SA waterbulletin

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SALINITY
WRC workshop prioritise research goals

WATER QUALITY
Stricter phosphate control on Hartbeespoort Dam evaluated.

WATER DISTRIBUTION
WRC report confirms the feasibility of leak detection and water loss analysis programmes in urban areas

SEMINAR ON WATER SUPPLY AND SANITATION – TRANSKEI

ORGANISERS

The seminar is organised by the South African National Committee of the International Water Supply Association in conjunction with the Departments of Agriculture and Forestry of the Government of Transkei and the Division of Water Technology, CSIR, with the assistance of the Development Bank of Southern Africa and the Conference Co-ordinators, CSIR.

AIMS

This seminar is the last in a series arranged by the South African National Committee of the INTERNATIONAL WATER SUPPLY ASSOCIATION (IWSA) intended as a contribution to the aims of the INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE. The 1980's Decade was introduced by the World Health Organisation to improve water supply and sanitation conditions in developing countries. The technical programme will concentrate on appropriate and acceptable technologies used in rural and urban areas in Southern Africa.

WHERE AND WHEN

Wild Coast Sun, Transkei from Tuesday 26 to Wednesday 27 June 1990.

FORM OF SEMINAR

The seminar will consist of invited papers, posters and workshop sessions when open papers will be presented, and will include the following topics:

WORKSHOP CONTRIBUTIONS

Technology transfer in developing areas - covering:

- ❑ Community involvement
- ❑ Labour intensive methods of construction
- ❑ Institutional frameworks
- ❑ Health aspects
- ❑ Experience in neighbouring states
- ❑ Training

POSTER PAPERS

- ❑ Focus on Transkei
- ❑ Catchment development projects
- ❑ Stategies/policies related to water supply and sanitation in Southern Africa
- ❑ Technology transfer in developing areas
- ❑ Training
- ❑ Peri-urban water supply, sanitation and progress

EXHIBITIONS

Manufacturers and suppliers of products and equipment relating to water supply and sanitation, are invited to apply for exhibition space at the seminar venue. Please give the name of the company and the contact person to whom further information should be sent. Space at the seminar venue is limited and exhibition spaces will be allotted on a first- come-first-served basis.

TOUR

There will be an optional tour leaving the Wild Coast Sun on the morning of Thursday, 28th June and returning the same evening. Places to be visited will include a regional supply scheme; the Umzimvubu Basin and various interesting agricultural projects.

SOCIAL FUNCTIONS

The social functions will include a cocktail party and a "Traditional evening". The Tuesday evening will be kept free for delegates to see the show at the Wild Coast Sun - more details will be given in the next announcement.

ACCOMMODATION

A block booking has been made at the Wild Coast Sun, Transkei. Full details including special tariffs and a hotel booking form will be given in the final announcement.

FEES

The registration fee should be about R350 per person and this will include attencance at all the sessions, a full set of papers, all the social functions and tea and coffee served during the seminar. This fee will not, however, include meals or accommodation.

FINAL ANNOUNCEMENT

A comprehensive final announcement containing advance details of the programme and including an enrolment form, will be distributed during the first half of April 1990.

CORRESPONDENCE AND INFORMATION

All correspondence related to the seminar should be addressed to:

The Conference Co-ordinators C.126
CSIR
PO Box 395
PRETORIA
0001

Tel: (012) 841-3816 or 841-4615 - Cilla Taylor or Monika Mersich; 841-2231 Phil Coombs. Telefax: 86-2856.

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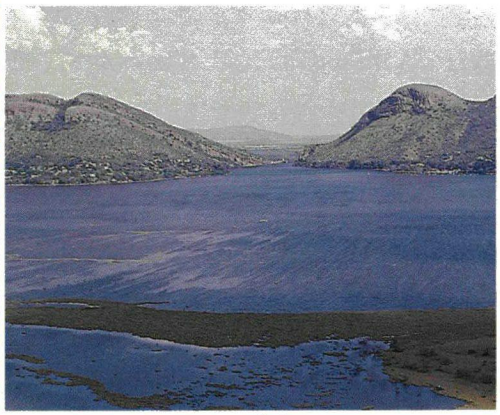

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Cover: Wemmershoekdam, near Franschhoek in the Western Cape

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HYDROLOGICAL SYMPOSIUM

The Fourth South African National Hydrological Symposium, sponsored by the Water Research Commission, was held at the University of Pretoria.

The symposium was convened by the South African National Committee for the International Association of Hydrological Sciences (SANCIAHS), the Limnological Society of Southern Africa (LSSA) and the Division of Hydraulic and Water Engineers of the South African Institution of Civil Engineers (SAICE).

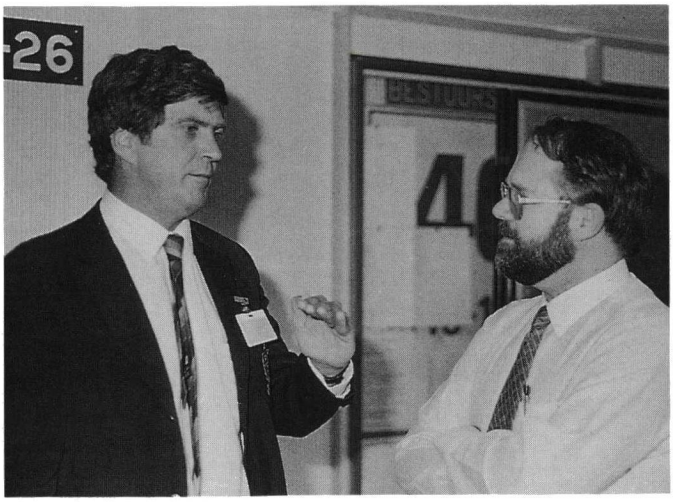
Prof DH Pilgrim from the School of Civil Engineering, University of New South Wales, Australia, delivered a keynote address and spoke on the recent developments in flood estimation and water resources management in Australia.

The keynote address by Prof JA Stanford from the University of Montana, USA, highlighted the consequences of stream regulation on biodiversity and ecosystem stability.

ABOVE: *Prof Dr JA Stanford, Director, Flathead Lake, Biological Station, University of Montana, Polson, USA at the SANCHIAS symposium.*
BELOW: *Mr Ian Russell (National Parks Board), and Dr J O'Keeffe (Institute for Freshwater Studies) Rhodes University.*

ABOVE: *Prof DH Pilgrim, School of Civil Engineering, University of New South Wales, Australia.*

BELOW LEFT: *Dr Dan Walmsley (FRD), and Prof Braam Pieterse (UOVS).*
BELOW RIGHT: *Mr Meiring du Plessis (WRC) and Mr Hugo Maaren (WRC).*



MEMBRANE GROUP MEETS AT WILDERNESS

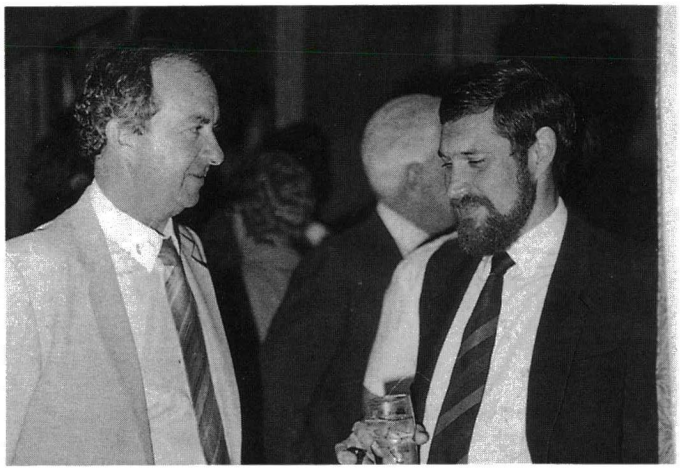
The South African Membrane Separation Interest Group (SAMSIG) held its 1989 symposium late last year at the Karos Wilderness Hotel near Knysna.

The group was formed in 1988 under the auspices of the Water Research Commission to create a forum where scientists, engineers, technologists and industrialists with an interest in membranes could exchange information.

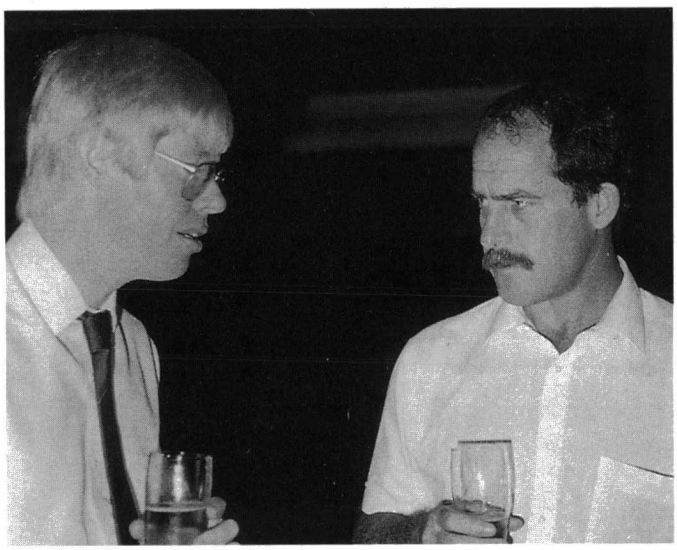
Delegates decided at the symposium that the interests of SAMSIG could in future best be served if SAMSIG was to be incorported as a technical division of the Water Institute of Southern Africa (WISA).

At present the Management Committee of SAMSIG comprises: Dr OO Hart, WRC, as chairman and Prof CA Buckley, University of Natal, as vice-chairman.

The committee members are: Mr GW Lok, Eskom, Dr EP Jacobs, University of Stellenbosch, Mr GR Botha, Stewart, Sviridov & Oliver and Dr JJ Schoeman, Watertech.

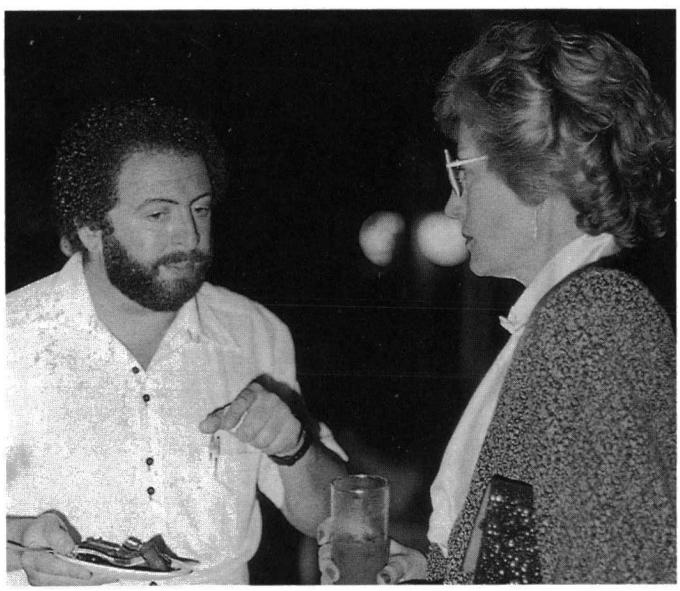


ABOVE: *Mr Dave Nozaic (BN Kirk Inc) and Mr Kevin Treffry-Goatley (Explochem Water Treatment)*

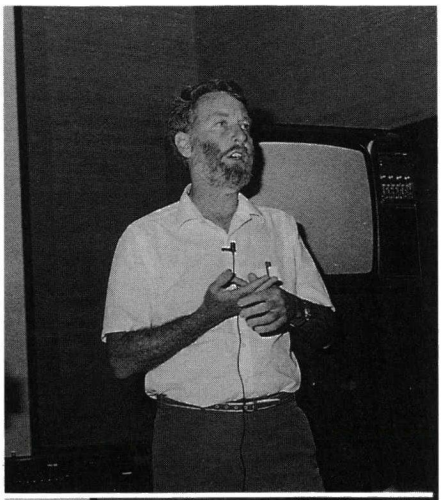


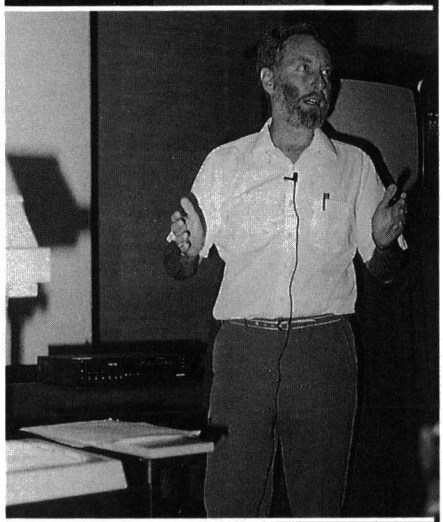
ABOVE: *Mr Duncan Rosie (CG Smith Chemicals) in conversation with Mr Dave James (Mondi) at the SAMSIG symposium.*

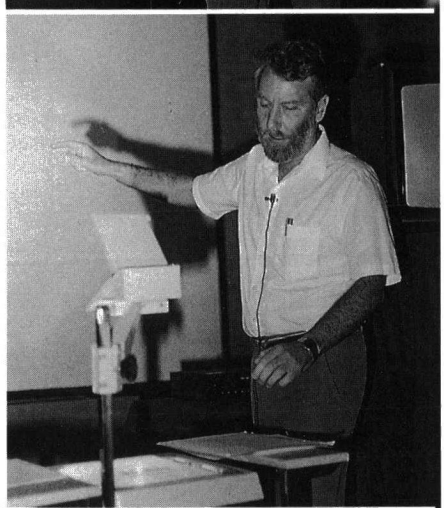
RIGHT: *Dr Tiby Mozes (DWT, Port Elizabeth) and Annamarie du Plessis (DWT, CSIR, Pretoria) engaged in some shoptalk.*

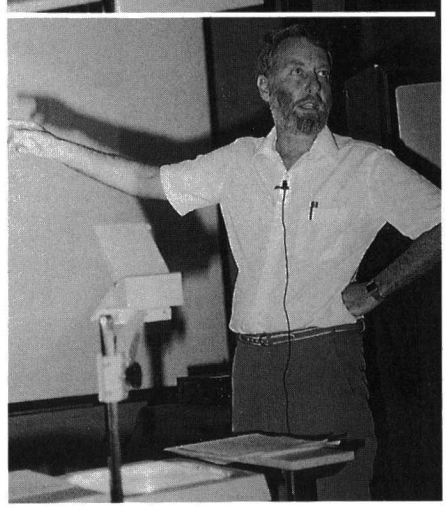


BELOW: *Eskom delegates at the Meet and Greet: From left, Mr JD Aspen, Mr T Spencer, Mrs N Spencer, Mr M van der Walt, Mr D Swanepoel (standing), Mr G Lok, and Mr S Lennon.*









Dr RD Sanderson

Membrane technology is rapidly gaining ground in the South African industry where it is nowadays used for almost anything from water and effluent management to the recovery of useful byproducts.

