Chapter 8

SECONDARY INDUSTRY—MANUFACTURING

FACTORIES

Historical

The evolution of Tasmanian farming is described in continuous annual statistics from 1818 but the early records relating to factories are extremely meagre. While the early colonial statisticians had immediately put on record such fundamental measures as acreages, crop yields and livestock numbers, they were content, in the matter of factories, to merely classify and count the number of establishments. Some concept of early manufacturing activity can be derived from the following table which has been adapted from the *Statistical Returns of Van Diemen's Land, 1824 to 1839*:

Comparative Account of Manufactories and Trades in Van Diemen's Land

Description of Establishment	Number of Establishments		Description of Establishment	Number of Establishments	
	1824	1838		1824	1838
Agricultural Implement Makers	..	9	Mills, Steam	..	3
Breweries	3	19	Mills, Water and Wind	5	51
Candle Makers	..	4	Potteries	..	1
Cooperages	..	9	Printing Offices	1	8
Coachmakers	..	2	Ropemakers	1	1
Distilleries	1	4	Sailmakers	1	5
Dyers	..	2	Sawmills	1	2
Engineers	..	7	Shipwrights	..	5
Fellmongers	2	4	Snuff Makers	..	1
Foundries	..	3	Soap Makers	1	1
Furriers	..	2	Tanners	6	15
Mast and Block Makers	..	1	Wool Staplers	..	3

The grinding of wheat for flour gave rise to the first demand for power, the original solution being water mills and windmills followed by use of the steam engine (the first steam mill commenced in 1831). Later records refer to "mills, horse-driven", the beast being driven around an endless circle. The relation between early factory activity and the farming and whaling economy in which it grew is indicated by the fact that, in the table, five of the descriptions (fellmongers, &c.) refer to processing of animal products, four (shipwrights, &c.) to the construction and maintenance of ships and two (breweries, &c.) to the making of alcoholic beverages for which there were nearly as many licensed outlets as exist today.

The *Account of Manufactories and Trades*, on a simple establishment basis similar to the last table, was published annually right throughout the 19th century and is at least a guide to the introduction of new industries and new skills to the State. The first attempt to value output occurred in the government sector; Table 38 of the *Statistics of Van Diemen's Land, 1824-1839*, puts a value on the work of boy prisoners at Point Puer according to the numbers engaged

in various occupations (e.g. carpenters, blacksmiths, tailors, sawyers, stone-masons, &c.). A more comprehensive value series is found in Table 41 entitled "A return showing the amount of labour expended (reduced to weeks) at Port Arthur, and the value of such labour during each year from 1830 to 1838". In this series, the convicts were classified according to trade, and their annual labour contribution, first compiled in weeks, was valued according to standard rates put upon a week's work for each calling (e.g. blacksmiths, $1.70; tailors, $0.80; shoemakers, $1.10). Presumably the compiler had been influenced by the writings of Adam Smith or David Ricardo to accept the labour theory of value. Over the period of the table, the total "value of labour" increased from $376 (1830) to $36,962 (1838).

The presentation of factory statistics, in the private sector, on a simple establishment basis failed to answer a number of questions such as the number of employees, the quantities produced, the value of output, the capital invested, &c., and this lack of information persisted until 1882 when the Government Statistician began publishing quantity, value and employment data for jam factories and breweries; the coverage of industries was then gradually expanded until, by 1911, publication had commenced of annual factory statistics showing most of the basic information sought in current collections.

Some indication of the transformation of Tasmania from a basically rural economy is given in the following table in which the proportion of the work force engaged in manufacturing activities is compared over the period 1911 to 1961:

Employment in Tasmanian Factories Compared with Total Work Force

Particulars	1911	1921	1933	1947	1954	1961
Work Force (*a*)—						
Males ..	61,182	65,998	69,226	80,201	93,976	101,289
Females ..	13,343	14,001	16,861	20,117	24,232	29,628
Persons ..	74,525	79,999	86,087	100,318	118,208	130,917
Factory Employment (*b*)—						
Males ..	8,737	8,525	7,147	16,186	20,249	24,811
Females ..	1,561	1,602	2,086	3,751	4,340	5,347
Persons ..	10,298	10,127	9,233	19,937	24,589	30,158
Factory Employment as Percentage of Work Force—						
Males ..	14.3	12.9	10.3	20.2	21.5	24.5
Females ..	11.7	11.4	12.4	18.6	17.9	18.0
Persons ..	13.8	12.7	10.7	19.9	20.8	23.0

(*a*) Source—censuses of population in years shown; includes employers and self-employed.
(*b*) Average number of persons engaged, including working proprietors, as reported in annual factory censuses for 1911, 1921 and for financial years ending in 1933, 1947, 1954 and 1961.

Electric Power and Industrialisation

In 1900, the Government Statistician published operational details of Tasmania's chief manufacturing industries; these read in part as follows (with specification of the number of "hands" employed): Sawmills, 920 hands; Jam Factories, 499; Boot Factories, 364; Brickyards and Potteries, 247; Woollen Mills, 177; Tanneries and Fellmongeries, 131; Flour Mills, 126; Breweries, 97; Butter Factories, 92; Fruit-drying, 76; Soap and Candle Factories, 57; Bark Mills, 33; Bacon Factories, 18. At this point in time, virtually all

power was generated by steam engine on the factory site, the alternative sources such as "gas, oil and electricity" being very little used. A year later the establishment of the Commonwealth of Australia introduced free trade between the States and this deprived Tasmanian industries of the protection which they had previously enjoyed. The free importation of Australian manufactures, chiefly from Victoria, brought about a period of stagnation and inhibited the further development of manufacturing industry within the State; loss of population by migration to other parts of Australia in each decade up to World War II reflected the lack of employment opportunities which an expansion of manufacturing activity would have provided.

If no new factor had been introduced in the years after Federation, the probability is that Tasmania would have maintained a predominantly rural economy, diversified to a limited extent by sawmilling and mining. In these circumstances, employment opportunities would have been severely restricted and the more industrialised continental States would have continued to drain off the island's population growth attributable to natural increase. The new factor that eventually transformed the State's economy was hydro-electric power but its possibilities could not be exploited without heavy capital expenditure and massive construction works, all of which required time. It is paradoxical, therefore, that the first major hydro-electric construction works were initiated in a period of stagnation immediately prior to World War I, and that the second major construction phase was pushed forward during the 1930's when the State's factory activity was at a very low ebb due to the general economic depression.

The key to the further industrialisation of Tasmania was its abundant supply of water at high level in the central plateau and the State's industrial revolution may be thought as beginning in 1916 when the Waddamana turbines below the Great Lake began operating; from the initial 10,000 horsepower then developed, the hydro-electric system has expanded to today's capacity of over one million horsepower. The availability of cheap electric power resulted in the establishment of new types of industry, some on a very large scale; examples are: electrolytic zinc production, 1917; carbide manufacture, 1918; cement manufacture, 1930; paper production, 1938; newsprint production, 1941; aluminium production, 1955; ferro-manganese production, 1962. The introduction of paper and newsprint manufacture is a special case to the extent that changes in technology made possible the use of native hardwoods for the first time; the production of a suitable pulp from eucalypts was pioneered in Tasmania before other plants were established in the continental States.

Given that electrical power is cheap and abundant, the question arises as to why the industrialisation of the State has not progressed faster and further. The two obvious impediments to the rapid introduction of new enterprises are the small size of the local market and the costs of transportation to the principal markets in the continental States. The weighing of these factors, (i.e. cheaper power against possibly higher transportation costs), has naturally had the effect of attracting industries requiring large quantities of power. Such undertakings are not necessarily large employers of labour so it is possible that industrialisation, measured by capital investment and electrical power consumption, may have progressed more rapidly than industrialisation measured by involvement of the work force in factory activities.

Definitions in Factory Statistics

The statistics dealing with factories have been compiled from returns collected under the authority of the Commonwealth *Census and Statistics Act* and supplied annually by manufacturers. A return must be supplied for every

factory, which is defined for this purpose as an establishment where four or more persons are employed or where power (other than manual) is used in any manufacturing process.

If a manufacturing business is conducted in conjunction with any other activity, particulars relating to the manufacturing section only are included in the statistics. Where two or more industries are conducted in the same establishment, a separate return is obtained for each industry, if practicable.

Manufacturers are required to state in their returns particulars of the number, wages, &c. of their employees, the value of premises and equipment and of factory stocks, the horsepower of machinery, the value, and, in many cases, the quantities of raw materials and fuel used, and quantities and values of principal articles produced. The returns obtained from manufacturers are not intended to show a complete record of the income and expenditure of factories nor to show the profits or losses of factories collectively or individually.

Employment Definitions

The average number of persons employed is compiled on two different bases: the average during the period of operation, and the average over the whole year. Of these, the former is simply the aggregate of the average number of persons employed in each factory during its period of operation (whether the whole or only part of the year). This average is used only for details dealing with the classification according to the number of persons employed. The latter, which is used in all other instances, is calculated by reducing the average number working in the factories to the equivalent number working for a full year.

Working proprietors are included in all employment figures other than those dealing with monthly employment, but salaries and wages paid in all cases exclude drawings by working proprietors.

Value Definitions

The value of factory output is the value of goods manufactured or their value after passing through the particular process of manufacture, and includes the amount received for repair work, work done on commission and receipts for other factory work. The basis of the valuation of the output is the selling value of the goods at the factory, exclusive of all delivery costs and charges and excise duties, but inclusive of Government bounty and subsidy payments to the manufacturer of the finished article.

The value of production is the value added to raw materials by the process of manufacture. It is calculated by deducting from the value of factory output the value (at the factory) of those items of cost, other than wages and salaries, specified on the factory statistical collection form, namely materials used, containers and packing, power, fuel and light used, tools replaced, and materials used in repairs to plant (but not depreciation charges); the remainder so derived constitutes the value added to raw materials in the process of manufacture, and represents the amount available for wages, taxation, rent, interest, insurance, &c. and profit.

Avoidance of Duplication in Values: It is considered that, because of the duplication of materials used (which means that the finished product of one process of manufacture often forms raw material for another), an inaccurate impression would be obtained by using the value of factory output in inter-industry and in year-to-year comparisons. Woollen manufactures will illustrate the point. Greasy wool forms the raw material for the woolscouring industry, the product of which is scoured wool. This is afterwards combed into wool tops

which are used in the spinning mills for the manufacture of yarn. In due course, the yarn is woven into cloth, the raw material for the clothing industry. If these processes are carried out separately in different factories, it is evident that the value of the wool would be counted at each of the five stages of manufacture, assuming value of output was used as the basis for comparisons.

The concept of *value added* (i.e. value of production) prevents this double counting and gives a truer picture of the relative economic importance of industries.

Classification of Factories

In the compilation of statistical data dealing with factories in Australia, a standard classification of manufacturing industries, formulated at a Conference of Australian Statisticians in 1902 and periodically revised, was used until the year 1929-30. A new classification based on that used in Great Britain for census purposes was introduced in 1930-31, and this, revised and extended to a minor degree in regard to sub-classes of industry in accordance with decisions of the Statisticians' Conference, 1945, still obtains.

It should be noted that where a factory, engaged in the production of such goods as would entitle it to a classification in more than one sub-class of industry, is unable to give separate production costs, &c. for such activities, it is classified to the predominant activity of such factory.

The list that follows shows *all* the classes and sub-classes in the current Commonwealth classification of factories. Each sub-class is followed by *the number of Tasmanian factories classified to that sub-class for the year 1963-64*. It will be noted that many sub-classes contain a nil entry, indicating that no factory of this type exists in Tasmania, or alternatively, that no factory entitled to classification in more than one sub-class engages predominantly in the described activity. Despite this, the complete list has been given because the fact that particular types of industry do not exist in Tasmania may be just as significant as the fact that other types do exist.

Classification of Factories Showing Number in Each Class and Sub-Class of Industry, 1963-64

Class and Sub-Class	Number of Factories
Class I. Treatment of Non-Metalliferous Mine and Quarry Products	
1. Coke Works	..
2. Briquetting and Pulverised Coal	..
3. Carbide	1
4. Lime, Plaster of Paris, Asphalt	7
5. Fibrous Plaster and Products	13
6. Marble, Slate, etc...	4
7. Cement, Portland	1
8. Asbestos Cement Sheets and Mouldings	1
9. Other Cement Goods	31
10. Other	..
Class Total I	58
Class II. Bricks, Pottery, Glass, &c.	
1. Bricks and Tiles	9
2. Earthenware, China, Porcelain, Terra Cotta	3
3. Glass (other than Bottles)	6
4. Glass Bottles	1
5. Other	..
Class Total II	19

Classification of Factories Showing Number in Each Class and Sub-Class of Industry, 1963-64—*continued*

Class and Sub-Class	Number of Factories
Class III. Chemicals, Dyes, Explosives, Paints, Oils, Grease	
1. Industrial and Heavy Chemicals and Acids	2
2. Pharmaceutical and Toilet Preparations	..
3. Explosives (including Fireworks)	..
4. Whitelead, Paints, Varnishes	3
5. Oils, Vegetable	..
6. Oils, Mineral	..
7. Oils, Animal	..
8. Boiling Down, Tallow Refining	11
9. Soap and Candles	3
10. Chemical Fertilisers	8
11. Inks, Polishes, &c.	..
12. Matches	..
13. Other	1
Class Total III	28
Class IV. Industrial Metals, Machines, Conveyances	
1. Smelting, Converting, Refining, Rolling of Iron and Steel	..
2. Foundries (Ferrous)	3
3. Plant, Equipment and Machinery, incl. Machine Tools	30
4. Other Engineering	84
5. Extracting and Refining of Other Metals; Alloys	4
6. Electrical Machinery, Cables and Apparatus	23
Construction and Repair of Vehicles—	
Tramcars and Railway Rolling Stock—	
7. Government and Municipal	4
8. Other	1
Motor Vehicles—	
9. Construction and Assembly	1
10. Repairs	335
11. Motor Bodies	52
12. Horse Drawn Vehicles	..
13. Motor Accessories	3
15. Cycles, Foot and Hand Driven, and Accessories	2
16. Other Conveyances	..
Ship and Boat Building and Repairing, Marine Engineering—	
17. Government	..
18. Other	10
19. Cutlery and Small Hand Tools	1
20. Agricultural Machines and Implements	5
Non-ferrous Metals—	
21. Rolling and Extrusion	1
22. Founding, Casting, &c.	8
24. Sheet Metal Working, Pressing and Stamping	30
25. Pipes, Tubes and Fittings—Ferrous	..
26. Wire and Wire Working (incl. Nails)	9
27. Stoves, Ovens and Ranges	1
28. Gas Fittings and Meters	..
29. Lead Mills	..
30. Sewing Machines	1
31. Arms, Ammunition (excl. Explosives)	..
32. Wireless and Amplifying Apparatus	8
33. Other Metal Works	2
Class Total IV	618
Class V. Precious Metals, Jewellery, Plate	
1. Jewellery	..
2. Watches and Clocks (incl. Repairs)	15
3. Electroplating (Gold, Silver, Chromium, &c.)	4
Class Total V	19

