Watering Inland Australia

By Dr. J. J. C. Bradfield

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By DR. J. [illegible] G. BRADFIELD

An outstanding constructional engineer widely known for his part in designing and superrising construction of the Sydney Harbor Bridge, Dr. Bradfield here outlines a scheme for the solution of the problem of irrigating and developing our vast inland. In his considered opinion the schemes he envisages are practicable, financially and as engineering propositions. In particular he deals with four great irrigation schemes in Central Australia and with the harnessing of floodwaters from coastal rivers to be used to develop western Queensland. To hold and develop Australia, projects such as this must be undertaken and carried out with vision and courage

IN the development of Australia the wings of dawn are but beating at the break of day. Our coastal rivers are unharnessed and in flood time some 20 million horse power or thereabouts are lost, power that could be brought into being by hydro-electric schemes—schemes that would give control of floods in the rivers with consequent mitigation of flood damage, schemes that would give great quantities of water for use in irrigation and electric power for industrial purposes. The need for hydro-electric power should particularly be kept in mind as Australia contains only 1 per-cent of the coastal resources of the world.

Our inland rivers when in flood flow on until the water is lost in the sand. The Finke, the Georgina, Cooper's Creek, the Diamantina and their tributaries could have their occasional flood waters stored for irrigation and domestic purposes. We have rivers of sand some 1,000 miles long. These can be cleaned out and rehabilitated *when we become irrigation minded* as the Chinese became over 4,000 years ago.

Shinnung, the divine husbandman of China, began to reign 2832 B.C., and instructed the people in agriculture and irrigation. Yu was raised to the throne of that country B.C. 2205 for his skill in draining and irrigating. In those days at any rate engineers received the regard they merited. A Chinese engineer, I Ping, took the Plain of Czechuan in hand and planned a system of canals. It was then uninhabited as there was no water. Today the Plain supports 43 million people. To make money we must spend money, *and to make irrigation schemes possible we must conserve water and spend money in so doing.*

Cost of Inland Schemes

Some inland rivers which have occasioned heavy floods could be dammed where there is a rocky bar with earthen levees extending at an angle of 45 degrees fanwise from the dam, each levee being say 140 miles long. They would hold up the flood waters when they occur over an area of 5,000 square miles some 20 feet deep and over.

A dragline caterpillar excavator with a ten yard shovel would put the material in place for a few pence per cubic yard. The river bed would be rehabilitated for 100 miles of its length (say 30 feet deep). The cost of dam, levees, rehabilitating river bed and incidental works could be carried out for about £10,000,000 spent wholly for Australian labor and material. The river would probably have permanent water owing to the water filtering in from the sand.

Four such schemes inland would provide a water surface of, say, 20,000 square miles in so called desert country as the floods came. The evaporation —100 inches per annum—from such a water surface could cause a fall of rain of 4 inches over 500,000 square miles of the dry inland. That rain after refreshing the vegetation would evaporate and fall again as rain.

Dam Sites in Central Australia

Is the expenditure of £40,000,000 all for Australian labor and material worth while for such water schemes? The interest at 3½ percent would be £1,400,000 per annum. What a scheme for post war development when work will be needed. If interest is charged (it need not be) *is the probable fall of 4 inches of rain over 500,000 square miles of the dry inland worth the interest?* Increased rainfall would eventually change the climate. Australia lacks rain inland because it lacks moisture. What a job for an engineer, and how it would develop and populate inland Australia!

The Finke River and its tributaries rise in Central Australia where there are two ranges of mountains, the MacDonnell and the Musgrave Ranges, about 200 miles apart and approximately parallel to each other east and west for a distance of 300 miles. They enclose an area of about 60,000 square miles. The country between these mountain ranges is approximately 1,500 feet high; some peaks are 4,000 feet and others approximately 5,000 feet above sea level, and are the sources of the Neales, the Macumba, the Alberga and Hamilton and the Finke River and its tributaries the Hugh and the Palmer.

In the Musgrave Ranges the Maryatt, Hamilton and Stevenson Rivers rise and flow south until they lose themselves in the sand.

Between the ranges, Mount Olga 1,400 and Ayers Rock, 1,100 feet high rise above the country which has a rainfall at times exceeding 15 inches per annum, whilst the average is 9 inches and over. Lake Amadeus is one of a chain of lakes, jackpots from which a large amount of moisture is evaporated which falls as rain in the area between the ranges; Ayers Rock has a perennial water supply on its summit.

Glen Helen Gorge, Simpson's Gap, the Finke River and the Valley of the Palms, a tributary of the Finke River and Ganger Waters, would be suitable dam sites. Salt-bush and indigenous grasses, mulga, parakellia and ghost gums flourish. Parakellia is an unique herbage which grows on sandy country in Central Australia. It is highly nutritious and so succulent that stock do not require water when feeding on it. Saltbush and mulga grow in the dry areas.

