The Water Weed Problem In Australia

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In many parts of the world today, water plants are more likely to be known because of their effects on boating or water-skiing, than for their usefulness or beauty. This has not always been the case in Australia.

The original inhabitants of Australia, the aborigines, made considerable use of some water plants as food. The seeds and fleshy rhizomes of the large blue waterlily (*Nymphaea gigantea*) as well as other species of waterlilies were eaten extensively. The aborigines of Northern Queensland were also known to roast and eat the tuberous roots of water-ribbons (*Triglochin procera*), the marshworts (*Nymphoides crenatum, N. geminata*) and the swamp lillies (*Aponogeton spp.*)

The early Dutch voyagers of the 17th century apparently were no more impressed with Australian water plants than they were with the Australian landscape, as nothing was recorded on the subject. However, during the first voyage to Australia of Captain James Cook, the English navigator, in 1770, many water and marsh plants were noted both at Botany Bay in New South Wales and along the Endeavour River in Northern Queensland.

The natural history draughtsman, Sydney Parkinson, who accompanied Cook, sketched the now familiar water plant water-ribbons (*Triglochin procera*) at Botany Bay in April 1770. Unfortunately, Parkinson died in January 1771 during the return passage to England, but J. F. Miller completed the water-ribbons drawing in 1775, along with Parkinson's other uncompleted drawings, and had it engraved. This and other engravings of Cook's voyage were eventually published by the British Museum in 1905.

Now, almost two centuries after Cook's voyage, people have become more concerned with destroying water plants than with drawing them. There is some justification for this change.

Australia, with an area almost equal to that of the U.S.A. (excluding Alaska), has grown in population to 12 million people. During this time, most of the development has taken place in the coastal strip in the east and south, and also in the southwest corner of the continent (Figure 1). As might be expected, this is also the region which receives more than a marginal supply of water, either from rainfall or from reservoirs.

Because of this localized development, and also the very dry nature of the remainder of the country, (40% of Australia receives less than 10" annual rainfall), water weed problems are not extensive, although they can be as intensive as anywhere in the world. Water weeds are a constant source of trouble in farm ponds and ornamental lakes, and are becoming an increasing problem in reservoirs used for water sports. While some tropical water plants like water hyacinth (*Eichhornia crassipes*), can cause great difficulties in rivers, particularly in Southern Queensland, the problem is undoubtedly most serious where water plants interfere with primary production, for example, in the supply channels and drains of irrigation areas

Editorial Note—The common names of plants are those used in Australia. The correct scientific name is also included for proper identification in other countries.

Water Hyacinth

"I would sound a note of warning against the introduction of this abominable, although pretty water-weed." These words were written by William Soutter of the Brisbane Acclimatization Gardens in the Queensland Agricultural Journal of 1st September, 1897. He was referring to the notorious water hyacinth.

In the same year, J. H. Maiden, then Government Botanist in New South Wales, drew attention to the rapid spread of water hyacinth in the Botanic Gardens, Sydney. Strangely, he did not think Sydney was warm enough for its full development. Subsequent events, however, proved that it could establish itself and grow well much further south than Sydney.

With the rapid development of an infestation in a tributary of the Clarence River near Grafton in Northern New South Wales in about 1898, and the appearance of vast masses of the plant in the Brisbane and Bremer Rivers in Southern Queensland in 1900, there was increasing concern. Eventually, in 1906, a special committee was appointed by the New South Wales Government to report on northern rivers affected by water hyacinth, and to make appropriate recommendations.

It was not until the plant was discovered in Southern New South Wales in 1906 that the full danger was realized. At that time, several acres of the weed were found in Wollundry Lagoon near Wagga, which had grown from a specimen planted there about 1895. The full significance of this discovery is described adequately in J. H. Maiden's own words:

"We view this position as one of great seriousness,as the proximity of such a pest to the long lengths of sluggish fresh-water rivers of the western slopes, such as the Murray, Murrumbidgee and the Darling Rivers, constitutes an element of danger. Here the natural conditions are favourable to the extensive growth of the plant, and if it once obtains a hold, would be much more troublesome and costly to cope with than is ever likely to be the case in the short coastal districts of the State."