**Classification of Factories Showing Number in Each Class and Sub-Class of Industry,
1963-64—*continued***

Class and Sub-Class	Number of Factories
Class VI. Textiles and Textile Goods (not Clothing except Knitted)	
1. Cotton Ginning	..
2. Cotton Spinning and Weaving	1
3. Wool: Carding, Spinning, Weaving	4
4. Hosiery and Other Knitted Goods	3
5. Silk, Natural	..
6. Rayon, Nylon and Other Synthetic Fibres	3
7. Flax Mills	..
8. Rope and Cordage	..
9. Canvas Goods, Tents, Tarpaulins, &c.	6
10. Bags and Sacks	..
11. Textile Dyeing, Printing and Finishing	1
12. Other	2
Class Total VI	20
Class VII. Skins and Leather (not Clothing or Footwear)	
Furs, Skins, Leather—	
1. Furriers and Fur Dressing	..
2. Woolscouring and Fellmongery	1
3. Tanning, Currying and Leather Dressing	1
Saddlery, Harness, Bags, Trunks and Other Goods of Leather and Leather Substitutes—	
4. Saddlery, Harness and Whips	2
5. Machine Belting (Leather or Other)	..
6. Bags, Trunks and Other Goods of Leather and Leather Substitutes	1
Class Total VII	5
Class VIII. Clothing (except Knitted)	
1. Tailoring and Ready-made Clothing	14
2. Waterproof and Oilskin Clothing	..
3. Dressmaking, Hemstitching	2
4. Millinery	..
5. Shirts, Collars, Underclothing	..
6. Foundation Garments	..
7. Handkerchiefs, Ties, Scarves	1
8. Hats and Caps	..
9. Gloves	..
10. Boots and Shoes (not Rubber)	2
11. Boot and Shoe Repairing	37
12. Boot and Shoe Accessories	..
13. Umbrellas and Walking Sticks	..
14. Dyeworks and Cleaning (incl. Renovating and Repairing)	31
15. Other	..
Class Total VIII	87
Class IX. Food, Drink and Tobacco	
1. Flour Milling	5
2. Cereal Foods and Starch	2
3. Animal and Bird Foods	8
4. Chaffcutting and Corncrushing	..
5. Bakeries (incl. Cakes and Pastry)	141
6. Biscuits	1
7. Sugar Mills	..
8. Sugar Refining	..
9. Confectionery (incl. Chocolate and Icing Sugar)	5
10. Jam, Fruit and Vegetable Canning	18
11. Pickles, Sauces, Vinegar	..
12. Bacon Curing	15
13. Butter Factories	12
14. Cheese Factories	8

Classification of Factories Showing Number in Each Class and Sub-Class of Industry, 1963-64—*continued*

Class and Sub-Class	Number of Factories
Class IX. Food, Drink and Tobacco—continued	
15. Condensed and Dried Milk Factories	4
16. Margarine	1
17. Meat and Fish Preserving	10
18. Condiments, Coffee, Spices	6
19. Ice and Refrigerating	23
20. Salt	..
21. Aerated Waters, Cordials, &c.	13
22. Breweries	2
23. Distilleries	..
24. Winemaking	..
25. Cider and Perry	1
26. Malting	1
27. Bottling	..
28. Tobacco, Cigars, Cigarettes, Snuff	..
29. Dehydrated Fruit and Vegetables	4
30. Ice Cream	2
31. Sausage Skins	2
33. Other	1
Class Total IX	285
Class X. Sawmills, Joinery Works, Boxes and Cases, Woodturning and Woodcarving	
1. Sawmills	305
2. Plywood Mills (incl. Veneers)	2
3. Bark Mills	1
4. Joinery	109
5. Cooperage	3
6. Boxes and Cases	9
7. Woodturning, Woodcarving, &c.	6
8. Basketware and Wickerware, (incl. Seagrass and Bamboo Furniture)	2
9. Perambulators (incl. Pushers and Strollers)	..
10. Wall and Ceiling Boards (not Plaster or Cement)	2
11. Other	1
Class Total X	440
Class XI. Furniture of Wood, Bedding, &c.	
1. Cabinet and Furniture Making (incl. Billiard Tables and Upholstery)	56
2. Bedding and Mattresses (not Wire)	8
3. Furnishing Drapery	..
4. Picture Frames	..
5. Blinds	6
Class Total XI	70
Class XII. Paper, Stationery, Printing, Bookbinding, &c.	
1. Newspapers and Periodicals	5
2. Printing, Government	1
3. Printing, General, incl. Bookbinding	30
4. Manufactured Stationery	..
5. Stereotyping, Electrotyping	..
6. Process and Photo Engraving	..
7. Cardboard Boxes, Cartons and Containers	2
8. Paper Bags	3
9. Paper Making	4
10. Pencils, Penholders, Chalks, Crayons	..
11. Other	1
Class Total XII	46

Classification of Factories Showing Number in Each Class and Sub-Class of Industry, 1963-64—*continued*

Class and Sub-Class	Number of Factories
Class XIII. Rubber	
1. Rubber Goods (incl. Tyres Made)	..
2. Tyre Retreading and Repairing	20
Class Total XIII	20
Class XIV. Musical Instruments	
1. Gramophones and Gramophone Records	..
2. Pianos, Piano Players, Organs	..
3. Other	..
Class Total XIV	..
Class XV. Miscellaneous Products	
1. Linoleum, Leathercloth, Oilcloth, &c.	..
2. Bone, Horn, Ivory and Shell	..
3. Plastic Moulding and Products	1
4. Brooms and Brushes	2
5. Optical Instruments and Appliances	3
6. Surgical and Other Scientific Instruments and Appliances ..	1
7. Photographic Material (incl. Developing and Printing) ..	1
8. Toys, Games and Sports Requisites	2
9. Artificial Flowers	..
10. Other	4
Class Total XV	14
Class XVI. Heat, Light and Power	
Electric Light and Power—	
1. Government	12
2. Local Authority	..
3. Companies	3
Gasworks—	
4. Government	..
5. Local Authority	..
6. Companies	2
Class Total XVI	17
Grand Total—All Classes	1,746

Summary of Factory Statistics

In the tables that follow, factory statistics, where appropriate, are presented in terms of the class of industry but not of sub-class. (Details for individual sub-classes appear in the bulletin *Secondary Industries*, a publication of the Tasmanian Office of the Bureau of Census and Statistics.)

The next table has been compiled to show factory development over the last fifty years as measured by number of factories, employment, value of production, &c. In making comparisons over so long a period, account should be taken of changes in the purchasing power of money.

Development of Factories from 1911—Selected Years

| Year | Number of Factories | Average Number of Persons Engaged (a) | Salaries and Wages Paid (b) | Value of— | | | |
				Materials Used, Fuel, &c. (c)	Produc- tion (d)	Output	Land, Buildings, Plant and Machinery
	No.	No.	$ mill.	$ mill.	$ mill.	$ mill.	$ mill.
1911 ..	609	10,298	1.7	4.2	2.9	7.1	4.5
1920 ..	616	10,225	3.0	8.8	5.5	14.3	5.8
1924-25	675	10,998	3.8	8.4	7.3	15.7	17.7
1929-30	845	10,820	4.1	10.0	7.1	17.1	19.9
1934-35	926	10,555	3.2	8.1	6.3	14.4	17.5
1939-40	980	14,670	5.4	13.5	12.5	26.0	21.1
1944-45	1,006	19,511	10.0	24.9	17.8	42.7	26.9
1949-50	1,456	23,506	19.3	51.5	38.7	90.2	44.8
1954-55	1,597	25,452	37.7	101.0	76.2	177.2	118.9
1959-60	1,683	29,662	57.6	147.7	120.4	268.1	251.3
1960-61	1,766	30,158	60.7	151.0	124.9	275.9	259.7
1961-62	1,760	30,070	61.4	155.7	127.9	283.6	280.7
1962-63	1,764	30,755	64.8	170.5	142.0	312.5	301.9
1963-64	1,746	31,833	70.6	188.5	152.6	341.1	310.1
1964-65	1,805	32,580	76.5	214.2	167.3	381.5	364.3

(a) Average for whole year after 1927-28; earlier averages relate to the period of operation. Includes working proprietors.

(b) Excludes drawings of working proprietors.

(c) Includes materials used plus cost of power, fuel, light, water and lubricating oils, containers, packing, &c., tools replaced and repairs to plant but excludes depreciation allowance and sundry overhead charges (e.g. rates, land tax, &c.) not specified on the factory form.

(d) Value of output *less* cost of materials used, fuel, &c. as defined in note (c).

Earlier, reference was made to the role played by hydro-electric power in the development of Tasmania's manufacturing industries. The next table has been compiled to show the sources of power employed to drive machinery in factories, and also the power available in the central electric stations; these series cannot be taken back to 1911 but the start-point, 1938-39, is early enough to illustrate the rapid growth in the application of industrial power.

Engines and Motors Employed in Factories; Generators in Central Electric Stations ('000 Horsepower)

| Year | Factories—Rated Horsepower of Engines Ordinarily in Use (a) | | | | Generators in Central Electric Stations (b) | | |
	Steam	Internal Combus- tion	Electric (c)	Total (d)	Total Installed Capacity	Effective Capacity	Maximum Load
1938-39	4.0	2.5	55.9	62.5	158.9	126.0	117.0
1949-50	4.6	8.7	131.5	145.0	256.0	267.7	262.5
1959-60	1.2	11.7	251.9	265.1	778.8	771.0	587.1
1960-61	1.1	10.9	268.0	280.2	817.8	812.7	622.5
1961-62	1.0	10.9	269.6	281.7	851.4	846.4	648.6
1962-63	1.0	11.5	290.2	302.7	884.9	879.9	778.3
1963-64	0.6	11.7	302.3	314.6	1,078.0	1,073.0	800.5
1964-65	0.5	13.2	308.5	322.2	1,149.1	1,144.2	828.4

(a) Excluding central electric stations.

(b) The kilowatt measures for the stations have been changed to horsepower equivalents.

(c) Excludes motors driven by electricity of plant's own generation.

(d) Includes, until 1962-63, small amounts of water power driving factory machinery directly.

The effective capacity of the central electric stations is obviously more than adequate to meet the power needs of machines in factories but there is additional demand for power for metallurgical refining (e.g. electric furnaces and electrolytic processes), for traction and for commercial, farming and domestic purposes. In 1964-65, machines in Tasmanian factories were driven by engines and electric motors with a total rating of 322,200 horsepower of which 96 per cent was available from electric motors.

Factories in Tasmania and Other Australian States

A comparison of Tasmanian factory activity with that in other States is shown in the following table. To compare the relative intensity of factory activity in the Australian States, account needs to be taken of their widely different populations and the first column in the table—"Population Relativity" —calls attention to this fact.

Australian States—Factories, 1963-64

State	Population Relativity (a)	Factories	Employment (Average Whole Year including Working Proprietors)	Salaries and Wages Paid (b)	Value of—			
					Materials Used, Fuel, &c. (c)	Production (d)	Output	Land, Buildings, Plant and Machinery
		No.	No.	$ mill.	$ mill.	$ mill.	$ mill.	$ mill.
N.S.W. ...	11.2	23,641	487,403	1,100	3,068	2,266	5,334	2,960
Victoria..	8.4	17,597	413,120	912	2,303	1,750	4,053	2,061
Queensland	4.3	5,955	110,696	219	850	442	1,292	520
S.A. ..	2.8	5,826	110,813	240	634	428	1,062	561
W.A. ..	2.1	4,609	55,705	109	325	231	556	274
Tasmania	1.0	1,746	31,833	71	188	153	341	310
Total ..	29.8	59,374	1,209,570	2,651	7,368	5,270	12,638	6,686

(a) Tasmania's total mean population for 1963-64 is expressed as 1.0; other State populations in proportion to 1.0.

(b) Excludes drawings of working proprietors.

(c) Includes materials used plus cost of power, fuel, light, water and lubricating oils, containers, packing, &c., tools replaced and repairs to plant but excludes depreciation allowance and sundry overhead charges not specified on the factory form.

(d) Value of output *less* cost of materials used, fuel, &c., as defined in note (c).

Applying the appropriate population relativity factors to Tasmanian factory figures, it will be seen that, on most indicators, Tasmania is relatively more industrialised than W.A. and Queensland, that its pro-rata value of production approximates that of S.A. and that its pro-rata value of land, buildings, plant and machinery exceeds that of any other State. In regard to the last comparison (land, buildings, plant, &c.), account should be taken of the fact that central electric stations are treated as factories for the purpose of these statistics and, in the case of Tasmania, over 40 per cent of the value of land, buildings, plant and machinery is derived from a single factory class, namely "XVI—Heat, Light and Power". Since the other States rely for power largely on thermal generation not generally involving such heavy capital outlays as hydro-electric construction, the results of this particular comparison are not unexpected.

Size Classification of Factories

The size classification of factories is based on the average number of persons employed during the period of operation and includes working proprietors. The following table has been compiled to show size changes in the structure of Tasmanian industry since 1928-29.

Number of Factories and Persons Employed by Size of Factory

Year		Size of Factory (i.e. Average Employment)							
		Under 4	4	5 to 10	11 to 20	21 to 50	51 to 100	101 & over	Total
NUMBER OF FACTORIES									
1928-29	..	187	96	305	112	49	22	14	785
1938-39	..	256	114	362	110	71	17	14	944
1948-49	..	478	142	390	162	106	43	25	1,346
1958-59	..	736	151	400	174	126	46	33	1,666
1963-64	..	751	155	414	198	140	44	44	1,746
PERSONS EMPLOYED (a)									
1928-29	..	430	384	2,091	1,632	1,558	1,492	3,984	11,571
1938-39	..	582	456	2,422	1,569	2,252	1,155	6,231	14,667
1948-49	..	1,062	568	2,633	2,344	3,308	3,033	10,549	23,497
1958-59	..	1,447	604	2,755	2,589	3,869	3,298	14,278	28,840
1963-64	..	1,448	620	2,922	2,872	4,560	3,132	16,684	32,238

(a) The average number of persons employed as shown in the above table (32,238 in 1963-64) differs from the average number of persons employed shown in all other tables (31,833 in 1963-64) because the average number of persons employed over *the period of operation* used for size classification exceeds average employment over *the whole year*.

The change in the size structure of Tasmanian factories since 1928-29 is summarised in the next table:

Change in Average Number of Persons Employed According to Size of Factory, 1928-29 to 1963-64

Particulars		Size of Factory (i.e. Average Employment)							
		Under 4	4	5 to 10	11 to 20	21 to 50	51 to 100	101 and over	Persons
Increase— Number Employed ..		1,018	236	831	1,240	3,002	1,640	12,700	20,667
Percent of Total Increase		4.9	1.1	4.1	6.0	14.5	7.9	61.5	100.0

As indicated in the previous table, the main characteristic of the period under review (1928-29 to 1963-64) has been the marked increase in employment in the largest establishments employing 101 hands and over.

The apparent disproportionate increase in the number of factories employing less than four hands can be misleading. The increase is thought to be due largely to definitional factors; establishments with less than four hands are excluded if using only manual power but included if using other types of power. Thus, over the years, the greater use of fractional horsepower electric

motors would have progressively qualified more and more small establishments as "statistical factories". (A two-man bakery mixing by hand is excluded; using a powered mixer, it is included.)

The next table has been compiled to indicate in which classes of industry the largest establishments occur.

Factories—Classification According to Number of Persons Employed in Each Industry Class, 1963-64

Class of Industry	Number of Factories Employing on the Average—				
	20 or under	21 to 50	51 to 100	101 and over	Total
I. Treatment of Non-Metalliferous Mine and Quarry Products	51	5	..	2	58
II. Bricks, Pottery, Glass, &c.	11	7	1	..	19
III. Chemicals, Dyes, &c.	25	1	..	2	28
IV. Industrial Metals, Machines, &c. ..	533	54	18	13	618
V. Precious Metals, Jewellery, Plate ..	19	..	..	..	19
VI. Textiles and Textile Goods (not Dress)	10	1	2	7	20
VII. Skins and Leather (not Clothing or Footwear)	4	1	..	..	5
VIII. Clothing (except Knitted)	82	2	3	..	87
IX. Food, Drink and Tobacco	243	27	7	8	285
X. Sawmills, Joinery, Boxes, &c. ..	401	27	7	5	440
XI. Furniture, Bedding, &c.	66	4	..	..	70
XII. Paper, Stationery, Printing, Binding, &c.	29	6	4	7	46
XIII. Rubber	20	..	..	..	20
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	13	1	..	..	14
Total Classes I to XV ..	1,507	136	42	44	1,729
XVI. Heat, Light and Power	11	4	2	..	17
Total All Classes	1,518	140	44	44	1,746

It will be seen that the largest establishments (101 hands and over) occur, with descending order of frequency, in IV, industrial metals, &c.; IX, food processing, &c.; XII, paper-making, &c.; VI, the textile group and X, sawmilling, &c. As a later table will indicate, nearly 90 per cent of all factory employment is concentrated in these five classes.