Investigation Necessary

Surveys and a comprehensive investigation are required to determine the most suitable impounding sites, but the *possibilities of a large irrigation scheme in the centre of Australia are apparent.* The water may have to be conveyed from the reservoirs in pipes or concrete lined channels to prevent it from seeping in the sand. The State of Bikaner, India, has run a concrete lined canal into the Thar Desert, 90 miles long, and settled some 200,000 people on a rainless area.

It would be possible to store in the many gorges the run off from this area of 60,000 square miles between the MacDonnell and Musgrave Ranges, and impound enough water *to irrigate at least 500 square miles of country in the heart of Australia with 48 inches of water annually.* The water to be impounded for an irrigation area of 500 square miles would be 56 thousand million cubic feet, which would represent a depth of water 70 feet over an area of 30 square miles. There are gorges in the Musgrave and MacDonnell Ranges where such dam sites exist and where a greater depth of water than 70 feet could be impounded and others where water can be stored to a depth of 100 feet and over.

In this area the evaporation reaches 100 inches per annum, so a storage of 100 feet in depth would last 12 years if no rain fell, but the average yearly rainfall of 9 inches and upwards is reliable. 500 square miles of irrigated permanent pasture could add over 3,000,000 sheep to Central Australia and would stabilise and make more certain the productivity of the surrounding area.

The water stored in these mountain ranges would be rain water free from minerals. An analysis of the water in the Farina Railway Reservoir on the Alice Spring railway line contains only 9.2 grains of mineral matter per gallon; artesian waters contain 38 grains and upwards per gallon, so there is no possible doubt whatever as to the suitability of water impounded from the MacDonnell and Musgrave Ranges for irrigation purposes.

At Katherine on the Katherine river, a Mr. Nixon has started an irrigation farm. Water is pumped from the river; the soil is rich and, given water, cabbages, tomatoes, pumpkins and other vegetables, bananas, and paw paws grow to perfection.

Diamantina and Cooper's Creek Sites

The map of Australia shows many possible irrigation schemes large and small, a few of which can only be briefly touched on, but there are many others.

Several mighty rivers with their numerous subsidiary creeks in flood time water Central Australia—Cooper's Creek, the Diamantina and the Georgina Rivers, and, from the west, the Finke, Hamilton and Mulligan Rivers. A dam across the Diamantina River at Hunter's Gorge south-west of Winton would impound an immense volume of flood waters. The country above the dam site is flat and intersected with numerous creeks. Extensive earthen dams and levees would thus have to be built to prevent the floodwater from flowing around the main dam and escaping down the many creeks. *To conserve an adequate supply of water above the Diamantina Gates is just a major engineering proposition.*

True, much of the water impounded would evaporate and seep away, but this water would not be lost. The seepage water would be available as sub-artesian water, and the humidity in the air caused by evaporation would be precipitated as rain, just where no one of course can say positively; but humidity in the air increases dewfall and so would have an ameliorating effect on the vegetation which hot dry air certainly does not have.

Another site for an immense storage reservoir is at Kullymurra Gorge on Cooper's Creek, near Innamincka in South Australia, where it appears as if floodwaters could be thrown back into Queensland and a freshwater lake approximately 40 miles by 100 miles created. This needs a complete investigation. Subsidiary earthen dams and levees would be required. Evaporation in only 20 days at 1 inch per day from the surface of this great lake would provide sufficient moisture to cause 100 points of rain to fall over an area of 20,000 square miles of country on the leeward side of the impounded water.

To provide sufficient moisture to cause a fall of one inch of rain over 20,000 square miles of country would require the combustion of upwards of two hundred and forty million tons of coal yearly. To mine, transport and burn this tonnage of coal in inland Australia is far, far beyond Australia's industrial, transport and monetary resources—it is equivalent to 800,000 tons of coal daily for 300

working days each year. In inland Australia the sun will do this work in 20 days only, without coal, and will work every day. *We can redeem the arid inland when we have acquired the commonsense to store above the ground the floodwaters which now sink into the sand and lose themselves,* so than the sun can get to work, and evaporate the conserved water. The rainfall after refreshing the country will evaporate and fall again as rain.

A dam at the bar of Strzelecki Creek would amplify the waters which could be stored from the floods in the Cooper.

No surveys have been made, so what the exact area and capacity of the Kullymurra Gorge scheme is, and what it would cost, no one can say with any degree of certainty. It needs to be investigated, but in my opinion an expenditure of 10 million pounds should defray the cost. *The Kullymurra scheme is feasible both financially and from the engineering standpoint* and though in the vicinity of Lake Eyre it appears a practical proposition.