Subsequent experience has proved Maiden's warning to be justified. Water hyacinth planted in Ramco Lagoon on the Murray River in South Australia in 1937 grew rapidly and covered an area of several acres within two years. It had also spread to many other lagoons along the river, but was quickly eradicated to prevent further spreading. In more recent times, it has been found near the Murray River at Albury, Torrumbarry and Mildura, and as far south as Maffra in Victoria, but all infestations have been treated and eradicated.

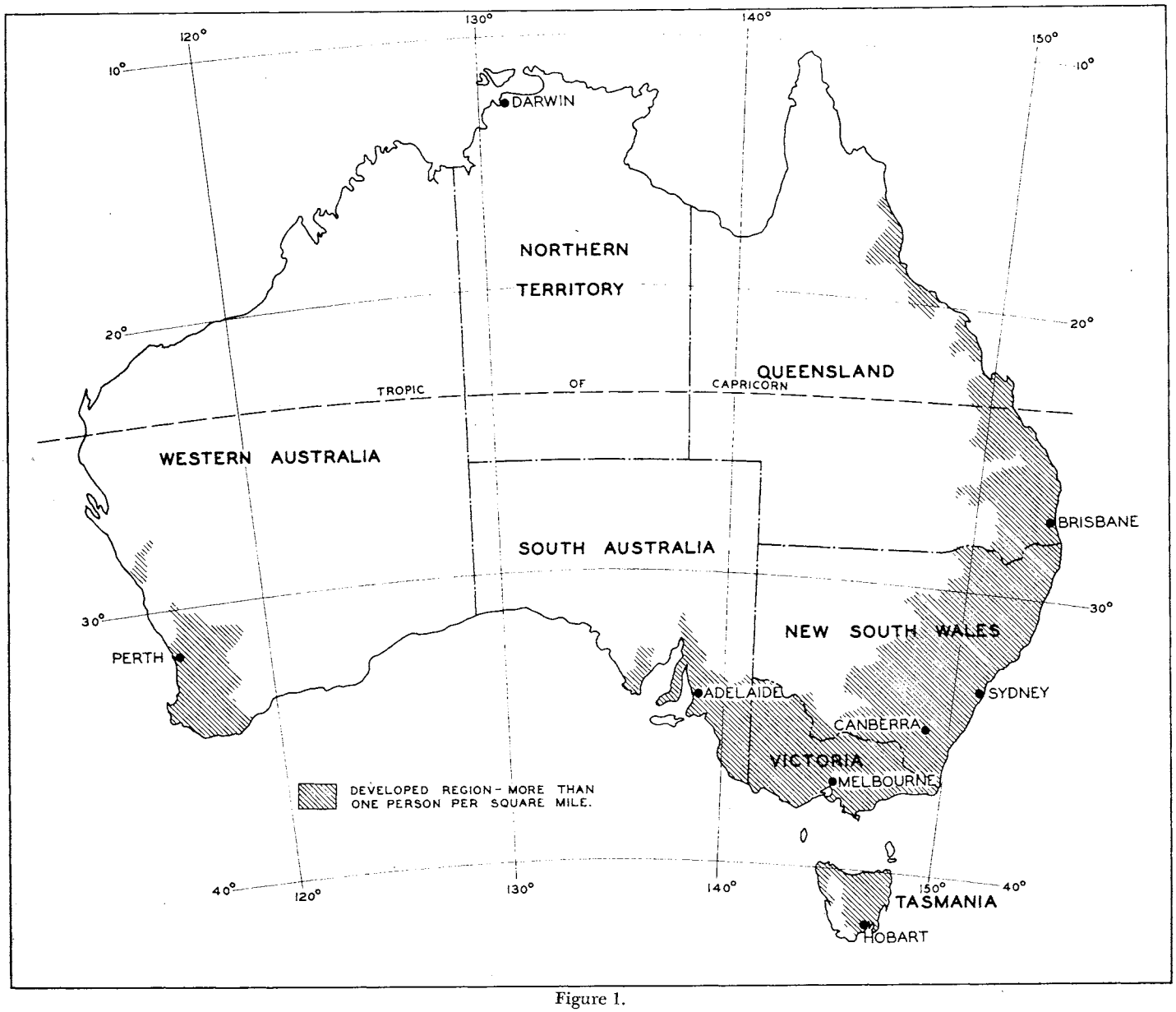

Figure 1.