Factories in Statistical Divisions

A general indication of the geographical distribution of factories is given in the following table, the analysis dealing with factory Classes I to XV inclusive. In Tasmania, factory Class XVI, "Heat, Light and Power", constitutes something of a problem in any geographical distribution because the chief component of the class is the power houses, or "central electric stations" generating electricity for the State Hydro-Electric Commission. To take a specific case, it is theoretically possible for the basic water storage to be in one statistical division, the generating stations in a second division and the point of delivery, through transmission lines, in seven other divisions. Since the output of energy from the stations is integrated into a State-wide grid, the allocation of value of output, value of production, &c. to various statistical divisions would merely confuse the issue; accordingly, Class XVI, "Heat, Light and Power", is not dissected according to area and is completely excluded from the table.

Factories: Principal Items by Statistical Divisions and Selected Areas, 1963-64 (a)
Classes I-XV Only

Particulars	Factories (No.)	Employment (No.)	Salaries and Wages Paid ($'000)	Value ($'000) of—			
				Materials Used, Fuel, &c.	Production	Output	Land, Buildings, Plant and Machinery
STATISTICAL DIVISIONS							
South Central ..	465	11,103	25,322	65,294	49,060	114,354	47,658
North Central..	305	6,838	13,132	29,204	22,584	51,788	20,350
North Western	425	7,843	17,606	49,540	37,680	87,220	50,266
North Eastern..	132	1,862	5,006	17,674	9,514	27,188	40,054
North Midland	71	929	1,976	5,518	3,786	9,304	4,502
Midland ..	58	288	532	1,630	1,072	2,702	590
South Eastern..	61	255	436	864	820	1,684	942
Southern ..	183	1,824	4,174	10,694	10,582	21,276	15,498
Western ..	29	523	1,258	7,152	4,268	11,420	904
Total Classes I-XV ..	1,729	31,465	69,442	187,570	139,366	326,936	180,764
SELECTED AREAS							
Hobart and Suburbs ..	494	11,198	25,462	65,652	49,366	115,018	47,980
Launceston and Suburbs ..	337	7,483	14,504	33,214	25,212	58,426	24,272
Remainder of State.. ..	898	12,784	29,476	88,704	64,788	153,492	108,512
Total Classes I-XV ..	1,729	31,465	69,442	187,570	139,366	326,936	180,764

(a) Definitions of employment, salaries and wages, materials used, fuel, &c., and value of production have been given in initial summary tables.

As indicated in the previous table, the chief centre of factory activity, measured in terms of value of production, was the South Central Division (Cities of Hobart and Glenorchy); its contribution to total added value was 35 per cent. Major establishments in the Division engaged in zinc and chemical fertiliser production, confectionery making, fruit processing and various types of metalworking and engineering.

Contributing 27 per cent to the total value of production was the N.W. Division, with major industries including paper manufacture, cement production, plywood and building-board making, fruit and vegetable canning and preserving, and some textile making. The North Central Division (City of Launceston) contributed 16 per cent and is the acknowledged textile "capital" of the State. Next came the Southern Division with eight per cent, major establishments engaging in newsprint production and carbide manufacture. With major industries devoted to aluminium and ferro-manganese production, and to food preserving, the N.E. Division contributed seven per cent. The principal industry in the Western Division is the smelting of copper, this Division contributing three per cent.

The previous table shows that Tasmanian factories are not concentrated in the metropolitan area to the extent found in most of the continental States and that a considerable degree of de-centralisation of industry has been achieved.

Factories Classified According to Class of Industry

The following table contains a summary of the principal statistics for factories by class of industry in Tasmania during the year 1963-64:

Principal Items by Class of Industry, 1963-64

Class of Industry	Factories (No.)	Employment (No.)	Salaries and Wages Paid ($ mill.)	Value ($ mill.) of—			
				Materials Used, Fuel, &c.	Production	Output	Land, Buildings, Plant and Machinery
I. Treatment of Non-Metalliferous Mine and Quarry Products	58	819	1.94	5.81	4.77	10.58	4.13
II. Bricks, Pottery, Glass, &c.	19	367	0.81	0.83	1.43	2.26	1.64
III. Chemicals, Dyes, Explosives, Paints, Oils, Grease	28	943	2.68	7.75	7.15	14.90	9.67
IV. Industrial Metals, Machines, Conveyances	618	10,719	25.50	61.41	49.25	110.66	68.83
V. Precious Metals, Jewellery, Plate	19	45	0.07	0.04	0.13	0.17	0.17
VI. Textiles and Textile Goods (Not Dress)	20	3,426	6.16	18.20	10.50	28.70	10.17
VII. Skins and Leather (not Clothing or Footwear)	5	47	0.10	0.65	0.16	0.81	0.12
VIII. Clothing (except Knitted)	87	710	0.98	0.96	1.82	2.78	2.53
IX. Food, Drink and Tobacco	285	5,053	10.17	46.08	22.47	68.55	31.18
X. Sawmills, Joinery, Boxes, &c., Wood Turning and Carving	440	3,886	7.66	18.72	13.58	32.30	10.59
XI. Furniture of Wood, Bedding, &c.	70	527	0.84	1.77	1.47	3.24	1.22
XII. Paper, Stationery, Printing, Bookbinding, &c.	46	4,683	12.10	24.69	25.72	50.41	39.05
XIII. Rubber	20	129	0.25	0.54	0.64	1.18	1.15
XIV. Musical Instruments	..	..	..	..	..	..	..
XV. Miscellaneous Products	14	111	0.18	0.12	0.27	0.39	0.31
Total Classes I to XV	1,729	31,465	69.44	187.57	139.36	326.93	180.76
XVI. Heat, Light and Power	17	368	1.14	0.92	13.21	14.13	129.29
Total All Classes	1,746	31,833	70.58	188.49	152.57	341.06	310.05

The next table shows the change in the number of factories in Tasmania during recent years:

Number of Factories in Each Class of Industry

Class of Industry	1954-55	1959-60	1960-61	1961-62	1962-63	1963-64
I. Treatment of Non-Metalliferous Mine and Quarry Products	55	50	52	48	51	58
II. Bricks, Pottery, Glass, &c.	18	19	18	18	19	19
III. Chemicals, Dyes, &c.	24	26	27	29	29	28
IV. Industrial Metals, Machines, &c.	446	532	599	602	602	618
V. Precious Metals, Jewellery, Plate..	6	6	20	19	19	19
VI. Textiles and Textile Goods (not Dress)	13	18	19	19	19	20
VII. Skins and Leather (not Clothing or Footwear)	8	8	8	7	6	5
VIII. Clothing (except Knitted)..	72	100	94	95	97	87
IX. Food, Drink and Tobacco	308	287	295	293	298	285
X. Sawmills, Joinery, Boxes, &c.	487	482	473	468	458	440
XI. Furniture, Bedding, &c. ..	84	65	69	67	69	70
XII. Paper, Stationery, Printing, Binding, &c.	33	39	42	41	43	46
XIII. Rubber	18	22	22	22	22	20
XIV. Musical Instruments, &c...	..	..	..	..	..	..
XV. Miscellaneous Products	14	15	14	16	16	14
Total Classes I to XV	1,586	1,669	1,752	1,744	1,748	1,729
XVI. Heat, Light and Power	11	14	14	16	16	17
Total All Classes	1,597	1,683	1,766	1,760	1,764	1,746

The largest contributor to the total of factory employment is factory Class IV—"Industrial Metals, Machines and Conveyances"—with 34 per cent; the most important sub-class within Class IV is "Extracting and Refining of other Metals (excluding iron and steel)." The next largest contributors are factory Class XII—"Paper, Stationery, Printing, Bookbinding, &c."—with 15 per cent, mostly employed in the manufacture of paper and newsprint; Class IX, food processing, &c., 16 per cent; Class X, sawmilling, &c., 12 per cent; and Class VI, textiles, &c., 11 per cent.

The total value of production (i.e. value added) in 1963-64 was $152,570,000. The major contributors to this total were Class IV, the metals group, with 32 per cent; Class XII, the paper group, with 17 per cent; Class IX, the food processing group, with 15 per cent; Class X, the sawmilling group, with nine per cent.

Employment in Factories

All persons employed in the manufacturing activities of a factory, including proprietors working in their own business and persons working regularly at home are counted as factory workers while those engaged in selling and distributing, such as salesmen, travellers and carters employed solely in *outward* delivery of manufactured goods, are excluded. The grouping of occupations comprises: (i) working proprietors; (ii) managerial and clerical staff including salaried managers and working directors; (iii) chemists, draftsmen, and other laboratory and research staff; (iv) workers in factories (skilled and unskilled); foremen and overseers; carters (excluding outward delivery only), messengers, and persons working regularly at home.

The figures showing average employment in factories represent the equivalent average number of persons employed, including working proprietors, over a full year.

The next table shows average whole-year employment in Tasmanian factories according to class of industry for a five-year period:

Employment—Total Number of Workers According to Class of Industry

Class of Industry	1959-60	1960-61	1961-62	1962-63	1963-64
I. Treatment of Non-Metalliferous Mine and Quarry Products	737	743	737	813	819
II. Bricks, Pottery, Glass, &c.	392	412	389	382	367
III. Chemicals, Dyes, &c.	840	870	910	926	943
IV. Industrial Metals, Machines, &c.	9,751	10,030	9,989	10,335	10,719
V. Precious Metals, Jewellery, Plate	20	38	40	43	45
VI. Textiles and Textile Goods (not Dress)	3,166	3,261	3,123	3,213	3,426
VII. Skins and Leather (not Clothing or Footwear)	61	67	63	61	47
VIII. Clothing (except Knitted)	878	838	831	716	710
IX. Food, Drink, and Tobacco	4,684	4,711	5,000	5,088	5,053
X. Sawmills, Joinery, Boxes, &c.	3,774	3,818	3,634	3,665	3,886
XI. Furniture, Bedding, &c.	470	409	438	476	527
XII. Paper, Stationery, Printing, Binding, &c.	4,229	4,301	4,258	4,419	4,683
XIII. Rubber	142	126	140	132	129
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	183	166	139	120	111
Total Classes I to XV	29,327	29,790	29,691	30,389	31,465
XVI. Heat, Light and Power	335	368	379	366	368
Total All Classes	29,662	30,158	30,070	30,755	31,833

The factory classes associated with the greatest employment are IV, industrial metals, &c., with 34 per cent in 1963-64; IX, food processing, &c., with 16 per cent; XII, paper-making, &c., with 15 per cent; X, saw-milling, &c., with 12 per cent; VI, the textile group, with 11 per cent. Nearly 90 per cent of Tasmanian factory employment is concentrated in these five classes and it is also in these classes that the largest establishments are found.

The following table shows the number of males and females employed in factories according to occupational groups.

Employment—Occupational Grouping in Factories by Sex

Year	Working Proprietors		Salaried Staff				Wages Staff (c)		Total Workers			Masculinity of Factory Workers (d)
			Managerial &c. (a)		Technical (b)							
	Males	Fe-males	Males	Fe-males	Males	Fe-males	Males	Fe-males	Males	Fe-males	Per-sons	
1954-55 ..	955	39	1,695	753	366	42	18,029	3,573	21,045	4,407	25,452	478
1959-60 ..	936	62	2,137	1,006	522	83	20,813	4,103	24,408	5,254	29,662	465
1960-61 ..	979	46	2,120	1,043	516	109	21,196	4,149	24,811	5,347	30,158	464
1961-62 ..	976	39	2,232	1,082	536	102	20,998	4,105	24,742	5,328	30,070	464
1962-63 ..	1,019	61	2,283	1,124	572	102	21,579	4,015	25,453	5,302	30,755	480
1963-64 ..	930	71	2,434	1,146	512	110	22,345	4,285	26,221	5,612	31,833	467
1964-65 ..	976	80	2,482	1,211	536	116	22,774	4,405	26,768	5,812	32,580	461

(a) Managerial and clerical staff, including salaried managers and working directors.

(b) Chemists, draftsmen and other laboratory and research staff.

(c) Foremen, overseers, workers in factories (skilled and unskilled), carters (excluding outward delivery only), messengers and persons working regularly at home.

(d) Number of males per 100 females.

The following table shows the age distribution of factory workers as at the last pay-day in June; the figures exclude working proprietors:

Distribution of Employees According to Age
(Excluding Working Proprietors)

Year	Number of Persons on Factory Payrolls on last Pay-day in June—							
	Males				Females			
	Under 16 years	16 and under 21 years	21 years and over	Total	Under 16 years	16 and under 21 years	21 years and over	Total
1955..	121	2,296	17,679	20,096	76	1,313	3,379	4,768
1960..	91	2,767	20,628	23,486	88	1,448	4,008	5,544
1961..	129	2,695	20,659	23,483	95	1,377	3,826	5,298
1962..	91	2,858	20,917	23,866	101	1,395	4,230	5,726
1963..	95	2,977	21,442	24,514	69	1,400	3,770	5,239
1964..	123	3,329	21,940	25,392	96	1,587	4,218	5,901
1965..	121	3,441	22,253	25,815	107	1,672	4,166	5,945

It will be observed that the proportion of factory workers under 16 years is extremely low, a reflection of the 16 year minimum compulsory leaving age operative in Tasmanian schools (the "under 16" workers shown are not breaking the law since a system of exemption allows limited departure from the legal minimum age).

The next table has been compiled to show the classes of industry in which female workers predominate:

Employment by Sex in Each Class of Industry, 1963-64

Class of Industry	Average Employment (Whole Year) including Working Proprietors					
	Number			Percentage in Each Class		
	Males	Females	Persons	Males	Females	Persons
I. Treatment of Non-Metalliferous Mine and Quarry Products	777	42	819	2.96	0.75	2.57
II. Bricks, Pottery, Glass, &c.	351	16	367	1.34	0.29	1.15
III. Chemicals, Dyes, &c.	887	56	943	3.38	1.00	2.96
IV. Industrial Metals, Machines, &c.	10,125	594	10,719	38.61	10.58	33.67
V. Precious Metals, Jewellery, Plate..	42	3	45	0.16	0.05	0.14
VI. Textiles and Textile Goods (Not Dress)	1,565	1,861	3,426	5.97	33.16	10.76
VII. Skins and Leather (not Clothing or Footwear)	44	3	47	0.17	0.05	0.15
VIII. Clothing (except Knitted)..	305	405	710	1.16	7.22	2.23
IX. Food, Drink and Tobacco	3,473	1,580	5,053	13.25	28.15	15.87
X. Sawmills, Joinery, Boxes &c.	3,745	141	3,886	14.28	2.51	12.21
XI. Furniture, Bedding, &c. ..	452	75	527	1.72	1.34	1.66
XII. Paper, Stationery, Printing, Binding, &c.	3,885	798	4,683	14.82	14.22	14.71
XIII. Rubber	116	13	129	0.44	0.23	0.41
XIV. Musical Instruments, &c...	..	..	..	..	..	..
XV. Miscellaneous Products ..	88	23	111	0.34	0.41	0.35
Total Classes I to XV	25,855	5,610	31,465	98.60	99.96	98.84
XVI. Heat, Light and Power ..	366	2	368	1.40	0.04	1.16
Total All Classes ..	26,221	5,612	31,833	100.00	100.00	100.00

As demonstrated in the above table, there is a considerable difference in the patterns of male and female employment. Four factory classes account for over 86 per cent of all female workers; in descending order of magnitude, these classes are the textiles group, the food processing group, the paper making group and the industrial metals group. The four factory classes accounting for most male employment (81 per cent) are, in descending order: the industrial metals group, the paper making group, the sawmilling group and the food processing group.

Salaries, Wages and Other Costs

The table that follows has been compiled to show male and female earnings and also to show separately the amounts paid to "managerial and clerical staff, including salaried managers and working directors, chemists, draftsmen and other laboratory and research staff".