In this article Dr RD Sanderson from the Institute for Polymer Science, University of Stellenbosch, gives a brief overview of some of the membrane applications.

An expert look at membrane applications

There is a tendency presently for companies to develop membrane plants and techniques, specific to a single separation need or to a small family of similar separation needs.

Of the wide variety of specific applications for membranes, a brief overview of the following will be given:

the portable desalination handpump unit; clarified juices; bulk fibre mousse; oenology; tomato puree; low-sodium beer; long-term milk; coupled transport; gas enrichment; bio-medical; pervaporation; and other applications.

THE PORTABLE DESALINATION HANDPUMP UNIT

The portable desalination handpump has been known for a few years now and has recently become available on the South African market at exorbitant prices. The sizes vary from a cup of water in fifteen minutes from seawater to a unit supplying fifteen litres per day, also from seawater.

The system is small, weighs only a couple of kilograms and is based on a simple pump with a long lever for pressurisation of a spiral housing which can accept two inch diameter, twelve inch long spiral elements. The larger units of course, will be able to take larger spiral elements.

The tendency is to use higher rejection so that the water becomes sterile even in terms of toxic substances that may be present.

CLARIFIED JUICES

This market is growing very fast since the quality of the juice is excellent. Both ultrafiltration and microfiltration are suitable clarification techniques. The growing tendency is for a type of hybrid membrane that has a very high cut-off for an ultrafiltration membrane, but is rather tight for a microfiltration membrane. Such a membrane allows through much of the colour and protein essential for maintaining original flavours and appeal.

Another reason for the exactness of the membrane selection is the need for producing a juice which is sterile and keeps well.

The systems used for juices are generally tubular from half inch to one inch, and membranes are generally of the polysulphones or polyethersulphone type.

BULK FIBRE MOUSSE

The idea of having a semi solid spoonable pulp seems to have arisen from two market trends, firstly the high bulk fibre consciousness of the consumer in breakfast foods and how best to make maximum profits out of juice clarification.

After the fruit has been de-pipped or cored and macerated, the pulp laden juice is pressurized in one inch tubes of either stainless steel or polysulphone housed in an outer pressure support. The juice permeates out of the tube with the pulp thickening. Normally a variation of the tube length is sufficient to ensure correct pressurization. The mousse issues out at the end of the tube while maintaining sufficient juice within it to maintain a fruity taste. Systems like these are presently rather expensive, since everything is made from sterilizable materials.

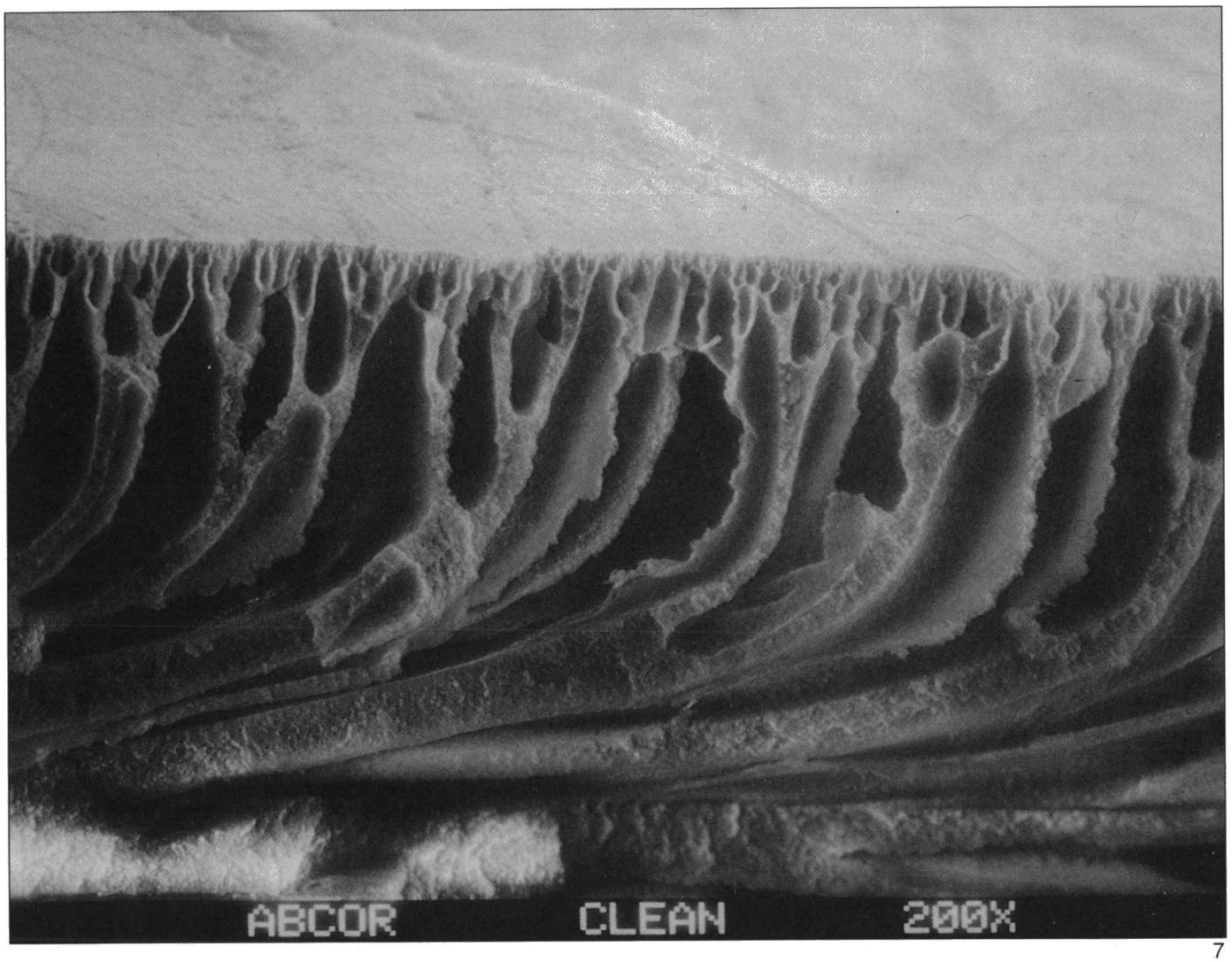
OENOLOGY

Wine clarification is an already accepted area for membrane technology. The product cost is high, therefore, the membrane treatment add-on cost is low. Wine production is not normally a very high volume production industry compared to the provision of water, therefore, the plant size for wine treatment is small to medium and also not excessively capital intensive, even though it is normally made from stainless steel and is highly sterilizable.

There are a number of systems available, essentially all are cross-flow tubular systems. The variety of wine products is boundless.

One case of interest is where one inch polysulphone tubular systems are used to sterilize grape juice. The sterile juice is then innoculated with a yeast of choice that a specific wine can be made. The wine after

An electron micrograph of an ultrafiltration membrane.



fermentation is reprocessed in the same microfiltration plant allowing for low temperature sterile bottling. The clarified juice alternatively can be reverse osmosis concentrated into a must for storage or later dilution and use in other food processing.

TOMATO PUREE

This is a new development and has been proved on pilot-plant scale, but will soon be implemented in Italy.

The Italian usage of tomatoes is higher than most countries and purees are used in many food preparations. Presently, these purees are made by reduced pressure distillation at low temperature for water removal.

New plant extensions are scheduled using the membrane process on the basis that the concentrate maintains the taste of a fresh tomato and is much superior to the heated concentrate where much of the freshness of the taste has disappeared.

Earlier attempts at tomato concentration had often failed because of the enormous pulp load of a macerated tomato. There is also a tendency for the market to require a certain paste consistency. In other words, a certain percentage of the cells should be kept intact meaning that maceration should not be excessive.

One approach used in Italy that appears to work perfectly is to use one inch microfilter tubes to make a concentrate from the tomato pulp and allowing a clarified tomato juice through as permeate. This juice is then concentrated in a spiral reverse osmosis plant at low temperature. Thereby removing only water and keeping all the taste and flavour ingredients in the concentrate. This concentrate and the pulp concentrate are recombined to make a puree.

LOW-SODIUM BEER

The worsening water situation in Europe results in waters high in organic matter and inorganic salts. The water reaching factories is, therefore, of a poorer quality than that available when the company was initially established. Typical of this trend, is the Heineken beer factory in Leiden. The need of the factory is to have a water low in heavy mineral ions and especially low in sodium ions, a prerequisite of the American beer market. Ion-exchange and membrane processes would be applicable, yet the company after trials selected cellulose diacetate spirals and the membrane process.

Initially the plant did not function properly due to deterioration of the membranes. The explanation given was that the American market is used to fast technological development, rapid commercialization of this, even at the expense of a short market life in the rush to profit from new developments. It was explained by the Heineken beer factory water expert that the European approach has often been one of arriving late in the market, but refining the development in such a way that the process becomes sound, both as regards technology and in terms of investment as well as a useful production life being a prerogative.

In this way the Heineken plant was redesigned around the initial plant provided by the USA and has performed trouble free for seven years and shows no tendency for deterioration of the membranes.

The plant still offers 95,6% overall salt rejection which is excellent for cellulose diacetate membranes after seven years.

Beer is not made with totally desalinated water as it is necessary to add calcium chloride before beermaking.

LONG-TERM MILK

There has been a need in many parts of the world to produce a milk that does not have to be kept in the refrigerator. The closest to this has been the high temperature milk which can be kept for many months in a sealed bottle, but which gives a new taste to the milk and has not, therefore, resulted in a major market change.

The need has been to create, without taste change, a low temperature sterilization method. This is indeed what membranes are capable of. The initial commercial plants are operating in France, whereas the same concept has been proven at the National Institute for Diary Research in the Netherlands.

The process involves separating the cream from the milk using a tight microfilter to separate the skim milk into a permeate which is sterile and a concentrate which is added to the cream fraction. The sterile permeate will contain the proteins which are normally denatured by the high temperature heating sterilization process whereas the emulsified fat globules in the cream fraction are not denatured by heat. The ultra high temperature process is, therefore, applied to the cream fraction and this is then recombined with the sterile skim milk permeate. Finally, the normal pasturisation process is used prior to bottling. The milk shows no noticeable flavour change and has been shown to be stable for six months.

Since membrane processes can be used for water sterilization, it should be obvious that with an expensive commodity such as milk, the add-on cost will not be excessive, in fact, it should be rather low.

COUPLED TRANSPORT

Coupled transport is mainly been used for metal-ion extraction from plating waste. It is a recovery system rather than a waste removal system. Its greatest possibility lies in the fact that low concentrations can be upgraded to higher concentrations which then become amenable to standard concentration techniques.

The driving force for this system is normally a pH difference and since pH is a logarithmic function, the driving force can be very high. The major problem to this date has been the stability of the membrane system, since coupled transport is in essence a liquid-extraction process where the extractant liquid is contained in a membrane. In order to avoid leakage of the extractant from the membrane, newer synthetic extractants with lower solubilities have had to be synthesised.

Locally, this system could be used to concentrate acids or other materials in waste streams which are not normally economically extractable by conventional techniques. Concentrations of 1 to 5 per cent and even 10 per cent have been claimed. In metals concentrations changes of 100 times and more have been claimed.

GAS ENRICHMENT

This is one of the most prolific development areas in membrane science and technology. Already the production of nitrogen is a commercial success. Oxygen enrichment is also now commercially available. The ammonia removal from methane is highly efficient, 10 000 to 1 have been obtained. The membrane systems are available in tubules, spirals, and more recently hollow-fine fibres.

The tendency is to have an asymmetric micro-porous hollow fibre overlaid by a highly permeable solid gel material and an ultra-thin skin of gas permselective material. Either vacuum on the one side or gas pressurization on the other side is the driving force.

With hollow-fine fibres the surface area is

very large and although diffusion rates are low, the total plant size does not have to be excessive for large volumes of gas enrichment.

Presently available membranes based on silicone, can give a 7 to 1 oxygen nitrogen separation ratio. The newer silanized polyimides and polyacetylenes offer separation factors as high as 27 to 1. The newer phthalocyanine complexes with cobalt for oxygen and manganese for nitrogen enrichment when used simultaneously offer lower permeation rates but even higher separation factors.

Many of these techniques will eventually gain significance in the separation of unique chemicals including uranium fluorides and toxic elements from chemical industry flue gases amd chimneys.

BIO-MEDICAL

Bio-medical uses normally involve ultrafilters and are used with broth cultures for the separation for amino acids, organic acids, vitamins, antibiotics, etc.

Ultrafiltration membranes are used for the concentration of enzymes including amylases, proteases, pectinases and esterases.

Ultrafilters are also extremely useful for the concentration of viral and bacterial vaccines. Minimizing outside contamination and the need for difficult chemical sterilization.

Also gaining wide acceptance is the fact that the mineralized water that is ultrafiltered becomes water of injection quality in medicine, and membrane plants that are steam sterilizable are, therefore, used to remove pirogens from antibiotics solutions, amino-acid solutions, etc.

PERVAPORATION

Pervaporation is presently emerging as the technology for concentrating azeotropic mixtures, such as ethanol water or dehydrating chemicals such as ethylene glycol, polyethylene glycol, etc.

The process adds a new dimension to distillation in that the surface of the distilling liquid in distillation is not easily modified. The pervaporation membrane becomes in fact the new distilling surface of the liquid.

The chemistry in this membrane can be so chosen as to be more selective for one component over the other in the distilling liquid.

The normal selectivity, therefore, of distillation falls away and ultra-high selectivities are suddenly obtainable.

Present plants are very costly. The science is still in its infancy, but much progress is expected.

APPLICATIONS

	RECOVER	CONCENTRATE	SEPARATE	PURIFY	STERILIZE	CLARIFY
The portable desalination handpump unit			●		●	
Beverages		●			●	●
Clarified juices						
Bulk fibre mousse		●				
Oenology				●	●	●
Tomato puree		●				
Low-sodium beer		●				
Dairy products						
Long-term milk					●	
Milk concentrates		●	●			
Whey	●	●				
Coupled transport			●			
Gas enrichment			●			
New applications						
Biotechnology						
Membrane reactors	●					
Enzymes		●				
Pyrogen removal				●		
Large-volume parenterals			●			
Lactic ferments		●				
Fermentation broth cultures		●				
Pervaporation			●			
Other applications						
Vinegar			●			●
Egg products		●				
Lysozyme recovery		●				
Blood				●		

NEW APPLICATIONS

A new application that looks interesting is the clarification of vinegar, connected directly to the fermentation tanks.

