressurising a separate seawater stream, (b) pressurising a fraction of the clarified (treated) effluent from the plant, and (c) pressurising all or part of the raw feed (before dosing with chemicals).

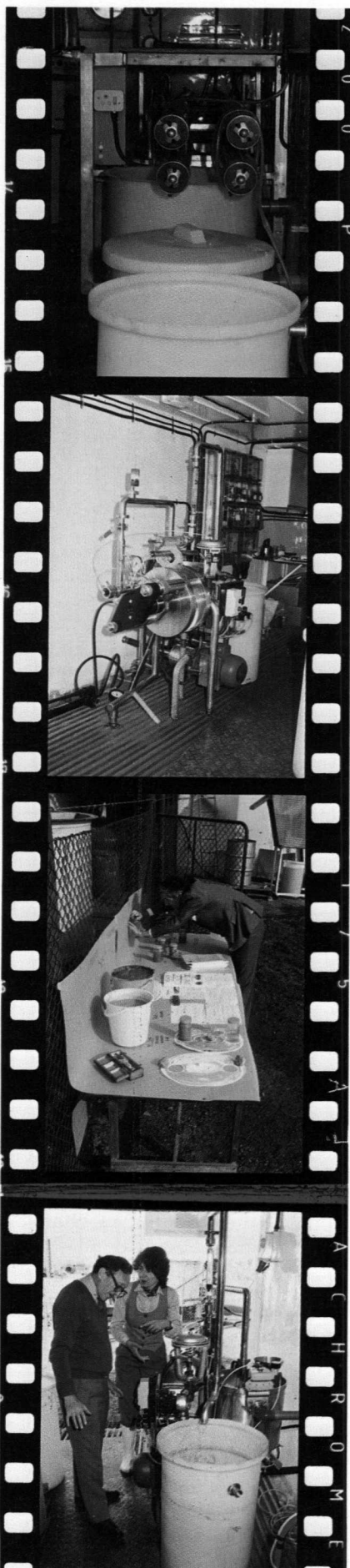
Each of these flotation modes have their particular advantages and disadvantages. Pressurising a separate seawater stream gives trouble-free air dissolution in the

saturator, but imposes an additional volumetric load on the flotation unit. Recycling treated effluent to the saturator also imposes an additional upflow velocity component in the flotation unit, and in addition can create corrosion problems in the saturator system if chemical dosing at low pH (as has been found to be effective) is practised. The third option, i.e. pressurising all or part of the raw feed, does not suffer the increased volumetric loading disadvantages of the other two modes of operation, but can lead to a reduced efficiency of saturator operation, particularly when the raw feed contains impurities such as oils in this instance.

The alternative modes of operation outlined above are all being tested in the current phase of the project. The findings will be incorporated along with the results of the previous work carried out to produce a design guide for the use of the industry.

As its name implies, ultra-filtration (usually abbreviated to UF) is a method of mechanical separation of suspended solids from a liquid and is similar in principle to filtration through screens or beds of porous media. A major difference is that, whereas conventional filtration processes are not capable of removing suspended particles finer than about 0,001 mm, e.g. colloids, UF operates in the macromolecular size range and can therefore be used to separate large organic molecules from liquid suspensions or even from solutions. It may be regarded as an ultra-fine sieving technique.

The means whereby such separation is achieved is to use ultra-thin synthetic or natural product-derived membranes in which are



present a very large number of very fine "holes", the size of which can be tailored to match the molecular dimensions of the range of organic compounds which it is desired to remove from the effluent. In the UF pilot plants currently in use on the project, membranes to provide molecular weight (M.W.) cut-offs from 6 000 to 20 000 M.W. are being used.

There are several basic types of UF systems, characterized by the geometry of the membrane and the hardware in which it is assembled. Each type has advantages and disadvantages for specific applications but, generally, the commercial objective is to achieve the greatest throughput and recovery from the smallest cost of hardware. Ultimately, the objective is to separate and concentrate the feed at minimum total capital and operating costs.

The two basic configurations of membrane plant being used on the project are the tubular and flat (plate-and-frame) types respectively. In each case, various membrane materials can be introduced into the plant to achieve the desired molecular weight cut-off range, chemical and temperature resistance, etc.

In each plant, the essential principles of operation are similar, although the means of achieving the desired flow pattern vary. Feedstock is pumped at pressures typically in the range 5 to 10 bar through a membrane stack, which can be arranged to give various combinations of series/parallel flow paths.

Stack

The membrane stack provides a barrier to the high molecular weight (large molecule) constituents of the feed, which are rejected in the "concentrate" stream, while the smaller constituent molecules (including water) permeate through the membrane as the clarified

"permeate" stream. If the objective is to obtain a highly concentrated reject stream, all or part of the concentrate is recycled back to the inlet of the plant. These modes of operation are referred to respectively as "batch recycle" (all concentrate recycled) and "feed-and-bleed" (fraction of concentrate recycled).

The pressurisation of the feed and frictional losses through the system produces a heat build-up in the plant. Depending on the temperature tolerance of the particular membrane material being used, this heating effect is in some cases beneficial in producing a lowered viscosity, and thereby improving flux rates through the membrane. The UF pilot plants have facilities for heat exchanging the feed (or recycled concentrate) with hot or cold water, so that a selected temperature of operation can be maintained.

As outlined earlier, the very high strength bloodwater from dry off-loading, which has been proved to have too high a solids content for economical DAF treatment, has been found to be amenable to concentration by UF. The primary objective is to produce a treated low-strength permeate stream, which can be discharged directly to sea without causing a marine pollution problem. The concentrate, containing a high percentage of the original solids, is however recoverable for return to the fish meal processing plant. The overall fish-solids recovery of the industrial operation is thereby improved as a side-benefit to the primary objective of effluent treatment.

The second major application of UF processes being investigated is the concentration of stickwater by this process rather than by thermal evaporation as is traditionally practised. The objective in these UF trials is to produce a stickwater concentrate of similar strength (typically 35% solids) as is normally achieved by evaporation. Approximately this level of concentration has been achieved in the current trials, using the plate-and-frame UF plant. Comparative trials are also being carried out using the tubular UF plant. In both cases, the "bottom line" is the relative capital and operating cost compared to using thermal evaporation.

(From top left): 1. PCI tubular RO membrane system. 2. DDS plate and frame RO unit. 3. Preparing the display. 4. Dr F Woods and Ms M. Peddersen (both Binnie's) discussing the performance of the system.

By the year 2020, the demand for water in the RSA will equal the available supplies. To ensure a sustained and healthy socio-economic development to maximize production per unit volume of water and to control pollution of the water resources, water will have to be used judiciously, particularly by agriculture and industry.

NATSURV IS COMING



Chemical engineers Paul Skivington and Andrew Elphinston with some of the surveying equipment.

Over the next few decades, South Africa must meet the challenge of stretching limited water resources to meet an ever increasing demand. Until now it has generally been possible to meet this country's demand from these relatively meagre resources without undue strain. Partly due to population drift to the urban areas but also because of increased industrialisation, water demand has been growing at an ever-increasing rate. The present drought may be regarded as a foretaste of what is in store as 2020 approaches.

The typical response to a water shortage has been to restrict domestic consumption. It was felt that this was the least painful answer to a short-term problem. The gardener's cries of anguish were met with the reply that industry and agriculture must have first call. However, a drought is a short-term phenomenon and this strategy will be untenable as an answer to the country's long-term water supply situation.

It cannot be gainsaid that water wastage is occurring on a grand scale in all sections of the community. A logical and long overdue step is to reduce this wastage,

thereby preserving such resources as this country is blessed with for maximum productive and recreational use. This is a mammoth task and only by intensive campaigning can every individual be made aware of the long-term situation and the part which he or she can play. We can all expect to experience an increasing pressure in the years ahead as water authorities are forced to impose stringent measures to control and optimise reserves.

INDUSTRY

It is estimated that industrial demand for water constitutes approximately one quarter of the nation's water consumed. While this is a significant quantity, of perhaps greater importance is that the resulting effluent is often highly polluting for the receiving body of water. Until now, industry has remained relatively unaffected during times of water shortage. This has been due to the difficulty of assessing the minimum water requirements of particular industries. To impose a blanket reduction in water consumption would be grossly unfair as it would penalise those in-

stallations which were already water-efficient. Thus the idea of a National Industrial Water and Wastewater Survey (NATSURV) came to being.

SURVEY

To account for regional differences, it was foreseen that the survey would have to be nation-wide. A postal survey was initially considered but then discarded because much of the required information was of a highly technical nature and beyond the normal resources of plant operating personnel. Consequently, it was felt that surveys should be conducted by chemical engineers who would personally visit each plant to obtain wide-ranging information on all aspects of water related practice.

Commencing in the PWV area, where approximately 45% of manufacturing industry is located, it is intended to include eventually, the whole country. Whilst South Africa's industrial base is growing very quickly, it is still just possible, given the resources, to obtain the data from every factory within a meaningful period of time. By iden-

tifying the country's prime industries and including examples of each at an early stage in the survey, it will be possible to create a database, albeit from a small sample initially, which will provide a rational and comprehensive basis for future legislation.

Having identified the need, the WRC in association with the Department of Environment Affairs, engaged the services of Binnie and Partners, consultants of long stan-

ding in all aspects of water engineering. A plan of action was formulated and funds made available for an early start. Soon the basic elements of the project, namely the surveying, chemistry and computing teams, were drawn together.

NATSURV is currently in full swing and initial results from factory visits are very encouraging. The surveying team has so far been well received by factory managements and it is hoped to have re-

port-back computing facility available soon. This will provide the factory with some interesting feedback on the findings of their particular survey. All data submitted by the factory or collected by the surveying and chemistry teams are treated as confidential.

NATSURV will come eventually to all industrial plants and through the columns of *SA Waterbulletin*, its progress will be followed undoubtedly with interest.

ISO

Waterstandaarde bepaal

Nie veel mense in die land is bewus van die rol wat die SABS vervul om die Republiek te laat deel in die voordele van internasionale standaarde nie. SA Waterbulletin het hieroor met mnr. W.A. Lombard, een van die voorsitters van 'n Tegnieese Komitee vir watergehalte, gaan gesels.

Die Internasionale Organisasie vir Standaardisasie, ISO, is 'n organisasie wat tans wêreldwyd uit ongeveer 2 300 tegnieese komitees en 20 000 spesialiste bestaan. Onder die tegnieese komitees tel onder andere Tegnieese Komitee 147 wat spesifiek met watergehalte gemoeid is.

ISO beywer hom vir die bevordering van standaardisasie en aanverwante aktiwiteite wêreldwyd, die internasionale uitruiling van dienste en goedere asook die samewerking op die gebied van wetenskaplike, tegnologiese en ekonomiese aktiwiteite. Die resultate van ISO se werk word as internasionale standaarde gepubliseer en minstens 5 273 standaarde het reeds verskyn.

Van die 90 nasionale standaardeliggame waaruit ISO tans bestaan, is 75 volle lede en 15 korrespondentlede. 'n Lid is die amptelike standaardorganisasie van 'n land. In die geval van Suid-Afrika is dit die Suid-Afrikaanse Buro vir Standaarde.

'n Korrespondentlid is 'n organisasie van 'n ontwikkelende land wat nog nie 'n eie nasionale standaardeliggam het nie. Korrespondentlede neem nie aktief deel aan tegnieese werk nie, maar is geregtig om ingelig te word oor sake wat vir hulle van belang is en hulle mag selfs die algemene vergadering van ISO as waarnemers bywoon.

Die tegnieese werk van ISO word gedek deur Tegnieese Komitees of



Mnr. W.A. Lombard

TK's soos hulle beter bekendstaan. 'n Tegnieese Komitee bestaan uit lede wat belang het by die spesifieke onderwerp waarmee die komitee gemoeid is.

In elke TK dien deelnemende en waarnemende lede. Eersgenoemde is lede wat tegnieese onderlê en in staat is om 'n inset in die komitee se werksaamhede te maak. Hulle mag vergaderings bywoon en stemreg uitoefen. In teenstelling hiermee mag waarnemende lede ook 'n inset lewer, maar het nie stemreg nie.

Tegnieese Komitee 147, die Komitee vir Watergehalte, bestaan uit 29 deelnemende en 26 waarnemende lede. Vir Suid-Afrika neem die SABS aktief deel aan die werksaamhede van hierdie komitee.

Die Komitee is onderverdeel in 6

subkomitees wie se take onderskeidelik terminologie, toetsmetodes, radiologiese, mikrobiologiese en biologiese toetsmetodes, en bemonstering is. Minstens 20 standaarde oor hierdie onderwerpe is reeds beskikbaar, terwyl ander tans in voorbereiding is.

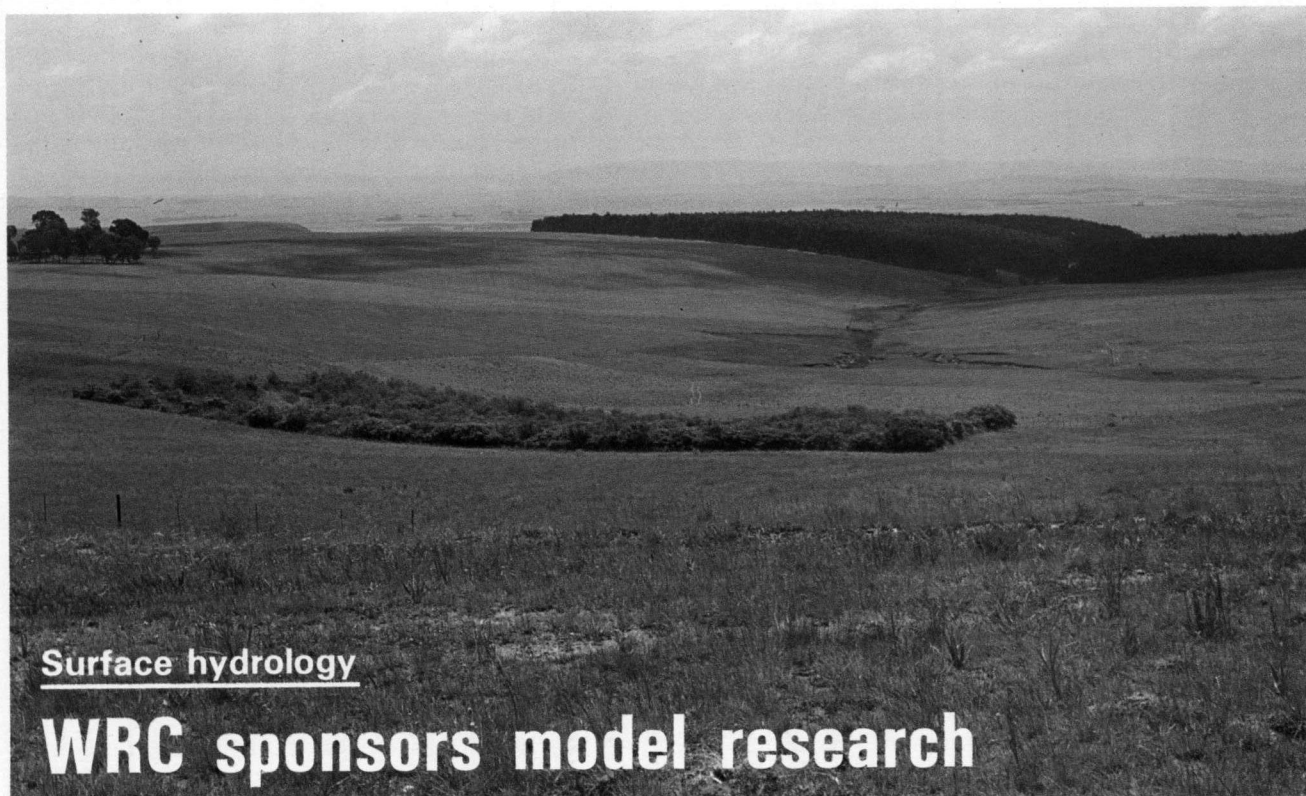
Die SABS verskaf die sekretariaat van die Subkomitee oor Terminologie en staan onder die voorsitterskap van mnr. W.A. Lombard, Assistent-direkteur van die Departement Chemiese Tegnologie van die SABS.

Alhoewel die volledige standaard oor terminologie, wat uit sewe dele bestaan, nog nie voltooi is nie, is dele I en II reeds as Internasionale Standaarde gepubliseer. 'n Publikasie van 'n Tegnieese Komitee word slegs as Internasionale Standaarde gepubliseer as die konsepstandaard deur 75% van die deelnemende lede van die komitee aanvaar is.

Op verskeie terreine is dit reeds bewys dat koördinasie van bestaande inligting en aksies belangrik is. ISO se rol in die daarstelling van internasionale standaarde, maak sulke aksies moontlik.

Verdere navrae of bestellings van publikasies kan gerig word aan:

Die Suid-Afrikaanse
Buro vir Standaarde
Afdeling Spesifikasieverkope
Privaatsak X191
Pretoria
0001



Surface hydrology

WRC sponsors model research

n'Tabamhlope: In the centre of the picture is seen a 20 year vegetation experiment where no burning or grazing was allowed. The difference in vegetation is striking.

The Water Research Commission recently signed another contract with the University of Natal whereby the Department of Agricultural Engineering is to undertake five years of applied research on hydrological processes and the development of hydrological models for the prediction of land-use management and sediment yield effects on water resources.

The research team will be under the guidance of Professor Roland E Schulze of the Department of Agricultural Engineering's Agricultural Catchments Research Unit (ACRU), and will work in collaboration with various organizations, including the *Natal Parks Board* (who will help with soil loss studies at Umfolozi Game Reserve); the *Hydrological Research Institute* (secondment of personnel and research on distributed models); the *Eshowe Soil Conservation Committee* (water yield/quality studies on indigenous forest and sugarcane); *Steffen, Robertson and Kirsten* (soil moisture movement studies); the *Natal Town and Regional Planning Commission* (water utilization by different land uses); the *Department of Botany*, University of Natal, Pietermaritzburg (analysis of water quality data), and the *Directorate of Forestry* (dynamic modelling of afforestation on water yield).