Other Conservation Sites

Yet another dam site is on the Georgina River in the vicinity of Marion Downs. This site has immense possibilities. A channel could probably be led into the Mulligan River and thence westward to Lake Caroline in the Simpson Desert, and by the miracle of irrigation create an oasis in the lowest rainfall country in Australia, furnishing stock-owners in Western Queensland with fodder-growing areas.

In Western Australia there are suitable dam sites in the Ashburton and Fortescue River country, and in many other streams. These rivers take the water from the Hammersley and Opthalmia ranges, in which area is situated Mount Bruce, the most elevated land in Western Australia. The water stored could be used to irrigate rich red soil country in the coastal region below.

Dr. Hayes, Bishop of Rockhampton, has proposed an irrigation scheme near Rockhampton at Wura on the Dee River. Here 60,000 acres could be irrigated either with water stored by a dam at Wura or from the water in the sand. This area with irrigation could produce cotton to the value of £1,200,000 yearly, or flax worth over £3,000,000 annually and would settle quite 5,000 people. If the raw cotton were manufactured into cotton goods and flax into linen and paper at Rockhampton it would add much to the wealth and scores of thousands to the population of the district.

Watering Western Queensland From the Coast

The floodwaters of some of the coastal rivers which now run to waste can be conserved and utilised for irrigation and for developing the resources of the centre of Australia.

Within an area of about 17,000 square miles, the headwaters of the Tully, the Herbert, the Burdekin, and the Clarke Rivers have their origin; in this area, on the other side of the Divide, are also the headwaters of the Flinders River. In this region the Storm King holds sway, flooding these coastal flowing rivers with heavy monsoonal rains as the clouds drift in from the ocean and break with fair regularity against the Main Divide and the Subsidiary Ranges. *It is possible to combine and store their flood flows in one or more reservoirs from which a permanent stream can be fed to traverse Queensland from near Hughenden to Windorah and the Queensland border, passing near Longreach and Winton.*

A dam across the Burdekin at Hell's Gate, about 15 miles below its confluence with the Clarke River, is one of the most important features of the scheme. The Hell's Gate Gorge is about 2,000 feet wide and 400 feet deep. A granite bar runs across the Burdekin and the dam wall could be founded without difficulty. Here the combined waters of the Tully, Herbert and Upper Burdekin would be stored and provide for a constant stream of 6,000 cubic feet per second, after allowing for evaporation.

The impounded waters can be taken to the Main Dividing Range by aqueduct and through the range by a tunnel 36 feet inside diameter into the Flinders River or one of its tributaries. Here it would be stored in one or more numerous gorges, and augmented by the floodwaters of the Upper Flinders. A perennial stream would flow down the Flinders River past Glendower and, by a cut under the Northern Railway, into irrigation canals on a rehabilitated Thomson River. A constant stream of fresh water of 6,000 cubic feet per second could be led by these irrigation canals to where it was required for stock and irrigation purposes.

On the Flinders River a series of large coolamons (the aboriginal name for a water-basin), one below the other, would be established to hold the pent-up waters which would be fed into irrigation canals or existing streams.

The canal to deliver 6,000 cubic feet per second would require to be 150 feet wide, 20 feet deep, flowing at the rate of 2 miles per hour. If the velocity of flow can be increased, the dimensions of the channel will be correspondingly less. *To utilise the 6,000 cubic feet of water per second from the coastal rivers for irrigation purposes is a payable practical scheme with no uncertainty.*

What a different Western Queensland you would have with such a canal capable of irrigating 2,000,000 acres of country with four waterings of 6 inches each. When the water is flooded on the area to be irrigated, the water is wanted to soak in the soil; it will not go far, as the growing crops, capillary attraction and the sun's heat will bring it to the surface for the benefit of the crops and much of the water will eventually find its way into the air, just as the rain water does.

Water evaporated inland from large storage reservoirs and canals would use up the heat of the sun and tend to a lowering of the mean annual temperature. The air would become moister and there would be a heavier fall of dew than takes place at present. A good fall of dew nightly will support a useful vegetation. After being used for irrigation purposes, the water vapor added to the atmosphere each year from the coastal rivers scheme would represent 1½ inches of rain over 60,000 square miles of arid country. In three years the moisture added to the air would represent 1½ inches of rain over 180,000 square miles.

Water for Two Million Acres

I have explained the Coastal River Scheme. What I do not definitely know is the shortest length of tunnel or pipe-line to get the water through the Divide, also the lengths of the dams at the various sites. Surveys are now required. *The levels I have taken and the information I have gathered prove that the scheme is feasible,* but until more detailed surveys are made I cannot accurately determine the cost.

Few, and, in most cases, no records have been taken of the daily flow of the Herbert, Burdekin and Flinders Rivers, and no estimate of the volume of the floods has been made; consequently, at the outset an estimate of the quantity of water available year by year appeared almost impossible.