Albumin concentration and whole egg concentration including lysozyme concentration has become attractive and is being operated locally.

This leak in a small diameter main running underneath a tarmac road surface, was detected with leak detection equipment.

Water loss from municipal distribution networks analised

A major investigation funded by the Water Research Commission has confirmed the feasibility of leak detection and water loss analysis programmes in South African urban areas.

The recently completed investigation commenced in November 1984 and was carried out in terms of a tripartite agreement between Castle Brass Holdings (Pty) Ltd, the Johannesburg City Council and the WRC. The aim was to investigate water loss analysis on municipal water distribution systems in order to establish water loss figures for representative urban areas in the country, to develop a water loss analysis procedure for local conditions and to determine a cost/benefit relationship with regard to water lost, repair cost and capital cost.

The final report, WRC report no 157/1/89, which summarises the major findings of the investigation, is now available from the Water Research Commission. To order, please complete the postcard in this Bulletin.

By analysing the data obtained from water loss control efforts, strategies to achieve the greatest cost-effectiveness can be developed. In addition, problem areas are identified, the effectiveness of different methods can be assessed and the frequency of repetitive surveys determined.

Areas in need of rehabilitation are also identified.

According to Mr Charles Chapman, research manager at the Water Research Commission, unaccounted-for water can be coarsely defined as the difference between the water purchased or produced, and the water sold to consumers. The magnitude is usually determined by the simple expedient of totalling the domestic meter readings and subtracting the sum from the bulk meter readings.

Mr Chapman says unaccounted-for water has three fundamental components, namely:

- meter inaccuracies
- unmetered consumption and
- leakage from the distributon system.

Unfortunately, the relative contributions of the three components to unaccounted-for water varies drastically from one town or area to the next and there exists absolutely no rule of thumb for the convenient elimination of the first and second components. However, the relative significance of these components can be reduced considerably by regular meter replacement programmes and the installation of proven meters which maintain accuracy throughout their design life, remembering also, that what works well on the Highveld might not necessarily work equally well at the coast. Similarly by progressively metering all water supplies, for example, to public parks and gardens, fire hoses and street washing the only remaining guestimate is actual discharge from fire hydrants for fire fighting, scouring or whatever. Mr Chapman says it is also important to remember that when planning a meter replacement programme to place your bulk meters high on your priority list and recheck them every year. Certain makes and types are notorious for going out of acceptable limits after a very short time in the field.

"Should yours be one of those rare cases where domestic meters are read on the same day, then it is a simple task to determine the unaccounted-for water via direct water balance. More often though, meters are read on a two or three month cycle and a bit of fancy mathematical gymnastics has to be applied to reconcile domestic meter readings with bulk meters."

Regarding the third component, there is only one sure way of accurately assessing leakage from the distribution system and that is to measure it.

PROJECT

The project required the establishment of typical system waterloss figures in representative urban areas in South Africa. The practical limitations of the project resulted in the definition of 19 test areas within the Johannesburg Municipality only. The areas were chosen to obtain figures on a cross-section of different types and ages of pipe installed under different soil/bedrock conditions.

The total length of water mains tested was 375,6 km and the length of service connections tested was 111,6 km. These 19 test areas covered 15 545 houses with a mean daily consumption of 1,01 kl.

The problem with a city the size of Johannesburg, Mr Chapman says, is that with an average daily consumption of 170 000 Ml, a loss of 10 per cent might be highly satisfactory, but if the normal rules apply, 80 per cent of this loss occurs in only 20 per cent of the area, implying that losses of up to five times the average actually occur. The truth is that leakage is NEVER uniformly distributed over a wide area. Obviously, therefore, large areas have to be compartmentalised into discreet districts, each with its own master meter (either permanent or temporary). Only through this approach can minimum night flows be regularly measured. Minimum night flow is of paramount importance as it is a direct indicator of the amount of leakage from the system. Minimum night flows do not necessarily give an indication of the general condition of the system however. Clearly therefore, the smaller such districts can be made the more accurately they can be controlled - but at an obvious cost.

For the 19 test areas or districts in Johannesburg the average water loss was 29,5 per cent, ranging from as low as 3 per cent to as high as 73 per cent.

In order to put the water loss figures for Johannesburg in perspective, it is necessary to do a world wide comparison. Although their accuracy cannot be vouched for, some figures of unaccounted-for water in urban distribution systems are given in Table 1.

Leak sizes and losses

A leak does not have to be very large to be significant as the following table calculated for a pressure of 5 bar (500 kPa or 75 psi), indicates:

Actual leak size		Litre per		m³ per	
mm	dia	minute	hour	day	month
0,5	•	0,33	20	0,48	14,4
1,0	•	0,97	58	1,39	41,6
1,5	•	1,82	110	2,64	79
2,0	•	3,16	190	4,56	136
2,5	•	5,09	305	7,30	218
3,0	•	8,15	490	11,75	351
3,5	•	11,3	680	16,3	490
4,0	•	14,8	890	21,4	640
4,5	•	18,2	1 100	26,4	790
5,0	•	22,3	1 340	32,0	960
5,5	•	26,0	1 560	37,4	1 120
6,0	•	30,0	1 800	43,2	1 300
6,5	•	34,0	2 050	49,1	1 478
7,0	•	39,3	2 360	56,8	1 700

BELOW: A map showing the complexity of an urban reticulation system

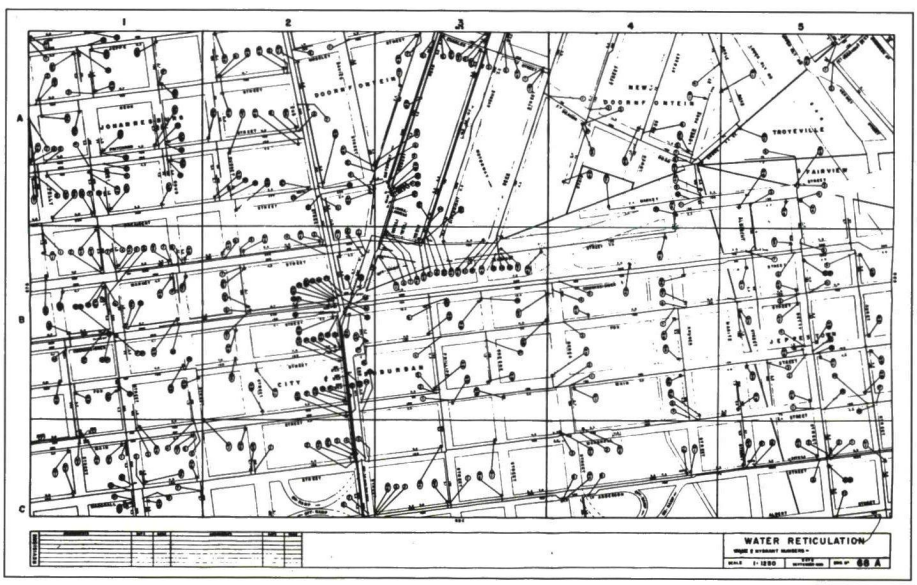


TABLE 1: WORLDWIDE COMPARATIVE LOSSES

PERCENTAGE OF TOTAL WATER SUPPLY NOT ACCOUNTED FOR DURING GIVEN YEAR

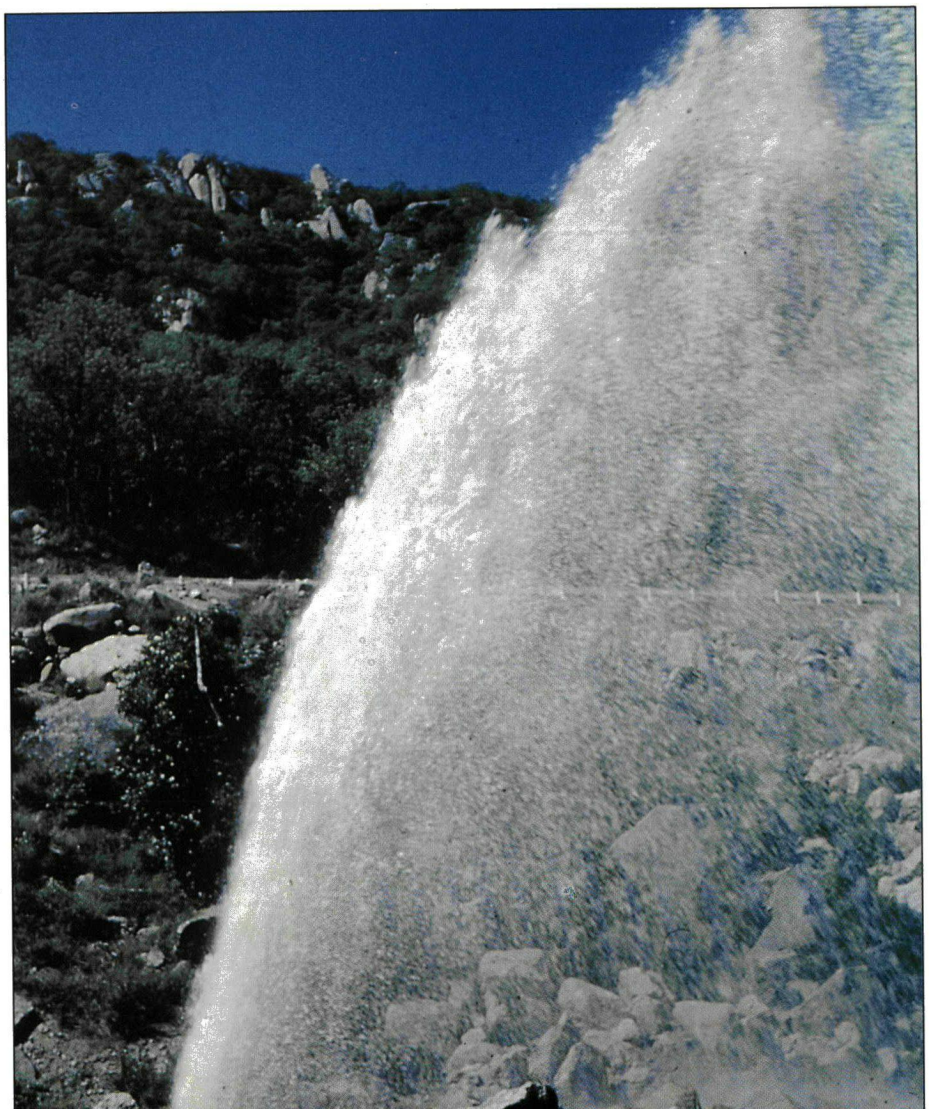
CITY	COUNTRY	1980	1984	1986
Pretoria	South Africa	10,5	21,8	12,1
Johannesburg	South Africa	10,5	12,8	-
Cape Town	South Africa	11,9	8,3	15,0
Bulawayo	Zimbabwe	13,5	-	-
Adelaide	Australia	15,0	15,0	
Sydney	Australia	15,7	14,1 (1983)	
Montevideo	Uruguay	40	32,2	
Tokyo	Japan	15,3	14,2	
Oslo	Norway	38,1	46,8	
Brussels	Belgium	13,4		
Vienna	Australia	15,4		
Paris	France	20,6	19,2	
Washington	USA	18,6	17,1	
Boston	USA	49,2	38,0 (1983)	
Cleveland	USA	28,5	23,0	

Reliable figures for London and New York are not available as in these cities only about one quarter of the water is metered to consumers.

Actual water losses from leakages are typically less than the unaccounted-for water as the latter includes unmetered supplies and meter errors.

From the table it is evident that the percentages of unaccounted-for water in urban centres in South Africa compare well with those for other cities in the world but according to the final report there is no reason for complacency for the following reasons:

- It is evident that, based on the average losses of 29,5 per cent of the supply for the 19 areas in Johannesburg, there are some city areas where the losses of water are far too high to be acceptable.
- South Africa, with its potential for water shortages should maintain a higher standard of loss prevention than the norms of 8 to 10 per cent loss of supply considered to be the maximum acceptable by the American Water Works Association. This is not the case unfortunately and many local authorities do not appear to realise the need for active loss prevention campaigns.



A leak needing no detection equipment

- The losses of 0,73m³/h km for pipelines in the 19 test areas in Johannesburg compared to the norm of 0,025 - 0,2m³/h km accepted as a maximum by AWWA shows the urgent need for a well-organised loss prevention programme.

THE COST EFFECTIVENESS OF LEAK REPAIR

The researchers say in the final report that the limited data available, established beyond doubt that the repair of leaks is generally cost-effective. It also permits conclusions as to the relationship between the degree of cost-effectiveness and the size of leak i.e., the larger the leak the greater the relative savings.

However, to establish the real cost-effectiveness of leak repair and in particular to establish the leak rate at which such repair becomes cost effective, more research is required taking into account factors such as leak rate increase in time, cost escalation of repair work, capital saving, life-cycle status of network etc.

It can, however, be categorically stated that total benefits far exceed the savings of lost water alone.

PROCEDURE

- The Test Programme investigated the relationship between the cost of leak repair and the annualised savings brought about by the elimination of the water losses.
- The leaks located were repaired by the Johannesburg Municipality and the cost of repair recorded.

The report emphasises that even the repair of leaks <1m³/h can be cost-effective when compared against the water savings achieved. The savings purely in terms of water at cost price appear to be considerable, escalating progressively with the increase in leak rate.

THE FEASIBILITY OF WATER LOSS ANALYSIS

To establish the feasibility of water loss analysis and leak detection programs the total cost of the project i.e. the total leak detection costs as well as the leak repair cost, were compared to the annual water saving achieved in the test area.

This limited information on its own cannot represent all the savings achieved but merely represents a particular set of savings i.e., the cost saving of water in terms of payments to the Rand Water Board.

It must be emphasised again that the exercise conducted allows no deductions as to the total savings in terms of capital cost, future repair costs, increased leakage losses in time, system maintenance, etc.

CONCLUSIONS

- From the results it is clear that the leak detection analysis undertaken in the test area paid for itself - taking into account only the cost of water saved within a period of approximately seven months. (Cost/Benefit ratio = 0,59)
- The costs included the expenses incurred in acquiring the services of two overseas experts for the first few months of the project. This expenditure should be of a non-recurring nature as this expertise is now available in South Africa i.e., the future cost of a similar exercise should be even more cost effective.
- The findings confirm both the feasibility of leak detection analysis as well as the need for ongoing leak detection programmes in all urban centres in South Africa.