Salaries and Wages in Factories (a), 1963-64
($'000)

Class of Industry	Managers, Clerical Staff, Chemists, Draftsmen, &c.		All Other Employees		Total		
	Males	Fe-males	Males	Fe-males	Males	Fe-males	Persons
I. Treatment of Non-Metalliferous Mine and Quarry Products	308	43	1,579	11	1,887	54	1,941
II. Bricks, Pottery, Glass, &c.	76	18	715	1	791	19	810
III. Chemicals, Dyes, &c.	577	81	2,011	11	2,588	92	2,680
IV. Industrial Metals, Machines, &c. ..	4,222	564	20,456	272	24,678	836	25,514
V. Precious Metals, Jewellery, Plate ..	13	3	50	..	63	3	66
VI. Textiles and Textile Goods (not Dress)..	625	250	2,854	2,428	3,479	2,678	6,157
VII. Skins and Leather (Not Clothing or Footwear)..	20	1	78	1	98	2	100
VIII. Clothing (except Knitted)	72	28	468	407	540	435	975
IX. Food, Drink and Tobacco	1,783	491	6,324	1,576	8,107	2,067	10,174
X. Sawmills, Joinery, Boxes, &c.	691	79	6,797	92	7,488	171	7,659
XI. Furniture, Bedding, &c.	107	28	656	48	763	76	839
XII. Paper, Stationery, Printing, Binding, &c.	1,838	294	9,160	804	10,998	1,098	12,096
XIII. Rubber	42	12	192	3	234	15	249
XIV. Musical Instruments, &c.	..	..	..	..	..	..	..
XV. Miscellaneous Products	27	10	129	16	156	26	182
Total Classes I to XV	10,401	1,902	51,469	5,670	61,870	7,572	69,442
XVI. Heat, Light and Power	98	3	1,039	..	1,137	3	1,140
Total All Classes	10,499	1,905	52,508	5,670	63,007	7,575	70,582

(a) Excludes drawings of working proprietors.

The ranking of factory classes according to salaries and wages paid in 1963-64 was: Class IV, 36 per cent; Class XII, 17 per cent; Class IX, 14 per cent; Class X, 11 per cent; Class VI, nine per cent.

The total amount of wages and salaries paid in Tasmania is shown in summary form with average amounts paid per employee:

Salaries and Wages Paid in Factories (a)

Year	Males		Females		Persons	
	Amount	Per Em-ployee	Amount	Per Em-ployee	Amount	Per Em-ployee
	$'000	$	$'000	$	$'000	$
1954-55	33,472	1,666	4,256	974	37,728	1,454
1959-60	51,236	2,182	6,336	1,220	57,572	2,008
1960-61	53,904	2,262	6,756	1,274	60,660	2,082
1961-62	54,496	2,294	6,944	1,312	61,440	2,114
1962-63	57,834	2,368	7,002	1,336	64,836	2,184
1963-64	63,006	2,492	7,576	1,368	70,582	2,290
1964-65	68,183	2,644	8,332	1,454	76,515	2,427

(a) Excludes drawings of working proprietors.

The item "salaries and wages" is a very substantial cost in some industries, whilst in others it is a relatively minor cost. In 1963-64 for example, salaries and wages in Class XVI amounted to only 8.1 per cent of the value of output; this is hardly an unexpected result since the major industry in the class is hydro-electric power generation. By way of contrast, salaries and wages in Classes II and VIII were over 35 per cent of the value of output, and in Class V they approached 39 per cent.

There is, of course, a tendency for labour costs to shrink in relative importance as mechanisation develops. The relationship between salaries and wages, and other costs is shown in a subsequent section headed "Relation of Costs to Output and Production".

Costs of Manufacture (other than Salaries and Wages)

The next table has been compiled to summarise the various costs which are specified in the factory collection (apart from salaries and wages):

"Statistical" Costs of Manufacture Other Than Wages and Salaries (a)
($'000)

Particulars	1954-55	1959-60	1960-61	1961-62	1962-63	1963-64
Power, Fuel and Light Used ..	6,004	12,027	12,456	12,702	13,959	15,768
Water Used (Not as Power) ..	110	234	237	274	296	404
Lubricating Oils	139	180	183	163	181	193
Repairs and Replacements ..	4,411	6,963	7,077	7,205	7,140	7,795
Wrappers, Containers, Labels, &c.	5,380	8,432	8,548	9,201	9,210	9,722
Total (Excluding Materials Used)	16,044	27,836	28,501	29,545	30,786	33,882
Materials Used	84,930	119,822	122,508	126,128	139,725	154,613
Total "Statistical" Costs (a)	100,974	147,658	151,009	155,673	170,511	188,495

(a) "Statistical" costs are restricted to those shown in the table and exclude items such as interest, rates and taxes, insurances, depreciation, &c.

As indicated in the above table, the two heaviest costs are those of power, fuel and light, and materials used in the manufacturing process. The following table shows the distribution of these costs and total costs as between the various classes of industry:

"Statistical" Costs of Manufacture in Classes of Industry, 1963-64
($'000)

Class of Industry	Materials Used	Power, Fuel and Light	Other Costs (a)	Total 'Statistical' Costs
I. Treatment of Non-Metalliferous Mine and Quarry Products	4,437	911	463	5,811
II. Bricks, Pottery, Glass, &c.	351	337	139	827
III. Chemicals, Dyes, &c.	5,438	1,263	1,046	7,747
IV. Industrial Metals, Machines, &c. ..	50,772	7,369	3,267	61,408
V. Precious Metals, Jewellery, Plate ..	32	4	2	38
VI. Textiles and Textile Goods (not Dress)	16,775	530	894	18,199
VII. Skins and Leather (not Clothing or Footwear)	630	10	10	650
VIII. Clothing (except Knitted)	799	79	77	955
IX. Food, Drink and Tobacco	37,127	1,238	7,716	46,081
X. Sawmills, Joinery, Boxes, &c. ..	16,805	730	1,186	18,721
XI. Furniture, Bedding, &c.	1,693	21	61	1,775
XII. Paper, Stationery, Printing, Binding, &c.	18,902	3,207	2,586	24,695
XIII. Rubber	475	36	33	544
XIV. Musical Instruments, &c.	..	..	..	..
XV. Miscellaneous Products	102	7	10	119
Total Classes I to XV	154,338	15,742	17,490	187,570
XVI. Heat, Light and Power	275	26	624	925
Total All Classes	154,613	15,768	18,114	188,495

(a) Water (not as power), lubricating oils, repairs and replacements, wrappers, containers, labels, &c

The table below shows the expenditure on power, fuel and light analysed according to type:

Cost of Power, Fuel and Light Used in Factories
($'000)

Year	Coal	Coke	Wood	Fuel Oil	Elec-tricity	Gas	Other, Including Steam	Total
1954-55 ..	2,072	455	336	750	2,089	73	229	6,004
1959-60 ..	2,726	695	425	1,691	5,724	88	678	12,027
1960-61 ..	2,469	660	212	1,958	6,374	83	700	12,456
1961-62 ..	2,231	741	210	1,883	6,926	85	626	12,702
1962-63 ..	1,962	666	192	2,425	7,953	85	676	13,959
1963-64 ..	1,368	645	158	3,251	9,697	73	576	15,768
1964-65 ..	1,085	578	132	3,634	11,522	76	649	17,676

As suggested by the above table, coal is not being used to the same extent as previously; in 1954-55, 234,000 tons were used, compared with 114,400 tons in 1964-65. By way of contrast, factory fuel oil consumption has increased from 4,875,000 gallons in 1954-55 to 45,982,612 gallons in 1964-65. The present importance of electricity for factories is underlined by the fact that its cost in 1964-65 represented 65 per cent of the total cost of power, fuel and light (in contrast with 1954-55 when it represented only 35 per cent); in the same period, the rated horsepower of electric motors ordinarily in use in factories has increased more than 50 per cent but the major factor in the increased use of electrical power has been in metallurgical refining (electric furnaces and electrolytic recovery).

The next table shows, in summary form, the cost of power, fuel and light used in each class of industry for a five-year period:

Cost of Power, Fuel and Light Used in Each Class of Industry
($'000)

Class of Industry	1959-60	1960-61	1961-62	1962-63	1963-64
I. Treatment of Non-Metalliferous Mine and Quarry Products	670	665	759	911	911
II. Bricks, Pottery, Glass, &c.	360	339	329	320	337
III. Chemicals, Dyes, &c.	1,027	1,115	1,208	1,062	1,263
IV. Industrial Metals, Machines, &c. ..	4,293	4,431	4,774	5,772	7,369
V. Precious Metals, Jewellery, Plate ..	2	3	4	4	4
VI. Textiles and Textile Goods (not Dress)	476	513	484	492	530
VII. Skins and Leather (not Clothing or Footwear)	8	9	10	10	10
VIII. Clothing (except Knitted)	82	82	78	76	79
IX. Food, Drink and Tobacco	1,021	1,093	1,184	1,205	1,238
X. Sawmills, Joinery, Boxes, &c. ..	642	682	649	681	730
XI. Furniture, Bedding, &c.	14	15	15	18	21
XII. Paper, Stationery, Printing, Binding, &c.	3,350	3,436	3,138	3,337	3,207
XIII. Rubber	42	38	38	38	36
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	10	9	7	6	7
Total Classes I to XV ..	11,997	12,430	12,677	13,932	15,742
XVI. Heat, Light and Power	30	26	25	27	26
Total All Classes	12,027	12,456	12,702	13,959	15,768

As indicated in the previous table, the total cost of power, fuel and light has increased $3,741,000 (31 per cent) in the five-year period to 1963-64, and most of the rise can be accounted for in Class IV, the industrial metals group, where the cost has increased $3,076,000 (72 per cent increase).

The largest single cost in manufacturing is that of the materials used and the next table shows, in summary form, this cost in each class of industry for a five-year period:

Cost of Materials Used in Each Class of Industry
($'000)

Class of Industry	1959-60	1960-61	1961-62	1962-63	1963-64
I. Treatment of Non-Metalliferous Mine and Quarry Products	2,470	2,696	2,703	4,038	4,437
II. Bricks, Pottery, Glass, &c.	441	456	467	380	351
III. Chemicals, Dyes, &c.	4,315	4,423	4,671	5,006	5,438
IV. Industrial Metals, Machines, &c.	37,438	38,149	40,121	45,091	50,772
V. Precious Metals, Jewellery, Plate ..	20	29	23	24	32
VI. Textiles and Textile Goods (not Dress)	11,514	12,386	11,532	13,262	16,775
VII. Skins and Leather (not Clothing or Footwear)	634	650	688	803	630
VIII. Clothing (except Knitted)	855	886	961	788	799
IX. Food, Drink and Tobacco	30,553	30,248	33,984	35,567	37,127
X. Sawmills, Joinery, Boxes, &c. ..	14,194	14,186	13,999	15,738	16,805
XI. Furniture, Bedding, &c. ..	1,199	1,218	1,254	1,277	1,693
XII. Paper, Stationery, Printing, Binding, &c.	15,305	16,355	14,953	16,877	18,902
XIII. Rubber	390	389	394	473	475
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	178	148	109	115	102
Total Classes I to XV ..	119,506	122,219	125,859	139,439	154,338
XVI. Heat, Light and Power	316	289	269	286	275
Total All Classes	119,822	122,508	126,128	139,725	154,613

The total cost of materials used in manufacturing has risen $34,791,000 (29 per cent) in the five-year period to 1963-64.

Value of Output and Value of Production

Value of factory output by classes of industry for a five-year period is shown in the following table:

Value of Factory Output
($ million)

Class of Industry	1959-60	1960-61	1961-62	1962-63	1963-64
I. Treatment of Non-Metalliferous Mine and Quarry Products	6.30	6.91	7.46	10.03	10.58
II. Bricks, Pottery, Glass, &c.	2.27	2.33	2.30	2.19	2.26
III. Chemicals, Dyes, &c.	11.26	11.62	12.56	12.16	14.90
IV. Industrial Metals, Machines, &c. ..	82.91	85.51	87.96	100.76	110.66
V. Precious Metals, Jewellery, Plate ..	0.07	0.15	0.13	0.14	0.17
VI. Textiles and Textile Goods (not Dress)	21.21	23.72	22.00	24.58	28.70
VII. Skins and Leather (not Clothing or Footwear)	0.89	0.91	0.95	1.02	0.81
VIII. Clothing (except Knitted)	2.73	2.75	2.86	2.72	2.78
IX. Food, Drink and Tobacco	55.06	55.52	63.25	65.42	68.55
X. Sawmills, Joinery, Boxes, &c. ..	28.93	28.23	27.48	29.69	32.30
XI. Furniture, Bedding, &c.	2.54	2.43	2.44	2.59	3.24
XII. Paper, Stationery, Printing, Binding, &c.	43.45	44.86	41.46	46.83	50.41
XIII. Rubber	1.07	0.95	1.01	1.08	1.18
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	0.61	0.49	0.42	0.43	0.39
Total Classes I to XV ..	259.30	266.38	272.28	299.64	326.93
XVI. Heat, Light and Power	8.75	9.52	11.27	12.91	14.13
Total All Classes	268.05	275.90	283.55	312.55	341.06

In the section dealing with the definitions used in factory statistics, it was indicated that value of output is not a satisfactory indicator for making year-to-year comparisons or for making comparisons between classes of industry. To the extent that the finished article from one industry may become a material for use in the manufacturing process of another industry, values of output are likely to be inflated by "double-counting". Cardboard boxes and containers, for example, are a finished product of Class XII but they may be used to pack the products of industries in most other classes; similarly, electric power is a final output from Class XVI but is also taken into all other industry classes as a cost of production. For these and other considerations, the better measure for purposes of comparison is undoubtedly value of production, (i.e. value of output less "statistical costs" but with no deduction of wages and salaries).

The next table shows the value of production in Tasmanian factories for a five-year period:

Value of Factory Production
($ million)

Class of Industry	1959-60	1960-61	1961-62	1962-63	1963-64
I. Treatment of Non-Metalliferous Mine and Quarry Products	2.65	3.01	3.51	4.54	4.77
II. Bricks, Pottery, Glass, &c.	1.27	1.38	1.37	1.36	1.43
III. Chemicals, Dyes, &c.	5.00	5.19	5.88	5.18	7.15
IV. Industrial Metals, Machines, &c. ..	37.99	39.74	39.49	46.72	49.25
V. Precious Metals, Jewellery, Plate ..	0.05	0.12	0.10	0.12	0.13
VI. Textiles and Textile Goods (not Dress)	8.54	9.98	9.24	9.99	10.50
VII. Skins and Leather (not Clothing or Footwear)	0.24	0.24	0.24	0.20	0.16
VIII. Clothing (except Knitted)	1.73	1.73	1.78	1.79	1.82
IX. Food, Drink and Tobacco	17.06	17.60	20.32	21.26	22.47
X. Sawmills, Joinery, Boxes, &c. ..	13.08	12.35	11.90	12.26	13.58
XI. Furniture, Bedding, &c.	1.31	1.18	1.15	1.28	1.47
XII. Paper, Stationery, Printing, Binding, &c.	22.54	22.83	21.56	24.35	25.72
XIII. Rubber	0.61	0.49	0.54	0.54	0.64
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	0.40	0.33	0.29	0.30	0.27
Total Classes I to XV ..	112.47	116.17	117.37	129.89	139.36
XVI. Heat, Light and Power	7.92	8.72	10.50	12.14	13.21
Total All Classes	120.39	124.89	127.87	142.03	152.57

The value of production for all factories has risen by 27 per cent in the period 1959-60 to 1963-64. Corresponding percentage increases in "added value" for individual classes of industry are: Class IV, industrial metals, &c., 30 per cent; Class VI, textiles, &c., 23 per cent; Class IX, food processing, &c., 32 per cent; Class XII, paper making, &c., 14 per cent; Class XVI, heat, light and power, 67 per cent.

The class of industry showing the greatest percentage increase was Class I, treatment of non-metalliferous mine and quarry products, 80 per cent.

Relation of Costs to Output and Production

The costs data collected from factories are not complete but cover major items such as materials used; power, fuel and light; lubricants, water and containers, &c. The following table summarises these costs for each class of

industry and gives the balance remaining after such costs, together with salaries and wages, have been deducted from the value of output. The balance so obtained for each industry is the fund available to provide for all other costs and overhead expenses such as rent, interest, insurance, pay-roll tax, income tax, depreciation, &c., as well as drawings by working proprietors and profit.