Close collaboration will also be maintained with the Department of

Agriculture at Cedara and Ntabamhlope, the Kwa-Zulu Department of Agriculture and Forestry, SA Sugar Association and the Hydrological Research Units at Rhodes and Zululand Universities.

The model development and testing will be undertaken with data from research catchments in humid, temperate and semi-arid environments in South Africa.

Models in current use in Southern Africa have not been developed to be sensitive enough to yield all the answers required in water resources decision-making.

According to the research leader, Professor Schulze, in a country like South Africa which is not endowed with an abundance of water and in which competition between ma-

jor water users will increasingly become a focal point of water planning, many important water resources management decisions in engineering, conservation and agriculture will have to be made before the turn of the century.

"Decisions and management in hydrology necessitate an understanding of the hydrological cycle, particularly in terms of changes in water and sediment production as a response to changes in land use/management.

"Because adequate hydrological measurement seldom takes place where the decisions are needed most, hydrological simulation models need to be developed which are sensitive even to small land use/management changes which might have repercussions in terms of water and sediment production. Models in current use in Southern Africa have not been developed to be sensitive enough to yield all the answers required in water resources decision-making."

According to dr Schulze, "Lumped catchment models, in which variations of land use, soils, topography, climatic data and erosivity are expressed by *average* values, too frequently do not give adequate answers because the variations are not accounted for in the models. For environmental impact studies/decision models one needs to know *where*, within a catchment, runoff or soil moisture or sediment is produced or accumulated. For this, *distributed* hydrological *models* are required, which in terms of input and output account for the varying hydrological responses within catchments. Distributed modelling is in its infancy in Southern Africa, and to date initial tests on small catchments with only one American model, in which moisture accounting procedures are very coarse, are being undertaken."

"In order to test user models adequately for hydrological responses within and between catchments, hydrological variables such as rainfall, runoff, soil moisture and water quality (suspended sediments and total dissolved solids) have to be measured or monitored in well-instrumented catchments. Other data on water utilization by different land used have to be acquired from agencies where these have taken measurements or have been monitored, in order to develop and test the efficiency of the proposed models."

Mr DHW Cousens, senior adviser of the Water Research Commission, says this development of models for the prediction of land-use management and sediment yield effects on water resources will place a great demand on the Natal team's expertise because the research project is very complex and difficult.

"It is the frontier of hydrological research, but one which has been identified by many as being extremely important. In this regard it may be worth noting the preamble and overall definition of the broad objectives as stated in the master plan for research into the hydrological effects of rural land use and catchment management on water resources:

'We as water resources managers and scientists, when looking into the future, should like to stress

that in SA we are reaching the limits of our natural resources in terms of water and food production. We should like to contend that immediate remedial management is required, as this is seen as a survival problem.

This goal may be achieved —

- by maximising the percentage of water that can be beneficially used through management and
- by obtaining optimal benefit/unit volume of water'.



Prof RE Schulze

According to Mr Cousens: "There are essentially two recognised scientific methods which may be used to research these areas i.e. land-use and sediment yield effects. One method is to develop experimental catchments which are then calibrated against each other in terms of their streamflow or sediment yield. A treatment is then applied to the one and the difference in hydrological response measured against the calibration period and the control catchment. This is a method commonly in use where the expected changes, in streamflow for example, are likely to be readily detectable in the measured values e.g. in the Directorate of Forestry's afforestation management experiments where the hydrological effects of afforestation are relatively large. However, where the hydrological effects are likely to be moderate as in the case of most rural land-use changes this method can take anything up to fifty years to complete. Furthermore, com-

plete control over catchment management or the treatments applied must be possible or the results could be delayed indefinitely.

"The experimental approach outlined above also still requires that the predictions of change can be applied in areas, other than the experimental catchments, where management is to be undertaken. For this transfer of results the most commonly adopted approach is via mathematical models developed on the experimental catchments.

"The second approach is to go directly to the model development phase using research catchments with which to test and validate model output. This approach requires intensive field monitoring to make reasonably sure that the models are working correctly and can in fact predict the effects of change sufficiently accurately. This does not require the application of treatment and controls but any land-use changes within each research catchment which does take place must be monitored to check whether or not the models adequately cater for it. The more catchments that can be used, of variable characteristics, like in this project, the more confidence one can place in the model predictions. It is hoped that this method will yield results sooner than the first approach outlined previously.

"Confirmation of results of one method by comparison with the results of the other approach would obviously enhance the confidence, if this could be done. It is, however,

"Lumped catchment models, in which variations of land use, soils, topography, climatic data and erosivity are expressed by *average* values, too frequently do not give adequate answers because the variations are not accounted for in the models.

unlikely that either approach will yield absolutely conclusive results when applied to areas outside the research set up. So far in South

(To page 10)

(From page 9)

Africa no-one has attempted to meet the objectives previously defined by the model development approach *per se*. Model development has generally been directed at supplying user friendly methods of extending or patching records by adequately reproducing the statistics of the measured existing data. Overseas not much has been done towards meeting the objectives of this project either, for the same reasons.

'In this new project the University of Natal will attempt to address the beginning phases of the second approach while drawing on the knowledge or lack of it that was so adequately and clearly exposed during the recent S.A. National Hydrological Symposium using the latest world-wide literature. It should be recognised that either approach will still take many years of intensive effort before any great confidence can be placed in the predictions. However, this should not deter us but in fact underlines the necessity of firmly addressing the problems as soon as possible. In this regard past research has revealed that there are two glaring problems to be overcome when attempting the second approach:

- The soil moisture movement component of present hydrological models is inadequate especially regarding spatial variability and the unsaturated zone.
- The evapotranspiration component used in most current models, which is so vital for predicting the effect of land-use changes or the water utilization of different land-uses, is also inadequate.

'To illustrate these points a recent publication by Morton of the National hydrology Research Institute in Canada can be quoted as saying, in the October 1983 edition of the *Journal of Hydrology*:

'... the assumptions used to estimate areal evapotranspiration in the conventional conceptual models are completely divorced from reality ... The concealment of unrealistic assumptions tends to be ignored because scientific

and engineering literatures provide few if any examples of the consequences of practical applications.'

'He states further that ...

'Evaluation and improvement of the water planning and management assumptions have been impeded by the apparent determination of hydrologists and engineers to ignore the significance of areal evapotranspiration in the modelling of the hydrologic cycle ... The main reason for ignoring ... (it) ... is that it is extremely difficult to measure or estimate ...



Mr DWH Cousins

Model development is also impeded by lack of communication between the scientific disciplines. The assumptions used for evapotranspiration components of current watershed models are inconsistent with findings published in the meteorological, botanical and soil science literature ...

'The same sort of example can be given for the soil moisture component too. Casual models or as sometimes termed, physically based models i.e. those based on the physical processes and interactions in the soil-plant-atmosphere system, although still in their infancy, are viewed by researchers world-wide as the wave of the future since research has shown that it is impossible to predict the effects of natural or man-made

changes without a detailed knowledge of the causal factors and their inter-actions. This applies equally to all the dominant hydrological processes such as soil movement and evapotranspiration.

It is no longer acceptable to merely rehash current models as they have been proven inadequate for the the purpose of predicting the effects of land-use changes on hydrology and sediment yield let alone the so necessary water quality aspects. James and Burgess, as quoted from a recent final report on hydrological research at Zululand University, draw attention to the pitfalls of the above vertical as opposed to lateral thinking in attempts to build and refine models. These authors use a quote from de Bono, the well-known author on lateral thinking.

'Logic is the tool that is used to dig holes deeper and bigger, to make them altogether better holes. But if the hole is in the wrong place, then no amount of improvement is going to put it in the right place. No matter how obvious this may seem to every digger, it is still easier to go on digging in the same place than to start all over again in a new place. Vertical thinking is digging the same hole deeper, lateral thinking is trying again elsewhere.'

It is essential that a completely fresh look is taken at current models and their pitfalls and inadequacies have to be avoided. This need is to be addressed in this new project.

Because of limited time, financial resources and manpower attention has to be given to only the fundamental aspects at this stage.

The Natal group will be looking at only a few relatively important land-use types; essentially maize, sugarcane and forestry. At the same time they will be attempting to utilize the latest research results for the components of soil moisture and water utilization of the various crops in their model development. The use of afforestation as one land-use may mean that they can compare their results with those of the experimental approach of the Directorate of Forestry.

Grondwatervnavorsing:

Nuwe kontrak vir die Instituut vir Grondwaterstudies

Die kritieke droogte van die afgelope tyd het die aandag weer eens gevestig op die noodsaaklikheid van nuwe en aanvullende bronne en die beter benutting van bestaande waterbronne, waarvan grondwater een van die talle moontlikhede is.

In 'n meesterplan wat in 1981 vir grondwatervnavorsing opgestel is, het die daarstelling van 'n gerekenariseerde databank hoogste prioriteit gekry. Die plan is opgestel deur die Watervnavorsingskommissie (WVK) in samewerking met die Afdeling Geohidrologie van die Departement Omgewingsake en die Instituut vir Grondwaterstudies (IGS) van die Universiteit van die Oranje-Vrystaat.

Aan die begin van hierdie jaar het die WVK 'n kontrak vir die skepping van 'n gerekenariseerde grondwaterdatabank aan die IGS toegeken.

Die gebruik van gerekenariseerde grondwaterdatabanke vir die ontwikkeling en beheer van grondwaterbronne neem toe in ontwikkelde lande. In die VSA byvoorbeeld bestaan daar 'n grondwaterdatabank wat toepaslike gegewens berg, en in verskeie sentra is terminale geïnstalleer waar data ingelees, onttrek en verwerk word.

In sy ontwerp van die nuwe grondwaterdatabank het die IGS strukture van ander bestaande databanke bestudeer. In besonder is na die stelsels van die Queensland Water Resources Commission in Australië en die Geologiese Opname in die VSA gekyk.

Die nuwe databank gaan in alle opsigte vir navorsing en grondwaterondersoeke van nut wees. Deurdat data vinnig gesif, verwerk en uitgedruk of grafiese voorgestel kan word na gelang van die gebruiker se behoefte, sal toepaslike geohidrologiese inligting so vinnig en volledig moontlik beskikbaar wees. Geordende indekslyste sal opsporing van gegewens verder bespoedig.

Veranderinge aan die struktuur van die databank in 'n laat stadium is moeilik en ondoeltreffend en moet reeds by die konsepstadium gefinaliseer wees. Onder andere sal daar gekyk moet word na diegene aan wie die databank 'n diens lewer, watter vrae beantwoord moet word en ook na die hoeveelheid inligtingspunte. Die bergingsvermoë van die databank word deur laasgenoemde beïnvloed.

Behalwe vir die vereistes van die Afdeling Geohidrologie sal die databank ook voorsien in behoeftes van die Boor-, Bedryf-, Beplanning- en Administratiewe seksies.

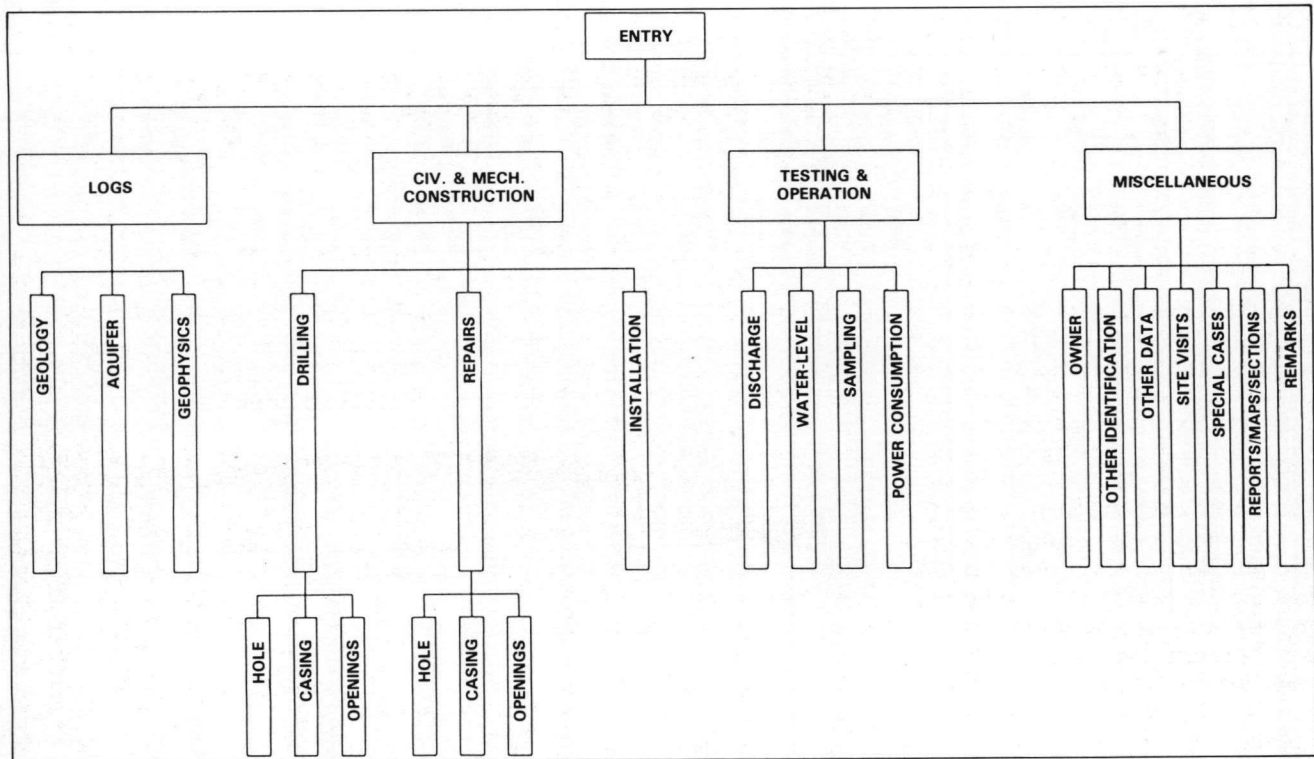
Gedurende die kontraktydperk van vier jaar, word programme vir die databank ontwikkel. Om alle bestaande geohidrologiese inligting na te gaan, te verwerk en in die rekenaar in te lees sal baie jare

(Na bladsy 12)

1. ENTRY

- | | |
|-------|----------------------------|
| * 1. | SITE IDENTIFICATION NUMBER |
| 2. | MAP NUMBER |
| 3. | NUMBER ON 1:50 000 MAP |
| 4. | SITE NAME |
| 5. | TOPOGRAPHIC SETTING |
| * 6. | LONGITUDE |
| * 7. | LATITUDE |
| 8. | COORDINATE ACCURACY |
| 9. | DRAINAGE AREA |
| 10. | ALTITUDE |
| 11. | METHOD OF MEASUREMENT |
| 12. | COLLAR ELEVATION |
| * 13. | SITE TYPE |
| 14. | SITE SELECTION |
| 15. | COMPLETION DATE |
| 16. | USE OF SITE |
| * 17. | WATER USE |
| 18. | DEPTH DRILLED |
| 19. | INFORMATION SOURCE |
| * 20. | DEPTH COMPLETED |
| 21. | INFORMATION SOURCE |
| 22. | ORIGINAL WATER-LEVEL |
| 23. | DATE OF MEASUREMENT |
| 24. | METHOD OF MEASUREMENT |
| 25. | W-L INFORMATION SOURCE |
| 26. | W-L STATUS |
| * 27. | LATEST WATER-LEVEL |
| 28. | DATE OF MEASUREMENT |
| 29. | ORIGINAL YIELD |
| 30. | INFORMATION SOURCE |
| * 31. | LATEST YIELD |
| 32. | REPORTING INSTITUTION |
| 33. | DATA RELIABILITY |
| 34. | EQUIPMENT |
| * 35. | SUITABILITY |
| 36. | DATE ENTERED |
| 37. | DATE RECORD UPDATE |
| 38. | REMARKS |

FIGUUR 1



FIGUUR 2

(Van bladsy 11)

neem en gaan die IGS vir eers konsentreer op bestaande data in die Vrystaat en dit op rekenaar plaas. Hierdie deel van die projek sal behels die evaluering van die Vrystaat-data wat by die Afdeling Geohidrologie beskikbaar is. Die Afdeling Geohidrologie van die Departement Omgewingsake sal ook 'n span hê wat grondwater-

data in die nuwe databank invoer.

Om lang soektye te vermy onderskei die databank tussen basiese en bykomstige inligting oor elke spesifieke inligtingspunt. Die totale items per inligtingspunt is ongeveer 140 waarvan 38 onder basiese inligting sorteer en wat in "entry" (figuur 1) gebêre kan word. Soos in figuur 2 uiteengesit val al die bykomstige geohidrologiese inlig-

ting onder een van 4 subgroepe te wete "logs", "konstruksie", "toets en bedryf" en "allerlei" (of soos dit op Engels genoem word: "Logs, construction, testing and operation" en "miscellaneous").

Die databank sal data bevat oor boorgate, fonteine en soortgelyke inligtingsbronne wat van die ongeveer een miljoen boorgate en inligtingspunte verkry sal word.

Geohydrology:

DR KAFRI TO SOUTH AFRICA

The Director of the Geological Survey of Israel, Dr Uri Kafri, is coming to South Africa in September. Dr Kafri will be under contract to the Water Research Commission during the period of his sabbatical leave.

During his stay Dr Kafri will assist the Division of Geohydrology of the Department of Environment Affairs in its research programme on the ground-water resources of the dolomites in the Rand Water Board supply area.

The major objective of the research programme will be to in-

stall high yield boreholes to tap water from the dolomites during times of crisis. It is envisaged that the ground-water component will eventually be incorporated as an integral part of the supply system for the Rand Water Board.