Leak detection equipment
(Castle Brass Holdings)

The enforcement of the 1 mg/ℓ orthophosphate-P standard for effluents released in the Hartbeespoort Dam catchment is not complete and the recent reduction of in-lake phosphate concentrations and the disappearance of *Microcystis* is not due to the effluent phosphate standard.

WRC REPORT EVALUATES IMPACT OF STRICTER PHOSPHATE CONTROL ON HARTBEESPOORT DAM

This is one of the conclusions reached by Dr FM Chutter of the Division of Water Technology, CSIR in a report to the Water Research Commission on the 1 mg/ℓ phosphate-P standard's effect on the water quality and trophic state of Hartbeespoort Dam.

Dr Chutter says in the report that it has, however, become clear that *Microcystis* occurrence is governed by phosphate availability and that strict enforcement of the effluent standard should be attempted.

The report, which emanated from a research project funded by the Water Research Commission, is now available and can be ordered from the WRC. Please complete the order postcard in this Bulletin.

This research report deals with the phosphates in effluents released in the catchment of Hartbeespoort Dam and the quality of water entering, within and leaving Hartbeespoort Dam from 1985 to March 1989. It also describes the phytoplankton and zooplankton populations of the dam and how they have responded to changing conditions in the dam. Data on Hartbeespoort Dam dating back to 1980 have been used in the interpretation of results, which to a considerable degree, is concerned with the impact of the effluent phosphate standard on the dam.

In 1985 a 1 mg/ℓ effluent orthophosphate-P standard came into effect in the catchment of Hartbeespoort Dam, although the largest effluent treatment plant was granted an exemption from the standard for three years. Effluent data are available only from the latter half of 1986, since then there has been insignificant change in the total mass of phosphates released in the catchment of Hartbeespoort Dam. The mean concentration of phosphate measured in the Crocodile River, where it enters Hartbeespoort Dam, declined by about 20 per cent from hydrological year 1984/85 to 1985/86. Since then there has been no concentration decline in the river. There is, nevertheless, evidence that without the standard the phosphate load would have been greater after 1984/85 than that measured.

Due to increased rainfall, the mean stored volume of Hartbeespoort Dam increased from 7 million m^3 (38 per cent) in 1985/86 to 174 million m^3 (90 per cent full) in 1978/88. The dam spilled in 1987/88 and 1988/89 for the first time since 1981/82. With the filling of the reservoir the in-lake mean annual ortophosphate-P concentration steadily declined from 476 µg/ℓ in 1984/85 to 134 µg/ℓ in 1987/88 and the trend of declining concentration has continued into 1988/89. This change in phosphate concentration was brought about within the impoundment rather than by a decline in the phosphate concentration in the inflowing water. Ultimately, it would appear to be the increase in the stored volume of water which was responsible for the decline in the phosphate concentration in the dam. Due to the increase in the surface area of the bottom, the mass of phosphorus sedimented or otherwise retained in the dam increased from 118 t/annum in 1985/86 to 190 t/a in 1987/88. Furthermore, due to the increasing volume of the dam the aerial and volumetric phosphorus loading rates declined.

Unlike phosphates, the loads of nitrogen species arriving in the dam were lowest in 1984/85 and increased sharply from 1 395 t/a in 1985/86 to 2 266 t/a in 1986/87 and 2 109 t/a in 1987/88. Nitrogen losses within the impoundment have increased from 769 t/a in 1985/86 to 1 734 t/a in 1978/88 as the stored volume has increased. A feature of water quality in summer 1988/89 is that phosphate-P concentrations in the surface (0- 5 m) water have been as low as 5 µg/l and that N:P ratios have risen to over 25:1.

With regard to the non-nutrient major anions and cations, the water stored in Hartbeespoort Dam has, for the most part, remained remarkably constant in quality as the dam filled from 1985/86 to 1988/89. The largest concentration change was a decline in sulphate concentration from 1985/86 (109 mg/l) to 1987/88 (92 mg/l). In general water quality in the dam was intermediate between the low quality water of the Crocodile River and the high quality of the Magalies River. Outflow water was very similar to impounded water.

Heavy metal concentrations and total organohalogen potential (TOHp) were measured in the inflowing rivers, in the impoundment and in the outflowing water at quarterly intervals in 1985/86 and 1986/87. Although concentrations of most heavy metals were higher in the Crocodile River than in the dam, at none of the sites heavy metal concentrations were at levels to be of concern. There was no indication that heavy metal concentration varied systematically with depth in the impoundment.

TOHp was of the same order (260 to 349 µg/l) in the dam, its outflow, the Magalies River and the Crocodile River in 1986/87. It was higher (556 µg/l) in the Crocodile River in 1985/86. There was

Euthrophication in the Hartbeespoort Dam.

no evidence that potential increased or decreased with depth in the dam or that the presence of large quantities of phytoplankton in the water increased the TOHp.

The chemical quality of water in Hartbeespoort Dam was classified following German Technical Standards (GDR, 1982) and was found to be moderately impaired, requiring comprehensive treatment for domestic and industrial use, but usable for irrigation. A similar classification was arrived at by comparing Hartbeespoort Dam data with a set of internationally accepted water quality standards.

The species composition of the plankton of Hartbeespoort Dam remained similar to that of previous years through to the end of 1987/88. In summer 1988/89 profound changes occurred in both the zooplankton and the phytoplankton. *Microcystis aeruginosa*, in previous years the dominant species (>80 per cent biomass) for ten months of the year, was almost entirely absent. The zooplankton came to be dominated by a predatory species, while filter-feeding species had previously been dominant. These biological changes are ascribed to the reduced phosphate and nitrogen species concentrations in the water and to the increased N:P ratio. Changes in wind speed and temperature, which might have resulted in phytoplankton change, were well within the previously recorded range of variation. The change in the phytoplankton could therefore not be associated with these physical factors. It could also not have been brought about by the observed change in the zooplankton to dominance by a predator.

SCUMS

Spilling of the reservoir, when scums formed at the end of summer was shown to result in low winter *Microcystis* populations. This greatly improved the aesthetic quality of the water and made it less variable for water treatment works. However, removal of the scums had a negligible impact on the nutrient content of the dam. The impact of scums flushed from the dam on the Crocodile River is unknown.

The full data base from 1980/81 through to 1988/89 was used to test simple predictive models of the phosphorus and chlorophyll concentrations in the dam. Several of the models used had been developed in the northern hemisphere for steady state lakes. The eight year data base on Hartbeespoort Dam shows that it is not in a steady state as regards volume, inflow, outflow, the inflow-outflow relationship, water retention time, combined nitrogen and phosphorus load and the inorganic nitrogen to phosphorus ratio. Despite the dynamic nature of the impoundment, the total phosphorus concentration in the dam was adequately predicted by the OECD (1982) model and some of its derivatives. The best, a very good model indeed, was due to Grobler and Silberbauer. (See final report to the Water Research Commission entitled The impact of eutrophication control measures on South African impoundments by DC Grobler and MJ Silberbauer, 1984).

No models were found that predicted chlorophyll satisfactorily. In no case was there a statistically significant relationship between observed and predicted values.

Examination of simpler relationships such as that between mean annual volume weighted inflow concentration of phosphorus, annual and volumetric phosphorus loading rates on the one hand and in-lake mean annual volume weighted phosphorus concentration on the other, showed few but important significant relationships. Surface phosphorus loading rate ($r = 0.94$) and volumetric phosphorus loading rates ($r = 0.92$) were very good predictors of mean in-lake phosphorus concentrations. Predictions of chlorophyll were again not significant.

CONCLUSIONS

Important conclusions arising from this study were that the enforcement of the 1 mg/ℓ orthophosphate-P standard is not complete. The recent reduction of in-lake phosphate concentrations and disappearance of *Microcystis* is not due to the effluent phosphate standard and is not likely to be permanent. Nevertheless it has become clear that *Microcystis* occurrence is governed by phosphate availability and that strict enforcement of the effluent standard should be attempted. The prevention of stratification through aeration would also tend to drive nutrient availability and the N:P ratio in a direction unfavourable to *Microcystis*.

The present study clearly reveals that the understanding of the quantitative functioning of South African hypertrophic lakes cannot be complete unless it includes the filling phase of the hydrological cycle. The changes in the composition of the plankton following the disappearance of *Microcystis* were not those predicted from earlier studies.

Microcystis scums should be removed, where possible, as scum removal greatly improved the aesthetic quality of the dam. Effects of flushed scum material on the receiving river should be taken into account.

Comprehensive treatment of Hartbeespoort Dam water is necessary prior to its use for domestic and industrial purposes. Dissolved heavy metal concentrations in Hartbeespoort Dam are acceptable and TOHp concentration is not increased by the storage of water in Hartbeespoort Dam. Prediction of mean annual in-lake phosphorus concentration is satisfactory but mean annual chlorophyll concentration cannot as yet be adequately predicted.

An example of salinisation.

WRC workshop looks at SA's future salinity research

A workshop to prioritise the goals and assist with the identifications of future salinity research needs in South Africa was organised by the Water Research Commission and held in November last year.

Experts on various aspects of salinisation were invited to present situation assessment statements on the four primary research goals identified by the WRC's Co-ordinating Committee for Salinity Research. As part of their situation assessments they, amongst others, analysed the state-of- the-art of existing knowledge, the availability of resources for research and the magnitude of the salinity problem that would be solved by attaining each goal. They also presented an analysis of the strenghts-weaknesses-opportunities and threats that would either promote or ham-

Trip Programme

Mon 18 June	: Depart Jan Smuts
Tue 19 June	: Arrive Zurich, stay in Weil am Rhein, W-Germany
Wed 20 June	: Training Seminar at Flowtec Switzerland
Thur & Fri 21 & 22 June	: Training Seminar at Endress + Hauser at Maulburg, W-Germany and visit to a Water Treatment Plant
Sat 23 June	: Excursion to Interlaken, Switzerland
Sun 24 June	: Travel through Black Forest to Stuttgart
Mon 25 June	: Training Seminar at Conducta in Stuttgart
Tue 26 June	: Training at Conducta Visit Waste Water Plant Travel to Frankfurt by bus Depart from Frankfurt to Johannesburg
Wed 27 June	: Arrive Johannesburg

Seminar Programme

1ST DAY

- Introduction: Flowtec and visit
- Flow measurement: vortex meters
- Flow measurement: magnetic flowmeters
- Mass flow measurement: Coriolis meters

2ND DAY

- Introduction
- Level measurement: Capacitive systems
- Level measurement: Hydrostatic systems
- Visit E+H Maulburg/factory
- Level measurement: Ultrasonic systems
- Level measurement: Vibration and Silopilot

3RD DAY

- Pressure measurement
- Open channel flow measurement
- Water treatment plant visit

4TH DAY

- pH measurement
- Redox measurement
- Dissolved Oxygen measurement
- Electrode Selection, holders, cleaning etc.

5TH DAY

- Chlorine measurement
- Conductivity measurement
- Water treatment plant visit

Travel and Accommodation Costs

Course participation is free.
The cost for airfares (from Johannesburg), hotels (single accommodation), all meals, bus transfers is R5 950.

Not included in the above are telephone calls, laundry, hotel mini bar usage and other items of a personal nature.

Payment

Deposit of R500 for reservation.
Balance payable by 15th May.
Deposit is non-refundable for cancellations received later than 15th May 1990.

Enrolment

The number of participants will be limited, therefore if you wish to participate, complete the attached slip and return it as soon as possible.

Application for Training Seminar and Study Tour at Endress + Hauser Germany and Switzerland, 18 to 27 June 1990.

Deposit of R500 enclosed for reservation for:

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2ND JOINT AWRA/SASAS SYMPOSIUM ON WATER: ECONOMICS, QUALITY AND MANAGEMENT

2 TO 4 JULY 1990

The American Water Resources Association AWRA is convening a joint meeting with the Southern African Society of Aquatic Scientists (SASAS). The theme of the 1990 Symposium is economics.
Economics pervade most water resource management decisions, and, to a large extent, determine the way in which society views and values the resource. This Symposium aims to provide an overview of the complex field of water economics and will address critical questions such as: is water undervalued? or how much pollution control is affordable? and who pays for pollution control?

VENUE

Faculty of Medicine, University of the Orange Free State, Bloemfontein, South Africa.

COSTS

All attendees, including authors, will be expected to make their own arrangements for travel, accommodation and payment of the registration fee. All fees for this Symposium are included in the registration fee for the 27th Annual Congress of the Southern African Society of Aquatic Scientists.

PRELIMINARY REGISTRATION

Persons interested in attending this timely symposium are asked to contact the organisers as soon as possible or complete the registration card in this Bulletin.

Dr JA Thornton
Town Planning Branch
PO Box 1694
CAPE TOWN
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(021) 210-2288
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Prof AJH Pieterse
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(051) 401-2425

per research from being carried out. With this background information at their disposal the twenty workshop participants from various government departments, the CSIR, universities and private consulting firms, proceeded to prioritise salinity research goals using the analytical hierarchical process.

According to Mr Meiring du Plessis, research manager at the WRC and convenor of the workshop, they allocated the highest priority to research aimed at an improved assessment of future salinisation trends and impacts, followed closely by research into the quantification of the present salinity status and its impact on water users. Specific aspects of alternative uses for saline water and management strategies for salinity control were also identified as priority research needs.

In his situation assessment of the primary research goal to quantify and assess the temporal and spatial variation and impacts of salt content and loading of surface waters on users, Mr Maarten van Veelen from the Hydrological Research Institute, Department of Water Affairs, said that in South Africa fresh water resources that could be economically developed and utilised were limited. Most of these sources were already developed to a large extent and the future will see a shift from water resource development to water resource management. In this regard the re-use of water, which already played a significant role in some parts of the country such as the Vaal River system, will play an increasingly important role.

"One aspect of the re-use of water is that downstream consumers and users of water will be faced with increasing salt concentration levels, while in other parts of the country, such as the Eastern Cape, salinisation as a result of natural phenomena has been a historic problem.

"In order to be able to effectively manage water quality, information systems that will allow managers and decision-makers to make sound decisions and also allow an assessment of the effectiveness of the implementation of management policies are needed. These information systems will also be needed to assess the effect of salinisation on users and thereby focus attention on priority areas."

He said salinity research to quantify the present salinity status and assess its impact on water users, could be divided into five sub-goals:

- Establishing adequate monitoring systems;
- developing and maintaining comprehensive data bases and
- data management systems;
- accounting on a systematic basis, with the use of existing data, for the contribution of point and non-point sources to the salt load of surface waters;
- determining water quality requirements (viz salinity) for different users; and
- quantifying the economic and other impacts of salinisation exceeding threshold concentrations, on various water users.