Today, water hyacinth is a greater potential hazard to the Murray River system than it was at the turn of the century. The flow is now regulated for irrigation purposes, and the numerous locks and reservoirs provide ideal conditions for the growth of the plant. Furthermore, in this river system, particularly in the lower reaches, high temperatures are frequent in summer, severe frosts are relatively uncommon, and the water is not very saline. All of these factors favor the rapid growth of water hyacinth.

Water hyacinth also occurs in Western Australia where it was introduced about 1929. At one stage, Lake Monger in Perth, became severely infested with the weed covering 40 acres.

Generally speaking, water hyacinth is not a serious problem today, except perhaps in some Queensland rivers. New outbreaks are quickly treated, usually with 2,4-D amine. In Victoria, a public awareness of the nature of the plant is encouraged by means of suitable publicity, and in addition, aerial inspections of selected streams are periodically made to ensure that no new infestations remain undetected

Weeds in Irrigation Areas

By world standards the amount of land, 2.9 million acres, under irrigation in Australia is relatively small. Of this area, 2.4 million acres, is located in the Southeast close to the Murray River and its tributaries in Victoria and Southern New South Wales (Figure 2.)

In Victoria, irrigation areas are served by 5300 miles of supply channels. Not all of these channels require treatment with machines or chemicals to control weed growth, because a small quantity of growth can often be tolerated and may even be an advantage. It is estimated that about one-half of these channels produce weeds in sufficient quantity to appreciably affect the flow of water. The main submersed weeds are ribbonweed (*Vallisneria spiralis*),