Tasks

Specific tasks Dr Kafri will attend to are:

- the re-evaluation of the ground-water research done in the past;
- work on alternative methods of siting high yield boreholes and

the determination of the hydraulic characteristics of the dolomite, and

- the investigation of ground-water aspects of other dolomitic compartments and the other promising geological formations within the supply area of the Rand Water Board.

Dr Kafri could make an important contribution to the urgent task of integrating the ground-water resources of the PWVS area into the supply systems of the Rand Water Board.

| Report No. | TITLE, AUTHOR & PAGES | No. Required |
|------------|---|--------------|
| HRU 79/1 | <i>"Updating and Modification of Flood Plain Models"</i> — 46 pp HRU Manual Series | ..... |
| HRU 2/79 | <i>"A Numerical Hydraulic Model of the Pongola Flood Plain"</i> — 18 pp by WV Pitman and HW Weiss | ..... |
| HRU 3/79 | <i>"Analysis of SWA/Namibia Rainfall Data"</i> — 70 pp by BFC Richardson and DC Midgley | ..... |
| HRU 2/80 | <i>"Analysis of Large-Area Storms in SWA/Namibia"</i> — 104 pp by WV Pitman | ..... |
| HRU 1/81 | <i>"Application of Illudas to Stormwater Drainage Design in Southern Africa"</i> — 148 pp by MD Watson | ..... |
| HRU 2/81 | <i>"Kinematic Flow — Introduction and Applications"</i> — 50 pp by D Stephenson | ..... |
| HRU 7/81 | <i>"Time-Area Method of Flood Estimation for Small Catchments"</i> — 174 pp by MD Watson | ..... |
| HRU 14/81 | <i>"Design Flood Determination in SWA/Namibia"</i> — 95 pp by WV Pitman and JA Stern | ..... |

PLEASE NOTE

By providing your name and address, you can be contacted and a price list supplied to you for the items you may be interested in.
PLEASE DO NOT ORDER NOW!

Name

Address

.....

.....

Code

ARE YOU INTERESTED IN HYDROLOGICAL RESEARCH REPORTS?

The Water Research Commission is considering reprinting certain volumes of the reports published jointly by the Commission and the then HRU of the University of the Witwatersrand.

To ascertain which reports should be reprinted, an estimation of the demand for the reports is required.

PLEASE NOTE THAT THIS IS NOT AN ORDER FORM, BUT THAT YOUR REPLY WILL DETERMINE THE NUMBER OF REPORTS TO BE REPRINTED.

Kindly, therefore, indicate how many of which reports you would order should they be reprinted. The price of the reports will be calculated to cover printing costs only. Please return this form to:
The Chairman, WRC, PO Box 824, Pretoria 0001.

| Report No. | TITLE, AUTHOR & PAGES | No. Required |
|-------------------------|---|------------------------------------|
| WATER RESOURCES: | | |
| HRU 8/81 | <i>"Surface Water Resources of South Africa — Drainage Region C: The Vaal Basin"</i> by BJ Middleton, WV Pitman and DC Midgley | Part I: 180 pp II: 262 pp |
| HRU 9/81 | <i>"Surface Water Resources of South Africa — Drainage Regions UVWX: The Eastern Escarpment"</i> by WV Pitman, BJ Middleton and DC Midgley | Part I: 180 pp II: 402 pp |
| HRU 10/81 | <i>"Surface Water Resources of South Africa — Drainage Regions A and B: Limpopo — Olifants"</i> by BJ Middleton, WV Pitman and DC Midgley | Part I: 180 pp II: 348 pp |
| HRU 11/81 | <i>"Surface Water Resources of South Africa — Drainage Regions D and F: Orange River/Namaqualand"</i> by WV Pitman, BJ Middleton and DC Midgley | Part I: 180 pp II: 314 pp |
| HRU 12/81 | <i>"Surface Water Resources of South Africa — Drainage Regions MNPQRST: The Eastern Cape"</i> by SA Lorentz, RM Robertson, BJ Middleton, WV Pitman and DC Midgley | Part I: 180 pp II: 414 pp |
| HRU 13/81 | <i>"Surface Water Resources of South Africa — Drainage Regions EQHJKL: The Western Cape"</i> by DJ Potgieter, WV Pitman, BJ Middleton and DC Midgley | Part I: 180 pp II: 527 pp |

Each of the above volumes is in two parts where Part I is the text and Part II is an Appendix.

FLOOD OCCURRENCES:

| | | |
|----------|--|-------|
| HRU 1/78 | <i>"Flood Forecasting for Reservoir Operation by Deterministic Hydrological Modelling — 157 pp"</i> by MS Basson | ..... |
| HRU 2/78 | <i>"A Depth-Duration-Frequency Diagram for Point Rainfall in Southern Africa"</i> — 59 pp by DC Midgley and WV Pitman | ..... |
| HRU 1/79 | <i>"Flood Forecasting for Reservoir Operation with Specific Reference to Hartbeespoort Dam"</i> — 182 pp by WV Pitman and MS Basson | ..... |

Aquaculture:

FIRST STEPS FOR AQUACULTURE AT CATHEDRAL PEAK

Cathedral Peak in the Drakensberg recently played host to a very successful Aquaculture Symposium where more than 100 scientists and aquaculture producers met for the first time at a formal occasion.

In an inaugural address which was read on his behalf, Mr JWE Wiley, Deputy Minister of Environment Affairs and Fisheries pointed to the unique characteristic of the symposium: "This is the first time to my knowledge, that scientists and producers have come together for in-depth discussions on the state of the industry. Bearing in mind the position of aquaculture in South-Africa, one realises that this industry has only started developing compared to that in certain European countries and the East.

"So far very little has been done to make better use of our water sources other than simply water provision, irrigation and water for livestock," Mr Wiley said. "There is a large variety of suitable production areas in South Africa, and with an area of 230 000 hectares covered by dams there is definitely much scope for expansion."

Brackish water

Mr Wiley also referred to aquaculture in dams with brackish water which has been proved to be successful overseas, and in Java for example, 15 million kilograms of fish and prawns are taken every year from about 80 000 hectares of dams with brackish water — another field aquaculture in South Africa could explore.

The symposium was presented by the South African Agricultural Union in collaboration with the Council for Scientific and Industrial Research (CSIR) and dealt with a wide range of topics in aquaculture. More than 30 papers on aquaculture species, production systems and the latest technology were presented by specialists and producers.

The immediate needs in aqua-

culture which were stressed at the symposium are: the need for market research and feasibility studies; the need to implement the fruits of research; the need for aquaculture experts in neglected

disciplines such as economists and engineers as well as training of aquaculturists; the need for communication and cooperation; and finally the need for subsidised finance to aquaculture.

Lombaard Presteer



Mnr HC Lombaard, direkteur van administrasie by die Waternavorsingskommissie, het onlangs 'n groot eer te beurt geval toe Trusteelidmaatskap van die SA Instituut vir Organisasie en Metode aan hom toegeken is. Op die foto ontvang mnr Lombaard (links) sy sertifikaat van mnr JWA van der Merwe (voorsitter van die Kommissie vir Administrasie). Trusteelidmaatskap is die hoogste graad van lidmaatskap van die betrokke Instituut.

'Daar kan sonder vrees vir teenspraak gesê word dat die doeltreffendheid van besproeiingskedulering in Suid-Afrika uiters laag is. Hierdie feit, tesame met swak fisiese beplanning van stelsels (veral vloedsproeiingstelsels) lei tot uiters ondoeltreffende benutting van besproeiingswater.' — Prof MC Laker, Universiteit van Fort Hare.

SKEDULERING: MIN WATER, BAIE GELD

'Behoorlike besproeiingskedulering is waarskynlik die belangrikste faktor wat die doeltreffendheid van benutting van besproeiingswater bepaal. Daar kan nie van 'n besproeiingstrategie gepraat word as hierdie saak nie breedvoerig die aandag geniet nie,' sê professor Laker. Hy het gepraat tydens 'n besproeiingsimposium wat in Junie in Cradock gehou en deur die Minister van Omgewingsake, mnr Sarel Hayward, geopen is.

Prof Laker was een van drie deskundiges wat referate gelewer het. Mnr Frans Stoffberg, Adjunkhoofingenieur: Beplanning van die Direkoraat van Waterwese het gepraat oor 'Die Oos-Kaap se plek en aandeel in die nasionale waterbenutting strategie 1984 – 2000'; mnr C van der Ryst van die Universiteit van die OVS se tema was 'Meganiese besproeiing'.

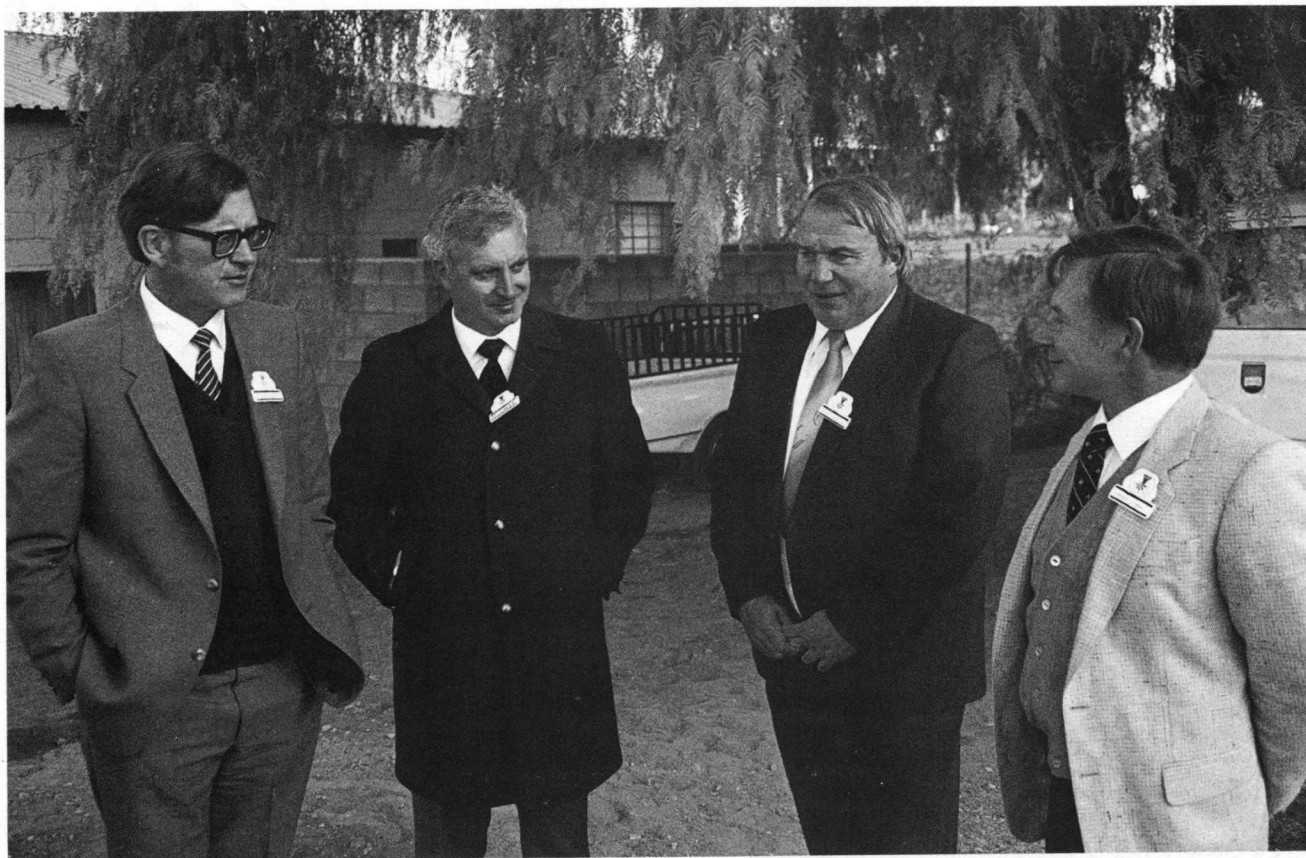
In sy referaat het prof Laker die uiters belangrike aangeleentheid van besproeiingskedulering bespreek. 'Swak besproeiingske-

dulering,' het hy gesê, 'lei feitlik deurgaans tot geweldige oorbesproeiing. Sodanige oorbesproeiing lei nie alleen tot vermorsing van skaars besproeiingswater nie, maar uiteindelik tot versuiping en verbraking van kosbare besproeiingsgrond. Voorbeelde in Suid-Afrika is volop.'

Behoorlike besproeiingskedulering lei nie net tot geweldige waterbesparing nie, maar het ook groot finansiële voordele vir die boer. Op een skema in die V.S.A. het die toepassing van behoorlike skedulering, met behulp van neu-

tronvogmeters, waterverbruik met 34 persent verminder. Dit het nie net 'n jaarlikse besparing van sowat R700 000 aan waterkoste vir die bestaande boere teweeggebring nie, maar met die water wat bespaar is, kon 'n bykomende sowat 5 000 hektaar onder besproeiing gebring word.

Aartappelboere in die Snake River Valley van Idaho het gevind dat hulle op drie maniere gebaat het by behoorlike besproeiingskedulering met behulp van tensionmeters:



Drie sprekers tydens die Cradock-simposium in gesprek met dr George Green (regs, senior adviseur van die WNK): V l n r Mnr Frans Stoffberg (Direkoraat van Waterwese); prof M C Laker (Univ. van Fort Hare) en mnr C van der Ryst (UOVS).

- hul besproeiingskoste baie laer.
- hul stikstofrekening baie laer omdat uitloping, wat vroeër weens oorbesproeiing voorgekom het, verhoed is.
- die gehalte van die aartappels baie beter en het hulle gevolglik hoër pryse daarvoor gekry.

'Talle sulke voorbeelde kan genoem word,' het prof Laker gesê.

'Die tegnologieë wat in Amerika aangewend word om die doeltreffendheid van skedulering soveel te verbeter, is eintlik eenvoudig en baie maklik om in die praktyk toe te pas. Daar is geen rede waarom dit nie onmiddellik op uitgebreide skaal hier by ons ook toegepas kan word nie. Die groot verbetering is dat die hoeveelheid water wat uit die grond onttrek is nou gemeet kan word sodat die korrekte hoeveelheid water aangevul kan word. Dit is nie meer nodig om skattings hiervan vanaf klimatologiese gegewens met behulp van sogenaamde "gewasfaktore" te maak nie,' het hy gesê.

Deurbraak

Die groot deurbraak het gekom met die ontwikkeling van hoogs doeltreffende en maklik hanteerbare nuwe neutronvogmeters. Hierdie vogmeters is nie onderhewig aan die tekortkominge wat die bruikbaarheid van ander metingstegnieke, soos tensiometers, so ernstig beperk nie.

Gereelde vogmeterlesings stel die boer ook in staat om sinvolle vooruitskattings te maak van hoeveel water hy wanneer gaan benodig sodat hy sy waterbestellings beter kan beplan. Deur die gegewens in 'n sentrale rekenaar in te voer, kan besproeiingsadministrateurs weer beramings maak van wanneer hoeveel water in 'n bepaalde deel van 'n skema benodig gaan word. Watervoorsiening aan verskillende gebiede word dan sover moontlik hiervolgens geskeduleer. Die beramings word deurlopend aangepas en boere word op 'n gereelde basis op hoogte gehou van beoogde watervoorsieningspatrone. Boere kan dan weer hulle waterbestellings hierby aanpas.

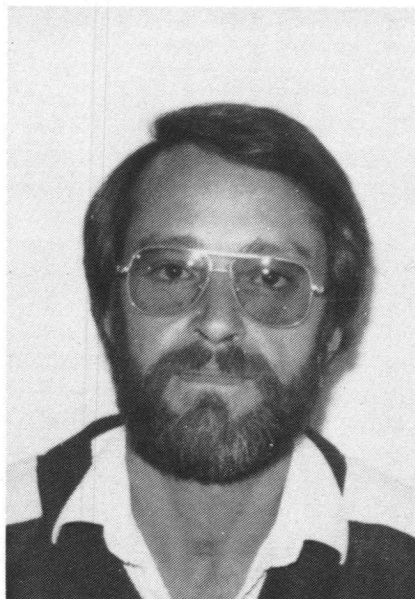
Die feit dat water, soos in Amerika, om praktiese redes drie

dae vooruit bestel en dan gebruik moet word, selfs al het dit intussen gereën, bly 'n probleem. Waar reën 'n groot moontlikheid is, kan die probleem 'n mate deur goed beplande onderbesproeiing ("deficit irrigation") oorbrug word. Onderbesproeiing is waar die grond toegelaat word om redelik ver uit te droog en die profiel daarna tydens besproeiings nie heeltemal tot by veldkapasiteit opgevolg word nie. Ruimte word dus gelaat vir die benutting van normale reëns. Die intervalle tussen besproeiings is natuurlik baie korter by onderbesproeiing as by volle besproeiing. Dit is in die V.S.A. gevind dat onderbesproeiing *onder sekere omstandighede* groot voordele ten opsigte van inkomste en hulpbronbenutting mag inhou.

'n Belangrike aspek is om te besluit hoe ver 'n grond toegelaat kan word om uit te droog voordat besproei moet word. Die Departement Grondkunde aan die Universiteit van Fort Hare is die afgelope aantal jare met intensiewe navorsing oor hierdie aspek besig dank sy 'n groot borgskap van die Waternavorsingskommissie,' het prof Laker gesê.

'Saam met doeltreffende skedulering is dit ook noodsaaklik dat die gewenste hoeveelheid water akkuraat toegedien moet word. Goed beplande besproeiingstelsels wat, 'n hoë toedieningsdoeltreffendheid het, is hiervoor 'n vereiste.'

