THE HYDROLOGICAL SOCIETY OF S.A.

℅ Water Resources Branch
Box 1751, Adelaide, S.A. 5001

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1. Programme of meetings for 1983 (remaining to be held)

25th August (Thursday): This is the Annual General Meeting. The proceedings for the night will take the form of a mini-symposium on the hydrology and management of the River Murray mouth.

27th October (Thursday): "Urban drainage", by Mr. J. R. Argue, South Australian Institute of Technology.

These meetings will be held at the CHARLES HAWKER CONFERENCE CENTRE, WAITE INSTITUTE, at 6.30 p.m. An informal gathering, with light refreshments will precede the meeting from about 5.30 p.m. onwards.

2. The Symposium on "The effects of changes in land use upon water resources".

This Symposium was held on 5th May, 1983, and drew an attendance of about 110 participants. The Symposium papers were bound into a book, that was available on the day of the Symposium. It is now available for purchase, at a price of $7-00 including postage. Orders should be addressed to Dr. G. Schrale, C/- Department of Agriculture, G.P.O. Box 1671, Adelaide, 5001. The book contains eight articles ranging through such topics as the effects of afforestation to consequences of land-fill and garbage disposal upon groundwater quality.

3. Frosts, high salinity in the Murray River and harm to the citrus orchards in the Riverland.

Mr. M. Till, Department of Agriculture has suggested the following interesting observations upon the 1982 season.

"The frosts suffered by citrus plantings in the River Murray areas in the winter of 1982 call to mind similar occurrences in previous years and in particular frosts which occurred in 1967.

In 1967/68 the flow in the River Murray became very low and salinities of water used for irrigation in Riverland areas were high throughout the season. In fact, this season has been used as a benchmark for studies of River Murray salinities.

The occurrences of frost and salinity are periodic calamities which have a severe effect upon citrus production in Riverland areas. Periodic disasters, such as these, are also experienced in other parts of the world where citrus is grown. Examples are cyclones in the Rio Grande area of Texas and freezing conditions in Arizona. They occur so infrequently and

so irregularly that routine measures to combat them directly are impractical. The defence usually sought is by breeding resistant plant material.

One generally assumes that these natural disasters occur at random and that they are independent.

A view which I propose is that in the River Murray Valley in southern Australia the occurences of frost and high salinity are not independent. In 1982 the dry weather and cold nights were followed by serious frosts which are the same conditions associated with light snowfalls in the catchment areas of the River and with subsequent low flows and high salinity. With absolutely no knowledge of the meteorological conditions that cause these occurrences I make the suggestion that in fact the two disasters are related.

The impact of salinity and frost on citrus growth are likely to be additive in their effects, i.e., the impact of each on production is likely to be exaggerated because of their interactions."

Dr. Byron-Scott, meteorologist at Flinders University, comments upon Mr. Till's suggestion as follows.

"Mr. Till's suggestion that an abnormally long series of clear, cold nights, such as would cause severe frosts in the Riverland, could be linked to unusually light precipitation in the catchment areas of the River Murray (and subsequent high salinities in that river) is very reasonable from a synoptic-climatological point of view and would certainly not be considered naive by any meteorologist familiar with the weather patterns of southern Australia.

In a region traversed by migrating anticyclones, the climatological anticyclone depicted on a chart of monthly-mean pressure distribution at MSL is more of a statistical than a physical reality, so that one cannot strictly associate various types of weather with its different parts. However, the central part of a climatological anticyclone does indicate the geographical region over which actual migrating highs tend to linger and/or attain their greatest strengths. In fact, both synoptic experience and Sutcliffe's development theory indicate that a strongly developing high tends to stir up its own 1000 - 500 mb thickness pattern so much that the thermal-steering effect is very much weakened and the *or* of the last sentence is almost superfluous. By contrast, the southern periphery of a climatological anticyclone defines a geographical region which is on the southern fringe of most of the actual anticyclones passing it during the month concerned. Even though the monthly-mean charts may show hardly any cyclonic curvature in the MSL isobars over such a region, the actual time-dependent pressure field from which they are calculated usually consists of a series of alternating ridges and troughs progressing eastwards. Such troughs almost always contain one or more cold fronts, with their well-known cloud and precipitation, and even the cyclonic curvature of the isobars well away from fronts can help to maintain air-stream activity, leading to non-frontal cloud and precipitation.