In India, Europe and the United States, the yearly rainfalls have been recorded over long periods. Experts have made a special study of the run-off based on the yearly rainfall, and have deduced formulae giving a run-off in inches in terms of the rainfall in inches. I have obtained particulars of the rainfall over the areas I have investigated from the State and Commonwealth Offices, and by using the formula most suitable to Queensland conditions have made estimates of the probable amount of water off-flowing from these areas. These estimates are on a conservative basis.

In a normal year, over 230,000 million cubic feet of floodwaters which now run to waste from the Tully, Herbert, Burdekin and Flinders Rivers could be stored in reservoirs. After allowing for evaporation, seepage, and allowing for riparian rights lower down the Tully, Herbert, Burdekin and Flinders

Irrigated land grows . . .

. . . tomatoes, cabbages, paw-paws . . .

. . . in the Northern Territory

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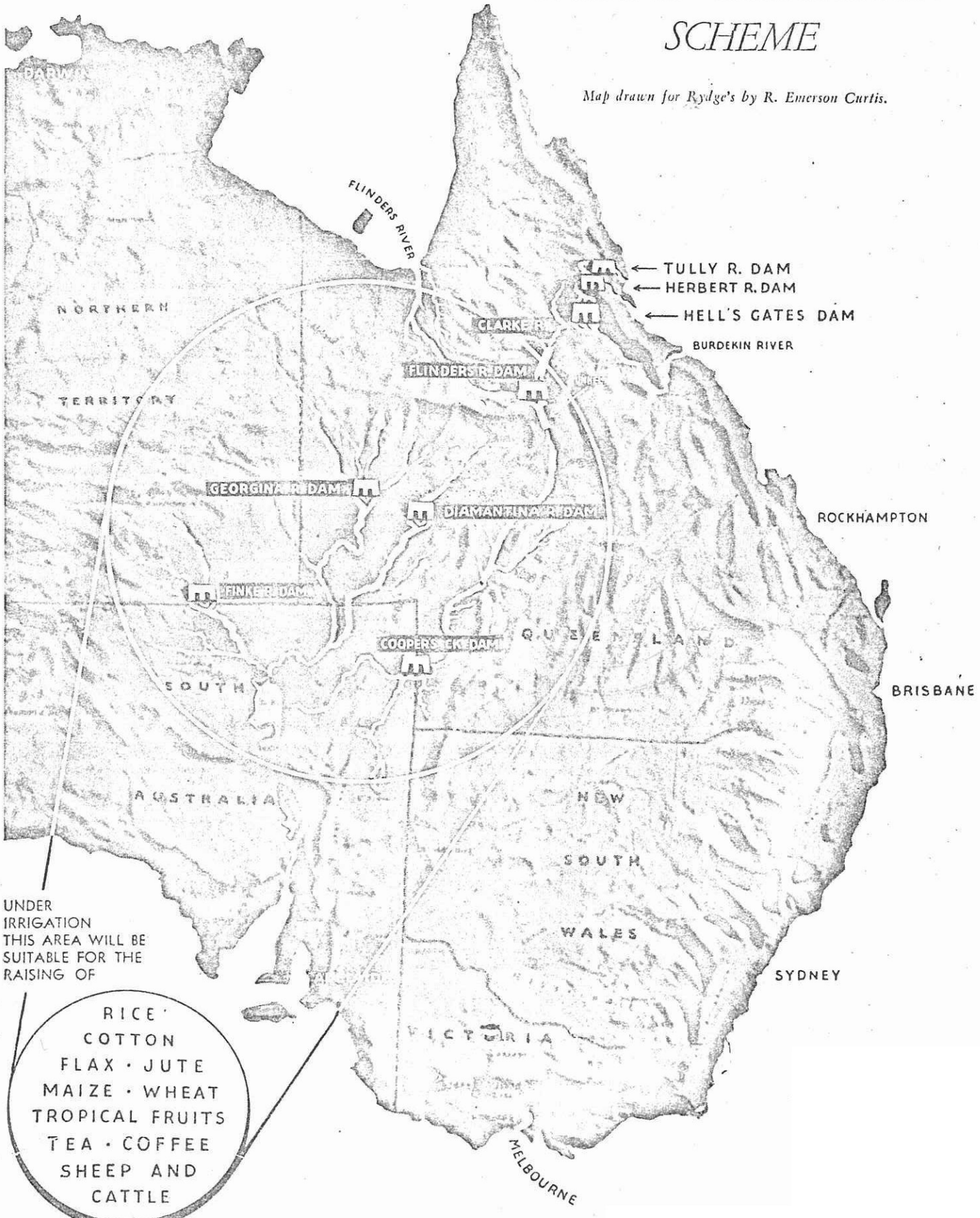
Dr. J. C. BRADFIELD'S

INLAND IRRIGATION SCHEME

Map drawn for Rydge's by R. Emerson Curtis.