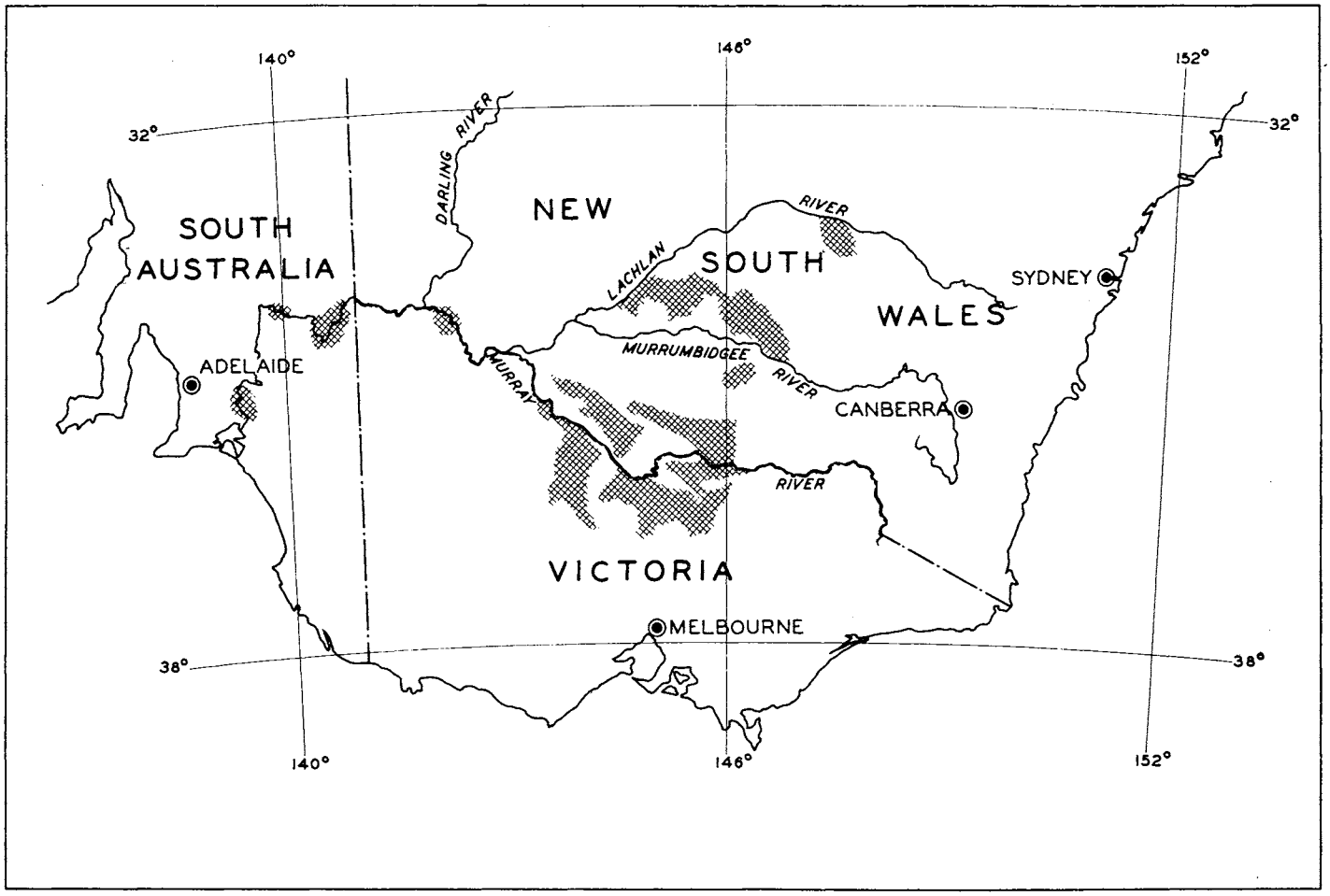

Figure 2. Location of the acreage under irrigation in Southeast Australia.

elodea (*Elodea canadensis*), cattail (*Myriophyllum elatinoides*), and floating pondweed (*Potamogeton tricarinatus*). The only emersed weed of any consequence in supply channels is cumbungi (*Typha angustifolia*).

Some 2400 miles of drains have also been built in the irrigation areas of Victoria to lower water tables and to discharge both surplus irrigation water and flood flows. Weed growth in most of these drains is generally prolific. The most troublesome emersed weed is water couchgrass (*Paspalum distichum*), and to some extent cumbungi (Figure 3). The most common submersed weeds are blunt pondweed (*Potamogeton ochreatus*) and elodea.

During 1966-67, $300,000[1] was spent on weed control operations in Victorian irrigation and drainage systems, the most commonly used chemicals were amitrole, acrolein, dalapon, T.C.A. and diuron. The principal uses for these chemicals are given in Table 1.

The irrigation areas of Southern New South Wales are comparable in many respects to those in Victoria. About the same acreage is under irrigation in each State, pasture is predominant, and in addition, similar species of water plants occur in the two areas.

At the present time, the Water Conservation and Irrigation Commission of New South Wales is spending $150,000 annually on chemical methods of controlling water weeds. There are minor differences between Victoria and New South Wales with regard to some treatments, but the most useful chemicals, i.e., acrolein, amitrole, dalapon and diuron, are used in much the same way.

In both States chemical control is used in conjunction with mechanical methods. In Victoria, the back-acter has

Figure 3. Water couchgrass (*Paspalum distichum*) almost completely blocking a drain.

[1]A$ 1 = U.S. $1.1084

TABLE 1. CHEMICALS USED FOR WEED CONTROL (1966-67)

Chemical	Quantity lbs.	Weed
Supply Channels		
Acrolein	40,000	ribbonweed (*Vallisneria spiralis*)
		elodea (*Elodea canadensis*)
		floating pondweed (*Potamogeton tricarinatus*)
		cattail (*Myriophyllum elatinoides*)
Dalapon	27,000	cumbungi (*Typha angustifolia*)
		canegrass (*Phragmites communis*)
T.C.A.	29,000	cumbungi cattail
Drains		
Acrolein	12,000	elodea
		blunt pondweed (*Potamogeton ochreatus*)
Amitrole	14,000	water couchgrass (*Paspalum distichum*)
		cumbungi
Diuron	3,500	water couchgrass

proven to be the most effective mechanical means of cleaning silt and weeds from drains, and is also relatively economical (Figure 4). Of other machines in operation, the dragline excavator with a special weed bucket is the most useful.