Factory Costs, Output and Residual Balance, 1963-64
($'000)

Class of Industry	Specified Costs of Production			Balance between Value of Output and Specified Costs (b)	Value of Output
	Materials Used	Other "Statistical" Costs (a)	Salaries and Wages		
I. Treatment of Non-Metalliferous Mine and Quarry Products	4,437	1,374	1,941	2,832	10,584
II. Bricks, Pottery, Glass, &c.	351	476	810	624	2,261
III. Chemicals, Dyes, &c.	5,438	2,309	2,680	4,469	14,896
IV. Industrial Metals, Machines, &c.	50,772	10,636	25,514	23,735	110,657
V. Precious Metals, Jewellery, Plate	32	6	66	66	170
VI. Textiles and Textile Goods (not Dress)	16,775	1,424	6,157	4,342	28,698
VII. Skins and Leather (not Clothing or Footwear)	630	20	100	56	806
VIII. Clothing (except Knitted)	799	156	975	851	2,781
IX. Food, Drink and Tobacco	37,127	8,954	10,174	12,295	68,550
X. Sawmills, Joinery, Boxes, &c.	16,805	1,916	7,659	5,924	32,304
XI. Furniture, Bedding, &c.	1,693	82	839	629	3,243
XII. Paper, Stationery, Printing, Binding, &c.	18,902	5,793	12,096	13,621	50,412
XIII. Rubber	475	69	249	388	1,181
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	102	17	182	92	393
Total Classes I to XV	154,338	33,232	69,442	69,924	326,936
XVI. Heat, Light and Power	275	650	1,140	12,064	14,129
Total All Classes	154,613	33,882	70,582	81,988	341,065

(a) Power, fuel, light, water, lubricating oil, repairs and replacements, wrappers, containers, labels, &c.

(b) Balance available for costs and charges not specified on the factory form and for profit (including drawings by working proprietors).

There are considerable variations in the proportions which the cost of materials and the expenditure on wages bear to the value of output in the various classes of industry. These are, of course, due to the difference in treatment required to convert the materials to their final form. Class XVI, heat, light and power, obviously constitutes a major deviation from all other classes of industry; the major component in this class is hydro-electric power production characterised by heavy capital expenditure and extremely light operational costs since the basic "raw material" is water. The comparatively large residual balance attributable to Class XVI is required to meet a heavy burden in interest and depreciation charges associated with the substantial outlay of capital which created the water storages and generating capacity.

In the following table, the previous data on costs and residual balances have been converted to percentages of the value of output for each class of industry:

Factory Costs and Residual Balance as Proportion of Value of Output, 1963-64
(Per Cent)

Class of Industry	Specified Costs of Production			Balance between Value of Output and Specified Costs	Value of Output
	Materials Used	Other "Statistical" Costs	Salaries and Wages		
I. Treatment of Non-Metalliferous Mine and Quarry Products	41.9	13.0	18.3	26.8	100.0
II. Bricks, Pottery, Glass, &c.	15.5	21.1	35.8	27.6	100.0
III. Chemicals, Dyes, &c.	36.5	15.5	18.0	30.0	100.0
IV. Industrial Metals, Machines, &c.	45.9	9.6	23.1	21.4	100.0
V. Precious Metals, Jewellery, Plate	18.9	3.5	38.8	38.8	100.0
VI. Textiles and Textile Goods (not Dress)	58.5	4.9	21.5	15.1	100.0
VII. Skins and Leather (not Clothing or Footwear)	78.2	2.5	12.4	6.9	100.0
VIII. Clothing (except Knitted)	28.7	5.6	35.1	30.6	100.0
IX. Food, Drink and Tobacco	54.2	13.1	14.8	17.9	100.0
X. Sawmills, Joinery, Boxes, &c.	52.1	5.9	23.7	18.3	100.0
XI. Furniture, Bedding, &c.	52.2	2.5	25.9	19.4	100.0
XII. Paper, Stationery, Printing, Binding, &c.	37.5	11.5	24.0	27.0	100.0
XIII. Rubber	40.2	5.8	21.1	32.9	100.0
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	26.0	4.3	46.3	23.4	100.0
Total Classes I to XV	47.2	10.2	21.2	21.4	100.0
XVI. Heat, Light and Power	1.9	4.6	8.1	85.4	100.0
Total All Classes	45.4	9.9	20.7	24.0	100.0

The next table has been compiled to summarise total specified costs of production, residual balances and value of output:

Total Factory Costs, Output and Residual Balance

Year	Specified Costs of Production			Balance between Value of Output and Specified Costs (b)	Value of Output
	Materials Used	Other "Statistical" Costs (a)	Salaries and Wages		
	VALUE ($'000)				
1959-60	119,822	27,836	57,572	62,820	268,050
1960-61	122,508	28,501	60,660	64,233	275,902
1961-62	126,128	29,545	61,440	66,434	283,547
1962-63	139,725	30,786	64,836	77,198	312,545
1963-64	154,613	33,882	70,582	81,988	341,065
1964-65	175,920	38,379	76,515	90,735	381,549

Total Factory Costs, Output and Residual Balance—*continued*

Year	Specified Costs of Production			Balance between Value of Output and Specified Costs (b)	Value of Output
	Materials Used	Other "Statistical" Costs (a)	Salaries and Wages		

PROPORTION OF VALUE OF OUTPUT (PER CENT)

Year	Materials Used	Other "Statistical" Costs (a)	Salaries and Wages	Balance (b)	Value of Output
1959-60	44.7	10.4	21.5	23.4	100.0
1960-61	44.4	10.3	22.0	23.3	100.0
1961-62	44.5	10.4	21.7	23.4	100.0
1962-63	44.7	9.9	20.7	24.7	100.0
1963-64	45.4	9.9	20.7	24.0	100.0
1964-65	46.1	10.1	20.0	23.8	100.0

(a) Power, fuel, light, water, lubricating oils, repairs and replacements, wrappers, containers, labels, &c.

(b) Balance available for costs and charges not specified on the factory form and for profit (including drawings by working proprietors).

Land, Buildings, Plant and Machinery

The values recorded in this section are generally the *values shown in the books* of the individual firms after allowance has been made for depreciation, but they include estimates of the capital value of rented premises and plant. The totals shown in the tables consequently do not represent the actual amount of capital invested in industry and are largely influenced by individual accounting methods and policies in use at a given point in time.

Where land and buildings, &c. and plant and machinery, &c. are rented by occupiers of factories, their capital value has been computed by capitalising the rent paid at fifteen years' and ten years' purchase respectively.

The table that follows shows the value of land and buildings used in connection with the various classes of manufacturing industries for a five-year period. Excluding Class XVI which is a special case because of its coverage of hydro-electric power generation, it will be seen that the value of land and buildings is greatest in Class IV ($28.95m), Class IX ($16.58m) and Class XII ($12.98m). An examination of the value of plant and machinery in a subsequent table shows the same classes as the three most prominent, namely Class IV ($39.89m), Class XII ($26.07m) and Class IX, ($14.60m). Associated with Class IV are major establishments at George Town, Risdon and Mt. Lyell, all concerned with the extraction and refining of metals (aluminium, ferro-manganese alloys, zinc and copper). Included in Class XII are major establishments at Burnie, Boyer and Geeveston, producing paper, newsprint and paper pulp. Class IX includes the northern and southern breweries, a major confectionery factory and a variety of large food-processing establishments. It is an interesting exercise to compare the number of persons employed in each factory class with the value of land, buildings, plant and machinery recorded for each class. For example, Class X employs almost as many persons as Class XII despite the big difference in values of land, plant, &c.

Value at 30th June of Land and Buildings in Each Class of Industry
($ million)

Class of Industry	1959-60	1960-61	1961-62	1962-63	1963-64
I. Treatment of Non-Metalliferous Mine and Quarry Products	1.40	1.46	1.48	1.57	1.64
II. Bricks, Pottery, Glass, &c.	0.60	0.73	0.77	0.85	1.03
III. Chemicals, Dyes, &c.	2.37	2.65	2.61	2.79	3.01
IV. Industrial Metals, Machines, &c.	20.77	22.01	23.69	26.76	28.95
V. Precious Metals, Jewellery, Plate	0.05	0.15	0.14	0.14	0.14
VI. Textiles and Textile Goods (not Dress)	2.82	2.89	3.15	3.21	3.52
VII. Skins and Leather (not Clothing or Footwear)	0.07	0.09	0.08	0.08	0.08
VIII. Clothing (except Knitted)	1.57	1.37	1.54	1.60	1.70
IX. Food, Drink and Tobacco	12.06	13.58	14.10	15.13	16.58
X. Sawmills, Joinery, Boxes, &c.	3.45	3.66	3.59	3.97	4.62
XI. Furniture, Bedding, &c.	0.69	0.65	0.77	0.84	0.99
XII. Paper, Stationery, Printing, Binding, &c.	12.05	12.48	12.28	12.96	12.98
XIII. Rubber	0.50	0.58	0.61	0.79	0.87
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	0.31	0.25	0.29	0.24	0.25
Total Classes I to XV	58.71	62.55	65.10	70.93	76.36
XVI. Heat, Light and Power	85.31	84.55	94.05	92.99	92.04
Total All Classes	144.02	147.10	159.15	163.92	168.40

It will be observed that the value of land and buildings associated with Class XVI, heat, light and power, is greater than the corresponding total value for all other factory classes. The chief component of Class XVI—hydro-electric power generation—has involved the creation of extensive dams, storages and flumes and the book value of such installations is included under "land and buildings"; the actual generating plant, however, is included under "plant and machinery".

The next table shows the value of plant and machinery in each class of industry for a five-year period:

Value at 30th June of Plant and Machinery in Each Class of Industry
($ million)

Class of Industry	1959-60	1960-61	1961-62	1962-63	1963-64
I. Treatment of Non-Metalliferous Mine and Quarry Products	1.98	2.55	2.37	2.65	2.49
II. Bricks, Pottery, Glass, &c.	0.51	0.68	0.72	0.61	0.61
III. Chemicals, Dyes, &c.	4.46	4.42	4.08	5.88	6.66
IV. Industrial Metals, Machines, &c.	22.49	23.80	28.37	39.09	39.89
V. Precious Metals, Jewellery, Plate	0.02	0.03	0.03	0.03	0.03
VI. Textiles and Textile Goods (not Dress)	4.53	4.74	5.28	5.27	6.65
VII. Skins and Leather (not Clothing or Footwear)	0.03	0.05	0.05	0.05	0.04
VIII. Clothing (except Knitted)	0.73	0.74	0.72	0.78	0.82
IX. Food, Drink and Tobacco	10.51	11.78	12.77	13.75	14.60
X. Sawmills, Joinery, Boxes, &c.	5.46	4.91	4.66	4.54	5.97
XI. Furniture, Bedding, &c.	0.15	0.15	0.15	0.22	0.23
XII. Paper, Stationery, Printing, Binding, &c.	20.39	22.65	24.11	27.00	26.07
XIII. Rubber	0.25	0.28	0.25	0.26	0.28
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products	0.08	0.07	0.07	0.06	0.06
Total Classes I to XV	71.59	76.85	83.63	100.19	104.40
XVI. Heat, Light and Power	35.72	35.78	37.96	37.74	37.25
Total All Classes	107.31	112.63	121.59	137.93	141.65

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Additions, Replacements and Depreciation Allowed

In stating the current book value of land and buildings and of plant and machinery, each factory proprietor is required to complete a reconciliation along the following lines:

	Land and Buildings	Plant and Machinery
	$	$
(i) Book value at beginning of year ..		
Plus (ii) Additions and replacements during year		
Less (iii) Depreciation allowed during year..		
Less (iv) Sales and losses by fire, &c., during year		
(±) (v) Adjustment due to revaluation ..		
(vi) Book value at end of year ..		

If no proprietors used rented land and buildings or rented plant and machinery, then the totals for the items "additions and replacements" and "depreciation allowed" would give a complete record of these important capital items in the factory sector. However, factory proprietors who rent premises or plant are simply required to report the annual rental and, to this extent, the totals for additions and replacements, and depreciation allowed, are incomplete since they refer only to land, buildings, plant and machinery *owned* by the factory proprietor. In 1963-64, nine per cent of the value of land and buildings comprised rentals capitalised at 15 years' purchase and two and a half per cent of the value of plant and machinery comprised rentals capitalised at 10 years' purchase. The following table summarises additions and replacements and depreciation allowed:

Factories—Reported Additions, Replacements and Depreciation Allowed

($ million)

Year	Land and Buildings			Plant and Machinery		
	Additions and Replacements (Excluding Rented)	Depreciation (Excluding Rented)	Book Value, 30th June (Including Rented)	Additions and Replacements (Excluding Rented)	Depreciation (Excluding Rented)	Book Value, 30th June (Including Rented)
1954-55 ..	5.47	0.71	59.20	9.40	3.98	59.76
1955-56 ..	28.34	1.08	93.16	16.68	5.18	80.85
1956-57 ..	19.16	0.93	112.95	16.03	5.55	89.67
1957-58 ..	3.54	1.52	118.91	10.61	6.51	93.72
1958-59 ..	4.53	1.66	123.66	8.70	7.19	96.45
1959-60 ..	21.05	1.77	144.02	17.39	7.70	107.31
1960-61 ..	4.33	1.83	147.10	13.69	8.50	112.63
1961-62 ..	13.93	1.86	159.15	19.16	9.01	121.59
1962-63 ..	4.92	1.91	163.92	24.60	10.19	137.93
1963-64 ..	4.77	2.16	168.40	15.04	11.65	141.65
1964-65 ..	41.35	2.22	209.01	24.62	11.78	155.34

Power Equipment in Factories

General

Since 1936-37, statistics of power equipment in factories relate to the "rated horsepower" of engines ordinarily in use and engines in reserve or idle, omitting obsolete engines. In addition, particulars of the power equipment of central electric stations are collected in greater detail. Since the central electric stations supply part of their power output to factories and since they are themselves classified as factories, it is necessary to make a clear distinction between engines in the stations and engines in all other types of factory, otherwise duplication may occur. In the following tables, central electric stations have been treated separately from other factories.

Rated Horse-power of Engines in Factories Other Than Central Electric Stations

The following table shows the types of engines and motors employed in each class of industry, also the horsepower rating related to each type:

Factories, Excluding Central Electric Stations—
Types and Power Rating of Engines in Each Class of Industry, 1963-64

Class of Industry	Rated Horsepower of Engines and Motors Ordinarily in Use—				Rated H.P. of Engines in Reserve or Idle (excluding Obsolete Engines)
	Steam	Internal Combustion	Motors Driven by Purchased Electricity	Total (b)	
I. Treatment of Non-Metalliferous Mine and Quarry Products	..	211	21,081	21,292	1,290
II. Bricks, Pottery, Glass, &c.	..	137	3,204	3,341	1,153
III. Chemicals, Dyes, &c. ..	15	157	17,028	17,200	3,406
IV. Industrial Metals, Machines, &c. ..	..	662	67,001	67,663	15,235
V. Precious Metals, Jewellery, Plate	6	..	90	96	3
VI. Textiles and Textile Goods (not Dress)	..	..	10,350	10,350	1,190
VII. Skins and Leather (not Clothing or Footwear) ..	..	..	507	507	26
VIII. Clothing (except Knitted)	3	1	808	812	67
IX. Food, Drink and Tobacco	114	851	27,608	28,573	2,846
X. Sawmills, Joinery, Boxes, &c.	463	9,728	43,093	53,284	2,349
XI. Furniture, Bedding, &c...	..	..	1,589	1,589	12
XII. Paper, Stationery, Printing, Binding, &c.	..	..	109,113	109,113	19,118
XIII. Rubber ..	5	..	505	510	48
XIV. Musical Instruments, &c.	..	..	..	..	..
XV. Miscellaneous Products..	..	..	230	230	32
Total Classes I to XV ..	606	11,747	302,207	314,560	46,775
XVI. Heat, Light and Power (a)	6	..	70	76	55
Total All Classes (a) ..	612	11,747	302,277	314,636	46,830

(a) Engines and motors in central electric stations excluded.

(b) Excludes motors driven by electricity of own generation.