Mr Van Veelen expressed the opinion that the current monitoring networks which were operated by the Department of Water Affairs were developed to collect data on as wide a basis as possible with the available funds and manpower. The existing national water quality monitoring system was however, mostly developed around the existing flow gauging network, and did not take specific water quality information requirements into account. The POLMON (pollution monitoring) system was specifically developed to monitor point sources of pollution, while diffuse sources were largely ignored.

He informed workshop participants that the Department of Water Affairs and the CSIR were currently involved in the development of a national water quality monitoring system, partially funded as a Water Research Commission research project, and it was already becoming clear that the existing knowledge and experience did not allow the development of the ideal system.

"The Department of Water Affairs is currently also in the process of implementing a comprehensive Hydrological Information System (HIS) which will contain both a chemical data base and a flow data base. The data base is well designed and retrieval of data is straightforward and relatively easy.

Mr Van Veelen was of the opinion that the presently available data would allow the assessment of the salt load contribution by point and diffuse sources but only for a limited number of specific cases in South Africa. The information gathered for these specific cases would have to be extrapolated to other cases in order to make an assessment for the whole country. The methods needed for such an extrapolation would also have to be developed.

He said an appreciable amount of research with regard to the contribution of diffuse sources to salt load in certain parts of the country, such as the Eastern Cape and the Western Cape, had already been completed. The knowledge gained during this research could be applied to the rest of the country, although some collaborative research would have to be conducted to ascertain the applicability of some of the assumptions that would have to be made.

Mr Van Veelen said that to determine the effect that salinisation has on each user of water, it is necessasry to determine a threshold concentration below which a difference in concentration has no effect on the water's fitness for use. "The Water Act recognises five groups of users, namely municipalities, industries, agriculture, recreation and nature conservation. Under each of these categories there are a number of individual users, which again are affected by different circumstances such as climate, soil types, etc. Not only are these users affected by salt concentrations as such, but also by the composition of the salts.

"Determining water quality requirements for different users in different parts of the country is therefore a mammoth task which cannot be taken lightly."

He mentioned that the results of a large number of resarch projects, both international and local, were available. "It is however, doubtful whether this information is directly and widely applicable, especially the results of research undertaken in other countries. It will therefore be necessary to collate all the information and correlate it for different South African conditions, especially the information on how crop yields are affected by salinity."

Mr Simon Foster of the Department of Water Affairs said in his situation statement on the future salinisation trends and impacts that the primary causes of salinity problems in South Africa were:

- natural conditions, such as geology and soils containing quantities of soluble salts, together with associated saline aquifers;
- flow reduction in rivers due either to the upstream diversion of dilution water or drought conditions;
- evaporative losses from surface waters such as rivers, large dams, canals and farm dams;
- irrigation return flow, including seepage losses from irrigation water storage and distribution systems;
- runoff from dryland agriculture;
- saline industrial effluents, including the discharge of water from surface and deep mines;

- urban development including both point source and diffuse source contributions;
- atmospheric deposition, from both natural and man made origins.

"In view of the known trends in water-use," he said, " it is reasonable to assume that salinities are increasing (in real terms), and that such increases are an inevitable consequence of increased abstractions, consumptive use and return flows. The effect of flood and drought sequences, dam construction and operation, water supply quality management strategies and pollution control measures, tends to conceal this underlying trend."

Mr Foster said the statistical techniques for analysing water quality data timeseries were well developed and comprehensively documented in the literature. Software to undertake the analysis of water quality timeseries was also available. But the preparation of water quality timeseries data for analysis by commercial software packages could still prove to be a lengthy and demanding task.

"However, statistical analysis is only one aspect of the detection of trends. Trends have to be related to causal effects and this relationship must be proven to be valid. It is in this area that the state-of-the-art might be inadequate at present. The problem is that there are invariably more than one possible cause of a trend, and that these causes are also in state of change. For example, the effects of irrigation expansion on returnflows might be hidden for several years by climatic cycles or low ground water tables. Alternatively, increased returnflows might be offset by changing irrigation practices.

MODELS

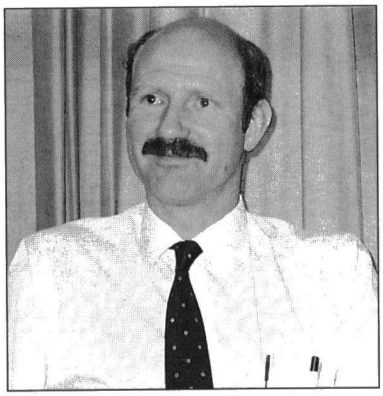
He said that the planning and operation of water resource systems in at least eight major catchments (i.e. Vaal, Breede, Fish, Sundays, Mgeni, Berg, Buffalo, Crocodile), relied on some form of hydrosalinity modelling.

"It therefore follows that a vast monitoring network is required to support such a modelling effort. In limited areas of the Berg, Breede, Sundays and Mgeni, detailed field studies support the modelling work through an effort to improve the understanding of hydrosaliny processes. The problem of severe spatial variability in South African catchments represent a challenge for modelling. This variability spans the categories of soils, geological formations, meteorological conditions and climatic extremes (at both micro and macro scales), crop diversity and changing land-use, changing irrigation techniques, and pollution control improvements."

CLIMATE

Mr Foster pointed out that many of the serious salinity problems experienced in South Africa to-date have occurred during, or as a result of, extreme climatic events. For example,

- the rapid rise in the salinity of the water in the dams of the middle and lower Vaal catchment as well as certain dams in the Eastern Cape was directly related to the 1979-84 drought; and
- the rise in the salinity of Lake Mentz during 1975-78 was a direct result of successive heavy seasonal rains in the Sundays River catchment.



Mr Simon Foster

"In essence, increases in salinity during drought conditions is primarily a result of the shortage of dilution water which under normal circumstances is generally available to maintain salinities at non-problem levels. If dilution water shortages occur while the discharge of saline effluent remains relatively constant then salinity levels will increase. It should be noted that during drought conditions, the mechanisms which mobilise and transport salts from diffuse sources is greatly reduced. Consequently, the contribution to salinity problems is reduced, and in certain catchments can sometimes result in a decrease in runoff salinity.

The ability to predict salinity levels as a result of both drought and reductions in the availability of dilution water, is relatively straightforward and largely requires the application of mass-balance modelling techniques. Such an approach has proved highly effective in the salinity modelling of the Vaal River catchment.

Unfortunately, the modelling and prediction of contributions to river salinity from diffuse sources and from saline aquifers is far more difficult to accomplish. The poor understanding of the interactions between the flow in river channels and fragmented secondary aquifers in South Africa, and the unsuitability of overseas ground water models (designed essentially for primary aquifers) are major obstacles. However, considerable progress has been made in this respect in the DWA's Breede River model development programme which includes routines for simulating irrigation return flow processes involving shallow alluvial aquifers situated adjacent to the river channel."

STRATEGIES

Mr Helgard Müller, from the Department of Water Affairs, discussed management strategies for salinity control and said that it could be achieved by

- identifying and evaluating management options in different land-use sectors
- developing more effective operating strategies for water supply systems
- developing appropriate mathematical models to aid decision-making

He said the various management options would have a great economic impact on water users.

In a WRC study by Heynike, he said it was estimated that the annual cost of salinisation to users of Vaal River water could run up to approximately R250 million per annum. On the other hand, applying unnecessary strict pollution control standards could also cost industry and the country millions of rands.

He said the Department was at present spending approximately R1 million on six projects in this field and that money would in future be allocated more to development, applied research and policy formulation than to basic research.

On the development of more effective operating strategies for water supply systems, Mr Müller said that operating strategies were needed for the operation of dams, canals, pipelines and river systems to reduce salinity levels to acceptable standards.

"Improvements can be achieved by mixing, blending, and/or importation of fresh water to certain dams or supply systems. An operating strategy can be followed by using canals or pipelines for good quality and rivers for poor quality water.

An irrigation channel in the Eastern Cape where salinisation affects agriculture.

"What is most important is the determination of the effect on water quality by applying these strategies and to formulate such strategies, using results from existing and future studies."

He said that to aid decisionmaking appropriate mathematical simulation models would have to be developed.

"As salinity can be fairly accurately modelled (as compared to modelling of non-soluble substances e.g. eutrophication) a great number of salinity models have been developed. But research needs that still exist are

- a model for the effect of air pollution on water quality and
- the calibration of existing models for simulating the effect of high salinity effluent on certain sensitive catchments."

Speaking on the alternative uses of saline water, Professor Hume Moolman from the University of Stellenbosch said that saline water could be used for

- irrigation of croplands
- enhancement of wetlands
- agroforestry production
- aquaculture for the production of fish
- generating electricity using solar brine-ponds

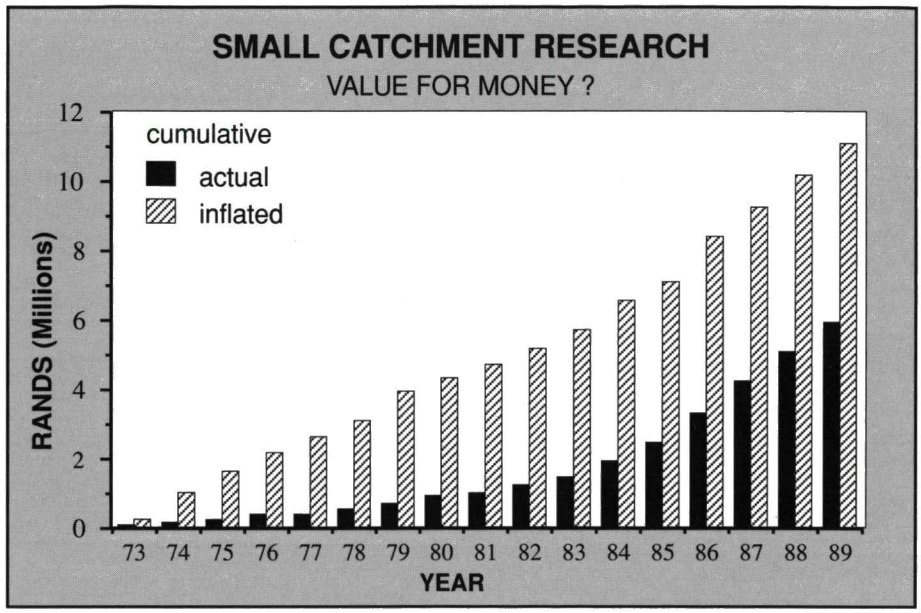
He warned, however, that these novel uses might be restricted by the possibility that saline drainage water from agricultural lands, as well as industrial effluents, might contain hazardous and toxic chemicals such as selenium, cadmium, arsenic and agricultural pesticides.

"Although many of these novel ideas are theoretically sound, the commercial application of them might be fraught with practical problems. An example is the production of electricity from solar brine-ponds where a large volumes of salty water is needed to begin operation. The salt concentration in such ponds is 32 times that of sea water. To concentrate saline drainage water to such high concentrations and still have a big enough volume of brine, will take time and a large volume of water. Similarly, a potential problem associated with agroforestry is the long time period required to establish controlled experiments and the difficulty in translating research results from the experimental area to larger irrigated areas."

Part of the catchment at Ntabamhlope in Natal.

Fifteen years of small catchment research through the Water Research Commission

The Water Research Commission has financed twenty projects dealing with aspects of small catchment hydrology since 1974. During this period individual projects have achieved considerable success, but, says Mr Hugo Maaren, research manager at the Water Research Commission, we now need more synthesis of typical South African hydrology as a whole.



Speaking at the Fourth South African National Hydrological Symposium, recently held in Pretoria, Mr Maaren said that the knowledge and understanding of small catchment hydrology should now be applied in supporting integrated large catchment management.

He discussed the WRC's initial objectives and the different approaches of project leaders to the research work. He also looked at what was achieved for the money spent on the projects and made recommendations for the future.

INITIAL OBJECTIVES

According to Mr Maaren hydrological modelling and the comparison of models were the major objectives at the start of the WRC research programme. He says in the original agreements between the WRC and the different research organisations, the following objectives were given:

- Not enough is known about the relationship between rainfall and runoff in small catchments in South Africa. Research into such a relationship has been orientated towards very large catchments within the broad framework of climatic regions and has resulted in the development of the mathematical models such as the HRU water resources model (now better known as the Pitman models). It is now possible to predict runoff from large catchments using mathematical models. However, when the models are applied to small catchments the amount of variation from predicted runoff that can be expected, is not known because of the scarcity of well kept data on small drainage basins (< 100 km^2)".
- In another project it was stated:"The proposed programme is aimed at the acquisition, digitisation and use of rainfall runoff data to optimise parameters in flood and yield models. Initially existing models applicable to small agricultural catchments (< 50 km^2) will be used with the objective of delineating areas in which parameters are uniform. This will enable the models to be applied by practising engineers in optimising runoff dependent structures. Such information is particularly pertinent to the economic design of culverts for roads, railways, soil erosion control works, drainage systems and low earth embankment dams, in addition to facilitating the economic development of the water supply of small catchments".
- These broad objectives were also perceived by AS Hope and GJ Mulder in a publication on *Hydrological investigations of small catchments in the Natal coastal belt in 1979.* They stated: "In promoting hydrological investigations in small catchments the WRC has the broad aim of modifying and refining models developed for large catchments to suit small catchments".

So it seems clear that from the start of the WRC research programme there was a common focus on mathematical modelling.

DIFFERENT APPROACHES

Although hydrological modelling and model comparison were the major objectives, the main thrust in the initial programme as a whole was the establishment of a small catchment hydrological research infrastructure for model verification purposes.

Hydrological models have been and are being developed in a great variety because research takes place from a fairly theoretical viewpoint. It stands to reason that only a rather arbitrary selection can be made for comparative purposes.

Roberts working in the semi-arid Eastern Cape catchments selected four hourly and four daily deterministic models in varying degrees of complexity with regard to simplification of the hydrological processes. Schulze working in Natal decided quite early in his project to use an existing empirical model known as the American SCS curve number model and to adapt it to South African conditions. Cousens and Burney also working in Natal tested the distributed grid model of Huggins on the Ntabamhlope catchments. Both models were found to show serious shortcomings. Further development of the distributed grid model was abandoned in favour of the SCS technique. Görgens following some of the recommendations by Roberts (1978) continued with the testing of another seven deterministic conceptual models using hourly, daily and monthly input data and including the locally developed Pitman models.

Hope and Mulder working in the Zululand catchments and the Natal midlands decided to concentrate on multivariate statistical analyses of annual and seasonal rainfall and runoff using physiographic variables of several small catchments throughout Natal. Hope and Mulder also used the Pitman monthly model and tried to find

correlations between important model parameters and measurable physiographic variables on small catchments.

