

the rest lignite. The latter is produced in Alberta, Saskatchewan and Ontario.

The Dominion Government has control over only Yukon and North-West Territories. In other provinces the ownership of the minerals belongs to the State in public lands and in areas not settled before 1887. Each Province has its own laws about leasing and tenure. In general, leases are for a period of 20 years with option of renewal for two or three like periods. The State and Dominion Governments control safety in mines but not output or prices. Special railway rates or rebates operate facilitating equal competition in markets by different producing regions. A bounty was also in force to help the use of Canadian coal in low temperature carbonisation plants.

Research in many phases of fuel problems is being conducted by the Federal Depart-

ment of Mines, the Ontario Department of Mines and the Research Council of Alberta.

The foregoing particulars will show that many countries have adopted measures for the control of the coal industry in all its phases—production, prices and distribution. The elimination of waste is an essential part of such control. This is achieved mainly through research institutes financed and directed by the State with the co-operation of all the interests concerned. A number of rich and influential private organisations also conduct researches, but they differ from the State institutions in that the problems are generally of limited interest and the results are not available to the industry as a whole. This note will, it is hoped, serve to focus attention on what is being done in other countries, so that India might benefit by their experience in the solution of her own peculiar problems.

### Water Requirement of Crops.

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THE construction of the Lloyed Barrage has brought very vast areas under irrigation and one of the most important problems in irrigation agriculture is the relations of the irrigation water to the crops on the one hand and to the soil on the other. All the older irrigation schemes have taught that a careful use of water is vital for the continued productivity of irrigated lands. The dangers of the misuse of water in Sind are twofold, viz., the possible rise of the water-table and the development of salt lands. Hence it was necessary to determine the "Exact water requirements of the different crops" in the area, which resolved itself into the following items for investigation :—

The minimum quantities of water needed to produce normal yields of the more important crops ;

The mode of distribution of a given delta (total quantity of water) during the life of a crop ;

The economics of a larger or smaller supply of water than the optimum ;

The effects of different delta given on :  
(i) the soil and (ii) the plant performance ; and

The optimum soaking doses,

The results of some of these investigations are recorded below :—

Sind is a land of extremes of temperature, with an average rainfall of less than 4 inches per year. The soil is a deep calcareous alluvium and the irrigation water is good.

Under these conditions of climate and soil, a series of experiments were conducted over a period of seven years. The experimental plots were levelled to perfection to ensure an even distribution of water in each plot and the water given at each irrigation was measured accurately. The plots were of uniform size of one *guntha* each and in the case of cotton, all the plots were thinned to grow nearly equal number of plants. The number of replications varied according to the number of treatments in the several years but was never less than four. The lay-out was always randomised.

#### OPTIMUM AMOUNTS OF WATER.

Duties of 100 for *kharif* crops and 200 for the *rabi* crops were taken as standard for purposes of comparison as recommended by the Baker Lane Report—duty meaning the number of acres of a crop which could be brought to maturity with one cusec discharge of water.

These experiments were conducted with two varieties of cotton and two varieties of wheat and the following are typical of the results obtained.

TABLE I.

	Yields in lbs. per Acre						
	Cotton 289 F				Wheat Pusa 114		
Duties	80	100	120	150	160	200	240
Water given in acre inches	46.5	37.2	31.0	24.8	18.0	14.4	12.0
Yields in							
1930	2760	2440	2280	..	..	..	..
1932	1120	640	..	280	1630	1240	1200
1933	1840	1520	..	1360	492	1006	640
1934	920	840	640	720	1080	1040	820

The 1932 season was unfavourable to cotton.

Examination of the data has shown conclusively that normal yields can be obtained with a duty of 100 for cotton and 200 for wheat. Larger supplies of water result in giving larger yields but these increases are statistically insignificant and are not economical.

#### JUDICIOUS IRRIGATION.

It has been the general practice to water all crops at certain regular intervals both because of convenience and the availability of water. But plants are known not to require identical quantities of water in the soil during all the different stages of their growth. In an experiment, therefore, certain crops were irrigated not at

any given intervals but only at such times when they were in need of it, of which the moisture content in the soil was taken as the index. Accordingly, the crops were irrigated only when the moisture in the soil decreased to a given percentage, in this case 5 per cent. which was arbitrarily 1 per cent. over the calculated wilting coefficient. The yields of cotton and wheat obtained were:

TABLE II.

Crop	Total water in acre inches	How given	Calculated Duty	Yield per acre in lbs.
Cotton	36.7	As usual (at 15 days' fixed intervals)	100	568
	37.1	Judicious (with soil moisture as index)	98	840
	45.9	As usual (at fixed intervals)	90	820
Wheat	14.4	As usual (at 30 days' interval)	..	1080
	13.5	Judicious	..	1100

The judicious administering of water is indeed profitable in cotton and for a given amount of irrigation a distinctly better yield is obtained. In fact, the yield obtained with 37.1" of water given judiciously is as good as that got with a delta of 45.9" water given at the usual regular intervals. Wheat however, did not respond to this treatment.

These experiments have shown that—

(i) plot duties of 100 for cotton and of 200 for wheat are the optimum, and

(ii) the cotton is definitely benefited by a more intensive supply of water during the later stages of its life as compared to an even distribution at equal intervals of time.