The total rated horsepower of engines and motors ordinarily in use in the previous table is free from duplication since electric motors driven by power from a factory's own generation are excluded. The same freedom from duplication is not possible in relation to the power rating of reserve engines and motors, the figures shown being simply unadjusted totals of reported capacity. In 1964-65, motors ordinarily in use and driven by electricity were rated at 308,521 horsepower using purchased electricity and only 280 horsepower using electricity of own generation. As indicated by the previous table, the class with the greatest horsepower rating of electric motors is Class XII, paper making, &c. This does not necessarily imply that Class XII uses most electricity since power is employed industrially for purposes other than the driving of machinery, e.g. for electrolytic processes. In actual fact, Class IV, industrial metals, &c. consumes more electricity than Class XII.

The table that follows summarises the types and power capacity of engines and motors in Tasmanian factories over a ten-year period:

Factories, Excluding Central Electric Stations—
Types and Power Rating of Engines

Year	Rated Horsepower of Engines and Motors Ordinarily in Use								Rated H.P. of Engines in Reserve or Idle (Excluding Obsolete Engines) (b)
	Steam		Internal Combustion		Water	Motors Driven by Electricity		Total without Duplication (a)	
	Reciprocating	Turbine	Light Oils	Heavy Oils		Purchased	Own Generation		
1954-55 ..	1,864	11	9,273	809	242	198,406	8	210,606	32,538
1959-60 ..	1,188	21	11,606	135	192	251,960	19	265,103	37,851
1960-61 ..	1,112	21	10,732	130	192	268,019	16	280,207	37,417
1961-62 ..	1,048	21	10,728	173	192	269,580	..	281,743	40,439
1962-63 ..	1,040	..	10,812	692	..	290,198	273	302,742	43,298
1963-64 ..	612	..	11,547	200	..	302,277	281	314,636	46,830
1964-65 ..	547	..	11,797	1,315	..	308,521	280	322,180	47,449

(a) Excludes electric motors driven by power of own generation; includes gas driven engines not specified in table.

(b) Includes all electric motors in reserve.

Central Electric Stations

The generation of hydro-electric power in Tasmania is sufficiently important to warrant detailed treatment in its own right but the Commonwealth uniform definition of factory establishments classifies producers of "electric light and power" as a sub-class of Class XVI, heat, light and power, and therefore a short account of the central electric stations is included at this point. A fuller description will be found in the section, "Hydro-Electric Power", further on in this chapter.

In 1963-64, the horsepower rating (or installed capacity) of generators in the Tasmanian central electric power stations was 1,078,034 horsepower; of this total, 1,077,290 horsepower was associated with turbines driven by water and 744 horsepower with internal combustion engines. The following table summarises the main power characteristics of the central electric stations (with horsepower equivalents for kilowatt measures):

Central Electric Stations—Power Rating Characteristics of Generators

Description	Unit	1959-60	1960-61	1961-62	1962-63	1963-64
Total Installed Capacity ..	kw.	552,494	580,394	604,530	628,530	767,990
	hp.	778,790	817,790	851,434	884,934	1,078,034
Effective Capacity ..	kw.	547,664	577,564	601,700	625,700	765,160
	hp.	770,990	812,690	846,414	879,914	1,072,970
Maximum Load	kw.	423,021	448,518	467,279	560,619	576,604
	hp.	587,108	622,526	648,621	778,276	800,477

In 1963-64, there were 15 establishments classed as central electric stations, 12 government and three "company". The only two establishments using internal combustion engines were located on King and Flinders Islands where the capacity for generation by water-power is almost non-existent. The government-owned stations, apart from an internal combustion unit on King Island, all derived power from water and formed part of an integrated generation, transmission and distribution system serving the whole State. In the continental States, by way of contrast, the predominant method of generating electric power is by the steam turbine although hydro-electric generation is being extended.

Principal Articles Manufactured

The next table lists the principal articles of manufacture in Tasmania, irrespective of the sub-class of industry in which production took place. Due to the limited number of producers, it is not permissible under statute to publish particulars regarding some articles of manufacture which would otherwise appear in the table; this difficulty is accentuated in Tasmania in which, for some articles, there may only be a single producer. To give some indication of changes in production, quantity details are given for 1938-39, 1959-60 and 1963-64, but values are shown only for 1963-64.

Principal Articles Manufactured

Article	Unit of Quantity	Quantity			Value 1963-64 ($'000)
		1938-39	1959-60	1963-64	
Acid, Sulphuric (100 per cent)	ton	14,158	127,038	158,832	(a)
Aerated Waters	'000 gal.	338	1,838	2,186	1,329
Bacon and Ham	'000 lb.	1,935	1,781	2,612	1,442
Bran and Pollard	short ton	8,939	13,201	11,111	470
Bread (2 lb. loaf equivalents) ..	'000	11,337	27,175	27,850	4,699
Bricks and Blocks, Cement ..	..	..	..	..	338
Bricks, Earthenware	'000	14,541	23,975	24,648	1,049
Butter (b)	ton	4,053	11,744	13,667	11,436
Cadmium, Refined	lb.	385,287	567,967	757,452	2,208
Cakes, Pastry, Pies	..	..	..	..	1,745
Cases, Fruit	'000	3,143	4,081	4,825	1,548
Cheese	ton	1,420	328	1,337	662
Copper, Refined..	ton	12,675	11,262	11,790	7,357
Cordials and Syrups	gal.	17,461	205,597	306,529	569
Electricity, Total Generated ..	mill. kwh.	567	2,532	3,414	(a)
Fertilisers—					
Sulphate of Ammonia ..	ton	..	57,601	42,819	(a)
Superphosphate	ton	30,086	102,613	132,113	(a)
Fibrous Plaster Sheets ..	sq. yd.	120,678	778,522	782,067	706
Flour	short ton	19,582	30,872	27,412	2,131

Principle Articles Manufactured—*continued*

Article	Unit of Quantity	Quantity			Value 1963-64 ($'000)
		1938-39	1959-60	1963-64	
Fruits, Canned or Bottled—					
Apples, Solid Pack	'000 lb.	2,313	16,584	17,251	1,865
Berry Fruits	'000 lb.	918	2,944	1,416	270
Fruit, Dehydrated and Evapora-					
ted Apples	'000 lb.	762	558	698	181
Fruit Pulp and Puree	'000 lb.	9,732	6,592	5,139	513
Furniture, Wooden	..	..	..	..	1,906
Joinery	..	..	..	..	3,577
Mattresses, Woven Wire ..	No.	3,386	7,286	5,533	46
Paper, Newsprint	ton	..	88,510	92,039	12,855
Structural Steel Fabricated ..	ton	(a)	10,154	10,205	2,480
Tallow	'000 lb.	1,694	7,699	7,955	413
Timber (Sawn, Peeled or Sliced)—					
Hardwood (c)	'000 sup. ft.	83,499	164,895	164,946	13,657
Softwood (c)	'000 sup. ft.	1,529	4,764	5,911	660
Dressed Timber—					
Floorboards	'000 sup. ft.	5,124	29,511	29,042	4,668
Weatherboards	'000 sup. ft.	1,911	3,743	2,974	510
Other	'000 sup. ft.	1,165	15,979	21,069	3,537
Tyres Retreaded and Recapped	No.	10,650	81,820	105,352	1,141
Zinc, Refined	ton	69,825	117,893	138,610	(a)

(*a*) Not available for publication.

(*b*) Includes butter equivalent of butter oil.

(*c*) Includes timber to be further processed.

The articles just listed do not include the following important Tasmanian products: aluminium, carbide, cement, confectionery, welding electrodes, ferro-manganese alloys, hand tools, paperpulp and other paper products, titanium di-oxide, woollen manufactures and other textile products. An unusual unlisted product is sodium alginate (a chemical used in ice cream mixes) which requires the harvesting of seaweed for treatment at an East Coast factory.

Individual Industries

In the section that follows, the term "individual industry" is used to denote a specific factory sub-class (for example I-3, "Carbide", is Class I, Treatment of Non-metalliferous Mine and Quarry Products; sub-class 3, the manufacture of carbide).

The items given for each industry are defined as follows:

Rating of Engines and Motors .. engines and motors driving factory machinery and ordinarily in use.

Average Number of Workers .. average whole year, including working proprietors.

Salaries and Wages Paid .. excludes amounts drawn by working proprietors.

Other Costs of Manufacture .. cost of power, fuel, light, water, lubricating oils, containers, &c., tools replaced, repairs to plant (but not depreciation charges).

Value of Production .. .. value of output less "statistical" costs, other than labour, (i.e. less cost of materials and "other costs of manufacture", as just defined).

Value of Land, Machinery, &c. at 30th June; includes estimated value for rented premises and machinery.

Selected Individual Industries, 1963-64

Particulars	Unit	I-5 Fibrous Plaster and Products	II-1 Bricks and Tiles	III-4 White-lead, Paints and Varnishes	IV-3 Plant, Equipment and Machinery	IV-5 Extracting and Refining, Non-ferrous Metals (a)
Factories	No.	13	9	3	30	4
Rating of Engines and Motors	HP.	151	2,071	221	2,515	47,453
Average Workers	No.	99	222	17	1,026	3,444
Salaries and Wages Paid ..	$'000	202	505	39	2,242	10,527
Cost of Materials Used ..	$'000	422	147	221	2,358	32,892
Other Costs of Manufacture	$'000	16	320	50	150	9,281
Value of Output	$'000	859	1,305	502	6,044	66,238
Value of Production ..	$'000	421	838	231	3,536	24,065
Value of Land and Buildings	$'000	171	506	97	2,246	12,652
Value of Plant and Machinery	$'000	34	460	25	932	33,761

(a) Includes aluminium, cadmium, copper, ferro-manganese alloy and zinc.

Individual Industries, 1963-64 (Continued)

Particulars	Unit	IV-7 Tramcar and Railway Work-shops, Government	IV-10 Motor Vehicle Repairs	IV-22 Non-Ferrous Founding, Casting, &c.	IV-24 Sheet Metal Working, Pressing and Stamping	IV-26 Wire and Wire Working (including Nails)
Factories	No.	4	335	8	30	9
Rating of Engines and Motors	HP.	3,101	2,293	355	793	416
Average Workers	No.	588	1,967	139	320	123
Salaries and Wages Paid ..	$'000	1,227	3,470	254	595	314
Cost of Materials Used ..	$'000	407	3,714	261	2,044	1,304
Other Costs of Manufacture	$'000	70	184	31	78	49
Value of Output	$'000	1,964	9,593	650	3,571	2,032
Value of Production ..	$'000	1,487	5,695	358	1,449	679
Value of Land and Buildings	$'000	1,386	5,367	135	710	480
Value of Plant and Machinery	$'000	641	900	92	357	333

Individual Industries, 1963-64 (Continued)

Particulars	Unit	VI-3 Wool Carding, Spinning, Weaving	VIII-14 Dyeworks and Cleaning	IX-1 Flour Milling	IX-5 Bakeries (including Cakes and Pastry)	IX-9 Confec-tionery
Factories	No.	4	31	5	141	5
Rating of Engines and Motors	HP.	7,054	559	1,814	1,071	6,550
Average Workers	No.	2,410	280	135	643	1,236
Salaries and Wages Paid ..	$'000	4,088	444	288	918	2,742
Cost of Materials Used ..	$'000	10,088	110	2,289	2,920	8,108
Other Costs of Manufacture	$'000	884	108	162	304	2,364
Value of Output	$'000	16,936	1,084	3,156	5,908	16,264
Value of Production ..	$'000	5,964	866	705	2,684	5,792
Value of Land and Buildings	$'000	1,658	824	656	2,042	2,278
Value of Plant and Machinery	$'000	2,946	436	700	1,208	3,992

Individual Industries, 1963-64 (Continued)

Particulars	Unit	IX-10 Jam, Fruit and Vegetable Canning	IX-12 Bacon Curing	IX-13 Butter Factories	IX-14 Cheese Factories	X-1 Saw-mills
Factories	No.	18	15	12	8	305
Rating of Engines and Motors	HP.	7,391	1,100	2,066	241	42,313
Average Workers	No.	1,313	274	228	36	2,754
Salaries and Wages Paid	$'000	2,470	577	499	90	5,296
Cost of Materials Used	$'000	3,146	3,400	9,403	500	13,379
Other Costs of Manufacture	$'000	2,670	247	332	68	1,207
Value of Output	$'000	9,192	4,982	11,499	730	23,952
Value of Production	$'000	3,376	1,335	1,764	162	9,366
Value of Land and Buildings	$'000	3,030	859	469	90	2,546
Value of Plant and Machinery	$'000	2,601	310	706	92	3,449

Individual Industries, 1963-64 (Continued)

Particulars	Unit	X-4 Joinery	XI-1 Cabinet and Furniture Making	XII-9 Paper Making	XIII-2 Tyre Retread-ing and Repairing	XVI-1 Electric Light and Power, Gov't.
Factories	No.	109	56	4	20	12
Rating of Engines and Motors	HP.	3,859	1,387	106,074	510	1,061,320
Average Workers	No.	601	440	3,373	129	310
Salaries and Wages Paid	$'000	1,211	716	9,227	249	978
Cost of Materials Used	$'000	1,938	1,189	14,906	475	..
Other Costs of Manufacture	$'000	63	42	5,531	70	598
Value of Output	$'000	4,034	2,447	41,114	1,182	13,570
Value of Production	$'000	2,033	1,216	20,677	637	12,972
Value of Land and Buildings	$'000	872	785	9,829	869	91,848
Value of Plant and Machinery	$'000	359	180	23,847	280	36,142

Repair Workshops

Earlier a "factory", for the purpose of these statistics, was defined as an establishment in which four or more persons are employed or where power (other than manual) is used in any manufacturing process. The concept of manufacturing is broadened in many fields to include repair work and some sub-classes of the basic classification are specifically reserved for repairing (e.g. IV-10, "Motor Vehicles—Repairs") while others include both construction and repair work (e.g. IV-7, "Construction and Repair, Tramcars and Railway Rolling Stock").

Government Factories

The concept of the factory is not restricted to the private sector of the economy and all factory data previously quoted in this chapter have referred to private and government establishments without distinction. Of the 1,746

factories in the 1963-64 collection, 70 were classified as "government", the term being applied to all levels whether Commonwealth, State, local or semi-government. To give an indication of the various fields of government factory activity, the next table has been compiled showing the number of establishments in the relevant sub-classes:

Number of Government Factories in Sub-Classes, 1963-64

Sub-Class of Industry	Title of Sub-Class	Number of Government Factories
I-4	Lime, Plaster of Paris, Asphalt	2
I-9	Other Cement Goods	3
III-8	Boiling Down, Tallow Refining	1
IV-3	Plant, Equipment and Machinery, including Machine Tools..	14
IV-4	Other Engineering	4
IV-6	Electrical Machinery, Cables and Apparatus	1
IV-7	Construction and Repair, Tramcars and Railway Rolling Stock	4
IV-10	Motor Vehicles—Repairs	17
IV-33	Other Metal Works	1
V-3	Electroplating (Gold, Silver, Chromium, &c.)	1
IX-5	Bakeries (including Cakes and Pastry)	1
IX-19	Ice and Refrigerating	1
IX-33	Other Food Processing	1
X-1	Sawmills	1
X-4	Joinery	2
XI-1	Cabinet and Furniture Making	2
XII-2	Printing, Government	1
XV-6	Surgical and Other Scientific Instruments and Appliances ..	1
XVI-1	Electric Light and Power, Government	12
	Total	70

Some of the major authorities maintaining these establishments are the Hydro-Electric Commission, the Transport Department, the Metropolitan Transport Trust, the various Marine Boards and the Public Works Department.