Hughes and Beater did not continue the work of Roberts and Görgens but started to compare different single event models, both in lumped and distributed format, while Green and Stephenson at Wits University compared four different urban drainage models and finally decided to develop their own model (WITWAT). Later on Schulze (1989) combined the SCS technique with soil water budgeting to produce the ACRU modelling system.

The objectives of the twenty projects reviewed for this purpose showed a gradual shift in emphasis which can roughly be summarised in three five year periods:

1974 - 1979

- ❑ Instrumentation and detailed description of research catchments
- ❑ Data collection and setting up of data processing facilities
- ❑ Selection and initial testing of existing hydrological models

1979 - 1984

- ❑ Adaption of single event models to local conditions
- ❑ Field studies on such processes as infiltration, plant water use, salt storage etc.

1984 - 1989

- ❑ Model development to assess land-use effects
- ❑ Large catchment systems models
- ❑ Initial data base integration

WHAT HAVE WE LEARNED?

As far as hydrological models are concerned the following are typical issues which have been investigated during the WRC's 15 year programme:

- ❑ Performance of models of differing complexity.
- ❑ Goodness of fit criteria and objective functions.
- ❑ Model parameter transfer between calibrated and ungauged catchments.
- ❑ Model parameter stability and relation between model parameters and physical catchment attributes.

PERFORMANCE OF MODELS OF DIFFERENT COMPLEXITY

Pioneering work in this regard in South Africa was done by Pitman between 1978 and 1977 on 767 km^2 of the Jukskei catchment outside Johannesburg. He compared the relatively simple Pitman hourly, daily and monthly models with the more complex

Mr Hugo Maaren, research manager at the Water Research Commission

Stanford watershed model. Some of his conclusions were:

The more complex models require accurately measured input in order to achieve full potential. Under the prevailing circumstances the more simple models performed better. Especially with regard to time spent on calibration, the simpler models have an advantage. These preliminary findings were largely confirmed by Roberts using a very short record of rainfall and flow in the Ecca catchment. Görgens came to a slightly different conclusion — some evidence was found of a correspondence between superiority of model performance and higher structural complexity of the models in the hourly, and daily input categories. He confirmed that daily flows are not better simulated using hourly input instead of daily input. Görgens (1983) did find indications that a minimum level of model complexity for the generation of daily and monthly flow series of acceptable accuracy did exist. He found that for the prevailing conditions the Pitman daily model produced the best overall results of the seven models tested. But he also found that none of the models tested was completely satisfactory and serious simulation failures occurred in all of them.

If we consider a semi-distributed model as a more complex model than the corresponding lumped model, Hughes and Beater (1989) found "The lumped models perform as well as the semi-distributed when the rainfall input is relatively spatially uniform. The semi-distributed models show demonstrable improvements for storms with spatially variable rainfall if this rainfall input is adequately defined by the available data".

From the above research findings we can now firmly conclude that the preferable model complexity is dictated by the spatial variability of the natural system (rainfall and physiography) and the degree of accuracy with which this is measured and available for input. This confirms Pitman's original conclusion.

One could summarise the issue of model performance simply by the slogan "Garbage in, garbage out!" But the obtaining of good input data is costly. Think of dense raingauge networks, soil- and land use maps etc. and we must realise that the so-called realistic physically based models are conceptual frameworks that can only reach their full potential if we can provide the necessary input data. This therefore also affects the question of what are the 'better models'? In the one argument one could say "the one that best simulates the real world process, not counting the cost". In the other argument one could say "the model that in the most cost-effective way leads to acceptable management decisions".

So the real challenge ahead of us is not the theoretical comparison of arbitrarily selected models on a very small sample of our natural catchments, (less than 0,1 % of the Republic) but to build up experience with a limited number of acceptable models under real world management conditions.

MODEL PARAMETER TRANSFER, AND MODEL PARAMETER STABILITY

One of the issues investigated in hydrological modelling is model parameter transfer because simulations are often required for catchments where no observed flows are available. Two methods have been looked at:

- ❑ Calibrate the model on a 'similar' catchment and use rainfall input to the ungauged catchment to predict flows in the ungauged one.
- ❑ Relate model parameters to measurable catchment attributes.

Roberts working on a short data set in the Eastern Cape concluded that indications are that apparent similarity in climate, vegetation and lithology may not be sufficient for the assumption of equivalent hydrological

response. Görgens, however, five years later concluded "In general, parameter transfer between two of the three apparently 'similar' catchments was highly successful but between these two and the third produced poor results. This finding can be explained by subtle but measurable differences in physical characteristics among catchments. Such physical differences could be signals of crucially different hydrological response characteristics and can be quantified before parameter transfer is embarked upon".

This idea was further investigated by Hughes in the Southern Cape. He used five catchments to calibrate two models - Flexifit and Pitman - using monthly input data and used the calibrated model parameters to predict flows in three neighbouring catchments. Calibrations were based on the coefficient of efficiency of monthly flows.

He found that catchment slope gave clear indications of the changes in the important storage parameter in the Pitman monthly model.

Hughes showed that the storage parameter is decreasing with increasing slope, which in turn increase the mean annual runoffs simulated.

Hope and Mulder calibrated the Pitman monthly model for 17 small catchments in Natal and developed multiple regression equations with measurable variables to predict such important model parameters.

Their equations apparently contradict the findings of Hughes. However, Hughes does warn that such relationships can be very site specific because catchment slope in the mountainous southern Cape is highly correlated with attributes such as vegetation cover and mean annual runoff ratios.

The overall conclusion of Hughes was that model parameter transfers guided by physical relationships may be successful. The fact that regionalised model parameters are often successful also suggests that there is a true physical base for model parameters even in simple conceptual models.

The inherent danger in these approaches is the fact that model calibration does not produce a unique set of "true" model parameters and therefore any correlation with measurable physical catchment attributes is still dominated by chance.

ACHIEVEMENTS

If we summarise the results of the Water Research Commission's 15 year programme we can highlight the following achievements:

- A valuable small catchment rainfall-runoff infrastructure and data base has been built up.
- Several nuclei of hydrological expertise have been established and a fair number of students have been educated in the principles of hydrology.
- The number of scientific papers in refereed journals is fairly impressive. The bulk of the papers are in the form of reports to the Water Research Commission and internal reports in the research organisations.
- With regard to application, the products that would qualify are the design manuals for small structures by Schmidt and Schulze, the WITWAT model for urban drainage by Green and Stephenson and the ACRU modelling system of Schulze for a variety of water management activities.
- Understanding. It is always difficult to measure this, but there is no doubt that several researchers individually, have gained a lot of hydrological understanding. However, for the hydrological community at large, "I am afraid not enough of this understanding is reaching them in a synthesized form". The pre-occupation with model testing and model development has also distracted a lot of our efforts away from the study of real world processes.

RECOMMENDATIONS

If we look at our South African hydrology as a whole, our focus varies from small to large catchments and we must ask ourselves the following question:

Is a large catchment simply the sum of a number of small catchments or is there more? In our modern water management we need to focus on both large and small catchments. Conley and Olivier from Strategic Planning in the Department of Water Affairs recently stated: "On the supply side (of water management) the need for improved hydrological insights requires the development of new generations of spatially distributed hydrological and water quality models to supplement traditional analysis and forecasts based on time series at isolated locations. Overall, ever finer detail must be considered more deeply..." For bulk water supply the focus can remain on large catchments but for integrated catchment management we need a focus on both the small and the large catchments. In order to critically assess the contribution of small catchment research we need a holistic view of our surface water resources situation.

Management of the system is dominated by potential conflict between users with regard to the equitable allocation of a limited resource. If hydrological research wants to be relevant in helping to manage this conflict situation, researchers must provide information on three fronts:

- Facts about local hydrological processes anywhere in the country as a whole,
- Value of water as perceived by different users,
- How different interest groups are using water.

"Not only do we need a rating of research goals as identified in master plans, we have to compile a comprehensive hydrological research strategy to which different groups of expertise in the country will contribute, not in competition with each other but complimentary to each other.

"Some of the priorities I see are:

- Experience has shown that the development of useful hydrological models is a very long process and with the setting of goals for our research we should be looking far ahead and work from a problem solving orientation.
- We should use our hydrological expertise to synthesise a more comprehensive picture of South African hydrology as a whole.
- We must stop comparing different hydrological models or try to develop entirely new ones. We should select a limited number of credible modelling systems and collectively build expert systems around such models using the entire South Africa as the experimental area.
- We need to develop methodology that will enable us to identify dominant hydrological processes in South Africa which in turn will help us to select modelling approaches, data gathering programmes and management strategies accordingly.
- We must develop the theory of large catchments having two main integrated components: the uplands (hill slope) and the river system. Semi-distributed models must be able to accommodate different runoff processes in different parts of the large catchments, again allowing for regional and local differences.

FOURTH SOUTH AFRICAN NATIONAL HYDROLOGICAL SYMPOSIUM

The Fourth South African National Hydrological Symposium took place at the University of Pretoria from 20 to 22 November 1989. It was held under combined auspices of SANCIAHS (South African National Committee for the International Association of Hydrological Sciences), SASAS (Southern Africa Society of Aquatic Scientists, formerly LSSA) and SAICE (South African Institution of Civil Engineers).

The objectives of the symposium, as formulated by representatives of the convening societies, were:

- To bring together water resource practitioners and researchers in the broad field of hydrology and water quality.
- To provide new and relevant information on the application of hydrology and limnology in water resources development and conservation.
- To identify some directions for future development, particularly on the interphase between the different water related disciplines.
- To discuss the feasibility of broader communication between the different organisations involved in the water field, following the concept of a "water week".

Almost 200 engineers and scientists from South Africa and neigbouring countries attended this symposium.

SYMPOSIUM

The symposium was appropriately opened by the Minister of Environment Affairs and of Water Affairs, Mr GJ Kotzé. His message was clear: With the problems of water resources management still increasing in complexity and the ever-growing need to find a balance between development and environmental conservation interests, working in interdisciplinary teams made up of experts over a wide spectrum, has become indispensible. The Minister highlighted, as examples, the new water quality management approach in South Africa, the acknowledgement of the environment as legitimate user sector of water and the need to conserve this environment as a life-giving heritage.

In line with the objectives of the symposium two keynote speakers addressed the quantity and quality sides of water resources development and conservation. Prof David Pilgrim from the University of New South Wales, Australia addressed floodplain management policy development and also the revision of flood estimation procedures recently undertaken in Australia. He also touched on the development of the Total Catchment Management Programme in New South Wales which is destined to play a major role in the rehabilitation and better management of water and related land-based resources.

Prof Jack Stanford from the University of Montana, USA highlighted the consequences of stream regulation on biodiversity and ecosystem stability. He showed how a catchment perspective, a thorough understanding of ecosystem structure and function and an interactive management dialogue can lead to an ecologically sound compromise discharge scheme, using as example the extremely complicated system of the Flathead River Basin, Montana.

Different sessions of the three day symposium were devoted to papers and discussions on:

- Water availability and allocation
- Floods
- General limnological aspects
- Water requirements of the aquatic environment
- Flow processes and sediment transport
- Catchment water quality
- Decision and information systems

Each session started with an overview lecture by an invited speaker. In line with the main objective of the symposium viz to stimulate interaction between scientists and engineers from different water-related disciplines. The overview lectures was to provide participants with perspectives from different fields of specialisation. This format found favour with the vast majority of those attending and it is recommended that this format be retained for future combined symposia.

Papers as well as their presentation was generally of a high standard. One could sense that people wanted to communicate with each other. Posters and software demonstrations contributed further to an active interaction.

"WATER WEEK"

A questionnaire completed during the symposium by approximately 50 per cent of the participants can provide further direction with respect to future symposia. The concept of having combined symposia, where members of different societies get together was endorsed by all who completed a questionnaire. From the feedback obtained it appears that such combined symposia should be held every two years with more specialised meetings by smaller groups in between. From the feedback it also apears that an ideal bi-annual water week in future would consist of a three-day long symposium with additional time for workshops and a field trip. Parallel sessions for specialist groups are suggested for about half of the symposium's duration with combined sessions during the rest of the time. To allow for people who can not give 4 to 5 days for such a bi-annual event, careful planning of the different components of the symposium should allow for block booking. It was stressed that individual co-convening societies should maintain their identity and make their contributions in the planning and organisation of such combined symposia.

From the positive results of the questionnaire, it appears that a combined bi-annual "water week" is strongly supported by scientists and engineers. It is hoped that the next combined symposium will be held either in Cape Town, Port Elizabeth or Bloemfontein.

E Braune

Chairman:

Organising Committee

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The Organiser
SASAS Congress
PO Box 4345
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Insert to *SA Waterbulletin* January 1990

SOUTHERN AFRICAN SOCIETY OF AQUATIC SCIENTISTS

SASAS 1990 CONGRESS

REPLY FORM

If you are interested in attending the congress and would like to receive further information, please complete and return *before* 15 March 1990 to:

The Organiser, SASAS Congress, P.O. Box 4345, Bloemfontein 9300.

Surname ..... Title .....Initials.....

Postal Address .....

..... Postal Code .....

Tel: ..... Institution: .....

I intend participating in the following session(s):

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I intend presenting Paper(s):_____ Poster(s):_____
Provisional title(s):

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BOOK ORDER

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

. . . copy/copies of: *Evaluation of the Impact of the 1 mgl^{-1} Phosphate Standard on the Water Quality and Trophic State of Hartbeespoort Dam* by Dr F M Chutter, Division of Water Technology, CSIR. (WRC Report no. 181/1/89).

. . . copy/copies of: *Water Loss Analysis on Municipal Distribution Systems* by Castle Brass Holdings (Pty) Ltd and Johannesburg City Engineer's Department. (WRC Report no. 157/1/89).

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Mrs Tineke van der Schyff
c/o Water Research Commission
PO Box 824
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CALL FOR PAPERS

IAHS FOURTH INTERNATIONAL SYMPOSIUM ON LAND SUBSIDENCE

The fourth in a series of symposia on land subsidence will be convened in Houston, Texas, USA, during 12 to 19 May 1991.

Oral and poster papers are solicited on case histories for a wide variety of subsidence types, such as fluid withdrawal (ground water, oil, gas); sink-hole; mining of coal, sulphur, and other products; organic; hydrocompaction; earth fissures, offshore, etc. Especially sought will be papers on new techniques for detecting, measuring, or predicting land subsidence, such as applications of remote sensing, geophysics, and the global positioning system (GPS). Persons interested in offering a paper should send an abstract of 300 to 500 words (with title, authorship, and complete mailing address and phone or fax number) by March 1, 1990 to Ivan Johnson, Chairman Fisols, A. Ivan Johnson Inc., 7474 Upham Court, Arvada, Colorado 80003 USA (phone: 303/425- 5610).