Die noodsaaklikheid van be-



Mnr PF Nortjé, Navorsingsinstituut vir Tuinbou.

sproeiingskedulering is ook vroeër by 'n boeredag in Bloemfontein beklemtoon deur mnr PF Nortjé (van die Navorsingsinstituut vir Tuinbou te Roodplaat) wat gepraat het oor besproeiingskedulering by tamaties.

Bestuur

'Besproeiingsskedulering is 'n term wat die oordeelkundige toediening van water omskryf. Die term verwys nie noodwendig na die bevrediging van die optimum waterbehoefte van 'n gewas nie maar dui op die bestuur van watertoediening. Deur middel van skedulering word gepoog om 'n vooraf bepaalde vogregime te handhaaf wat in die groeistadium waterbehoefte van die gewas sal voorsien,' hyt hy gesê.

Hedendaagse kapitale koste verbonde aan besproeiingstoerusting en energiekoste dwing produsente om met meer aandag te kyk na oordeelkundige watertoediening. Onoordeelkundige besproeiing lei tot toestande wat nadelig is vir plante en kan ook veroorsaak dat duur besproeiingsgronde ongeskik raak vir verbouing. Die belangrikste praktiese gevolge van oormatige besproeiing kan as volg opgesom word:

- Die ontwikkeling van versuip-toestande waarby plantwortels aan 'n gebrekkige suurstofomgewing blootgestel word.
- Die opbou van watertafels.
- Die uitloping van voedingstowwe.
- Loging van plantdoders wat lei tot ondoeltreffende beheer van onkruide; skade aan gewas.

Onderbesproeiing lei tot:

- Ondoeltreffende benutting van voedingstowwe.
- Stremming van wortelgroei en dus
- Onderbenutting van die wortelsone.

Genoemde nadele lei tot groeiverliese wat opbrengsverliese, kwaliteitverlaging en laer winsgrens tot gevolg het. Op die langtermyn is dit egter die nadelige invloed van onoordeelkundige watertoediening op die grond wat blywende skade veroorsaak en wat nie altyd met duur praktiese reggestel kan word nie,' het mnr Nortjé gesê.



GRASKARP VERSLIND MEER SE PROBLEEM

Germistonmeer.

Dié *trés formidable* is so vaartbelyn soos 'n geelvis, gehard soos 'n gewone karp en is die ideale teenvoeter vir die beheer van die onwelkome waterplant, *Potamogeton pectinatus*, wat watersportliefhebbers by die Germistonmeer gekortwiek het — 'n beskeie opsomming vir die Chinese graskarp (*Ctenopharyngodon idella*).

Waterplantontwikkeling in Suid-Afrika wek tans groot kommer. Hierdie probleem ontstaan weens besoedeling en word aangehelp deur snel ontwikkelende nywerheids en landbouaktiwiteite. Die ontplofing van waterplantgemeenskappe is 'n wêreldwye probleem en hou verskeie nadele in: dit belemmer visseryaktiwiteite, benadeel hidroëlektriese en besproeiingskemas, vertraag water vloei, verhoog verdamping, meng in met ontspanningsaktiwiteite en

kan gesondheidsprobleme veroorsaak.

In Suid-Afrika waar ernstige watertekorte ons in die gesig staar, is dit uiters noodsaaklik dat waterplante doeltreffend beheer word — 'n aspek waarby die graskarp 'n belangrike rol kan speel.

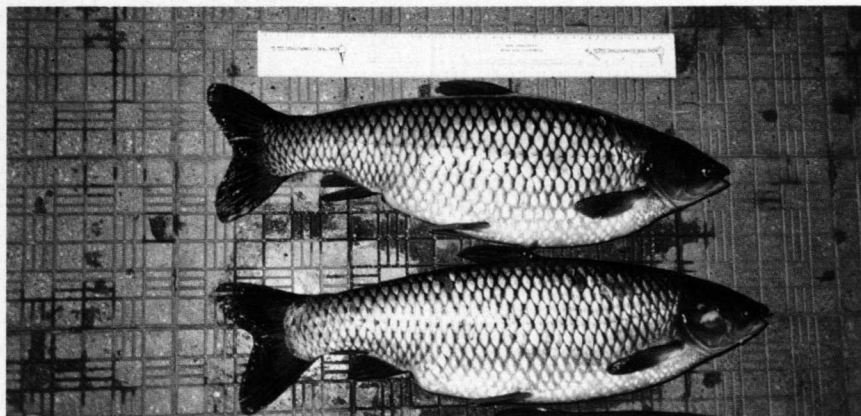
Karp se kind se weg na die Germistonmeer is so lank soos die riviere waar hy vandaan kom. Professor H.J. Schoonbee van die Randse Afrikaanse Universiteit vertel: "Die Chinese graskarp kom

oorspronklik van Rusland en China en is vir die eerste keer in 1967 vanuit Maleisië na Natal ingevoer. Weens hierdie beperkte invoer, word Transvaal genoodsaak om in 1975 vis vanaf Duitsland te verkry met die oog op onderwaterplantbeheer."

Omdat die Chinese graskarp slegs in hoogs uitsonderlike gevalle buite sy natuurlike omgewing van Asië aanteel, het daar met die invoer van hierdie vis die probleem van kunsmatige teling ontstaan.



(Onder): Voorbeelde van die ingevoerde Chinese graskarp wat by die Germistonmeer vir onderwaterplantbeheer gebruik word.



Prickelfaktore wat die vis induseer om te broei is klaarblyklik in Suid-Afrika afwesig. 'n Broei eier moet ook vir 24-36 uur nadat dit vrygestel is deur die vis, kan dryf in 'n riviersisteem met 'n vloedvlakte wat die eier daartoe in staat stel om uit te broei.

In teenstelling met die lang riviere van China en Rusland is die Suid-Afrikaanse riviere kort, met versnellings en kort vloedvlaktes wat, al sou die vis in staat wees om natuurlik te broei, die eier summier sal breek. Hierdie kenmerk hou egter die voordeel in dat indien broei in uitsonderlike gevalle wel plaasvind, die vispopulasies beheer kan word en vervuiling onder plaas

like toestande moeilik sal kan plaasvind.

Kunsmatige teling van die graskarp is egter moontlik met behulp van 'n hormoon-toedieningsprogram. In 1977 het Professor Schoonbee en die Afdeling Natuur-bewaring van Transvaal die resep van kunsmatige teling vir plaaslike toestande aangepas. Die proses sorg dat teling in die laboratorium beheer kan word en oorlewing van vingerlinge word op hierdie wyse verhoog.

Een van die Chinese graskarp se mees uitsonderlike eienskappe is sy vermoë om tussen een- en vyfmaal sy liggaamsmassa in plantmateriaal per dat te verorber

(resultate in Germistonmeer dui op minstens eenmaal). In Asië bereik die graskarp 'n massa van tot 50 kg en in Suid-Afrika is massas van 20 kg reeds bereik. In Westerse lande bestaan tans 'n toenemende aanvraag vir die graskarp as biologiese beheeragent.

In teenstelling met die vis se sukses as beheeragent vir onderwaterplante, dui waarnemings daarop dat hy nie so suksesvol is vir die beheer van drywendewaterplante (byvoorbeeld die waterhiasint, *Eichhornia crassipes*) nie. Hy maai die wortels af en in hierdie opsig bekamp hy in 'n mate die opbloei van die plant, maar beheer hom nie.

(Na bladsy 18)



(Van bladsy 17)

Germistonmeer

Vir Germistonmeer, nou 'n toonbeeld van pret en plesier vir watersportliefhebbers, was daar 'n tydperk toe dit gebuk gegaan het onder ernstige besoedeling. Die band van die Randse Afrikaanse Universiteit met die meer dateer terug tot sover as 1969 toe die universiteit deur die Munisipaliteit van Germiston genader is om in 'n komitee te dien wat na die erg besoedelde meer se toekoms moes omsien.

Tot in 1967 is die meer as 'n opgaardam vir van die aangrensende myne gebruik en bevat hy in daardie stadium 'n groot hoeveelheid piriet wat oorsprong aan swawelsuur gee. Die gevolg is dat die pH van die water in 1969 so laag as 3,6 op plekke was. Saam met ander faktore het die lae pH-waarde 'n klein spesievariasie en populasie van plante en diere tot gevolg gehad.

Ten spyte van die lae pH vind daar gedurende hierdie tydperk 'n aansienlike vermeerdering van muggies plaas. Nadat die muggieplaag vererger het, besluit die munisipaliteit na konsultering met verskeie instansies om die meer se pH te neutraliseer om visplasing moontlik te maak. Deur middel van die plasing van vis kon die muggies onder beheer gehou word.

Die meer se pH is geneutraliseer deur die toevoeging van ongeveer 1 miljoen liter vloeibare NaOH en meer as 50 000 kg landboukalk wat ook as buffer moes dien. Hierdie stappe en die ondersoeke van die R.A.U. in samewerking met die Munisipaliteit van Germiston, het alle bronne van besoedeling, insluitende mynsypelwater, ver-

wyder en het die meer sodanig van besoedeling herstel dat dit die inplasing van vis moontlik gemaak het.

Die plasing van gewone karp, geelvis, vleikurpers en swartbaars in die meer, het dit binne drie jaar in 'n hengelparadys omskep.

'n Faktor waarmee egter nie rekening gehou is nie, is die groot aantal nutriënte wat met die jare in die meer versamel het. Hierdie nutriënte is uitstekende plantvoedingstowwe en die ideale toestand wat na die herstel van die meer geheers het, lei tot die opbloeit van die waterplant *Potamogeton pectinatus*. Die watergras het binne 8 jaar in so 'n mate toegeneem dat hengel en watersportaktiwiteite ernstig benadeel en selfs kortgeknip is.

In 1982 word besluit om daadwerklik teen die probleem op te tree. Twee moontlike oplossings, chemies en meganiese, is oorweeg voordat Chinese karp as biologiese metode die uiteindelijke oplossing met die meeste potensiaal was.

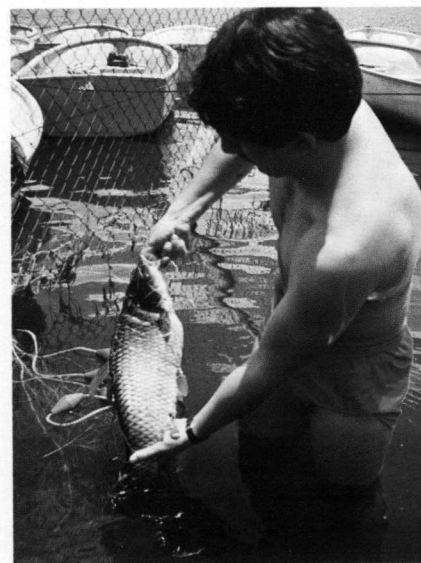
Die chemiese middels wat in die eerste plek voorgestel is, was duur en het gesondheids- en ekologiese probleme ingehou. Meganiese beheer wat reeds 'n geruime tyd deur die Parkeafdeling op die proef gestel is, was nie baie suksesvol nie en het die munisipaliteit 'n aansienlike bedrag uit die sak gejaag. Twee drywende onderwatergrassyers is byvoorbeeld aangeskaf teen die bedrag van R80 000 elk en kostes het verder die hoogte in geskiet met die onderhoud verbonde aan die projek; 4 vragmotors, 26 arbeiders en 4 bestuurders was nodig om die gras van tyd tot tyd weg te ry. Die totale koste het meer as R100 000 per jaar beloop.

(Links): 'n Deel van een van die onderwatergrassyers wat deur die Munisipaliteit Germiston aangekoop is. Prof HJ Schoonbee van RAU en mnr FJ Schoeman, direkteur van die Parke-afdeling van Germiston, kyk toe.

Biologiese beheer deur middel van die graskarp, die derde alternatief, word gedurende die tweede helfte van 1982 'n werklikheid nadat toestemming van die Afdeling Natuurbewaring van die Transvaalse Provinsiale Administrasie verkry is om die vis op 'n eksperimentele skaal in die Germistonmeer te gebruik.

In Desember 1982 word vyf duisend graskarpvingerlinge met 'n gemiddelde massa van 26 g in 'n aanhoudingshok van 1 000 m² in die meer geplaas. Die vingerlinge is hier grootgemaak en beskerm teen predasie deur swartbaars en watervoëls. Na formele toestemming is die visse in Augustus 1983 in die meer vrygelaat.

Die graskarp blyk heel tuis te wees te midde van hierdie watergrasparadys en is uitstekend in die beheer daarvan. Sedert die inplasing van die visse was geen verdere meganiese beheer tydens die somermaande nodig nie, wat 'n beraamde besparing van R150 000 meebring. Die meer is tans weer geskik vir talle watersportaktiwiteite.



Mnr Jan Vermaak, 'n M Sc-student aan die RAU, besig met 'n graskarp wat die onderwerp van sy verhandeling uitmaak.

IMIESA

Waterherwinning onder die loep

"Dit is ironies dat Windhoek se waterherwinningswerke, ten spyte van sy sukses, moontlik binne enkele jare oorbodig sal wees en gesluit sal kan word," het mnr PGJ Meiring van die ingenieursfirma Meiring & Vennote gesê toe hy onlangs in Kaapstad op die jaarlikse konferensie van munisipale ingenieurs oor waterherwinning vanuit die oogpunt van die ontwerpingenieur gepraat het.

Mnr Meiring het gesê dat die vraag na bykomende water in Windhoek so toeneem dat regverdiging moontlik in die afsienbare toekoms gevind sal kan word vir die bou van 'n Staatswaterskema wat water 750 kilometer ver uit die Kunenerivier na Windhoek sal bring. Die herwinningsaanleg sal waarskynlik dan nie meer nodig wees nie.

Mnr Meiring het gesê dit was juis die goeie diens wat deur die jare van die Windhoekse waterherwinningswerke verkry is wat Windhoek in staat gestel het om 'n

tydperk van groei deur te maak sonder om bykomende waterbronne te ontwikkel.

"Water uit so 'n alternatiewe bron sou destyds baie duur gewees het veral omdat klein hoeveelhede water baie ver vervoer sou moes word."

"Hierdie aansluitende of konjunktiewe gebruiksmoontlikhede wat waterherwinning bied, kan dus dikwels die belangrikste regverdiging vir 'n waterherwinningsskema wees. 'n Projek om aanvullende water ver te gaan haal, wat op 'n vroeë stadium baie duur sou wees, kan op 'n later stadium as die water meer optimaal benut kan word, veel makliker ekonomies geregverdig word," het mnr Meiring gesê.

Met verwysing na die hergebruik van water as 'n bystandsmaatreël het mnr Meiring gesê dat deur water te herwin en weer te gebruik die voorsiener minder afhanklik word van 'n enkele waterbron.

"As hergebruik nie vertolk word as 'n bron wat onder die normale loop van omstandighede die las op die primêre bron verlig nie, maar as 'n aanvullende bron wat slegs in tye van waterskaarste in werking gestel word, kan die aanvaarbare tempo van onttrekking uit die primêre bron merkbaar verhoog word sonder om die gevaar van ernstige watertekorte te vergroot," het hy gesê.

"Hergebruik as bystand doen ook grootliks weg met die vrese wat mense het vir die moontlike akkumulatiewe effek van toksiese stowwe as herwonne water oor lang tydperke gebruik word, maar dit bots ongelukkig met 'n riglyn (nr 6) van die Departement Gesondheid wat die vermengingsverhouding en samestelling van die gelewerde water so konstant moontlik wil hou.

"Indien minder klem op hierdie riglyn gelê word, sou 'n uitgestrekte vlak opgaardam met groot verdampingsverliese tydens hoëwaterstand heelwat doeltreffender benut kan word, wat ook beteken dat die totale volume herwonne water wat oor jare ingeneem word baie verminder.

"Dit sal wel die eenheidskoste van die herwonnewaterkomponent verhoog maar dit sal waarskynlik die saamgestelde koste van al die water wat oor 'n lang tydperk voorsien word, verminder.

"As hiermee saam in beginsel aanvaar word dat in Suider-Afrika altyd droogtes sal voorkom en rantsoenering van tyd tot tyd ingestel sal moet word, kan die omvang van rantsoenering met herwonne water verlig word terwyl effektief heelwat meer water beskikbaar gestel word as wanneer daar gemik word op 'n versekerde lewering waartoe herwonne water 'n vaste persentasie bydra," aldus mnr Meiring.

Dr OO Hart, senior adviseur van die Waternavorsingskommissie, het gesê water, in watter vorm ook al, is té kosbaar om net een keer gebruik te word en dit dan weg te gooi.

(Na bladsy 20)

Quite applicable to the always present issues on environmental policies is a quotation of the poet T.S. Eliot: "I sat upon the shore fishing, with the arid plain behind me. Shall I at least set my lands in order?"

ENVIRONMENTAL FILM AIMS AT PUBLIC EDUCATION

The Great Threat to South Africa's environment, apart from a rapid expanding population, is public ignorance. The Conservation for Development Awareness Project (CDAF) is a programme aiming to, amongst others, create awareness for the Republic's inland water ecosystems and vulnerable coastal areas and estuaries.

The project, which involves professional ecologists, film makers and public relation consultants, is an extension of the work carried out by the Wild Life Society. They will produce a film series along with an educational programme which have been developed to guide public opinion and will distribute it to all sections of South Africa's population.

Because the Wild Life Society has limited funds, the CDAF cannot rely on them or on the Government for financial support. The CDAF, therefore, has to appeal to business corporations for financial support. Those interested can contact the Project at the following address or telephone number:

CONSERVATION FOR DEVELOPMENT AWARENESS PROJECT
P.O. Box 3311
Cape Town
8000
Tel: (021) 70-9512/46-2892

IMIESA

(Van bladsy 19)

Hy het gepraat oor die faktore wat 'n rol speel wanneer die moontlikheid oorweeg word om 'n waterherwinningsaanleg te bou vir die hergebruik van water as drinkwater.