Looking at the monthly-mean pressure distributions for the Australian region (which I have appended), it is clear that both the S.A. Riverland and the upper Murray catchment areas should normally lie on the southern fringe of a climatological anticyclone covering the interior of the

continent during June, July and August. This means that both regions should be traversed frequently by precipitation-producing fronts and showery following-airmasses during winter and that the spells of 'better', ridge-type weather should be brief. The frequent cloudiness associated with such weather, the fact that the airmasses traversing the region have often just come off a not-so-cold sea surface and the general windiness (i.e., turbulence of the airflow) would certainly inhibit the occurrence of severe frosts in the Riverland. Obviously, this same type of weather is also responsible for the normal winter precipitation in the upper catchment areas of the River Murray.

From an informal inspection of the weather maps in our Common Room, it seems to me that June and July, 1982 have been months in which the tracks of the migratory highs have been displaced southwards from their normal latitudes and that south-eastern Australia has come under the influence of some very strong and persistent anticyclones. If the mean MSL pressure distributions for June and July, 1982 were to be computed, I am fairly certain that they would show the centres of the climatological anticyclones for those months to have been displaced south-eastwards (i.e., towards the River Murray!) from their normal positions. By producing relatively long sequences of calm clear nights at a time of year when diurnal insolation is at its weakest and the nights are longest, such an abnormality creates a situation in which the minimum temperature at the end of each night is lower than that for the night before and severe frosts eventually occur in the S.A. Riverland. Obviously, when such weather also occurs over the upper reaches of the Murray, it deprives the river's catchment areas of their winter precipitation.

Perhaps the most intriguing question to be answered by meteorologists is that of why a situation such as the above can arise in the first place and what mechanisms allow it to persist. According to Sutcliffe's development theory, the regions where anticyclonic and cyclonic development will take place are mainly determined by the 1000 - 500 mb thickness pattern and, by steering weather systems, this pattern also determines the large-scale storm tracks. Probably, the 1982 monthly-mean thickness patterns were abnormal for the time of year, but it is not easy to obtain the data necessary to calculate them. Since changes in the 1000 - 500 mb thickness of an air column can be due to advection, subsidence or ascent, net radiative heating or cooling, buoyant convection and turbulent exchange of heat with the lower boundary, there is plenty of scope for speculation! Through the latter two mechanisms, for instance, it would be quite possible for anomalies in the sea-surface temperature patterns to produce abnormalities in the thickness patterns and hence to change the storm tracks a little. The question then becomes the oceanographic one of whether the resultant changes in the wind-stress patterns would tend to enhance the sea-surface temperature anomalies or destroy them. The philosophical problem, I suppose, is that of determining which anomalies are capable of starting an abnormal situation going and which situations will be inherently self-preserving for a period of several months. No one really knows the answer, but I suppose that the atmosphere-ocean models under development at the ANMRC, Melbourne, will eventually shed some light on these problems."

4. Soil Erosion, Water Quality and Land Management in the Piccadilly Valley

Piccadilly Valley is unique in South Australia as a vegetable growing area, for the following reasons.

- Excellent quality and ample supplies of groundwater.
- Cool summer climate.
- Suitable soils.
- Close to the Adelaide market.

However, steep slopes, high rainfall and farming techniques that involve frequent soil cultivation, predispose the valley to severe soil erosion and consequent pollution of runoff water. Plant nutrients, particularly nitrogen and phosphorus, are removed with the soil. For instance, more than 90% of the nitrogen and phosphorus in the runoff water are attached to eroded soil particles. Heavy fertilizer applications on the intensively cropped land exacerbate the problem.