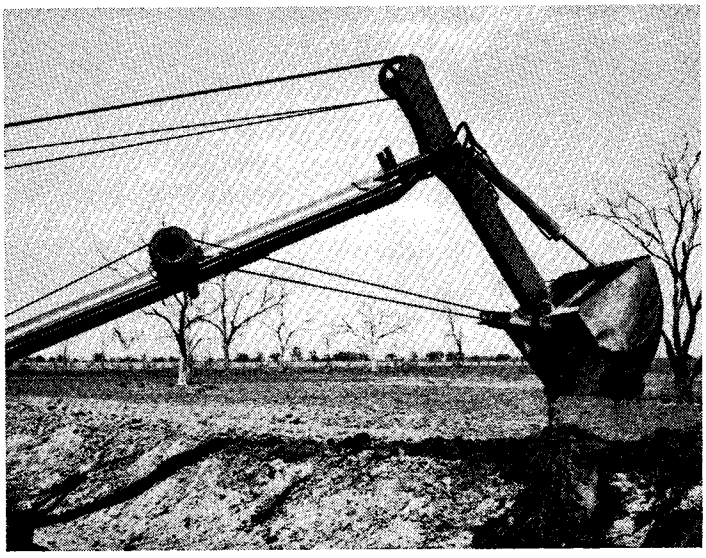

Figure 4. Boom, dipper-arm and hydraulically-operated bucket of a back-acter removing silt from a drain.

In Victoria the treatment of water couchgrass in drains with amitrole accounts for 40% of the total annual expenditure on chemical weed control operations (Figure 5). The cost per mile depends on various factors but is approximately $150 for the normal double spraying totalling 20 lb/A of amitrole. In new drains, or where diuron is used as well, the cost would be less, but in long-established and poorly maintained drains, the cost would be greater.

Figure 5. Drain in background maintained with amitrole and diuron. Note water couchgrass (*Paspalum distichum*) in the untreated drain (foreground).

Acrolein is the most useful chemical in channels used to supply water for irrigation. The usual method is to treat the channel at a concentration of 13 ppmv for a period of 5 hours. The cost varies considerably, but is generally about $50 per mile. One treatment each year is generally sufficient. (Figure 6).

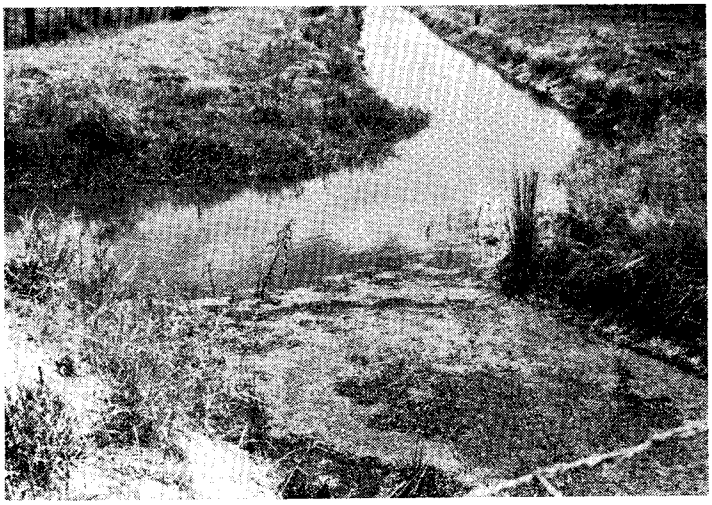

Figure 6 Blunt pondweed (*Potamogeton ochreatus*) blocking a drain (foreground). The same weed in the drain (background) has been controlled with acrolein.

South and Western Australia

Until fairly recently, water weed control programs were not undertaken in South Australia, except on a very restricted scale. Some progress, however, has been made with the control of weeds in drainage systems of the Southeast. Very recently a program was started with the Southeastern Drainage Board which has 900 miles of drains to keep

clean. The main weeds are cumbungi or bulrush (*Typha angustifolia*), canegrass or common reed (*Phragmites communis*) and various pith rushes (*Eleocharis* spp.)