Dr Hart het gesê dat waterherwinning en — hergebruik 'n betekenisvolle bydrae kan lewer om die probleem van die eenmalige gebruik van water die hoof te bied.

"Geen wetenskaplike, ingenieur of besluitnemer sal ooit die gebruik van herwonne water aan Jan Publiek wil opdrag nie. Maar, algemeen gesproke, kan gesê word dat waar die verwagte vraag na vars water die ekonomies-beskikbare voorraad oorskry, soos wat verwag word in Kaapstad gaan gebeur, die moontlikheid bestaan dat herwonne water gebruik sal moet word en is dit 'n alternatief wat ondersoek kan word."

Dr Hart het gesê dat die navorssing oor waterherwinning wat vir langer as tien jaar deur talle instansies in Suid-Afrika uitgevoer is, saamgevat is in 'n *Gids vir die beplanning ontwerp en bedryf van waterherwinningsaanleë*. Die Gids is onder beskerming van die Waternavorsingskommissie deur 'n firma raadgewende ingenieurs opgestel.

Die doel van die Gids is om plaaslike owerhede en die nywerheid te help met die beplanning van waterherwinningskemas asook om riglyne aan ingenieurs wat by waterherwinningsprojekte betrokke is, te verskaf.

Water Up!

According to the British Water Bulletin a household water use survey carried out by Severn Trent Water estimates an individual's average daily consumption of water to rise from 123 to 150 litres by the year 2001.

Since 1977 ownership of showers, automatic washing machines and dishwashers has more than doubled and outside taps are also on the increase. Calculations indicate a rise of about 25 per cent in water usage in 25 years time.



Prof G van R Marais.

UCT HONOURS MARAIS

At the recent June graduation ceremony of the University of Cape Town Professor Gerrit Marais was awarded the degree of D Sc (Eng). With this degree comes the distinction for Professor Marais of being one of only six people to have received the award from the University.

Professor Marais was appointed to the Chair of Water Resources and Public Health Engineering at the University in 1967 and has established himself as an authority in the field of the treatment of municipal wastewaters by means of the activated sludge process. His submission for the D Sc (Eng) degree was made up of 8 papers published over the period 1976 to 1983 and contributions to a monograph entitled "Theory, Design and Operation of Nutrient Removal Activated Sludge Processes" published in 1984 by the Water Research Commission. These

papers simply highlight a much larger body of research work. His first publication appeared in 1961 on oxidation ponds and has been followed by 50 papers in international journals on oxidation ponds, the activated sludge process and the carbonate chemistry of aqueous systems. He has also submitted 50 technical reports and is co-author of three books, one on the theory, design and operation of nutrient removal activated sludge processes mentioned earlier and two on the carbonate system in low and high salinity water.

Professor Marais has been a member of the World Health Organization Expert Committee on Sanitation since 1970. In 1972 he was elected distinguished foreign visitor of the American Society of Sanitary Engineering Professors. In 1975, and again in 1980, he participated in Pan-American Health Organization projects, on planning and implementation of laboratory and pilot studies of the activated sludge process.

More recently Professor Marais has been appointed to an international task group of six members to draw up a definitive statement on the mathematical modelling of the activated sludge process. This task group was formed by the International Association of Water Pollution Research and Control (IAWPRC).

Spanspek floreer op soutwater

'n Belangrike ontdekking vir besproeiing is deur 'n gekombineerde navorsingspan van Egipte en Israel gemaak. Volgens *World Water News* het die span gevind dat spanspek tot 9 000 mg/l sout in besproeiingswater kan inneem sonder oes-vermindering, wat beteken dat die brak- en soutwater wat in Egipte en Israel gevind word, daarvoor geskik is.

Die regte tegniek is egter belangrik en so moet tamaties byvoorbeeld eers in vars water gekweek word tot die vierde blaartjies ontwikkel het voordat daar na water met 'n soutinhoud van 5 000 mg/l oorgeskakel kan word.

The new Water Amendment Bill

Conference explains

The new Water Amendment Bill and its influence on industry was the controversial topic of a conference presented in Johannesburg by the Manpower and Management Foundation of Southern Africa. The how's, the why's, the do's and the don'ts are all closely-linked aspects which were discussed.

Best gives practical guidelines . . .

Some practical guidelines on permits required in terms of the Water Act, were given by Mr HJ Best, the Director for Water Pollution Control of the Department of Environment Affairs.

"Activities such as feedlots and chicken batteries will be considered as industrial undertakings and will be subject to the provisions of the Water Act. Holiday

resorts, hotels, restaurants and hospitals which use more than 150 m³ of water on any one day will be required to apply for section 12 permits to authorise such usage. If effluents are not discharged to municipal sewers, the section 12 permit will contain conditions relating to the safe disposal of sewage and other effluents," Mr Best said.

"The Department", he continued, "favours the establishment of Industries producing saline effluents to be located at the coast so that, subject to specific conditions, the saline effluents could be disposed of into the sea. In this way mineralization of inland fresh water resources can be reduced."

(To page 22)

A ROUGH GUIDELINE TO INDUSTRY OF PERMITS REQUIRED IN TERMS OF THE WATER ACT

| WATER INTAKE FROM WHATEVER SOURCE | LOCATION | EFFLUENT DISPOSAL | REQUIREMENTS UNDER WATER ACT AS AMENDED |
|--|---|--|--|
| Less than 150 m ³ /day on any one day. | Within a Local Authority's area of jurisdiction. | Effluents meet Local Authority by-laws and is discharged to sewer. | No permit required, unless the Minister otherwise decides. |
| | | Not discharged to sewer (own effluent disposal). | Requires a permit in terms of section 21 of the Act before commencement of operation. |
| | Outside a Local Authority's area of jurisdiction. | Effluent meets quality requirements of the applicable* standards and is discharged into the public stream of origin. | No permit required. |
| | | Effluent does not meet quality requirements of applicable* standards <i>neither/nor</i> discharged into the public stream of origin. | Requires a permit in terms of section 21 of the Act before commencement of operation. |
| More or Equal to 150 m ³ /day on any one day. | Within a Local Authority's area of jurisdiction | Effluent meets Local Authority's by-laws and is discharged to sewer. | Requires a permit in terms of section 12 of Act before starting operations. |
| | | Not discharged to sewer (own effluent disposal). | Requires permits in terms of section 12 and 21 of the Act before starting operations. |
| | Outside a Local Authority's area of jurisdiction. | Effluent meets quality requirements of the applicable* standards <i>neither/nor</i> is discharged into the public stream of origin. | Requires a permit in terms of section 12 and 21 of the Act before starting operations. |

*Applicable standards can be the General or Special Standard depending on the catchment in which the effluent is discharged.

Water pollution: threats . . .



Water Bill continues

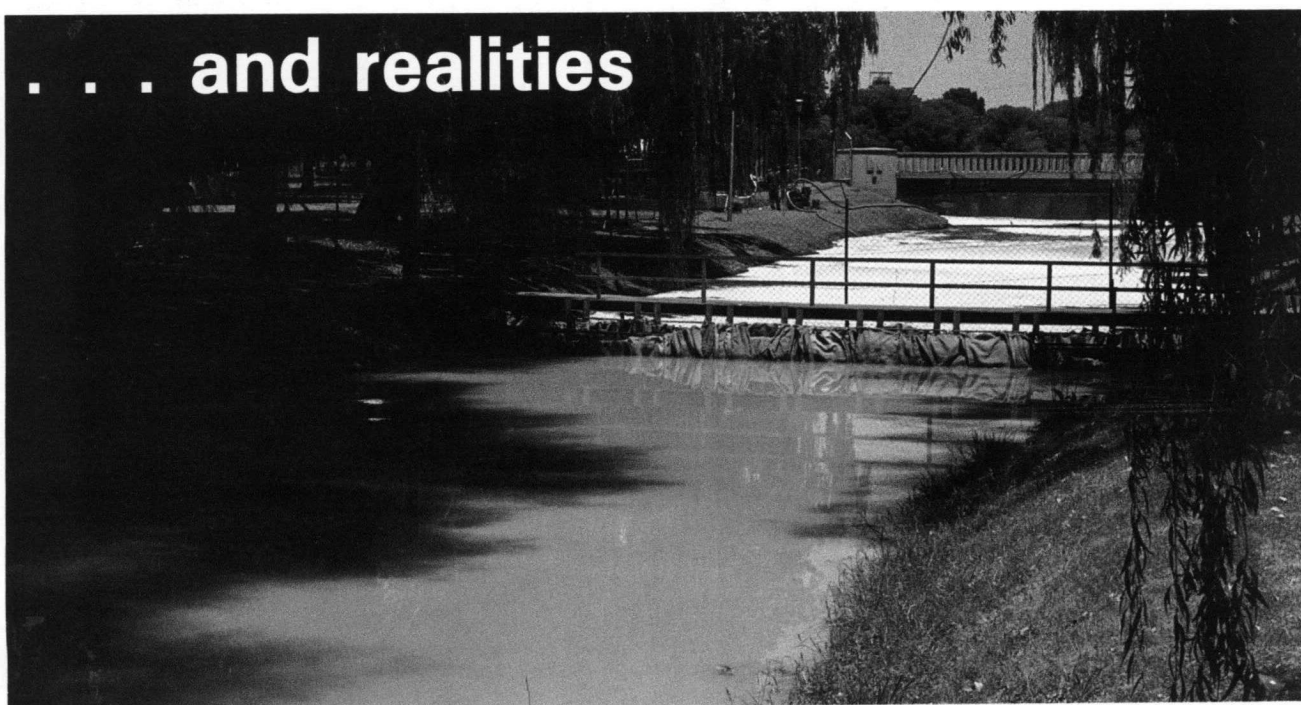
(From page 21)

Attending the same conference

was Mr NFE Parker who gave talk with slides on water pollution and the effects of eutrophication and mineralization — the two major

pollution problems — on water. Mr Parker is the Water Pollution Control Officer for the Department of Environment Affairs.

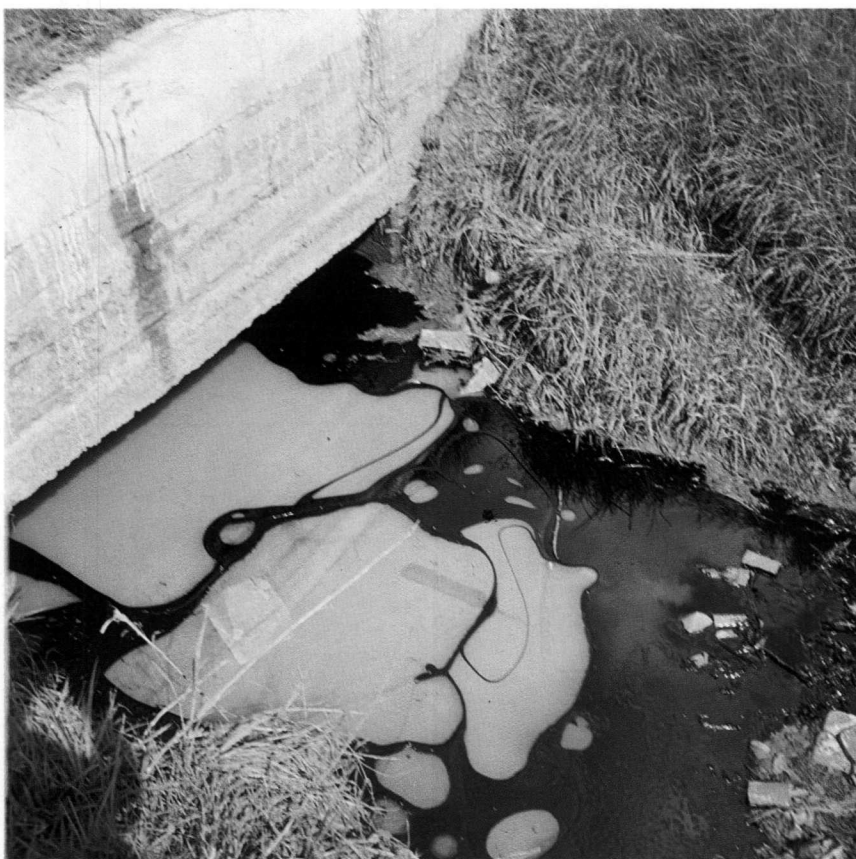
. . . and realities



(Right): Soluble oil and oil are floating on the surface of the water. Soluble oil forms a stable emulsion and can be carried long distances.

(Opposite page top): The damage done to the cabbages seen on the photograph is due to the salinity of irrigation water drawn from a river which was polluted by an industrial company.

(Opposite page bottom): In this stream entering Boksburg lake, the yellow in the foreground is due to pollution with sulphonic acid (used to make detergents). Foaming in the background under the bridge is because of aeration of the river to break down the chemical.



Water Act's implications for plant and facilities

In his presentation, the spokesman for Fluor Engineers S.A., Mr. MP Sterne emphasised the implications for plant and facilities of compliance with the Proposed Amended Water Act: "The threat of curtailment of supplies, increasing costs and expanding state regulatory powers are leading industry to take an even closer interest in the consumption and discharge of water.

"Technological implications of the Proposed Water Amendment Act lie in the greater powers of control which are given to the Department of Environment Affairs over both industrial water consumption and effluent discharge," Mr Sterne said. "Under Section 12 all consumers of industrial waters exceeding 150 m³ per day in quantity would require a permit. Control is therefore extended to smaller industries that previously did not require permitting."

On industrial effluent discharge Mr Sterne said: "The Proposed Water Amendment Act makes no changes to the discharge standards laid down in 1956. However, it seems reasonable to expect tighter enforcement of these standards, particularly applied to smaller industries. It may not be unreasonable to expect some changes to the standards subsequent to the passage of the bill. In addition, municipalities may tighten their standards and increase tariffs.

Highlights of the Proposed Water Amendment Act as seen by Mr Sterne are sections 9, 12, 21, 22, 26. Section 9 will affect investigation procedures, section 12 the permit required for water used for industrial purposes and section 21 the treatment of effluents. In sections 22 and 26 powers over water pollution are extended.

For an existing industry which is required to address water and ef-

fluent management for the first time, Mr Sterne recommended a phased approach:

- Measure intake and effluent water rates, effluent pollution, and loads and compare results against water permit requirements, applicable discharge standards as well as against plant design or theoretical figures.
- Formulate specific objectives.
- Encourage good housekeeping procedures.
- Identify minimum water quality requirements for all water users.
- Investigate segregation and reuse of effluents.
- Conduct a feasibility study to identify applicable technologies and costs.
- Conduct pilot plant work if required.
- Select the lowest cost programme to achieve objectives.

Water management and industry:

WHAT DOES THE FUTURE HOLD?

— by PE Odendaal

"To predict the future interaction between water and industry in South Africa is fortunately, or unfortunately, eased by the certain knowledge that water will progressively become a scarcer and more expensive commodity, and industry will enter — in fact is already entering — a phase where water conservation and pollution control will have to feature more strongly in its management objectives."

This was said by Mr PE Odendaal, Chief Adviser of the Water Research Commission when he sketched a picture of South Africa's future water situation at a conference on the new water amendment bill, organized by the Manpower and Management Foundation.

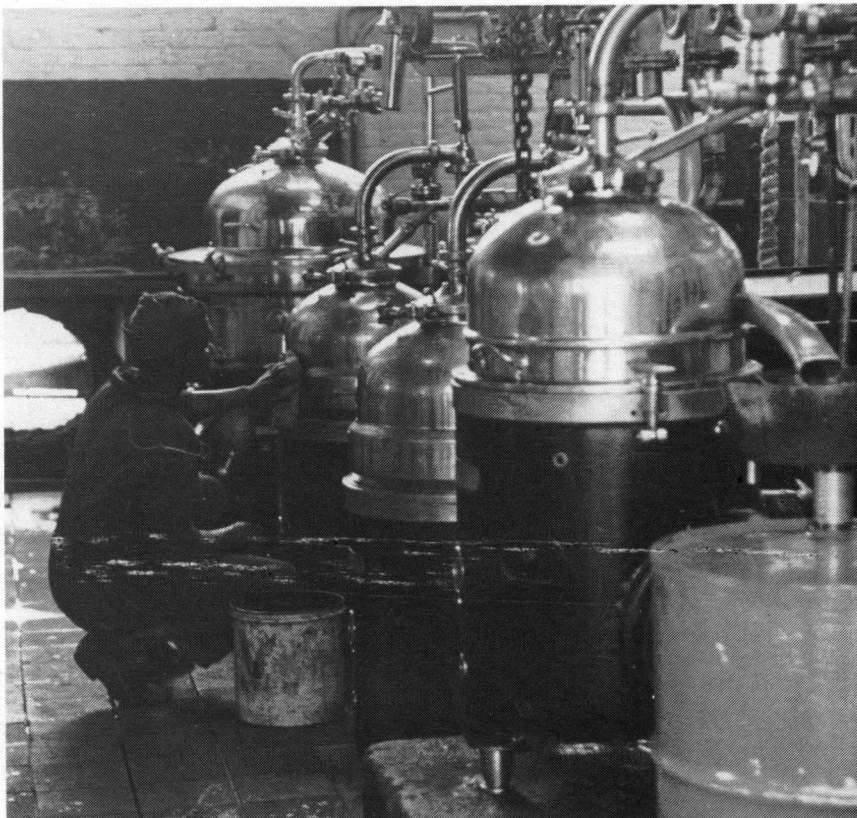
Mr Odendaal said that by taking early note of these projected developments, industrialists can take action in good time to adapt to the changes that will come.

He outlined the following probable areas of future development which he said would impinge on industrial water management:

- ★ The development of national norms for industrial water usage and pollution discharge.
- ★ Improved technology for water and effluent management.
- ★ Improved management structures for handling water and effluent.
- ★ The integration of water supply and effluent treatment.
- ★ Improved recovery of by-products.
- ★ Curbing of industrial development in water sensitive areas.
- ★ Water quality problems.