INTERNATIONAL SYMPOSIUM ON MAPPING AND GEOGRAPHIC INFORMATION SYSTEMS

This symposium is sponsored by the American Society for Testing and Materials (ASTM) and is scheduled for 21 to 22 June 1990 in San Francisco, California.

Invited and offered oral and poster papers will be presented on each of the three main topics namely mapping, remote sensing, and GIS, especially in relation to the general state-of-the-art development of standards. Topics are expected to include, but not be limited to, the following:

Maps: design, preparation, new applications, and suggestions for standards for maps of all types - geologic, hydrogeologic, soils, environmental, engineering, geologic, waste management, mineral, vegetation, land use, and others. Poster exhibit space for maps will be available.

Remote sensing: applications of all types and disciplines, hardware and software (especially related to desk-top computer applications). Papers relating RS to development and interpretation of maps and interface and integration to GIS will be very desirable.

GIS: hardware and software (especially the use of desk-top computer systems); interface of maps and remote sensing with GIS; new applications; success and problems; need for data standards and other standards.

After peer review, approved papers will be published by ASTM in a Special Technical Publication.

Meeting information can be obtained from Ms Dorothy Savini, Symposium Manager, ASTM, 1916 Race Street, Philadelphia, Pennsylvania 19103 USA (Phone: 215/299-5413, Fax: 215/977-9679).

NEW PUBLICATION

GEOTECHNICAL APPLICATIONS OF REMOTE SENSING AND REMOTE DATA TRANSMISSION

The publication Geotechnical Application of Remote Sensing and Remote Data Transmission has been released as ASTM Special Technical Publication 967. This volume results from an "International Symposium and Geotechnical Applications of Remote Sensing and Remote Data Transmission".

The purpose of the symposium and its proceedings was to develop information that could be used to prepare guidelines for the use of remote sensing techniques and of satellite and meteor burst instrumentation for remote data transmission for a variety of projects involving the geotechnical sciences. The volume discusses advantages and disadvantages of a variety of remote sensing and remote data transmission techniques, equipment and programs related to soil mechanics, rock mechanics, geologic engineering, ground- water and flood hydrology, and other scientific input to geotechnical projects.

The publication may be ordered, for 59.00 US dollars to non-members and 47.00 US dollars to members of ASTM, from the Publications and Marketing Division, ASTM, 1916 Race Street, Philadelphia, PA 19103, USA. (Phone: 215/299- 5400).

ORANGE RIVER MOUTH ECOLOGY EXAMINED

Interested parties have reached consensus on the management strategies and ecological water requirements of the Orange River mouth.

During a workshop arranged by the Orange River Environmental Task Group of the Department of Water Affairs at Oranjemund, scientists, engineers, nature conservationists, local community members and consultants agreed on the development of a management plan for the Orange River mouth system.

The extreme natural conditions to which the Orange River mouth is subjected has to be considered when the management plan is drawn up. Ecological water requirements were determined for three scenarios, namely the ideal situation where the mouth remains open for the whole year and flooding occurs naturally, a situation in which the mouth remains open for six to ten months with one flood during January to March and possibly another later in the year, and lastly, drought conditions when water restrictions are applied to all water users.

The Orange River mouth is the most important habitat for migrant birds on the south-western coast of Africa up to and including the Kunene River. Maintenance of the Orange River mouth as habitat for birds will ensure that components of the system such as plant communities, wetland areas, fish habitat, wildlife habitat as well as the aesthetic character will be maintained.

MODERNISING RHODES FISH FARM

The Anglo American and De Beers Chairman's Fund Educational Trust has donated a heat exchanger worth R99 238 to the Experimental Fish Culture Unit in the Department of Ichthyology and Fisheries Science at Rhodes University, Grahamstown, making the Rhodes fish farm the most modern in southern Africa.

The heat exchange unit will be used to provide accurate temperature control of water in the various culture systems and will facilitate more precise environmental manipulation during experimentation.

The unit will also allow the Department to house both tropical and temperate fish species simultaneously during every month of the year.

It will be especially useful for the controlled breeding and rearing of the larval and juvenile stages of several species of fish which are considered to be important for the aquaculture industry.

FISH POSTER AVAILABLE

A colour poster (87 x 60 cm), focusing on the ecology of fishes in South African estuaries, has been produced by the JLB Smith Institute of Ichthyology at Rhodes University, Grahamstown.

The poster shows a few of the more important estuarine fishes and some of their food items. In addition, the importance of estuaries is highlighted, and the threats to these systems are also outlined.

An information leaflet will accompany the poster, explaining and illustrating basic life-cycle information about estuarine fishes.

The poster was designed by Dr Alan Whitfield and Mr Dave Voorvelt. It is available at R5,00 a copy to ICHTHOS members and R6,00 to non-members, from ICHTHOS, the Society of Friends of the JLB Smith Institute of Ichthyology, Private Bag X1015, Grahamstown 6140.

DEFLUORIDATOR DEVELOPED

A defluoridation device for individual households has been developed.

The Intercountry Center for Oral Health developed a defluoridator with assistance from the Dental Faculty of Bangkok's Chulalongkorn University and the World Health Organisation. The device is based on the filtration and absorption principle and uses charcoal and charred bone meal. It was tested in 100 households in northern Thailand where the natural fluoride content is between 3 and 7 milligrams per litre. With a flow rate of 4 litres per hour, the device reduced the fluoride content of 480 litres of water from 5 mg/l to less than 1 mg/l. The initial capital cost of the ICOH defluoridator is about 4.00 US dollars per unit.

International Water Report 12487

An Ainsworth 450 mm NB High Pressure Parallel slide valve.

LARGE VALVE ORDER

The South African gold mining industry has placed a large order for high pressure shaft pumping and refrigeration valves.

The valves, which are to be used at Freegold North's Freddies No 1 Shaft near Welkom in the Orange Free State, comprise more than 50 isolating valves of the parallel slide and wedge gate types with nominal bores from 200 mm to 460 mm and pressure ratings of 100 bar (class 600) and 160 bar (class 900). Valve test pressures are as high as 320 bar.

All valves ordered will be 100 per cent locally manufactured at the new premises of Ainsworth Engineering (Pty) Ltd at Robertsham, Johannesburg.

Ainsworth are presently the only manufacturer of high pressure parallel slide valves in South Africa.

WATER RESOURCES 1990

HYDROLOGIST/ENGINEER
TECHNICAL SUPPORT STAFF

The Water Research Commission has appointed a joint venture consortium (comprising WLPU, SS & O and SRK) to undertake a complete revision of the publication "Surface Water Resources of South Africa".

The project is scheduled to start in 1990 and will run for approximately 5 years.

The Consortium is looking for suitable staff to become involved in this challenging and rewarding project which will embody a substantial research component.

There are many aspects to this interesting project including Geographic Information Systems (GIS), hydrological modelling, system analysis, general computer applications, field verification and liaison with relevant organisations.

Normal benefits will apply.

Interested persons please contact Prof DC Midgley, PO Box 221, Rivonia 2128. Tel: (011) 803-3200; Fax: (011) 803- 3222.

GLOBAL RUNOFF DATA CENTRE

Information on the discharge of rivers throughout the world is contained at the global runoff data centre, established last year at the Federal Institute of Hydrology in Koblenz, Federal Republic of Germany. It is designed for use by both climatologists and scientists for research on global climate fluctuations and for use in calibrating global circulation models. The information was collected by the World Meteorological Organisation and the member states of UNESCO, from 1978 to 1982. The Centre stores daily discharge data of small river basins accumulated from 1 200 monitoring stations in 67 countries. It is available on tapes or diskettes.

The Centre also maintains monthly discharge data from countries participating in the International Hydrogical Decade that is published by UNESCO in the International Hydrological Programme Information series as "Discharge of Selected Rivers of the World". It aims to improve knowledge of global and continental water balances. A report containing monthly flow data from 1965 to 1985 will be published next year. For further information contact the Global Runoff Data Centre, Federal Institute of Hydrology, Kaiserin-Augusta-Anlagen 15-17, D-5400 Koblenz, FRG.

International Water Report 12489

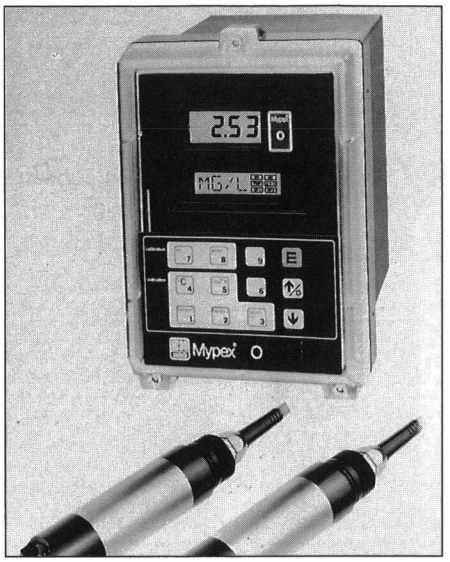
GYPSUM BLOCKS MONITOR SOIL MOISTURE

Field instruction in the use of low-cost, buried gypsum blocks for more efficient irrigation has been extended through 1990 with support from the California Energy Commission, USA. 50 farmers in 12 countries of California's Central Valley and adjacent Sierra foothills are taking part in the program sponsored by local resource conservation districts, USDA's Soil Conservation Service, and INFORM, a nonprofit group that has tested and promoted the gypsum block irrigation method since 1984.

Gypsum blocks, about the size of a thumb, are made of plaster of Paris, contain two metal electrodes, and are buried in the soil with wires leading to the surface. As the blocks gain and lose moisture with the soil, the electrical resistance changes. Regular readings with an impedance meter, which measures resistance, give farmers a picture of water levels in the root zone reservoir at several strategic points and depths.

Compared with other tools such as the soil probe, soil auger and tensiometer, gypsum blocks (which cost 5 US dollars apiece) may have the broadest potential applicability for soil moisture monitoring of surface or sprinkler irrigation systems.

Water Newsletter 312 103189



Mypex O and the Triostat sensors.

CONTROL OF DISSOLVED OXYGEN

Mypex O from Endress + Hauser is a microprocessor-based instrument and together with the Triostat sensor is particularly suitable for the measurement of dissolved oxygen in industrial or municipal sewage (where measurement is made at two points and an average signal generated) and for monitoring waterways, drinking water, and fish farming waters.

Programming of key parameters allows the instrument to be set up to match process conditions. It is housed in a robust, impact resistant IP65 plastic housing, and communication is via a waterproof front-mounted keyboard, giving simple push-button calibration.

The Triostat sensor has a potentiostatically driven three- electrode system providing continuous self-checking and an alarm is given when membrane damage, electrolyte fatigue or contamination is detected. The potentiostat makes for long-time measuring stability, resulting in calibration cycles of three to four months.

The Mypex O/Triostat system is practically free of residual current, making zero calibration unnecessary. The 'elephant skin' membrane is extremely strong and contamination resistant, practically no minimum liquid flow is required and a long service life (up to five years) can be expected.

Address enquiries to Colin Jury, Endress + Hauser, PO Box 783996, Sandton. 2146. Tel: (011) 802-2520.

NEWS FROM THE INTERNATIONAL ORGANISATION FOR WATER POLLUTION RESEARCH AND CONTROL (IAWPRC)

The following news item has been received from the Secretary of the IAWPRC's SA National Committee, Phil Coombs.

The establishment of the Water Institute of Southern Africa (WISA) in 1988 was a development which was to have an impact on the entire water scene. Not only was it to be an autonomous body and no longer a branch of a parent organisation based in the United Kingdom, but it was able to approach the South African National Committee of the IAWPRC and suggest a merger. This led to the drawing up of a new constitution, which has been accepted and which means that the National Committtee is now a Standing Committee of WISA. This should have the effect of strengthening support for both organisations, the one local and the other international.

On the international front the IAWPRC continues to expand as scientists and engineers discover the benefits of IAWPRC membership and participation in the biennial conference and the various specialist groups. A good indication of the current state of the IAWPRC can be gained from the following extracts from the President's letter.

PRESIDENT'S LETTER

I am writing to you to bring New Year greetings at the beginning of 1990. A momentous year, for it is not only the 25th Anniversary of IAWPRC's founding but also the first year in the last decade of the century. The decade is one of great opportunity. Never before has there been so much interest in environmental protection. Large sums of money are to be spent on water pollution control. This means more research and more experience to be made available to colleagues around the world. IAWPRC will make its significant contribution to this development.

We have excellent foundations on which to expand our activities to meet the growing need. Our journal, Water Research, has once again been Number One in the Citation Index for its category. Our other journal, Water Science and Technology, is now moving steadily up the list in the same category, thanks to recent improvements in the quality of papers published and its increasing circulation. Our award winning news magazine, Water Quality International, continues to make good progress.

During 1989 a strong programme of specialised conferences were supplemented by exciting developments on regional conferences. Our first East African regional conference was held, very successfully, in Nairobi in October. And the Egyptian National Committee has just announced plans for the first IAWPRC Middle East conference in Cairo, in 1991. Our policy of introducing regional conferences in various parts of the world is now beginning to show results.

Interest in our Specialist Groups has never been higher and I am convinced they are the great strength of our Association. We held a meeting in the UK in May 1989 with all the Group Leaders. I was deeply impressed by their enthusiasm in commitment as well as by the greatly increased membership in all the Groups. That meeting highlights the key points in the success of the Group structure - it is driven by members' interest; and the leaders have a high level of authority with very little interference. The Groups and the members are the roots of our scientific and technical programme - the very basis on which the Association justifies its existence.

Our membership continues to grow. Individual members now number more than 2 000 for the first time, and continue to increase. Three more countries have indicated their intention to join as national members. Yet we have some way to go to meet our targets for our 25th Anniversary and must make a renewed effort.

I want to conclude by asking for your assistance on two matters of great importance to IAWPRC. Firstly, I want you to give maximum support to our membership recruitment campaign. Personally, and through your national committee, I would like you to make every possible effort to recruit more members to meet our target. We need another 170 corporate members and 500 extra individual members. Neither of these targets is particularly difficult and, with your help, we can meet them.

*Secondly, I want you to help the Japanese Host Committee to get as many delegates from your country to the Kyoto Conference as possible. The new biennial conference format is excellent and costs in Kyoto are much lower than Tokyo. It is also where we shall have our main 25th Anniversary celebrations and I want to see as many delegates there as possib*le. With your help we can do this.