Rivers, a constant flow into the Thomson River at Muttaburra or into irrigation canals of 6,000 cubic feet per second could be maintained.

Critics may say the water is not available, but to provide the 4,000,000 acre feet of water requires a run-off of 6½ inches only from the catchment area, and the monsoonal rains are measured in feet. It is only the flood-waters which the scheme proposes to store; the normal run-off from the catchments would flow down the respective rivers as at present.

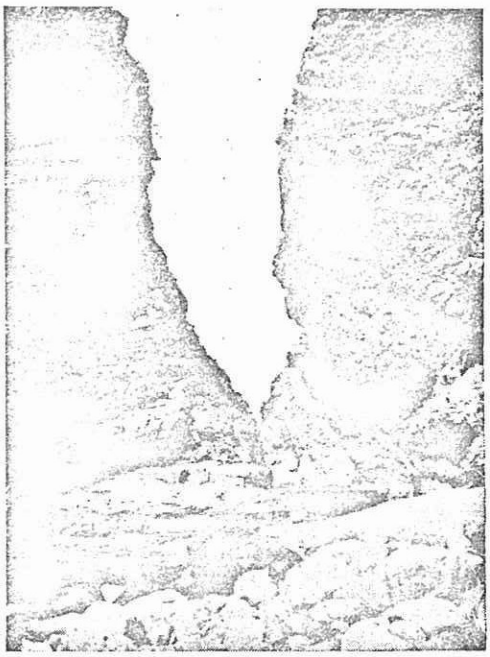
The money expended would be spent on Australian labor and material. Some 40,000 tons of steel plates would be required, to produce which 470,000 tons of iron ore would have to be mined, 360,000 tons of coal for producing coke for the blast-furnaces and 100,000 tons of limestone; whilst some 20,000,000 bags of cement would be required as well as 4,000,000 cubic yards of crushed metal and 2,000,000 cubic yards of sand for making concrete for the impounding reservoirs. Surely a man sized job!

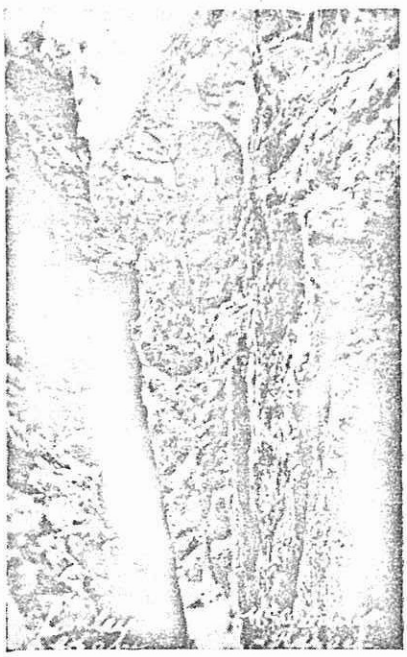
The scheme will cost not less than £30,000,000 sterling. With interest during construction, canals, preparing the land for irrigation, planting with permanent grasses, and other charges it may total £40,000,000 on which the interest at 3½ percent would be £1,400,000. Administration £75,000, maintenance and other charges £175,000 would bring the total annual charge to £1,650,000. The annual sinking fund required to liquidate the capital expenditure of £40,000,000 in 60 years at 3½ percent would be £200,000. Total charges £1,850,000.

The water available, 6,000 cubic feet per second, is sufficient to cover 2 million acres, or 3,200 square miles, with 2 feet of water per annum. Taking the cost of water at 10/- per acre foot or 272,250 gallons, i.e., £1 for water rights of 2 feet of water per annum, the revenue would be £2,000,000. It will thus be seen that the scheme would be financial at the outset.

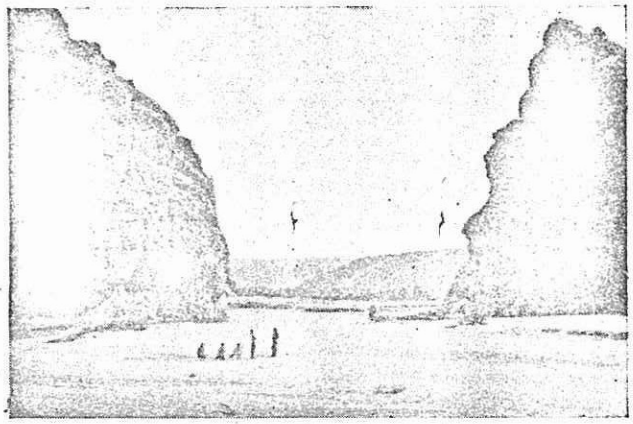
Affecting Climate' Changes

It is important to impound all water possible, as such water would be added to the water resources of Australia either as stored water above ground or as increased humidity in the air. Some of the impounded water would seep away, strengthening the natural springs and the sub-artesian and artesian waters some would be used for domestic purposes by man and for drinking purposes by animals; the remainder would be evaporated either from the surface of the stored water or irrigation canals or from land irrigated. The moisture would become