National Norms

Mr Odendaal said that the need for national norms for water usage and pollution discharge by related groups of industry became apparent to the Water Research Commission (WRC) during the present drought. The WRC therefore decided, in collaboration with the Department of Environment Affairs,



By-product recovery at a wool scouring plant.

to launch a national survey of industrial water management in order to build up the necessary data base.

"The Water Research Commission realized that this would be a formidable and time consuming task, and although the findings would probably only become available after the present crisis had passed, we must nevertheless prepare for the future," he said.

Mr Odendaal said: "The value of the data base will go beyond the establishment of targets for in-

dustry. It will provide guidelines to local authorities if water restrictions again become necessary; in addition it will guide the Department of Environment Affairs in allocating water quotas for new factories, and also other water supply authorities in planning for new industrial developments."

Improved Technology

Mr Odendaal said: "There is little doubt that the regulatory control aimed at water conservation and

pollution control will progressively become more severe. This, together with an increase in the price of water, will be a natural adjunct to the mounting pressures on the quantity and quality of our water supplies.

"What will the effect be on industry? If these developments are not preceded by a steady generation of technically and economically feasible technology, it will be tantamount to killing the goose that lays the golden eggs.

"The only rational approach, therefore, is a concerted and sustained research effort to improve the relevant technology. Research in this field is in fact being done world-wide. Nevertheless, as South Africa's need is perhaps greater than that of any other country, we must take the lead and not wait on the results from overseas. Also, overseas research is tailored for overseas problems and that resulting technology cannot be transferred to local conditions without thorough evaluation and possibly modification.

"The Water Research Commission's research approach in this field is twofold: Firstly, to look at the water and effluent problems of specific industries, and secondly, to improve and develop specific technologies that can be used in the industrial situation.

"Under the first approach the industries receiving attention are the textile industry, the tanning and fellmongering industries, the fruit and vegetable processing industries, the fishing industry and the meat processing industry.

"In each instance the Water Research Commission involves, as far as possible, all interested parties, including the Department of Environment Affairs and the relevant industrial associations, to assist in defining the research needs and priorities and to guide the research projects which follow. This is done through the establishment of co-ordinating R & D committees and project steering committees. Pilot plants are operated on the premises of a representative factory. In this way it is ensured that the potential users of research findings are involved at all stages of the research process. Results are disseminated through open days and the publication of practical guides.

"The Department of Environment Affairs is represented on all the committees mentioned and is thereby kept fully informed of progress made. It can therefore, be assumed that the future tightening up of regulatory control will be based on the rational consideration of progress made in the improvement of technically and economically feasible technology.



Mr PE Odendaal, chief adviser at the WRC — *"To be forewarned is to be forearmed"*.

Improved Management

During the current drought, Mr Odendaal said, many factories had achieved dramatic reductions in water usage, without a corresponding reduction in output. He said: "At first glance this seems rather strange, but on closer consideration the explanation is probably very simple: for the first time, in many of our factories, water conservation has been recognised as a specific management objective. Water has in the past just been too cheap to merit close attention. During the drought and its concomitant water restrictions, industrialists who have never done so before, were forced to look closely at their water circuits. In many cases specific officers were for the first time charged with this responsibility. The results were marked improvements in water conservation through the introduction of low-cost measures — a natural consequence of improved in-house management.

"The effect of expert water management is apparent in the impressive reuse of pollution control systems that have been developed by a number of large factories such as SASOL, ISCOR and AECI. The main reason for success in these cases is that each of these factories have created special sections devoted to water and effluent management.

"The message is clear: Improved water management in industry can only result from improved management structures and directives. Factories that have not yet created effective water management structures will have no choice but to do so in future. Not all factories will be able to afford to build up an in-house expertise in water. Business opportunities will therefore, exist for consultants who can specialise in providing a service to industry for the planning, operation and maintenance of water systems."

Integration

On this topic Mr Odendaal said: "At present, water supply and effluent treatment in South Africa often falls under different authorities. For example, in the PWV-area, the bulk supplier is the Rand Water Board while the responsibility for effluent treatment falls mainly on the various local authorities in the region. Even where both functions are performed by a single local authority, water supply and effluent purification are mainly seen as unrelated activities.

"The concept of integrating the responsibility for water supply and effluent treatment on a regional basis is now under serious consideration. Such regionalisation must lead to a more holistic approach in which effluent treatment and water supply can to some degree, be integrated. Many factories do not need water of potable quality for all their processes. Secondary sewage effluents, possibly with some upgrading, are suitable for certain industrial processes. This has been adequately proven by a number of pulp and paper factories in South Africa. Regional water authorities will be in an excellent position to recognise those fac-

(To page 26)

Industry

(From page 25)

tories which can beneficially use treated effluents, so that this form of water recycling can be expected to increase in future.

"Along the same lines, there are situations where the effluent from one factory could serve as intake water for another factory. At present no one is really in a position to recognise and act upon such situations. Regional water authorities will be ideally placed to do so.

"The national data base for industrial water and effluent as described earlier on will be an invaluable tool for recognising industrial water reuse opportunities on a regional basis.

"A third development that should evolve from the establishment of regional water authorities is a greater consolidation of effluent treatment in a particular region. Greater expertise can be brought to bear on effluent treatment by a large authority than collectively by a number of smaller authorities. Through the dilution effect, larger treatment plants can more easily cope with industrial effluents than smaller plants where the presence of proportionally large quantities of industrial effluents could inhibit the effective performance of purification systems."

Mr Odendaal said that the regional approach to effluent treatment should also lead to the construction of centralised facilities for the handling of industrial wastes. This was exemplified in the pipeline for the marine disposal of highly mineralised industrial wastes which was being planned by the Department of Environment Affairs in the Berlin area between East London and King William's Town.

RECOVERY OF BY-PRODUCTS

Mr Odendaal said that an approach which was becoming enmeshed in research on waste disposal was that of by-product recovery.

"In many instances the wastes carried in an effluent have poten-

tial value and although their recovery would rarely be a profitable venture, it could significantly offset the cost of wastewater management.

"In the past this approach has largely been neglected, mainly because a factory involved in the production of a specific commodity line usually does not wish to become involved in the relatively small-scale recovery of a different type of product.

"This situation is changing, however. In view of the tighter regulatory control that must come to conserve water and control pollution, water recycling will, to an increasing extent be incorporated by industry. In upgrading effluents for recycling, wastes become more concentrated and easier to recover. At the same time the potential market for certain by-products is rapidly improving. A case in point is that of protein recovery for animal feed. During 1983 South Africa had to import fish meal and oil cakes to the value of R150 million. This situation will deteriorate. By the year 2000 we will have a shortfall of 1,1 million tons of oil cake equivalent. Potentially 450 000 tons of protein could be recovered from for example, the poultry, meat processing, dairy, brewing, maize and other food processing industries. This could contribute greatly in narrowing the deficit gap in available protein for animal feed.

"It is likely that firms specialising in the recovery and reprocessing of by-products from waste stream will establish themselves and through appropriate arrangements relieve factories of a task that may not easily fit in with their basic activities.

"Energy recovery too should not be overlooked. Many wastewater streams are hot and by upgrading and recycling these, valuable energy can be reclaimed. In an era of rising energy costs this can become a significant factor in effluent management."

CURBING INDUSTRIAL DEVELOPMENT

Mr Odendaal said that the Minister of Environment Affairs and Fish-

eries, Mr SAS Hayward, recently expressed the view at a symposium of the Vaal River Catchment Association in Pretoria that a serious look had to be taken at the advisability of further industrial expansion in the PWV-area, and it was likely that industrialists would soon find it difficult to establish or expand wet industries in this area.

WATER QUALITY PROBLEMS

Mr Odendaal said that the water pollution phenomenon did not only have an impact on industry by way of the effluent standards to which it had to conform under the Water Act. Industry was also on the receiving end in that pollution was progressively degrading the quality, and in particular the mineral quality, of its water intake.

He said this problem was already manifest in the PWV-area where there is clear evidence that the salt content of the water in the Vaal Barrage is increasing from year to year.

How will this problem be handled?

Salt pollution

Mr Odendaal said: "One will have to look at the controllable sources of salt pollution and to the available technology to deal with these — in other words, what is the status of desalination technology? This technology, membrane technology in particular, has shown great progress over the last decade or so. The NIWR and the WRC are involved in a number of projects to improve or evaluate desalination processes in South Africa. A collaborative project between the WRC and ESCOM to evaluate electrodialysis (EDR) for the desalination of cooling tower blowdown has been successful to the extent that ESCOM has installed a full-scale unit at Kriel power station, while another is being installed at Tutuka. The WRC and the Chamber of Mines are collaborating in testing EDR and seeded slurry reverse osmosis for the desalination of high TDS mine waters.

"A rough cost estimate for the desalination of industrial effluents at this stage would be 50-69 c/m³.

Out of the Wilderness:

CRITICAL ASPECTS STUDIED

Over one hundred delegates, of whom fourteen were from overseas countries, attended the Symposium on Perspectives in Southern Hemisphere Limnology convened by the Inland Water Ecosystems and the Limnological Society of Southern Africa (LSSA) under the auspices of the International Association of Limnology (SIL), from 3-6 July 1984. The objectives of the symposium were:

- To review and synthesize knowledge and understanding of significant features of southern hemisphere/low latitude inland waters.
- To examine the degree to which limnological principles developed in the northern hemisphere/high latitudes are applicable in the southern hemisphere/low latitudes.

- To interpret current knowledge in the light of environmental concerns, management strategies and future research and management needs.

The four main themes of the symposium were thermal characteristics; aridity and hydrological characteristics; seasonality/aseasonality and suspensoids/turbidity.

The symposium proceedings, edited by Dr BR Davies (Department of Zoology, University of Cape Town) and Dr RD Walmsley (Department of Plant Sciences, Rhodes University) will be published in the journal *Hydrobiologia* and as a hardback edition in the series *Developments in Hydrobiology*.

The symposium was followed by a workshop "Limnological criteria in the management of southern

hemisphere inland waters" which sixty-four invited participants attended from 9-13 July 1984. The workshop proceedings will be edited by Professors BR Allanson and RC Hart and will be published in the South African National Scientific Programmes Report series or by an international commercial publisher. This report will be aimed at an audience including the research community, managers of water resources and funding agencies. The workshop focused on the identification of questions that are critical to the management of water bodies and provision of limnologically sound guidelines to their solution. Gaps in existing knowledge that require research were indicated as a guide to the funding agencies and research groups.

— Lezanne Lombaard



A few happy layers of limnologists at the Wilderness.

new books . . . new books . . . new books . . .

HYDRAULIC ENGINEERING

DEVELOPMENTS IN HYDRAULIC ENGINEERING — 2

Edited by P Novak

Published by Elsevier Applied Science Publishers Ltd., Ripple Road, Barking Essex, England. 243 pp, illustrated, 1984

This book, the second of the series, represents an authoritative, comprehensive and up-to-date review written by specialists familiar with the background of their subjects, who are active in the subject and have significantly contributed to it. The book consists of five chapters which deal with important problems encountered in the design of hydraulic structures. The areas covered are vibrations in hydraulic structures, gate vibrations, aeration at hydraulic structures, spillways of high dams and energy dissipation at high dams.

The first chapter serves as a comprehensive introduction to flow-induced vibrations in hydraulic structures and a general discussion of the principles involved. This chapter deals, *inter alia*, with computational techniques, studies of added mass, added rigidity, added damping and self excitation and excitation forces.

The second chapter is a detailed and well illustrated presentation of flow-induced vibration of gates. It deals with characteristics of gate vibrations, theory of self excitation (with 17 examples illustrating theory), self controlling gate vibrations, seal design, prevention of vibrations, cavitation and the use of hydroelastic scale models.

The third chapter deals with air intrainment in hydraulic structures, aerated flow in open channels, transition phenomena, air vents, natural de-aeration of vertical descending flow in shafts and oxygen enrichment at hydraulic structures.

The third chapter is followed in the remaining two chapters by a

wide ranging account of approaches, pitfalls and recent developments in the design of spillways and energy dissipators at high dams. The fourth chapter deals with the design of spillways of high dams and special attention is given to chute and tunnel design considerations with special reference to cavitation, cavitation damage and its control. The fifth chapter deals with the design of energy dissipators, specifically the hydraulic jump basin, roller bucket

dissipators, flip buckets and plunge pools. Other aspects dealt with in this chapter include cavitation in energy dissipators, cavitation control by aeration and dissipators for high pressure outlets.

The text is very well supplemented by useful references and illustrations and represents a good practical evaluation of the state of the art and presents the designer with practical design tools. This is a very suitable book for practising engineers and for graduate courses in civil engineering hydraulics and hydraulic structures.

J E Mc

HEALTH ASPECTS

"Maximizing Benefits to Health — an appraisal methodology for water supply and sanitation projects" WHO Offset Document ETS/83.7, WHO Geneva 1983.

"Maximizing Benefits to Health" considers all of the aspects that must be taken into account if maximum benefits are to result from investments in water supply and sanitation technology. A methodology is proposed which permits the conversion of community and project information into a numerical form, thus simplifying the project appraisal process prior to the allocation of resources to project implementation.

The proposed methodology is a unique one. Fourteen aspects are identified and described in the four broad areas of local health conditions, the nature of physical facilities for water and sanitation, human behaviour and available support services. Each of the fourteen aspects is further subdivided in such a way that a simple scoring system can be applied. The result is that a score of from 0 to 4 can be determined for each of the fourteen aspects. The sum of the aspect scores yields a project score which, when high, indicates a good chance for a successful project.

Conversely, a low project score or a zero in one or more of the aspect scores is indicative of potential project failure.

The methodology has two readily evident applications. First, it is a rational procedure for the selection of projects for implementation from among a number of candidate projects. By greatly increasing the prospects for successful projects, scarce resources — financial, human and material — are conserved. The second application relates to programme design since use of the methodology for project selection will quickly reveal those aspects of a programme that are consistently weak. Thus, programme can be redesigned to overcome those weaknesses.

Planners, decision makers, programme implementers and evaluators should find "Maximizing Benefits to Health" to be a useful and practical tool which will help ensure that health benefits will be one of the major dividends from investments in water supply and sanitation.

Copies of the document may be requested from The Manager, Environmental Health Technology and Support Unit, World Health Organization, 1211 Geneva 27, Switzerland.

TOERUSTING

Ten einde 'n inligtingsdiens aan ons lesers te lewer, verwelkom die redakteur bydraes vir publikasie (beperk tot ongeveer 300 woorde en een of twee foto's en diagramme) deur vervaardigers en verspreiders van nuwe toerusting en prosesse wat met die bevordering van water-aangeleenthede verband hou.

Sulke bydraes word egter ontvang of gepubliseer met dien verstande dat: (1) die betrokke vervaardiger of verspreider wat die bydrae lewer, verantwoordelik bly vir die inligting of menings daarin vervat en vir aansprake ten opsigte van daardie toerusting en prosesse; en (2) publikasie daarvan nie impliseer dat die redakteur of die uitgewer of die Waternavorsingskommissie die inhoud van so 'n bydrae aanbeveel of daarmee in ooreenstemming is nie.

Lesers wat meer inligting verlang, word versoek om direk met die vervaardigers of verspreiders in verbinding te tree.

Anton Prinsloo
REDAKTEUR



SA Waterbulletin
PO Box/Posbus 824
Pretoria 0001

EQUIPMENT

As an information service to our readers, the editor welcomes for publication contributions (limited to approximately 300 words and one or two photographs and diagrams) by manufacturers and distributors of new equipment and processes related to the promotion of water affairs.

Any such contribution is, however, received or published on the understanding that: (1) the relevant manufacturer or distributor submitting the contribution is responsible for the information or opinions expressed in it and the claims made therein for that equipment or those processes; and (2) its publication does not imply that the editor or publisher or the Water Research Commission underwrites or is in agreement with the contents of such contribution.

Readers who require further information are requested to contact the manufacturer or distributor direct.

Anton Prinsloo
EDITOR

PVC GUTTER SYSTEM

A PVC gutter system which will not warp, bend or twist and designed to combine the best in aesthetic appeal with technical innovations for speedier erection has been developed by Duropenta.

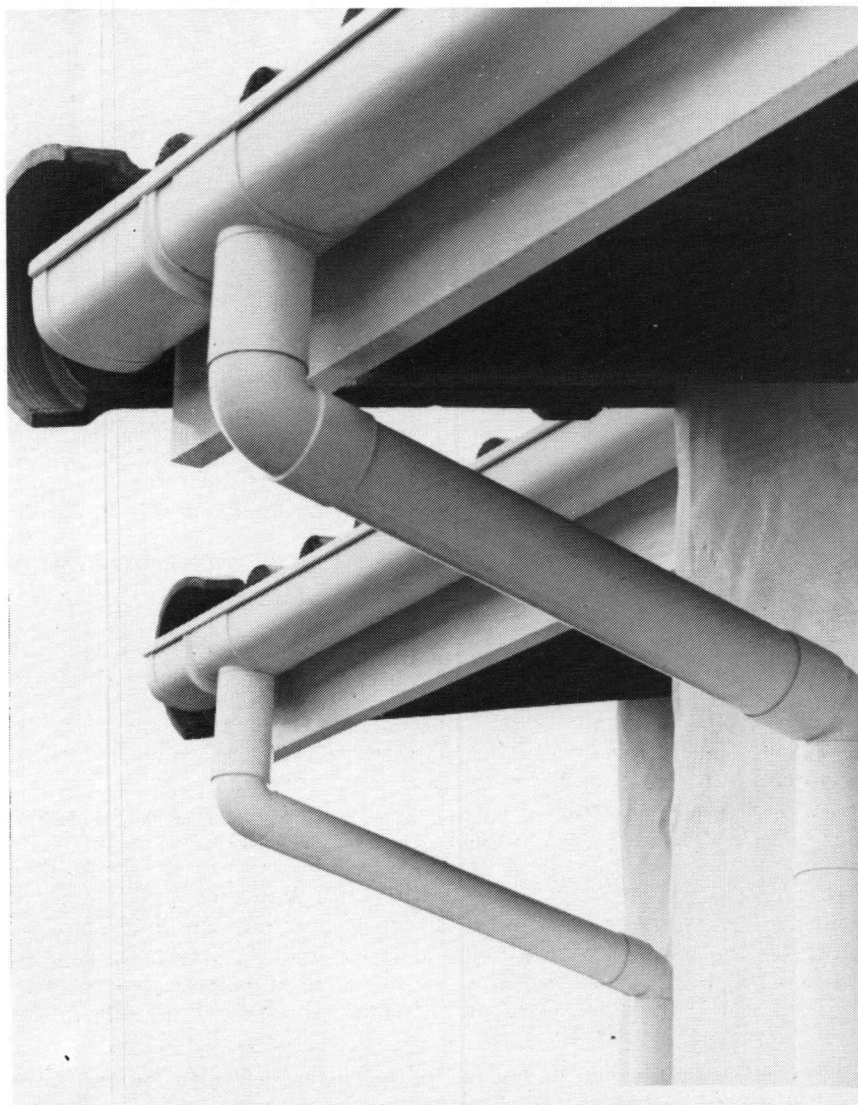
The system known as "Penthouse", is a PVC clip-on gutter which combines the appearance of a square gutter, whilst improving on the free-flowing characteristics of the traditional half-round guttering but with a unique "D" profile. Manufactured from rigid white PVC compound, Penthouse is tough, flexible, resistant to weather and ultra-violet light, and needs no paint protection, say Duropenta.