In Western Australia, the most common water weed is cumbungi. Control is generally obtained with 2,4-D ester at 8 lb/A, although amitrole and dalapon are used. Water hyacinth (*Eichhornia crassipes*) is considered to be the second most widespread water weed, but only occurs in lakes around Perth. Because 2,4-D would be a danger to nearby gardens, diquat at 1 lb/A is preferred.

Ponded Water

As in other parts of the world, plants are often a problem in ponded water – in farm dams, lakes and reservoirs.

The most notable example of weed control in lakes is Albert Park Lake in Melbourne, Victoria. Here the predominant weed is elodea (*Elodea canadensis*), although blunt pondweed (*Potamogeton ochreatus*) and water-mat (*Lepilaena australis*) also occur. Some measure of control was obtained for several years by means of a weed boat, but it soon became apparent that an improved method was necessary.

Following trials in 1963 with diquat, paraquat, copper sulphate, endothal amine and acrolein, it was decided to attempt control of the weed with acrolein over the entire area (113 acres). While a concentration of 10 ppmv proved adequate during the trials, it was increased to 12 ppmv because of the low water temperature (50°F), and also because of the great quantity of weed present. This treatment, together with a retreatment six weeks later at 10 ppmv, resulted in almost complete removal of the weed, and annual treatment at a concentration of 5 ppmv was sufficient to give control in following years. In all cases the chemical was applied by injection below the water surface from an airboat (Figure 7).

Lake Wendouree, at Ballaarat, 60 miles west of Melbourne, Victoria, the site of the rowing events during the 1956 Olympic Games, has been infested with water plants for many years. The main species present are cattail (*Myriophyllum elatinoides*), ribbon weed (*Vallisneria spiralis*) together with some floating pondweed (*Potamogeton tricarinatus*) and sago pondweed (*P. pectinatus*). Many chemical methods of control have been attempted but none has been entirely satisfactory. Some control is being obtained by means of weed boats.

Figure 7. Airboat applying acrolein to control elodea (*Elodea canadensis*) in Albert Park Lake, Melbourne, Victoria.

In recent years, Lake Burley Griffin in Canberra, A.C.T., the capital city of Australia was completed. This lake, named after W. B. Griffin, the American architect who designed Canberra, was only filled as recently as 1964, but by December of the same year, curly pondweed (*Potamogeton crispus*) had colonized quite large areas. Later, small patches of curly pondweed (*P. crispus*), floating pondweed (*P. tricarinatus*) and ribbon weed (*Vallisneria spiralis*) also appeared.

Treatment of several acres of Lake Burley Griffin with acrolein at 5 ppmv achieved a measure of control, but also resulted in a heavy fish kill in some areas. Experiments are under way at present to assess the value of diquat as an alternative to acrolein, but in spite of some success, there is not yet enough evidence to make a positive recommendation.

Water plants can also be a hindrance in farm dams and small reservoirs, but as yet, chemicals are not widely used. Chemicals are generally used for the control of the emersed species, particularly cumbungi (*Typha angustifolia*), and also sometimes rushes (*Juncus* spp., *Scirpus* spp., *Eleocharis* spp.) and sedges (*Cyperus* spp., *Carex* spp.). The chemicals most commonly used are dalapon, amitrol and 2,4-D ester.

In dams in Victoria, duckweed (*Lemma minor*), red azolla (*Azolla filiculoides*) and blunt pondweed (*Potamogeton ochreatus*) are common, with red milfoil (*Myriophyllum verrucosum*) sometimes also occurring. Chemical methods of control are rarely adopted with these plants. Some years ago, salvinia (*Salvinia auriculata*) was becoming a problem on the North Coast of New South Wales, but now seems to be less prevalent. In Southern New South Wales, sago pondweed (*Potamogeton pectinatus*) and naiad (*Najas tenuifolia*) also occur in dams.