The following table analyses the principal items of factory statistics, showing the government and non-government components of the totals:

Government and Non-Government Factories, 1963-64

Particulars	Government Factories	Non-Government Factories	Total
Factories .. .. .. (No.)	70	1,676	1,746
Average Employment (a)—			
Males .. .. .. (No.)	2,352	23,869	26,221
Females .. .. .. (No.)	49	5,563	5,612
Salaries and Wages Paid (b)—			
Males .. .. ..($'000)	5,660	57,347	63,007
Females .. .. ..($'000)	60	7,515	7,575
Cost of Materials Used ..($'000)	5,286	149,327	154,613
Other Costs of Manufacture (c)($'000)	980	32,902	33,882
Value of Production ..($'000)	20,010	132,560	152,570
Value of Output .. ..($'000)	26,276	314,789	341,065
Value at 30th June of Land and Buildings .. .. ..($'000)	(d) 96,130	72,272	168,402
Value at 30th June of Plant and Machinery .. ..($'000)	38,598	103,054	141,652

(a) Average whole year (including working proprietors).

(b) Excludes amounts drawn by working proprietors.

(c) Comprises cost of power, fuel, light, water, lubricating oils, containers, tools replaced and repairs to plant.

(d) Includes value of dams, flumes, earth works, &c. ancillary to production of electricity from water.

In the costing of the output of some Government factories, reliance is placed on internal accounting procedures since, in most cases, the product does not find its way to the open market but may appear as a book-entry between sections of the one department. An obvious example of this occurs in sub-class IV-10 (Motor Vehicles—Repairs), the situation being that various departments and authorities maintain repair workshops for maintenance of their own vehicles.

GOVERNMENT HYDRO-ELECTRIC POWER

Introduction

Tasmania is unique among Australian States in that its electric power system is based exclusively on hydro-electric installations. Other Australian States rely, in the main, on thermal plants and hydro-electric power, if available, is used only to supplement the basic supply. The Snowy River Hydro-Electric Scheme which feeds power to the Victorian and N.S.W. grids is not designed to cope with the base load demand in these two States, and its essential function is to provide the extra power necessary to meet peak loads, and also to supply irrigation water to the inland.

Thermal power stations of any type are best suited to steady operation on base load. Steam cannot be raised at a moment's notice and having thermal capacity standing by to meet peak demands becomes very expensive. By way of contrast, a water turbine can pick up load very quickly as soon as the valve is opened.

In the Tasmanian situation, water power is required to meet the base load at all times and yet have the extra capacity to cope with peak loads. The Poatina machines, for example, with a head of 2,729 feet and a turbine rating of 415,200 horsepower, have the ability to take up a very big load, up to a maximum of 300,000 kilowatts, in a matter of minutes.

Concentration on water as a source of power has, in Tasmania, resulted in a particular pattern of development. Since water is virtually the sole source of electric power, it must be conserved even if rainfall is bountiful. Accordingly certain characteristics can be seen in the massive engineering works undertaken by the Hydro-Electric Commission:

(i) Emphasis on creation of storages; a scheme depending on the "run of the river" is found at Trevallyn but the decision not to create any substantial storage was forced by consideration for valuable agricultural land up-stream.

(ii) Emphasis on use of the same water over and over again; for example water from Lake St. Clair may pass through eight power stations before reaching the tidal waters of the Derwent at New Norfolk. Water from Lake Echo, thirty miles to the east of Lake St. Clair, also may pass through eight stations, the lower six being those fed by water from Lake St. Clair.

Certain indirect advantages have also accrued to the State through its concentration on hydro-electric power development. The first major undertaking at Waddamana on the Great Lake, opened in 1916, had relied heavily on horses and a wooden railway to get plant to the construction site. Subsequent development, usually in remote areas, led to the making of excellent roads, initially built by the Hydro-Electric Commission for access and construction purposes. In 1963, the Prime Minister announced that his government would make available a $5,000,000 grant for a road in the remote south-west to facilitate investigations of future projects and this highway is being driven west to the junction of the Gordon and the Serpentine rivers.

The extensive storages built by the Hydro-Electric Commission on the Derwent drainage system have given engineers the ability to exercise extensive control over the flow, to the point where the scheme can be viewed as equivalent to flood prevention. If no extensive irrigation systems have yet been based on the controlled flows now available, the fact remains that the storages are there and the irrigation potential exists.

The possibilities of the Derwent catchment area have been almost fully exploited and the centre of activity is now shifting to the head waters of the north-west rivers, Mersey, Forth and Wilmot. The north-west scheme will not be finished until approximately 1971 but, in the meanwhile, survey is pushing ahead in the remote south-west (the Gordon River) and in the far west (Pieman River). The future development of hydro-electric power in either, or ultimately both, of these areas is full of exciting possibilities for the State. Quite apart from the massive loads of power available from these heavy-rainfall river systems, there is the certainty that an adequate road system will penetrate areas which have traditionally been described as "uninhabited and virtually unexplored."

A recent interesting development has been a 76 per cent increase in the effective storage of Lake King William, the work requiring the raising of the Clark Dam by 20 feet in the period 1964-1966. The original storage was 387 square mile feet and the new figure is 678 square mile feet.

In the generation of power from water, Tasmania has tended to be the pioneer State of the Commonwealth, as the following historical section will indicate.

Beginnings

The pioneering of public hydro-electric power in Tasmania was undertaken by the City of Launceston in 1895 when a 579 horse-power generator was installed at Duck Reach, situated on the South Esk two miles from its junction with the River Tamar. The station, with enlarged capacity, ran for sixty years but its function was purely municipal supply.

The scheme which eventually led to the establishment of a State-owned, State-wide supply of electricity was based upon exploitation of the waters of the Great Lake on the Central Plateau; the original impetus was given by Complex Ores Ltd. which, under an act of 1909, was given the right to generate power by diverting water from the River Shannon into the River Ouse, from the River Ouse via the Great Lake and back into the River Ouse, and from the Great Lake and the lakes and lagoons forming the source of the River Ouse. Complex Ores Ltd. assigned its property and undertakings to Hydro-Electric Power and Metallurgical Company Ltd. which began construction; in 1914 physical and financial difficulties eventually persuaded this company to sell out to a newly formed State authority, the Hydro-Electric Department, the purchase price being $624,000.

Construction proceeded despite war-time difficulties, the work requiring a low dam across the Shannon outlet of the Great Lake to increase the lake storage to 500 square mile feet, a diversion canal from the Shannon, and finally pipelines to contain a head of 1,123 feet above Waddamana powerhouse on the left bank of the Ouse. In May, 1916, two machines, each of 4,900 horse-power, were brought into operation. Some indication of construction difficulties may be gained from the fact that chaff was a significant part of the capital cost—in the absence of adjacent roads or railways, a horse-drawn wooden tramway gave the only access.

In January, 1930, the *Hydro-Electric Commission Act* 1929 came into force; the Hydro-Electric Commission was created to manage the existing works and to control the waters of the State, and in the Commission was vested the sole right of generating, distributing and selling electricity throughout Tasmania. Considering that present capacity of the generating system exceeds one million horsepower, it is interesting to record the system taken over by the Hydro-Electric Commission in 1930. It consisted of a single power station, Waddamana "A", with an installed turbine capacity of 65,800 horsepower; load on the system was 65,070 horsepower of which 37,000 horsepower was being taken by the Electrolytic Zinc Co. This company had commenced operations in 1917 at Risdon (near Hobart), the attraction to a Tasmanian site being the availability of cheap power for metallurgical refining.

Subsequent Development

To trace the expansion of turbine capacity from 65,800 horsepower in 1930 to the present day would be confusing if undertaken purely chronologically; the better course is to show the development of each major section of the generating network.

Waddamana-Shannon

A new Miena dam in 1922 replaced the original low weir across the Shannon outlet of the Great Lake and increased the storage to 1,482 square mile feet. The 1916 plant consisted of two 4,900 horsepower turbines (Pelton-type) and by 1923, nine turbines were in operation at Waddamana "A" with a rating of 65,800 horsepower. From the lagoon below Miena dam there was a considerable fall before the gorge of the Ouse was reached, and a Shannon power station using a head of 258 feet was completed in 1935; the added turbine capacity was only 14,500 horsepower but the principle—using the discharge of one station (Shannon) as the input for another (Waddamana)—was to be used over and over again in subsequent schemes. During World War II, a Waddamana "B" station was built, its last turbine coming into operation in 1949 and increasing total turbine capacity of the system by 66,800 horsepower.

An essential requirement for full development of the Waddamana-Shannon scheme was an increase in the volume of water draining into the Great Lake. To the west lay the upper Ouse and Lake Augusta in a rainfall belt exceeding 70 inches; by rockfill dams and the five and a half mile Liawenee canal, it became possible to divert water from the upper Ouse system into the Great Lake.

Details of the Waddamana-Shannon scheme in its final form are as follows:

Waddamana-Shannon

Power Station	Head Ft.	Turbines		Station Capacity	
		No.	Rating H.P.	Turbines H.P.	Generators K.W.
Waddamana "A" ..	1,123	2 7	4,900 8,000	65,800	49,000
Shannon	258	2	7,250	14,500	10,500
Waddamana "B" ..	1,127	4	16,700	66,800	48,000
Total	..	..	..	147,100	107,500

In 1964, the waters of the Great Lake started flowing through turbines at Poatina on the northern end and the generators of Waddamana "A" and Shannon stations were closed down; the more recent machines at Waddamana "B" are retained as spare plant and for emergency peak operation.

Tarraleah-Butlers Gorge

The essence of the Tarraleah-Butlers Gorge scheme was to divert the waters of the upper Derwent at a point 12 miles south of Lake St. Clair, lead them by canals to the gorge of the Nive River, and to obtain a head of 981 feet above Tarraleah power station on the right bank of the Nive. If full exploitation of the Derwent were to be made later, this was a logical starting place since Lake St. Clair (2,417 feet) is the source of the Derwent which achieves the major part of its fall to the sea in its first forty miles.

The scheme as stated above could have been carried through without any further refinement but the catchment area lies in a rainbelt where 90 inches per annum is not exceptional; accordingly the plan involved the creation of storages to achieve maximum practicable regulation of flow in a river system liable to sudden and considerable floods. The major control measure planned was the creation of the Clark Dam at the diversion point (Butlers Gorge) and of a 13 square mile reservoir (Lake King William) behind the dam. A further control measure was a dam across the Lake St. Clair outlet to raise its level ten feet and the installation of pumps capable of drawing off another twenty feet of water.

The decision to proceed with the scheme was taken in 1933, and, by 1938, the first three turbines were running in Tarraleah power house. The diversion canal (No. 1) ran from Butlers Gorge, but the intended dam was still under construction so the turbines had to rely on the Derwent "run of the river" and the storage in Lake St. Clair. War-time shortages slowed work and it was not until 1951 that the Clark Dam was completed. The dam, a concrete gravity arch structure 200 feet in height, is the biggest dam so far built in Tasmania, and incorporates a ski-jump spillway capable of discharging 20,000 cusecs; north of its walls, Lake King William then began to fill and eventually gave sufficient head to operate the 17,100 horsepower turbine in the Butlers Gorge power station at the foot of the dam. The Tarraleah station, which in 1938 was operating from the 11 square mile storage of Lake St. Clair, could now rely upon the combined storage of two lakes with total area 24 square miles (the creation of Lake King William increased the available storage from 241 square mile feet, as contained in Lake St. Clair, to a combined storage of 628 square mile feet, later raised to 919 square mile feet).

The original diversion canal was 12 and a quarter miles long but a second and shorter canal of eight miles was completed in 1955, an auxiliary feature being an electrical pump which can raise water, when required, from the Derwent through 160 feet. (The economics of using a pump here depend on the fact that the pumped water now passes through two extra power stations—Tarraleah and, lower down, Liapootah.) The two canals meet in a forebay, from which two steel pipelines lead to the crest of the gorge of the Nive River. From this point, six steel penstocks fall almost a thousand feet to the power station below.

The final work on the scheme involved diverting minor tributaries of the upper Nive by the eight mile Wentworth Creek canal and feeding their waters through the Tarraleah machines. Details of the Tarraleah-Butlers Gorge scheme are:

Tarraleah-Butlers Gorge

Power Station	Head Ft.	Turbines		Station Capacity	
		No.	Rating H.P.	Turbines H.P.	Generators K.W.
Butlers Gorge	184	1	17,100	17,100	12,200
Tarraleah	981	6	21,000	126,000	90,000
Total	..	..	..	143,100	102,200

Tungatinah-Lake Echo

The essence of the Tungatinah-Lake Echo scheme was to divert the waters from two rivers, the Nive and the Ouse, to lead them to the gorge of the Nive and to obtain a head of 1,005 feet above the Tungatinah power station on the left bank of the gorge. (Tarraleah on the right bank is almost opposite, providing the spectacle of two power stations simultaneously discharging into the same river bed but drawing their inputs from separate and distinct catchment areas.) A further source of power was envisaged on the route from Lake Echo to Tungatinah where a head of 568 feet could be utilised.

The scheme was approved in 1947 and the Tungatinah power station was finally completed in 1954. Since two rivers were involved, the scheme needs to be envisaged as two distinct operations which, for convenience, can be thought of as forming the two arms of a "Y". The west arm of the "Y" represents the diversion of the Nive by a 121 foot concrete gravity dam (Pine Tier) and the leading of water, via Bronte Canal, and Bronte Lagoon to Bradys Lake. Most of the new water-ways, apart from canals, were created by low clay and rockfill dams on the borders of former marshlands. The east arm of the "Y" represents the diversion of the Ouse by a weir and the passage of water through Monpeelyata Canal to Lake Echo; from Lake Echo, dammed by a 62 foot clay and rockfill wall, water passes through a canal into Lake Echo power station and discharges into Dee Lagoon, formed by blocking off the Dee River with a clay and rockfill dam 65 feet high; the water then passes through a two and a quarter mile tunnel into Bradys Lake where it mingles with water flowing in from the west arm diversion. The foot of the "Y" represents the chain of waterways, commencing with Bradys Lake, leading to Lake Binney and finishing at Tungatinah Lagoon, 1,000 feet or so above the Nive Gorge.

The final movement of water to Tungatinah power house is through a half mile tunnel to five steel penstocks, 3,376 feet long. Details of the Tungatinah-Lake Echo scheme are as follows:

Tungatinah-Lake Echo

Power Station	Head Ft.	Turbines		Station Capacity	
		No.	Rating H.P.	Turbines H.P.	Generators K.W.
Lake Echo	568	1	45,000	45,000	32,400
Tungatinah	1,005	5	35,000	175,000	125,000
Total	..	..		220,000	157,400

The power station at Lake Echo is operated by remote control from Tungatinah and the machine is fitted with numerous protective devices to guard against such mishaps and defects as accidental overspeeding, over-heated bearings and other faults which could arise while running unattended.

Liapootah-Wayatinah

It will be observed that the schemes so far described have, in the main, depended on heads of water in the vicinity of a 1,000 feet. From the Tarraleah tailrace, however, the fall to the sea is only 1,121 feet distributed over eighty miles; it necessarily follows that stations below Tarraleah have to be designed to operate with lower heads, but this disadvantage can be partly offset if the volume of water is increased.

The essence of the Liapootah-Wayatinah scheme was to dam the water discharged by the stations at Tarraleah and Tungatinah into the bed of the Nive; to use the impounded water to drive a power station at Liapootah; to merge the Liapootah discharge with the waters of the Derwent in Wayatinah lagoon and finally to drive a station with the head in the lagoon, discharge to flow into the Derwent lower down.

The Liapootah dam, a concrete gravity structure 120 feet high, carries a steel drum gate 20 feet high and 120 feet long on the spillway. It is automatic in operation, and retains the upstream pond at fixed level so that Tarraleah power station, two miles upstream, is not subject to flooding by any "backing up" of the flow. From the dam, water passes into a tunnel four miles long, then via three steel penstocks into Liapootah power station (head 361 feet).

The discharge from Liapootah power station then enters a new lagoon at Wayatinah, the pond being created by a clay and rockfill dam at the confluence of the rivers Derwent and Nive. The lagoon is drained by a tunnel a mile long and the waters then enter Wayatinah power station via twin pipelines; discharge occurs on the left bank of the Derwent.