The unique "D" profile eliminated the warp and twist originally associated with PVC gutters. In addition the design enables Penthouse to be erected in far less time taken to erect traditional guttering.

Two down pipe designs are available; the standard round and a stylish square design.

The jointing method used is a combination of solvent adhesive joints for positive fixing, and rubber sealing expansion joints where necessary to take up thermal movement. The expansion joint is of robust construction fitted with double lip rubber seals. All seals are pre-lubricated with a special silicone grease on assembly at the factory.

Enquiries:
Duropenta (Pty) Ltd
PO Box 86
New Germany
3620



METER-BOX

The concept of having a water meter piped in a cast-iron box for easy installation and replacement has been expanded to a double meter-box where two meters are mounted side by side in one box.

Because there is only one excavation to be done, one mains connection to be made and one box to fit for every two houses, service and installation costs are virtually halved. Meter reading and servicing is also rendered more cost effective. There is a capital cost saving too, as one double meter-box is less expensive to buy than two single boxes.

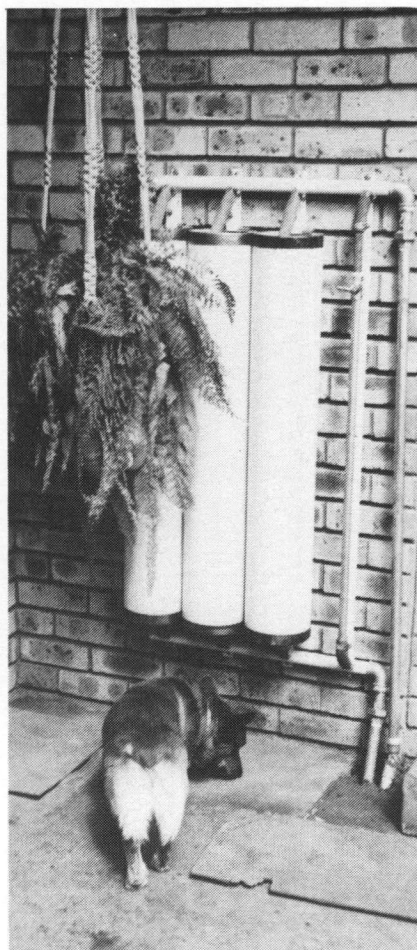
The single inlet connection of the meter box is 25 mm (1 BSP) female, while the two outlet connections are available as 20 mm ($\frac{3}{4}$ BSP) female, 20 mm ($\frac{3}{4}$ BSP) male or 15 mm ($\frac{1}{2}$ BSP) male.

With housing developments mushrooming all over the country, local authorities are set to save significantly in terms of installation costs.

As with the single meter-box, the double meter-box houses the accurate and reliable Optima 2000 meter and the box can be installed in a matter of minutes.

Enquiries:

Castle Brass Holdings (Pty) Ltd
PO Box 4340
Luipaardsvlei
1743
Telephone (011) 762-2412
Telex 4-30257 SA



ONTKALK WATER

'n Nuwe ontkalkingstoestel wat onnodige ongerief en onkoste vermy deur water te ontkalk voor dit in die pypstelsel van 'n woning invloei, is onlangs in Lichtenburg op die mark gebring.

Dié toestel is ontwerp veral vir streke met waterryke dolomietneerslae wat die bron van water se hoë kalkinhoud is.

Buiten vir die toestel se billike prys is adisionele voordele die volgende:

- Geen gevaar van kalsium, magnesium of natriumchloried in die pypstelsel wat roes veroorsaak nie.
- Die watertoevoer word nie onderbreek gedurende onderhoud van die stel nie.
- Minimale maandelikse betaling dek alle onderhoudskoste.
- Die huiseienaar gee geen aandag aan die stel nie. Die firma sien self om na die maandelikse onderhoud.
- Netjies gemonteer teen 'n buitemuur.
- Gewaarborg vir vyftien jaar.

Navrae:

Mnr JJ Nel
Cement Plant Services
Posbus 1500
Lichtenburg
2740
Tel: (01441) 2554



HYGIENIC TOILET FACILITY—MOBILE

To meet the demand of Health Authorities and Contractors alike, Ballam-Waterslot (Pty) Limited is producing a highly efficient hygienic toilet facility which is a complete innovation in the field of temporary sanitation.

The fully patented water-sealed "Ballam-Waterslot" system is now available adapted to a mounting which fits the aperture of a sewerage manhole, whereby a blockage-proof, maintenance-free flushing toilet may be set up within minutes at any point where a manhole is located.

The all stainless steel toilet pedestal is totally enclosed with no moving parts exposed to vandalism or occasional damage. No external cistern, valves or controls exist other than a floor-level flushing pedal.

The water supply is simply connected by way of a 12 mm ϕ garden hose from a stand pipe, or, a low pressure reservoir similar to a 200+ litre drum, to the rear of the pedestal. The choice of cabana, or, toilet housing is left entirely to the client, although the manufacturer offers a quality I.B.R. cabana which could include such extras as washhand basin, toilet roll holder and stainless steel wall mirror.

In completion of the toilet necessity on site, the unit is simply removed from its place of "employment", the manhole cover replaced, and the toilet is ready for storage or moved to its next required place.

The toilet consumes 2 litres of water only per flushing and is thus a boon to Local Authorities, Builders, Civil Engineering Contractors, or the individual requiring a water-sealed toilet facility at short notice, comments Mr. John Ballam, the inventor and designer.

The system does not require the support of chemicals or a honey-sucker, and no masonry work whatsoever is involved in commissioning the toilet, thus the toilet has an unlimited life.

Enquiries:

Ballam-Waterslot (Pty) Limited
PO Box 40482
Arcadia
0007
Phone: Pretoria (012) 47-6070

STAINLESS STEEL MIXER

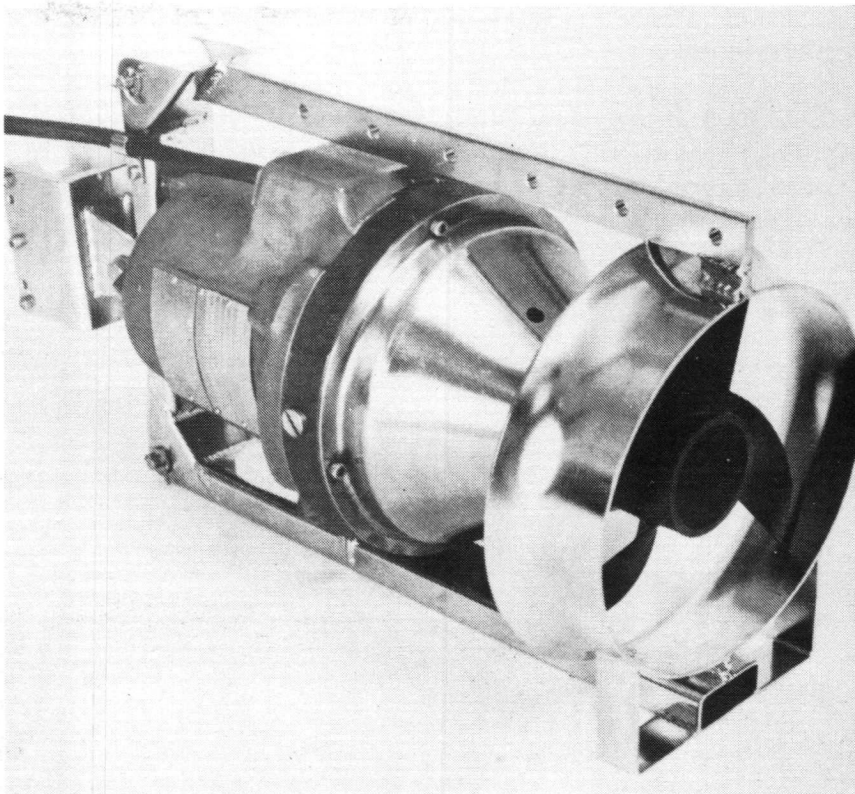
Hugh Mellor have now launched a new stainless steel mixer, complementary to the range of Flygt mixers for tanks, flotation plants, sewage tanks and the like. The Flygt 4400 submersible mixer is designed for keeping corrosive liquids (pH 3-14) slurries, and sludges in suspension. The mixer is intended to be used in, for example, tanks where floating crusts or bottom deposits prevent complete emptying.

The mixer is designed for stationary installation. A lifting and guide arrangement offers easy installation and handling, in that the actual mixer can be raised or lowered along a vertical guide by means of a small hand winch. Two motor sizes are available, viz 2,0 kW and 1400 RPM, or 0,9 kW and 935 RPM., and alternative voltage ratings of 380, or 500 V.

The three bladed stainless steel propellor can be provided with pitches of either 180 mm or 150 mm. The propellor has backward-curved front edges and forward thrust in order to prevent it from becoming clogged, even in heavily contaminated liquids.

Maximum and minimum flow is quoted at 0,15 m³/s and 0,08 m³/s respectively.

Enquiries:
Hugh Mellor (Pty) Ltd
PO Box 700
Edenvale
1610



AUTOMATIC DIAPHRAGM VALVE

A recent addition to the range of automatic water control equipment designed and supplied by FLUID DYNAMICS SYSTEMS is the AUTOMATIC DIAPHRAGM VALVE.

SEATS

A major technical book covering the correct procedure in selecting seats for mechanical seal applications is available from Crane Packing (Pty) Ltd of Springs.

Providing essential selection, design and installation information the book has been created for design engineers needing information on mechanical seals for rotating shafts.

The first publication of its type to come to South Africa, the 48 page full colour book is intended to be used in conjunction with the company's 'Guide to Seal Selection' which has been available for some time. Together, these two books provide the engineer working in industry, and those in educational institutions, with the only comprehensive guide to selecting a total sealing mechanism for almost every pump and mixer vessel application.

Enquiries:
Crane Packing
PO Box 890
Springs
1560

The F D S Diaphragm Valve is primarily a low head, large diameter flow control device. The valve uses no external power source, and functions using the differential head between upstream and downstream water level. Differential heads as low as 0,20 m are sufficient to operate the valve. The valves have been designed to cater for upstream pressures of 20 m but greater pressures can be accommodated.

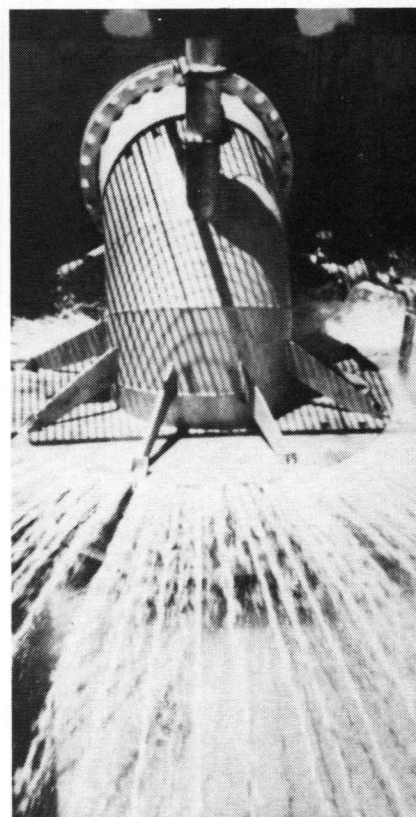
The diaphragm valve can be used wherever there is available 'head', either as an automatic on/off valve, or as an automatic flow regulating valve.

Typical applications are:

- 1) Maintenance of a selected flow for irrigation from a fluctuating canal.
- 2) Maintenance of fixed levels in water purification ponds.
- 3) Maintenance of constant levels in balancing dams for any water works.

Valves ranging in diameter from 150 mm to 900 mm have been installed on major irrigation schemes and water works.

Enquiries:
Mr P Telle
Flotrol (Pty) Ltd
PO Box 89526
Lyndhurst
2106
Tel: (011) 608-3372



In this extract from his keynote address at the International Ozone Conference which was held in Pretoria earlier this year, Dr Maarten Schalekamp, President of the *Internationale Vereinigung der Wasserversorgungen* in Zürich, Switzerland, takes a look at the latest water treatment processes designed to cope with the increasing pollution of the lakewaters of Switzerland.

Ten lakes and the River Rhine are used for drinking water supply in Switzerland. The lakes involved are: lake Constance (eight water treatment plants), lake Zürich (ten plants), lake Lemman (seven plants), lake Lucerne (three plants), lake Neuchâtel (two plants), lake Lugano (two plants), lac du Bret (one plant) and the lakes of Murten, Sempach and Biel (one plant each).



Water treatment in Switzerland

Of these 36 Swiss lakewater plants, 45% have a two-stage, 30% a five-stage and 25% an eight-stage water treatment system. But 80% of the total quantity water produced is treated through eight stages, and in future all treatment plants will have a five to eight-stage treatment system, all using ozone.

Nine of the 36 lakewater plants have in 1982 adopted the process of rapid filtration with subsequent ozonation and chlorination. Another nine plants use pre-chlorination, multilayer rapid filtration with granular activated carbon (GAC) and sand, subsequent ozonation, chlorination or chlorine dioxide treatment. Nine plants have pre-chlorination, multilayer rapid filtration with sand and pumice or anthracite, ozonation, GAC filtration and chlorine dioxide treatment. And the last nine plants treat their water through pre-chlorination, flocculation, multilayer rapid filtration (sand and pumice), neutralization ozonation, GAC filtration and chlorine dioxide treatment.

In future all Swiss lakewater

plants will use the new eight-stage treatment technique which consists of the following processes: pre-chlorination, flocculation, double-layer rapid filtration with sand and pumice, neutralization, ozonation, GAC filtration, slow sand filtration and chlorine dioxide treatment.

The question, however, is: "Why and how are these processes used in Switzerland?"

1st STAGE: PRE-CHLORINATION OF RAW WATER

In the catchment head of the lake intake pipe raw water is chlorinated with 1 mg Cl_2/ℓ . The pre-chlorination of the raw water is considered necessary. This stage keeps the raw water facility up to the rapid filter absolutely clear of any algae or *Dreissena Polymorpha Pallas* (DPP) larvae deposit and reduces the dissolved organic substances in the water 6 to 20%. This reduction occurs, if one or several milligrammes Cl_2 per litre water are added. However, if only

0,5 mg/l of Cl_2 are added, the reduction can almost not be ascertained. Also the DPP cannot be destroyed with any certainty. Tests have shown that an addition of 1 mg and a resultant chlorine content of 0,5 mg/l in the rapid filters will eliminate the DPP within 13 days. It is known that the larvae require 14 days to pass through the filter, so that the elimination time is just sufficient.

Chlorination also improves the colour of the water. The greenish appearance of the water is replaced with a blue tint. The halogen compounds formed by chlorination amount to only 10 to 15 $\mu\text{g}/\ell$ and, it is true, they are as yet hygienically harmless, but unwanted. If this process had been changed to chlorine dioxide, you would get chlorites instead of haloforms, but chlorites are also unwanted.

Today, new data have been obtained on the preoxidation stage and the dosage is 0,6 mg Cl/ℓ and 0,3 mg ClO_2/ℓ in the lakewater works. The Zürich drinking water hardly contains any haloforms and the concentration of chlorite is on-

ly 0,01 mg/l and chlorate <0,3 mg per litre which is not harmful to human health. This system of preoxidation is reasonable in price and very effective.

To ensure that the drinking water is of impeccable quality, the bank filtrate resp. the groundwater require treatment. To inactivate viruses that could be present and to prevent excessive algae development in the enrichment basins, the bank filtrate is pre-oxidized, whereby the dosage amounts to $\frac{1}{3}$ chlorine dioxide and $\frac{2}{3}$ chlorine, a total of 1,2 mg/l. Treatment with chlorine only results, in conjunction with the organic substances present in the Limmatt bank filtrate in the formation of up to 5 $\mu\text{g/l}$ haloforms. A single dosage of chlorine dioxide of 1 to 1,5 mg/l ClO_2 , a concentration having a satisfactory algacide effect, does practically not produce any haloforms, but after a prolonged contact time 0,1 to 0,2 mg chlorite are formed in the bank filtrate. This chlorine compound, just as the haloforms, is not wanted in the drinking water. Therefore, the two oxidation processes are also combined. For instance, combining 0,8 mg/l chlorine with 0,4 mg/l chlorine dioxide results in five times fewer haloforms in the bank filtrate (resp. up to 1 $\mu\text{g/l}$) and less than 0,1 mg/l chlorite. These values are still lower in the drinking water obtained from the horizontal filter wells. This is the reason why both oxidizing agents are being used.