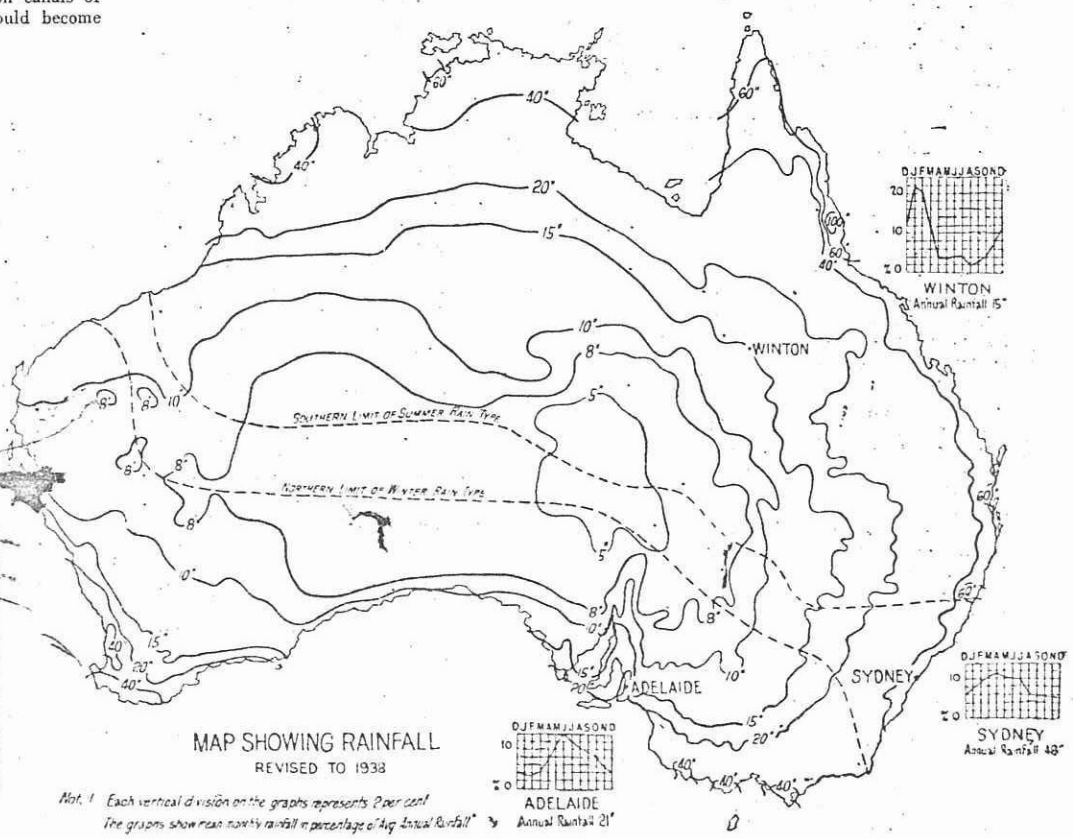
Gorges such as these in the McDonnell Ranges in Central Australia provide suitable sites for impounding water for storage and irrigation. Illustrated are: top left, Simpson's Gap; top right, Stanley Chasm; right, Glen Helen Gorge.



This rainfall map (based on a map supplied by Mr. H. N. Warren, Acting Government Meteorologist) shows the principal isohyets or lines of equal rainfall from 60 inches to 5 inches average annual. It also shows the southern limit of the summer rain and northern limit of the winter rain.

The graph for Winton is typical of the average monthly rainfall in the area of summer rain. At Winton 22 percent of the rain usually falls in January decreasing to 2 percent in July; at Adelaide in the winter rain area 14 percent of the annual rainfall falls about June, decreasing to about 4 percent in December.

Sydney lies between the southern limit of the summer rain and the northern limit of the winter rain; its heaviest average rainfall takes place in April. The graph shows that increased rainfall may be looked for in December reaching a maximum in April but, after the continued drought for 5 or 6 years, the rain storms from the south and south-east should be above the average in intensity and there is little doubt but that Sydney's water supply will be replenished during the months after the sun shines vertically over the equator on September 21, and travels southward to the tropic of Capricorn over which it shines vertically—December 22.



MAP SHOWING RAINFALL
REVISED TO 1938

Note: Each vertical division on the graphs represents 5 per cent
The graphs show mean monthly rainfall in percentage of the Annual Rainfall

the humidity in the air. The higher the temperature the greater is the amount of humidity which can be stored in the air.