PAUL HARREMOËS

PROFESSOR

PRESIDENT OF IAWPRC

If you would like to know more about membership of the IAWPRC or this year's 25th Anniversary Biennial Conference in Kyoto, Japan, simply contact the Secretary of the SA National Committee, Phil Coombs, at (012) 841-2231.

SOUTHERN AFRICA

ANALYTICA '90

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

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

WASTEWATER SEMINARS

Three concurrent seminars on wastewater treatment will be held at a country hotel near Pretoria and Johannesburg from 2 April to 4 April 1990. The seminars are entitled: Nutrient removal from wastewater streams, Design and operation of biological treatment plants and Industrial and hazardous waste treatment.

Enquiries: Conference Co-ordinators C126, CSIR, PO Box 395, Pretoria 0001.

WASTE LOAD ALLOCATION

A short course on waste load allocation is to be held from 13 to 15 June 1990, in Pretoria, at the WRC. Lectures will be given by Dr Ray Whittemore from Tufts University, Massachusetts, USA, as well as Drs Dirk Grobler and Jane Harris. Topics will include water quality management, waste load allocation, water quality modelling required for waste load allocation investigations and some applicable case studies of waste load allocation in RSA.

Enquiries: Ms H Joubert, Water Research Commission, PO Box 824, Pretoria 0001. Tel: (012) 330-0340.

WATER SUPPLY

A seminar on water supply and sanitation will be held in Transkei from 26 to 27 June 1990.

Enquiries: The Conference Co-ordinators C 126, CSIR, PO Box 395, Pretoria 0001.

SASAS

The annual congress of the Southern African Society of Aquatic Scientists (SASAS) will be held from 2 to 4 July 1990 at the University of the Orange Free State, Bloemfontein.

Enquiries: Prof AJH Pieterse, Chairman, Local Organising Committee, Department of Botany, UOFS, PO Box 339, Bloemfontein. 9300.

IRRIGATION

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

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

OVERSEAS

EFFLUENT TREATMENT

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

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

HYDRAULICS

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

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

WATER TREATMENT

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

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

WASTEWATER

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

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

IRRIGATION

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

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

WATER DEVELOPMENT

An international symposium on the development of small scale water resources in rural areas will be held in Khon Kaen, Thailand, from 21 to 25 May 1990.

Enquiries: SITRA CO, LTD, 158 Emmanual Building, Rachdapisek Road, Bangkok 10310, Thailand.

WASTE DISPOSAL

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

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

WASTEWATERS

The 3rd Symposium on forest industry wastewaters will be held in Tampere, Finland, from 6 to 8 June 1990.

Enquiries: Prof M Viitasaari, Tampere University of Technology, PO Box 527, SF 33101, Tampere, Finland.

WATER RESOURCES

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

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

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

SEWAGE COLLECTION

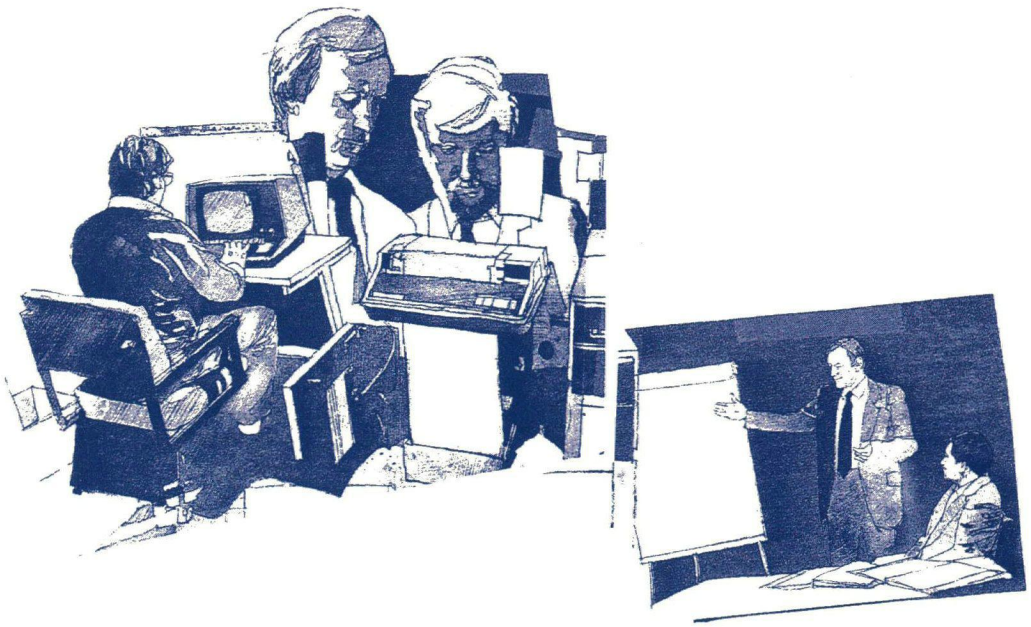
A conference on innovative cost-effective sewage collection and treatment systems will be held from 11 to 13 June 1990 in Sao Paulo, Brazil.

Enquiries: Dr SAS Almeida, Multiserre, Av President Wilson 210, 9th Floor, 20030 Rio de Janeiro, RJ Brazil.

WATER RESOURCE SYSTEMS

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

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



ONE WEEK SHORT COURSE ON THE DESIGN OF WATER QUALITY MONITORING SYSTEMS

OBJECTIVES

The course will introduce the systems approach to water quality monitoring. The system components are:

- ❑ determination of the information expectations,
- ❑ the monitoring network,
- ❑ analysis of the data accumulated, and
- ❑ reporting the information in a format suitable to meet
- ❑ information expectations.

This short course was offered in 1988. It has been revised and, by popular demand, will be offered again in 1990.The short course will present detailed procedures for designing water quality monitoring systems which have as their objectives the determination of water's fitness for use, assessment of trends, determination of pollutant loads, and monitoring compliance to standards. Design procedures apply to both fixed station and special monitoring studies. This wide variety of monitoring situations can be covered in one week by focusing on basic, common components of all water quality monitoring programmes. Most illustrations of the design procedures use effluent, stream, and ground water quality monitoring examples. The course will begin with an overview of the entire monitoring, system, including the role of statistics in water quality monitoring. This will be followed by discussions of the principles involved in selecting water quality variables to be measured, locating sapling sites, and calculating sampling frequency. Demonstrations of computer software that can be used in solving water quality monitoring problems will provide practical guidance. The course will concentrate on the basic principles of monitoring, therefore it will be valuable not only to persons involved in the study and management of freshwater systems, but also those responsible for information on terrestrial, marine, and atmospheric systems.

PARTICIPANTS

The short course is aimed at those persons actively involved with the design, operation and/or management of monitoring programmes, with emphasis on quality of surface and ground water, and those that use the information produced by monitoring programmes in decision-making. The course assumes that attendees will have little or no background in statistics. A text book on the design of water quality monitoring systems will be furnished at the course. Attendees should bring a calculator as it will be needed during the problem solving sessions.

REGISTRATION CARD

Postage stamp required

Dr J A Thornton
Town Planning Branch W/S 4151
PO Box 1694
CAPE TOWN
8000

Insert to *SA Waterbulletin* January 1990

REGISTRATION CARD

2ND JOINT AWRA/SASAS SYMPOSIUM ON WATER: SPECIALIST SESSION ECONOMICS, QUALITY AND MANAGEMENT

2 TO 4 JULY 1990

Please complete and return this card as soon as possible to the organisers.

Name: ..... Title: .....

Organisation: .....

Address: .....

..... Postal Code: .....

Telephone no: ..... Fax: .....

Signature: ..... Date: .....

All fees for this Symposium are included in the registration fee for the 27th Annual Congress of the Southern African Society of Aquatic Scientists.

Short course on the design of

WATER QUALITY MONITORING SYSTEMS

PRELIMINARY REGISTRATION FORM

I wish to attend the one week course which will be held from 13 – 17 August 1990 at the Conference Centre, CSIR, Pretoria. Please include my name on the list of participants and send me the final programme and enrolment form when available. (Course fee of R700,00 to be paid later.) DO NOT SEND ANY MONEY NOW.

Please type or use block letters.

SURNAME: _____ INITIALS: _____

TITLE (Prof/Dr/Mr/Mrs/Ms): _____

ORGANISATION: _____

POSTAL ADDRESS: _____

_____

TELEPHONE: _____ POSTAL CODE: _____

TELEX: _____ TELEFAX: _____

SIGNATURE: _____ DATE: _____

By returning this postcard you are indicating your interest without any obligation.

POSTCARD

Postage stamp required

Ms Helene Joubert
Water Research Commission
PO Box 824
PRETORIA
0001

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INSTRUCTORS

Dr ROBERT C WARD, Associate Dean and Professor, Department of Agricultural and Chemical Engineering, Colorado State University, Fort Collins, Colorado, USA.

Dr THOMAS G SANDERS, Associate Professor, Department of Civil Engineering, Colorado State University, Fort Collins, Colorado, USA.

Dr DC GROBLER, Deputy Director, Water Quality Management, Department of Water Affairs.

Dr JANE HARRIS, Senior Engineer, Division of Water Technology, CSIR.

GUEST LECTURERS

A number of experts in water quality monitoring and related fields will participate as guest lecturers.

WHERE: **Conference Centre, CSIR, Pretoria.**

WHEN: **13 - 17 August 1990.**

ADDRESS ALL CORRESPONDENCE TO

Ms Helene Joubert
Water Research Commission
PO Box 824
PRETORIA
0001
Tel: (012) 330-0340

Please register for this short course by filling out and returning the postcard. If the card is unavailable, please contact Ms Joubert at the address above. Include your name, address, and company affiliation.

Avoid disappointment by registering as soon as possible because the facilities can accommodate a maximum of 50 people. The positions will be allocated on a first come, first served basis. DO NOT send money now. You will be notified later if your application has been accepted.

FEE

The course fee is estimated at R700 which includes tuition, all class materials, text book, daily refreshments, lunch, and two evening functions.

ACCOMMODATION

There are a number of hotels in close proximity to the CSIR, we will be happy to furnish a list upon request.

COURSE OUTLINE

Monday

- ❑ Introduction
- ❑ Water quality management in the RSA
- ❑ Systems approach to water quality monitoring
- ❑ Water quality variables as stochastic processes
- ❑ Basic concepts of probability and statistics
- ❑ Evening social

Tuesday

- ❑ Estimating means and confidence intervals
- ❑ Hypothesis testing
- ❑ Distribution-free tests
- ❑ Exploratory data analysis
- ❑ Compliance monitoring
- ❑ Establishing a data base for compliance monitoring

Wednesday

- ❑ Sampling site location
- ❑ Sampling frequency
- ❑ Effects of data characteristics on sampling frequency
- ❑ Regression analysis for trend detection
- ❑ Problem session

Thursday

- ❑ Water quality variable selection
- ❑ Analytical laboratory as part of a monitoring system
- ❑ Quality control in a water analysis laboratory
- ❑ National Water Quality Monitoring System
- ❑ Software demonstration
- ❑ Evening social

Friday

- ❑ Reporting water quality with an index
- ❑ Comparison of components of water quality monitoring for different objectives
- ❑ Practical implications of environmental monitoring

IMPORTANT ANNOUNCEMENT

ANNUAL CONGRESS: THE SOUTHERN AFRICAN SOCIETY OF AQUATIC SCIENTISTS (SASAS)

The annual Congress of SASAS, formerly known as the Limnological Society of Southern Africa, will be held at the University of the Orange Free State, Bloemfontein, 2 to 4 July 1990.

As the quality of water becomes increasingly threatened due to population increase, urbanisation and industrialisation, we expect this to be an important gathering of aquatic scientists.

The venue will be the Medical Faculty of the UOFS. The program will include a number of plenary sessions, workshops and poster displays. Social functions will include a dinner and two or three less formal gatherings (e.g. braai or cocktail party). A post-congress excursion of two days to the sites of the Lesotho Highlands Water Scheme is planned.

The Congress will be attended by aquatic scientists from various centres in the Republic. A number of foreign guests will also attend the Congress.

All persons interested in the aquatic environment are invited to attend the Congress. Come and enjoy the company of those who take water matters seriously! Share your own experience in matters pertaining to the aquatic environment with others, and so make a contribution towards a better understanding of our major limiting resource.

In response to previous requests, individuals have proposed session topics and agreed to act as co-ordinators. Co- ordinators will base their sessions partly on offered papers. To assist the co-ordinators (listed below), if you feel you would like to be part of a structured session, please contact them at your earliest convenience for your possible participation and further information. If you do not wish to be part of a structured session, but would still like to offer a paper to the local organising committee, your paper will be allocated to a general session.

General sessions will be subdivided into specific subtopics according to interest should the need arise. It is still possible to develop and organise session(s) in addition to those listed below.

Members with marine and estuarine interests are encouraged to attend and participate. Offered papers will be allocated to appropriate sessions, while a separate marine or estuarine session is possible should anyone like to organise one.

The following important topics will be discussed in different sessions chaired by a specialist in each field:

RIVER REGULATION AND INTER-BASIN TRANSFER

Professor BR Davies, Freshwater Research Unit, University of Cape Town, Rondebosch. 7700.

WATER PURIFICATION BIOLOGY

Professor AJH Pieterse, Department of Botany, University of the Orange Free State, PO Box 339, Bloemfontein. 9300.

THE BIOLOGY OF SOUTHERN AFRICAN FISHES

Professor JG van As, Department of Zoology and Entomology, University of the Orange Free State, PO Box 339, Bloemfontein. 9300.

THE ECOLOGY OF TEMPORARY WATERS AND WETLANDS

Mr MT Seaman, Department of Zoology and Entomology, University of the Orange Free State, PO Box 339, Bloemfontein. 9300.

THE BIOGEOGRAPHY OF AQUATIC ORGANISMS

Dr J Day, Freshwater Research Unit, University of Cape Town, Rondebosch. 7700.

AQUATIC PRODUCTIVITY AND THE MICROBIAL LOOP

Professor JU Grobbelaar, Department of Botany, University of the Orange Free State, PO Box 339, Bloemfontein. 9300.

WATER: ECONOMICS AND MANAGEMENT

Dr J Thornton, Town Planning Branch, PO Box 1694, Cape Town. 8000.

ATTENTION

FIRST-TIME CONGRESS ATTENDERS

Free membership of one year is offered to all non-members who attend the Congress for the first time.

ENQUIRIES:

Professor AJH Pieterse. Chairman: Local Organising Committee, Department of Botany, University of the Free State. PO Box 339, Bloemfontein. 9300.

TO REGISTER FOR THIS SASAS CONGRESS, PLEASE COMPLETE THE POSTCARD IN THIS BULLETIN.