2nd STAGE: FLOCCULATION AND FILTRATION

Rapid Filtration. Before the chlorinated water reaches the rapid filter, a flocculant and a flocculant aid are added. Tests have established that a flocculant aid, will yield the optimum results. The cleaning effect on the phytoplankton larger than 20 μm and detritus larger and smaller than 20 μm is 6%, i.e. without microflocculation 92,5% are kept back and with microflocculation the removal amounts to 98,5%. The cleaning effect on the phytoplankton smaller than 20 μm is considerably better; without microflocculation 50% are still present in the rapid filter, with microflocculation only 28% still exist. The target,

however, is to remove also these 28% from the drinking water. Therefore, other filtration stages must be used after the rapid filtration to reduce the above percentage still further. The addition on flocculants causes, besides the above-mentioned cleaning effect, a partial precipitation of phosphates which serve as food for the plankton and bacteria. Efficient filtration of the plankton prevents the development in the drinking water pipes of higher organisms such as Oligochaeta, Nematodes, Ostracodes, Asellus, Nauplius, Cyclops and Canthocamptus.

Multilayer Filtration. By using the multilayer filtration with sand and pumice, a six to eight times longer operation, the same cleaning effect is obtained. When one knows that, at peak times, many lake water plants must wash their rapid filters twice a day, multilayer filtration is a real improvement. Especially important is the fact that, despite the longer operation time, the efficiency of the cleaning remains the same. This process is of great economical advantage, because considerably less scavenging water is required.

3rd STAGE: NEUTRALIZATION

Prior to or after filtration, the water is neutralized, i.e. deacidified. Most of the lakes have lost their carbon dioxide balance. The pH-value should be about 8.2. However, it is according to lake and intake depth 7 to 7.8. Flocculation with aluminium sulfate also reduces the pH somewhat. It must, therefore, be corrected upward to prevent corrosion in house installations and water pipelines. The value will be corrected to within 10% above pH equilibrium. The waterworks of St. Gall, Basle and Zürich were very successful with this type of neutralization. Corrosion of the insides of the pipelines is now under control. Comparison tests at the Swiss Federal Institute for Material Testing (EMPA) between neutralized lake water and non-neutralized ground water show that the effect is excellent.

4th STAGE: OZONATION

Swiss people love good air and cleanliness. They are possibly

spoiled by the fresh mountain air. Air which contains a minute quantity of ozone gives the impression of being fresh mountain air when breathed. Maybe this is one of the reasons why Switzerland is such an ozone favouring country. The fact that 24 ozone production plants per million inhabitants are in operation, speaks for itself. This is more than twice the number of plants that France possesses and it makes Switzerland number one in the world.

First I will answer the questions: "Why use ozone? And in what concentration?" To answer these questions better, the effect of a dosage of 1 to 5 mg/l of ozone will be compared. Most of the results refer to investigations of lake water from Switzerland and cannot be used otherwise without the necessary corrections.

Just as one can drink alcohol of various concentrations, so it is also possible to ozonate in smaller or larger concentrations. What effects these various concentrations of ozone can have shall be discussed shortly, but first a few words about the behaviour of the germs in the water.

Whether lake Zürich water is treated with 1 or 5 mg of ozone makes no difference to germ development. After three weeks the first germ development starts, and from the fourth week on the number of germs is 10^4 - $10^5/\text{ml}$. The regermination in water which has been chlorinated with 1 mg/l prior to dosing with 1 and 5 mg O_3/l starts from the sixth week onward instead of from the third week. Furthermore, it is important to know, how viruses behave. According to the studies of Katzenelson and Shuval the various ozone concentrations of 0,3, 0,8, and 1,5 mg O_3/l to inactivate viruses all have the same effect. In conclusion it can be said that in regard to the destruction of bacteria and the inactivation of viruses in water which is not too contaminated a higher concentration of ozone than 1,0 to 1,5 mg/l is not necessary.

Decolouration by ozone in various concentrations. With an ozone concentration of 1,0 mg/l the colour intensity is reduced by

(To page 34)

Water treatment in Switzerland

(From page 33)

50% and with a concentration of 5,0 mg/l by 70%. For better decolouration a higher ozone concentration could be used.

Contrary to the tests with DOC, where no alterations occurred with oxone of various concentrations, the KMnO_4 -values decreased by 14% at a dosage of 1,0 mg O_3/l and a decrease of 18% at a dosage of 5,0 mg O_3/l was noted. The initial values of the UV-extinction values are reduced by 33% at a dosage of 1 mg O_3 and by 57% at a dosage of 5,0 mg O_3/l . This means that, if a lot of humic acid had to be removed, a higher ozone dosage will more easily reduce it.

Ozone is an excellent agent to remove the taste of phenol or trichlorophenol. A dose of 1,0 mg O_3/l reduced 100 μg phenol and 500 μg trichlorophenol; 5,0 mg O_3/l reduces 500 μg phenol and 2 500 μg trichlorophenol. It is of great advantage to be able to carry out a high ozone dosage when a phenol accident has occurred.

Ozone strongly reduces haloforms and produces large amounts of aldehydes and ketones. Let us consider the aldehydes. Laboratory tests at Zurich Waterworks confirm the values of Grob. With a reaction time of from ten minutes up to one day the concentrations of the aldehydes will be 9,5 times larger at a dosage of 1 mg O_3/l and 30,6 times larger at a dosage of 5 mg O_3/l . Through their decay, aldehydes and ketones produce corresponding acids which serve as food for microorganisms. Therefore, a higher concentration of ozone prior to a biological treatment stage should be an advantage. If the ozone is used as a last stage, the concentration should be as low as possible, because of the regermination. Ozone during a very long reaction time reduces the halogen compounds by 31% at a dosage of 1,0 mg O_3/l and 77% at a dosage of 5,0 mg O_3/l . This long contact time is possible, if there is an intermediate reservoir after the ozonation, as is the case at the lake Constance Waterworks.

With a reaction time of 10 minutes — the plants at Lengg and Moos operate like this — the haloforms at 1 mg O_3/l are practically reduced by the same amount: at 5 mg O_3/l by 47%, which means less than is the case with the longer reaction times. Looking at the flocculation effect during ozonating at 1,0 to 5 mg O_3/l , one can say that the optimum lies between 1,0 and 1,5 mg O_3/l and that at 5,0 mg O_3/l the opposite of flocculation occurs.

Before the selection of the proper ozone dosage an exact analysis should be made of what the ozone will be required for. A high dosage can in many cases be of great advantage, however, in other cases it can be a disadvantage. A higher dosage of ozone is good to reduce the phenol compounds and haloforms as well as improving the UV and colour values. However, it negatively influences flocculation, and, if no refiltering takes place, also the regermination. For the destruction of bacteria and the inactivation of viruses as well as for flocculation, no increase in the ozone dosage is necessary. In case of a breakdown, for instance, when a phenol accident occurs, it would be an advantage to be able to increase the dosage. At many waterworks in the world peak consumption occurs only during one to two weeks per year which are twice as high as the normal average requirement. It is, therefore, possible during a breakdown, which will hardly occur at peak times, to dose higher ozone amounts by reducing the plant capacity. *Every plant manager should construct his ozone units in such a way as to be able through a reduction of the plant capacity to dose more ozone.* This is especially true if he operates a facility which has been designed for normal dosage. Everywhere where ozone is used, its concentrations in the water and in the air must continually be monitored. Those who do not have an ozone unit should realize the following: ozone can do a lot, but not everything. Ozone has saved many plant managers

from ultimate disaster. Today no water surface treatment plant should be built without an ozone stage.

5th STAGE: GRANULAR ACTIVATED CARBON (GAC) FILTRATION

To remove the excess chlorine and ozone from the water, the water is passed over a GAC filter. The GAC operating speeds vary between 10 and 20 m/h at a filter bed height of 1,20 m. The GAC filters usually rest on a bed of sand of about 50 cm thick. Besides the removal of excess chlorine and ozone, the GAC filter also extracts large amounts of organic substances from the water. In one waterworks, for instance, it has been discovered that the uppermost layer, consisting of Pittsburgh F 400, showed a load of 37 g/kg after two months in operation. At the beginning the new GAC filter had a load of 4 g/kg. After three months of operation the load was 63,5 g/kg and after seven months of operation the highest load, namely 68,2 g/kg, was measured. These tests have clearly shown that without GAC filtration, many more organic substances would still be present in the drinking water. Other tests have shown that these substances are absent from good, i.e. unburdened spring water. One of the main responsibilities of a waterworks is the provision of water of unimpeachable quality, be it spring, ground or surface water. For that reason GAC filtration is absolutely necessary for the purification of surface water in Switzerland.

Measurements have shown that after six months, if not ozonation occurs, and after three years, if pre-ozonation takes place, the GAC filter layer is so loaded with organic substances that renewal and reactivation becomes necessary. The reactivation is carried out by means of the so-called "Fluid bed process" — the Norit system. In this furnace the following GAC were reactivated: the GAC Norit ROW 08 Super, which emerged from the

Water treatment in Switzerland

latest comparison tests as the best GAC, Norit PKST, a light GAC, and Pittsburgh F 400. The losses were only 50% of the customary reactivation process. The GAC Norit PKST for instance was only loaded with 28 g/kg; the fresh GAC showed a load of 5g/kg and the reactivated GAC only 8 g/kg. The GAC loss amounts to 12%, measured from the filter via the silo, furnace, silo back to the filter. The results show that the efficiency of the reactivation can be classed as excellent. For the Water Supply Zürich there are three important criteria for changing the GAC: if the halogens and UV of the drinking water are higher than the permitted level or if the upper layer of the GAC in the filter is loaded to capacity (dimethyl formamide + dioxan extract) and the bottom layer is loaded with 70% of the maximum of the upper layer.

Although three and four-digit germ figures occurred after monthly backwashing in the various GAC filters of the Zürich test plant, it was then already discovered that after weekly backwashing the bacterial figures were four times less. In today's operating GAC filters no higher than two-digit bacterial figures can be discovered (i.e. 0 to 5 per cm³). However, this is only valid, if the filters are backwashed at least every two to three days by air and water. If the cleaning occurs at longer intervals and without air, the germ figure rises again, as experience has proved in Zürich.

6th STAGE: SLOW SAND FILTRATION

In Switzerland slow sand filtration is still used at five lake water plants. This is a process which becomes more important for artificial groundwater enrichment. Tests have shown that with an effective pretreatment the slow filtration can in future be operated at an average speed of 15 m/d instead of the now usual 3 to 7,5 m/d. It was discovered in actual operation that because of a thorough pretreatment the operat-

ing period, without cleaning is three years. Formerly, the filters had to be cleaned every six to nine months. The cleaning effect with reference to the filtration of the phytoplankton detritus as well as to elimination of the germs is equally efficient, if the slow sand filter is operated slowly or rapidly. Investigations have established that the slow sand filter, with regard to the bacteriological and biological cleaning effect, has to be clearly classified as a spatial filter. It is only a surface filter with reference to the mechanical cleaning. Despite the higher speed a slow sand filter with the same standard of water treatment is not more expensive than a rapid filter, not counting the price of land.

7th STAGE: PIPELINE PROTECTION

The addition of chlorine dioxide is not only useful for water treatment but also for pipeline protection — it will ensure that the water in the supply and distribution network remains hygienically perfect. The dosage is only 0,05 mg ClO₂/ℓ, so that the chlorite production is negligible.

Increase and decrease of the halogenated hydrocarbons during the treatment stage with and without ozone: It is quite obvious that without ozone, as a result of the chlorine drift, the halogenated hydrocarbons increase up to the GAC filtration and are subsequently heavily reduced after this stage and the slow filtration. When ozonation takes place, the halogenated hydrocarbons at least do not increase anymore. After ozonation, they are even partly reduced, so that in any case, in the end a better result is obtained by the use of ozone.

The cleaing effect of the above-described treatment process can be gathered from the following. The organic substances are reduced by 90% this means that the UV extinction, measured at 254 nm, amounts to 0,040 in raw water and 0,004 in drinking water.

The high standard of the water treatment processes of the Swiss lake water plants also extends to their construction and technical operation. And, because of the shortage of personnel, most waterworks operate fully automatic. A remote control centre monitors, controls and evaluates the whole operation.

Water hygiene was one of the greatest problems of the European water suppliers in the last century. Only after the construction of the slow filters and since the introduction of chlorination, diseases which are transmitted through water, such as cholera, typhoid, dysentery, etc. vanished in the industrialized countries.

Today the target in Switzerland regarding water supply is as follows:

In principle pollution must be hundred percent compensated for; If possible by combating the causes and if not, the symptoms. The water supply bodies shall deliver enough drinking water of first-class quality at sufficient pressure and, if possible, at a reasonable price.

Conferences

(From page 36)

GROUNDWATER

A symposium, Groundwater 85, is to be held from 1 to 3 July 1985 in Pretoria. The symposium will deal with resource assessment, management and conservation. Enquiries: The Organizing Secretary, Groundwater 85, PO Box 8856, Johannesburg 2000.

WASTE TREATMENT

The 1st Asian Conference of IAWPRC on the treatment, disposal and management of human wastes is to be held in Tokyo from 1 to 3 October 1985. Abstracts by 30 November 1984. Enquiries: IAWPRC, Alliance House, 29-30 High Holborn, London WC1V 6BA, UK.

CONFERENCES AND SYMPOSIA

IRRIGATION

Kansas City, USA, will be the venue for the International Irrigation Exposition and Conference from 21 to 25 October 1984.

Enquiries: Irrigation Association, 13975 Connecticut Avenue, Silver Spring, Maryland 20906, USA.

WATER CONFERENCE

An International Water Conference will be held at the 45th annual meeting of industrial water engineers in Pittsburgh USA, from 22 to 24 October 1984.

Enquiries: Engineers' Society of Western Pennsylvania, Wm Penn Hotel, 530 Wm Penn Place, Pittsburgh, PA 15219, USA.

SEWAGE EFFLUENT

A symposium, cosponsored with ICID, on Reuse of Sewage Effluent is to be held from 30 to 31 October 1984 in London.

Enquiries: Conference Office, Institution of Civil Engineers, 1 Gt George Street, London SW1, UK.

IWSA

The IWSA will present a congress and exhibition at the 15th biennial meeting for international water suppliers in Monastir, Tunisia from 29 October to 2 November 1984. Enquiries for exhibition: SEPIC, 40 rue de Colisee, 75381 Paris Cedex 08, France.

WATER SUPPLY HYDROLOGY

An international conference and exposition on water supply hydrology will be presented by NWWA from 12 to 14 November 1984 in Johannesburg. WSIA is occupying 13 November with a Water Reuse and Desalination Conference.

Enquiries: Pat Alcorn, National Water Well Association, 500 W Wilson Bridge Road, Worthington, OH 43085, USA.

WASTEWATER

The 4th IAWPRC workshop on instrumentation and control of water and wastewater treatment and transport systems will be held in Houston and Denver from 27 April to May 4 1985.

Enquiries: Dr HNS Wiechers, Water Research Commission, PO Box 824, Pretoria 0001.

ORGANIC MICROPOLLUTANTS

An international symposium on organic micropollutants in drinking water and health will be held in Amsterdam from 11 to 14 June 1985.

Enquiries: Symposium DWH, Q.L.T. Convention Service, Keizersgracht 792, "Alton House", 1017 EC AMSTERDAM. Tel: (020) 26-1372. Telex: 31578, inter nl att. qlt.

(To page 35)

finally . . .

NEWSMAKER

In maintaining its reputation for serious reporting this column is calling for nominations for Newsmaker-of-the-year (NOTY) in the field of serious water research, (candidates in some old disciplines will be informed if theirs do not qualify for 'serious').

This column seeks, and has always sought, to reward the mediocre rather than the excellent, since mediocrity may be intentional whereas excellence may be coincidental, or designed to fool the Receiver. The ideal candidate for the NOTY award would be one who, to quote a prominent parliamentarian, 'has cheated fate, has escaped the obscurity he so richly deserves'.

Macabre devotion to duty may be considered for the award, such as that displayed by a colleague who revels in the throes of leak detection: Recently he was watching tea spilling from a tea pot with a hole in it and exclaimed: 'That's a leak, and I saw it first!'

Frivolous capers occurring during office parties, election celebrations and wakes will not be considered. This specifically excludes any person who, for an encore, gets up on the piano and dives into the punch bowl. Diving from a windmill into an evaporation pan may be considered for an honourable mention.

Groups may be nominated providing that their ranks are closed — a rare occurrence in this day and age. For this very reason, or lack of it, the groups who recently met in the Wilderness will not be considered.

Down south they had gathered to write a limnologist's guide to what's right, but the spate of limnologists were dammed by hydrologists who could not decide whom to fight.

The previous NOTY award could not be presented as the recipient (a Southern university) had razed the venue to the ground.

SA WATERBULLETIN

SA Waterbulletin is 'n kwartaallikse nuusbrief oor water en waternavorsing wat uitgegee word deur die Suid-Afrikaanse Waternavorsingskommissie (WNK), 'n statutêre organisasie wat in 1971 by Wet gestig is.

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

Redaksie: WNK, Posbus 824, Pretoria 0001, Republiek van Suid-Afrika. Tel (012) 28-5461.

Redakteur: Anton Prinsloo
Asst-redakteur: Jan du Plessis
Red. asst: Marietta Theron

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

Subscription is free. Material in this publication does not necessarily reflect the considered opinions of the members of the WRC, and may be copied with acknowledgement of source.

Editorial offices: WRC, PO Box 824, Pretoria 0001, Republic of South Africa. Tel (012) 28-5461.

Editor: Anton Prinsloo
Asst editor: Jan du Plessis
Ed. asst: Marietta Theron