Thunderstorms would become more frequent when the inland air is better supplied with moisture, or, when winds blow over from the sea, the added moisture in the air from off the ocean would augment the inland moisture and make the precipitation of the rain more certain. The rain will evaporate and fall again as rain. In this way the water conserved will be used over and over again, and moisture in the arid inland will be augmented and maintained at such a level that the rainfall will slowly at first but steadily progress.

Once Australia has conservation schemes numerous and comprehensive enough to make an impression favorable to the country, amelioration will become marked. The converse is likewise true. Droughts are cumulative in their results, and as long as there are no projects completed that are of sufficient size to combat and master the drought conditions they will prevail and become emphasised year by year.

Small irrigation schemes will allow for a limited number of individuals to thrive along the few rivers that are weired up; but the rest of the country will remain stationary to go backwards. Local benefit will accrue from small schemes, *but far reaching schemes are required to ameliorate the climate and rejuvenate inland Australia.*

When the rainfall in Central Australia is increased, dewfall will also increase and become constant, soil erosion caused by the winds will cease, as the surface will become clad with indigenous vegetation which will protect the soil and enhance its fertility, and the temperature will be lowered.

Stored Water Affects Climate

Mr. E. T. Quayle, B.A., Commonwealth Meteorological Department. for many years past has investigated the possibility of improving the rainfall over inland Australia, and reverse the persistent decline of past millennia. Through neglect other nations have ruined their lands, converting them into deserts of drifting sand. We have a new country still largely unspoiled, but which is rapidly deteriorating.

Mr. Quayle gives the following fundamental facts in connection with our inland rainfall:—

1. Practically all important inland rains are of tropical origin.

2. The rain bearing clouds, mostly of higher altitude than in coastal districts, come from some northerly direction, averaging between north-west and north.

3. The surface winds in front of the rain storms blow usually from some easterly direction, thus feeding the oncoming storms some miles south-west of the evaporation area.

4. In good years, these tropical storms are comparatively frequent and cloud directions correspondingly northerly in direction.

5. In dry years, tropical storms are infrequent, and the general cloud direction westerly.

6. Conditions favoring inland rains originate over the Pacific Ocean, and enter Australia via the northern half of Queensland.

7. Storm systems coming from the west bring rain to Victoria and New South Wales if the upper air over Western Queensland is humid, otherwise they are liable to die away and fail as inland rain producers. Night temperatures (i.e. minimum) are a valuable index to these upper air humidities.

For his researches, *Rainfall Improvement by Human Agency*, Mr. Quayle selected two areas in Victoria and South Australia, the first under the influence of Great Lakes, Torrens and Frome, and the second, a strip of country in north-west Victoria.

In the former case it has been reliably shown that for a period of as much as two years after the parched lakes had been somewhat replenished, the areas in the lee of and extending for over 150 miles from the lakes benefited by an increased annual rainfall varying from 10 percent to 20 percent above the average of the whole country extending in other directions from the lakes.

Elaborating upon this, subsequent investigations over a strip of country extending from Lake Hindmarsh in north western Victoria to the Leeton irrigation area in New South Wales, revealed sharp increases in rainfall to any areas lying south-east from lakes or river valleys extending in a north-westerly direction. The distance between these limits was 275 miles, the elevation throughout was below 500 feet, and the strip may be considered as being remote from the sea with similar rainfall controls.

He found that the average rainfall of stations south-east from lakes, rivers or irrigated cultivations varied by as much as plus 3 inches over those interposed. The assumed reason for this can only be, that increased evaporation induced a greater precipitation from the moisture-laden atmosphere.

There are records which show that the country in the lee of Lakes Torrens and Frome have always benefited when the Lakes were carrying water, on one occasion to the extent of 60 percent of its normal amount.

Professor Vonwiller and Dr. Malcolm Fraser have estimated that "in Central Australia the heat received daily by one square mile of the earth's surface is 20 million million calories, also that the heat lost by the evaporation daily of ¼ inch of water from a surface of one square mile is 12 million million calories." Allowing a wide margin for contingencies, this loss of heat would reduce the temperature of the hot air over an area of one square mile by about 30°F.

Saturated air at 100°F contains 19.8 grains of moisture, at 70°F the air can contain only 8 grains. Cooling the air 30°F would cause 11.8 grains of moisture per cubic foot of air to condense and become rain, dew or dense fog. If the saturated air extended to a height of 3,200 feet, cooling it by 30°F could precipitate one inch of rain. These facts bear out the researches of Mr. Quayle that on the leeward side of lakes, stored waters and irrigation areas rainfall increases.