Precautions

The whole question of controls, residues and safe limits is a complex one, not only because of the technicalities involved, but also because the true role of pesticides is not completely understood by the Australian public. As a result, a lengthy process of weedicide evaluation is always undertaken by the State Rivers and Water Supply Commission of Victoria before attempting large-scale operations. This evaluation takes the following form:

i. Selection of only non-toxic chemicals for weed control experiments, or if toxic, then only if not persistent in water.

ii. Measurement of the amount of pollution of channel or drain water following the use of weedicides.

ii. Measurement of the effect of trace quantities of weedicides in water on useful crop and pasture species.

iv. Establishment of maximum pollution limits (tolerances) for particular weedicides in consultation with the Pesticides Review Committee.

The Pesticides Review Committee is a committee appointed by the Victorian Government to investigate and advise on all matters concerning the safe use of pesticides. It consists of representatives of the Departments of Health, Water Supply, Lands, Soil Conservation, Agriculture and Fisheries & Wildlife.

The tolerances for weedicides in water, approved by the Pesticides Review Committee, govern all spray operations conducted by the Victorian State Rivers and Water Supply Commission. The limit for amitrole, for example, is 0.002 ppm in streams, for diuron it is also 0.002 ppm, and for dalapon it is 0.004 ppm. These limits severely restrict the extent of chemical weed control in some situations, but in general, a great deal of use is being made of the various control methods developed.

There are of course many other precautions observed during spray operations conducted by the State Rivers and Water Supply Commission, depending on the particular chemical being used. Acrolein can be hazardous, particularly when in the concentrated form, and special precautions are always taken to ensure that no injury occurs to operators, to stock drinking from channels, or to people either swimming in or pumping out treated water for domestic purposes. Hormone sprays, because of their volatility, are never used in orchard areas or close to vegetable crops. Special care is also taken with residual chemicals such as diuron to ensure that they are not applied near the roots of useful trees.

In New South Wales there is no committee which has a similar function to the Pesticides Review Committee operating in Victoria However the water supply authorities in the two states, i.e. the State Rivers and Water Supply Commission of Victoria, and the New South Wales Water Conservation and Irrigation Commission maintain close contact regarding weedicide limits and other safety practices, and have very similar techniques and standards of operation.

In the case of Lake Burley Griffin in Canberra, there is an interdepartmental committee which reports and makes recommendations to the Commonwealth Minister for the Interior. On this committee there are representatives of the Departments of Interior, Works and Health and also the National Capital Development Commission. All recommendations to use specific chemicals must be approved by this committee before being adopted as treatments.

Research

As might be expected in any country with a small population, the amount of research being conducted in Australia on water plants and their control is relatively small in comparison with the work in progress in other parts of the world, e.g. the U.S.A. Moreover, the investigations are generally of an applied nature and are largely taking place in Southeastern Australia.

In general, Government Departments are conducting these investigations. For example, the Department of the Interior continues to look into methods of controlling water-plants in Lake Burley Griffin, Canberra. At the present time also, the Snowy Mountains Authority at Cooma, in New South Wales, is investigating the nature and distribution of water weeds in creeks flowing into dams in the Authority's hydroelectric scheme.

A great deal of the research work, however, is being carried out in the irrigation areas by the State Rivers and Water Supply Commission of Victoria and the Water Conservation and Irrigation Commission of New South Wales. The main lines of investigation are:

(i) The evaluation of dichlobenil and fenac for control of weeds in irrigation supply channels and lakes.
(ii) Modification of the standard acrolein treatment for controlling submersed weeds in channels, to develop the most economical method.
(iii) Assessment of the efficiency of xylene and also the residue problems associated with its use when applied to submersed weeds in drains.
(iv) Modification of equipment and techniques to reduce water contamination to a minimum, particularly by amitrole.
(v) Measurement of the toxicity of certain chemicals to useful plants, e.g., the effect of acrolein on rice.

Eventually it is hoped that experimental work on the control of water plants with the weed-eating fish—the grass carp (*Ctenopharyngodon idella*), will be undertaken. If this species of fish proves to be suitable, i.e. if it is relatively non-selective in its weed-eating habits, if it breeds well and has no significant effect on other fish populations, it should be of great benefit in Australia. It will first be necessary, however, for the Advisory Committee on the Importation of Food and Sport Fish to approve the importation of grass carp for experimental purposes, and then for interested Departments to pool their research facilities, before some of the answers can be found.

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