The valley is drained by Cox Creek, which flows via the Onkaparinga River, into Mt. Bold Reservoir. Although the area occupies only 2% of the reservoir catchment, it is responsible for up to 30% of the nitrate pollution in the reservoir.

About 30 cm of topsoil have been eroded from the sloping market gardens of the valley since they were first settled. If current land management practices continue, all of the topsoil will soon be eroded leaving very unstable and unproductive subsoil clays.

The Water Management Section of the Department of Agriculture's Division of Land Use and Protection is involved in a co-operative study to control erosion and pollution of water resources in the valley. Other groups involved in the project include the Engineering and Water Supply Department, the Central Region of the Department of Agriculture and the Waite Agricultural Research Institute.

The study comprises the following phases:

Landholder Survey

This involved an assessment of present land management practices of growers and their attitudes to problems and possible means of controlling problems. The survey indicated that growers have a positive attitude to changing their present land management systems for the control of erosion.

Catchment Monitoring

A series of gauging stations continuously measure rainfall and associated runoff. Runoff water samples are collected automatically and analysed for sediment content and nutrient concentrations. Soil moisture levels, evaporation and plant water use are monitored continuously. These measurements provide base information on the water balance and erosion/pollution levels associated with current land management practices.

Catchment Modelling

The data collected during the monitoring programme will be used to verify two computerized catchment models commonly used in America for predicting the effects of land use on water quality. These models may prove useful for water quality predictions in other catchments of Adelaide's water supply reservoirs.

Modified Land Management Systems Evaluation

The key to controlling soil erosion and hence water pollution is responsible land management. One system which reduces the time of bare soil exposure and improves soil structure is minimum tillage. This system involves the replacement of cultivation by herbicides for the control of weeds. Trials aimed at developing viable minimum tillage techniques for vegetable production are currently in preparation. The performance of these techniques to control erosion on a catchment basis will be evaluated using the existing monitoring equipment.

Herbicide Residue Assessment

It is known that some herbicides will affect aquatic systems and consequently degrade water quality. Should minimum tillage techniques be introduced in the valley, it is important to ensure that one form of pollution is not being replaced by another. A further phase of the project will assess the residual effects of herbicides on soil, groundwater and surface water quality from Piccadilly Valley.

5. Recent publications

A. Members of the Hydrological Society who attended the recent Symposium on "The effects of changes in land use upon water resources", may be interested to consult an issue of the Journal of Hydrology that appeared just after the symposium. It is a special issue entitled "Migration of contaminants in groundwater at a land-fill : a case study". The guest-editor was Professor J. A. Cherry. The reference is J. Hydrology 63, 1-197, 1983.

B. A new book that may interest our hydrogeologist members is "The boundary integral equation method for porous media flow", by J. A. Liggett and P. L-F. Liu (George Allen and Unwin, 1982, pp 272, £17-50). The publishers state ....."this book will be useful to hydrologists, numerical analysts and many other engineers faced with the problems posed by porous media."

6. Forthcoming Symposia and Conferences

A. International Groundwater Conference - Groundwater and Man : To be held in Sydney, 5-9 December, 1983. Correspondence and enrolment can be done through the address, P.O. Box 1929, Canberra City, A.C.T. 2601.

B. Seminar on "Forage and fuel production from salt-affected wasteland" : To be held at Cunderdin, Western Australia, 19-27 May, 1984. This seminar is to be sponsored by ADAB and the W.A. Department of Agriculture. It has a sub-title, Research for Development Seminar. Further information is available from the Seminar Organiser, C/- Division of Resource Management, Department of Agriculture, Jarrah Road, South Perth, W.A., 6151.

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MONTHLY-MEAN MSL PRESSURE DISTRIBUTIONS FOR THE AUSTRALIAN REGION (from NAVAIR 50-1C-55, U.S. NAVAL WEATHER SERVICE, 1969).