In conjunction with these findings even greater benefit would be evinced if, in some of our not so dry areas, the natural flora were demolished and crops and grasses substituted. Generally, in the areas approaching desert conditions of dryness, the tree or shrub flora is sparse with scanty foliage. The encouragement of some types of grasses would naturally increase the transpiration of moisture from the ground and set up greater evaporation.

Developing Australia

We need vision to see where opportunity lies to develop Australia's great though as yet unexplored resources. New fields beckon ahead, new vistas open before us. Water conservation schemes large and small; developmental roads east-west, north-south through north and Central Australia giving access to our arid and so called desert country and opening it up by wells worked by windmills or sun engines to bring the sub-artesian water to the surface; developing our mineral, pastoral and agricultural wealth and manufacturing in Australia the finished products therefrom, steel, aluminium, tin, copper, coton goods, paper, linen, ginger, arrowroot, etc., spinning our wool, cotton and flax into the goods we require, and in numerous other ways we must develop Australia and bring population here.

The railways throughout the Commonwealth must be standardised to a uniform gauge of 4 feet 8½ inches and strategic railways must be built away from the coast. The railway system from Sydney to Cairns could be easily put out of action by an enemy.

Australia's heart is not dead, heavily sandbagged maybe; it needs rejuvenating. When the all too infrequent rainstorms deluge the desert, it rejoices and blossoms like the rose with its wealth of wild flowers and herbage, alas only for a short period, as they soon dry up and wither away.

I have outlined but a few schemes, there are many others. Four great irrigation schemes, Central Australia, Cooper's Creek at Kullymurra Gorge, the Georgina River at Marion Downs and the Diamantina River at its gates should be thoroughly investigated and if found satisfactory, constructed in the near future. The cost may reach 40 million pounds, money well spent to increase rainfall in our arid centre, as well as irrigation areas where fodder could be grown and stock depastured.

Irrigate and Populate

To populate and develop Australia, we must spend money to make money. The money spent would all be for labor and materials of Australian origin. Australia has 2,000 million acres of land of which under 10 percent are alienated. An expenditure of 5/- per acre or 500 million pounds, in well thought out schemes throughout Australia during the next 40 years would greatly increase the value of our heritage, and add the population we need to hold what we have. To do this we should endeavor to have a population of 40 millions say 50 years hence. We must plan how to get these millions; closer settlement and commonsense in developing our primary and secondary industries will induce people to come here. Australia eventually should easily accommodate 90 million people, 30 per square mile.

Europe has a population of 121 people per square mile, Belgium has 698 per square mile, the United Kingdom 506, Italy 339, Germany 352 and Russia 58 per square mile. Asia has a population of 73 per square mile, Japan 398 per square mile, China and India 200. Africa's population is 13 per square mile, North and Central America 21, South America 13 and Australia 2.3 per square mile. Australia's menace obviously will come from Europe and Asia. It may not come during this war as the Asiatic Axis partner is unprepared economically; the spirit however, is willing but the flesh measured by money and materials is apparently weak. But come the menace will.

The life and death struggle which the Empire is now fighting against the dictators of Europe will not end war. The peace loving world hopes that it may be the means of solving some of the economic, financial and social problems of international life, and help in the control and distribution of populations and the inauguration of a scheme of international life in which each nation plays or is compelled to play the game, so that the spirit of service and goodwill replaces that of international jealousy, merciless competition and selfishness.

The wars of this century have revealed that man's ability to destroy immensely exceeds his power to create. Australia needs to adopt a long range constructive policy to develop, populate and defend itself.

Australia must control her own economic independence, not London. A rejuvenated inland, creating employment and settling a population in comfortable circumstances would be one part of such a long range policy.

Vision for the Future

The nation without vision perishes, but the heart and mind of any vigorous people responds to the dream of its national destiny and will endeavor to make full use of its heritage. We can hold the Commonwealth only by effective occupation.

We must make no mean plans for our future development, for mean plans have no magic to stir any man's blood or awaken enthusiasm in any one. The cost of the major works should be financed by the Commonwealth without interest, as Australia would be spending money to increase its wealth. The reticulation canals and other works necessary which benefit individuals should be constructed by loan money, the people benefited being charged a rate sufficient to pay interest, maintenance, administration and redemption of loan.

[illegible]WAY AUSTRALIA: By a bold programme of national development rejuvenate our arid lands; provide hydro-electric power for industrial purposes; open up our vast territory by highways, aviation ways and railways; house our people in healthy surroundings; manufacture our primary products into the goods we require; populate, develop and defend Australia; be a free and vigorous people keeping our place in the sun by our individualism?

WITHER AWAY AUSTRALIA: Let matters drift, do nothing, depend on other countries and nations, watch our fertile soil be eroded by the wind, and our arid inland become more arid, and probably become 50 years hence or less maybe, the helots of nations who now are made to subordinate themselves body and soul to an all devouring State because we cannot defend ourselves?

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