Details of the Liapootah-Wayatinah scheme which began yielding in 1957 and reached full capacity in 1960, are as follows:

Liapootah-Wayatinah

Power Stations	Head Ft.	Turbines		Station Capacity	
		No.	Rating H.P.	Turbines H.P.	Generators K.W.
Liapootah	361	3	39,000	117,000	83,700
Wayatinah	203	3	20,500	61,500	38,250
Total	..	..	..	178,500	121,950

Catagunya

In the lower reaches of the Derwent, opportunity for developing large heads gradually lessens but compensation is derived from the increased flow. Thus the Catagunya scheme not only depends on using the discharge from Wayatinah but also the waters of the Derwent augmented by tributaries—the Florentine and Black Bobs Rivulet. Compared to other schemes, it is relatively simple to describe, consisting of a dam across the Derwent, a short flume and twin penstocks leading to Catagunya power station; the discharge is again into the Derwent.

There are two unusual features: (i) the power station is worked by remote control from Liapootah; (ii) the Catagunya Dam, 165 feet high, is built of pre-stressed concrete, thus cutting in half the amount of concrete that would be required by a concrete gravity dam. In effect, the dam was "tied" to the base dolerite by means of steel cables and tensioning force was applied to the cables with hydraulic jacks. Details of the scheme which began yielding power in 1962 are as follows:

Catagunya

Power Station	Head Ft.	Turbines		Station Capacity	
		No.	Rating H.P.	Turbines H.P.	Generators K.W.
Catagunya	144	2	33,500	67,000	48,000

Lower Derwent

At Catagunya power station tailrace, the height is only 411 feet above sea level but the Derwent in its lower course is fed by a number of tributaries which build the volume to the point where exploitation is still economic despite the low head. On the other hand, the Derwent below Catagunya is starting to emerge into farm land and no scheme could be considered which would put such property under large tracts of water. The Lower Derwent scheme, still under construction, consists of three stations:

Repulse. A dam across the Derwent will arrest the Catagunya discharge, residual flow in the Derwent and the added flow of the Repulse River. Head will be 88 feet and installed capacity 28,000 kilowatts.

Cluny. A low dam across the Derwent will arrest the Repulse discharge, residual flow in the Derwent and the added flow of the Broad River. Head will be 56 feet and installed capacity 21,250 kilowatts.

Meadowbank. A final dam across the Derwent will impound the Cluny discharge, residual flow in the Derwent and the flow of the Dee, Ouse and Clyde Rivers. Head will be 96 feet and installed capacity 40,000 kilowatts. Meadowbank power station will discharge into the Derwent not far from New Norfolk where the river becomes tidal; thus, at Meadowbank, the last opportunity is taken of exploiting water which originated in Lake St. Clair, Lake Echo, the upper Derwent or its tributaries, and which has already, in the main, passed through a series of stations.

Capacity. The Lower Derwent scheme will add at least a further 123,500 horsepower to system capacity and is expected to be completed in 1967.

Trevallyn

It will be observed that all schemes so far described, from Waddamana through to the Lower Derwent, have depended on the Derwent catchment area, including the Great Lake. An exception is the Trevallyn scheme, based on the South Esk which tumbles through a precipitous gorge within sight of the city streets in Launceston. In essence, the scheme consists of a dam across the South Esk, a tunnel to take diverted water to Trevallyn power station and a tailrace which discharges into the tidal Tamar River.

Design of the scheme was complicated by certain characteristics of the South Esk—recorded flow has dropped as low as 40 cusecs yet in April, 1929, it exceeded 150,000 cusecs. If a large storage were created, the waters would

obviously "back up" and flood valuable agricultural land upstream. Accordingly Trevallyn is a "run of the river" scheme with only daily pondage at the tunnel inlet. The dam is a concrete gravity type, 108 feet at abutments and 72 feet to the spillway crest and the diversion conduit includes an open pipe section between two tunnels, the total tunnel length being two miles.

One particular advantage claimed for the scheme is the fact that the South Esk responds well to easterly rains, since the river drains the eastern slopes of Ben Lomond. The easterly weather often provides the flow down the South Esk to run the Trevallyn machines during comparatively dry periods over the western catchments. Westerly weather replenishes the main system's storages and provides water to the Derwent stations while the Trevallyn output is reduced to a minimum.

Details of the scheme, completed in 1955, are as follows:

Trevallyn

Power Station	Head Ft.	Turbines		Station Capacity	
		No.	Rating H.P.	Turbines H.P.	Generators K.W.
Trevallyn	415	4	28,000	112,000	80,000

Great Lake (Poatina)

As already related, the first development of a State generating system was based on using the waters of the Great Lake at its southern extremity. The discharge from the Shannon and Waddamana power stations passed into the Ouse River and further development along the bed of the Ouse was a possibility considered. The north-eastern end of the Lake, however, presented an opportunity for much greater exploitation; this end of the Lake is separated by a single mountain ridge from a precipitous fall to the midland plain more than half a mile below. The essence of the Poatina scheme was to tunnel through a ridge of the Great Western Tiers and to develop a head of 2,729 feet above an underground power station, the discharge to flow into a tributary of the South Esk. In other words, a lake that naturally drained south was to be drained artificially to the north. Since the high head obtained by this diversion would yield an estimated 415,200 horsepower, it was planned to put Waddamana "A" (65,800 horsepower) out of operation and to keep Waddamana "B" (66,800 horsepower) as stand-by plant only. Thus the waters of the Great Lake would still be a prime source of power but the northern station would use them with greatly increased efficiency.

A headrace tunnel three and a half miles long, of 19 foot diameter, leads the Lake water through the Western Tiers to a penstock tunnel 3,270 feet long lined with steel pipe; this tunnel emerges from the ridge to join a surface penstock of 5,080 feet, made from hot banded high-tensile steel; the surface penstock terminates above a 480 feet vertical shaft leading to the underground power station; the discharge from the station flows through a tailrace tunnel two miles long before entering a tailrace cut terminating in Brumby Creek.

Only six miles from the Great Lake lie two others known as Arthurs Lakes; an important part of the scheme was to block off an outlet and create one enlarged lake, of which the waters would then be pumped to a height of 256 feet before passing by flume into the Great Lake. The economy of this

operation depends on the fact that water raised 256 feet by pumping acquires a head of 2,729 feet above Poatina power station; the new Arthurs Lake increases the usable storage by approximately one quarter.

Details of the Poatina scheme, which started yielding power in 1964, are as follows:

Poatina

Power Station	Head Ft.	Turbines		Station Capacity	
		No.	Rating H.P.	Turbines H.P.	Generators K.W.
Poatina	2,729	(*a*) 6	69,200	(*a*) 415,200	(*a*) 300,000

(*a*) Five turbines had been installed before June, 1966.

With the completion of the Poatina scheme, the possibility of further developing the Derwent catchment area was exhausted (apart from the Lower Derwent Scheme which is expected to be operating at all three sites by 1967). The centre of activity now is located in the area of three rivers, flowing towards Bass Strait.

Mersey-Forth (Under Construction)

The theory of the Mersey-Forth-Wilmot scheme is derived from the fact that none of these three rivers in isolation provides an economic source of power; the essence of the scheme is the diversion of the Mersey and Wilmot Rivers into the Forth River and the construction of Forth River dams, the power to be derived from the operation of seven distinct power stations. Some idea of the magnitude of the undertaking can be gained from considering two factors: (i) output capacity; when the new scheme is completed, by 1971, the output capacity of the State system will have risen by 44 per cent; (ii) installed capacity, turbines; on completion of the new scheme, the installed turbine capacity of the State system will stand at over 1,640,000 horsepower.

To comprehend the scheme, it is necessary to visualise the Forth as lying in the centre with the Mersey to the east and the Wilmot to the west. The power stations are planned as follows:

(i) *Rowallan.* The upper Fisher, a Mersey tributary, will be dammed to form Lake Rowallan and a power station built with a head of 163 feet.

(ii) *Fisher.* Fisher power station (head 2,100 feet) will be fed from Lake MacKenzie and discharge into the Fisher above its junction with the Mersey.

(iii) *Lemonthyme.* The Mersey will be dammed below its junction with the Fisher and diverted, through Lemonthyme power station (head 530 feet) into the Forth River.

(iv) *Cethana.* A dam lower down the Forth will feed the Cethana power station (head 320 feet).

(v) *Wilmot.* A dam on the Wilmot will divert water to the Forth through Wilmot power station (head 840 feet); the discharge will occur above Cethana station.

(vi) *Devils Gate.* A dam on the Forth below Cethana will feed Devils Gate station (head 230 feet).

(vii) *Paloona*. The final dam on the Forth will feed the Paloona station (head 100 feet). The discharge from Paloona will be about 70 feet above sea level, so all possibility of further exploitation will have been exhausted at this point.

The order of stations in the previous description was chosen to show the logical progression from the headwaters in the highlands to the final point on the coastal plains. The actual programme approaches the task in a different order, the stations in construction sequence being: Rowallan, Lemonthyme, Devils Gate, Paloona, Cethana, Wilmot and Fisher. The first station is expected to be in operation by 1968 and the last by 1971.

Summary of System

The previous sections have shown details of each scheme; the following table brings the information into consolidated form and gives a measure of the total capacity of the generating system:

Capacity of Each Station and Estimated Total Capacity in 1967

Power Stations	Date of Entry Into Service	Station Capacity	
		Turbines H.P.	Generators K.W.
Waddamana	A—1916 B—1944	132,600	97,000
Shannon	1934	14,500	10,500
Tarraleah	1938	126,000	90,000
Butlers Gorge	1951	17,100	12,200
Tungatinah	1953	175,000	125,000
Trevallyn	1955	112,000	80,000
Lake Echo	1956	45,000	32,400
Wayatinah	1957	61,500	38,250
Liapootah	1960	117,000	83,700
Catagunya	1962	67,000	48,000
Poatina	(a) 1966	346,000	250,000
Lower Derwent Stations	1967	123,500	89,250
Gross Total (b)	..	1,337,200	956,300
Less Waddamana "A"	1916	65,800	49,000
Less Shannon	1934	14,500	10,500
Net Total (c)	..	1,256,900	896,800

(a) The first turbines came into operation in 1964. The last will not be installed before 1970 or 1971.

(b) Total capacity of all machines installed at any time.

(c) Remaining capacity, with Waddamana "A" and Shannon machines dismantled.

Control

The Hydro-Electric Commission is an autonomous semi-governmental authority, responsible almost entirely for the conduct of its own affairs. The "Minister Administering the Hydro-Electric Commission Act" is answerable to Parliament for the activities of the Commission, but the Commission is not directed by or responsible to the Minister as is a government department. In other words, the Commission is envisaged as a trading or business organisation, and the purpose of the legislation that created it was to remove it from day to day political control. The power exerted by Parliament is mainly

financial, not over the ordinary revenue and expenditure of the authority, but over the supply of loan moneys for new capital works. Thus at the 30th June, 1965, the loan debt of the authority stood at $248 million of which $225 million came from State loan funds; the balance was raised by the authority itself on the semi-governmental loan market, power to raise money in this field having been conferred in 1952. New power developmental works require the sanction of Parliament before any work may be commenced, and loan funds are allocated through the State Treasury from the sums made available to the State by a Federal body, the Australian Loan Council which borrows money on behalf of all States.

GREAT LAKE SYSTEM

DERWENT RIVER SYSTEM

MERSEY–FORTH SYSTEM
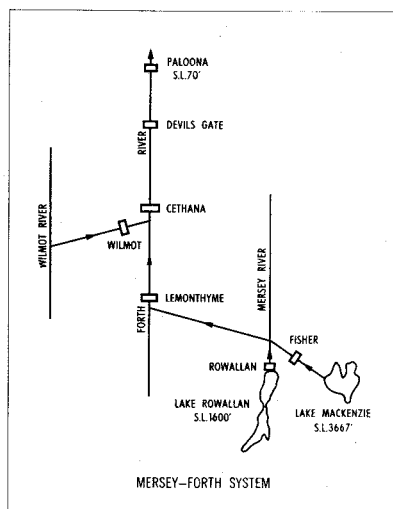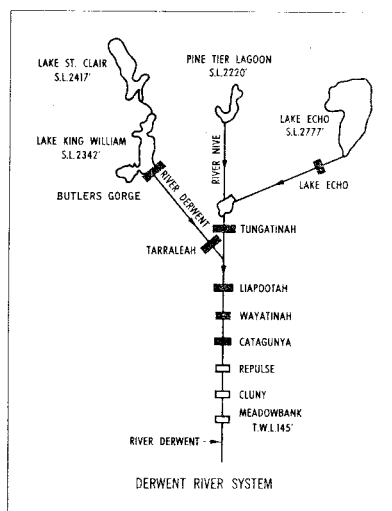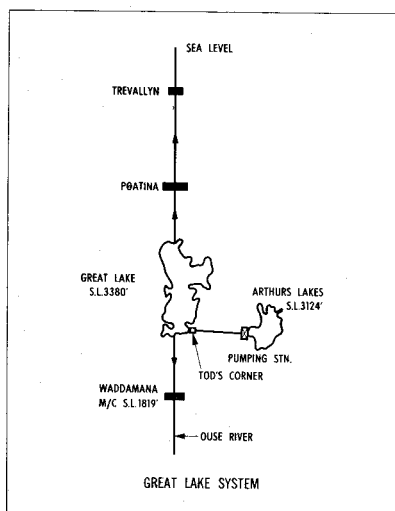
Diagrams to illustrate the Great Lake, Derwent and Mersey - Forth hydro electricity generating systems. The black rectangles represent power stations; open rectangles indicate proposed stations.

Two other restrictions on the Commission can be listed: (i) It cannot change its tariff charges for the supply of electricity to consumers except with the approval of the Governor-in-Council. Theoretically this could lead to tariff charges being deliberately kept lower than at an economic level; in practice, this has not happened since the Commission is expected to operate as a bona-fide business organisation and to recoup its operating expenses from adequate charges. (ii) In certain of its dealings, such as in real estate, the Commission must obtain the approval of the Minister.

The status of the Commission was described thus by the High Court of Australia in a judgment delivered in 1950: "In the eye of the law the corporation is its own master and is answerable as fully as any other person or corporation. It is not the Crown and has none of the immunities or privileges of the Crown. Its servants are not civil servants and its property is not Crown property."

Organisation

Under the Commission, with its full time Commissioner and three part-time Commissioners, there are five branches:

(i) *Civil Engineering Branch.* Responsible for: survey of water resources; design and construction of all civil works involved in power development and allied projects.

(ii) *Electrical Engineering Branch.* Responsible for: studies of load growth and system development; design and construction of all electrical engineering works in conjunction with the Civil Engineering Branch.

(iii) *Power Branch.* Responsible for: operation and maintenance of completed power developments; generation and transmission of power in bulk.

(iv) *Retail Supply Branch.* Responsible for: distribution of electricity to consumers; operation and maintenance of the distribution system; inspection of installations and equipment.

(v) *Secretarial.* Responsible for: general administrative business of Commission with sub-sections dealing with accounts, law, personnel, transport, stores and purchasing, medical services, central records and other services.

Construction Policy

Apart from its function of meeting all present demands for electrical power, the Commission has the heavy responsibility of estimating probable future demand and of having the necessary capacity to satisfy it as it occurs. In making estimates of future demand, there are four basic factors to be considered:

(i) Growth of population affecting number of home consumers, light industries, shops, &c.

(ii) Technological change favouring greater use of electrical power in homes, factories, shops and offices.

(iii) Increased demands for power by heavy industrial users now operating e.g. in the metallurgical, chemical and paper pulp industries.

(iv) Possibility of other "power-intensive" industries setting up plants in the State.

The difficulty of good planning is accentuated by the fact that hydro-electric development consumes capital far more avidly than the creation of equivalent capacity by thermal generation (put another way, thermal plants are cheaper to build but much more expensive to operate). Prudent economic policy dictates that an authority should try to keep just ahead of demand, and not have an unremunerative investment in a large block of idle generating capacity; the margin in hand at any given time is therefore comparatively small. Construction is a continuous process regulated to ensure that future demand will be met and restrictions in supply avoided. The pattern of the Commission's plan for the immediate future can be seen in terms of the following schedule:

By 1967: full development of Lower Derwent scheme with all three power stations in operation.

By 1970: full development at Poatina with six turbines operating.

By 1971: full development of Mersey-Forth-Wilmot scheme with seven power stations operating.

It will be observed that the Lower Derwent and Mersey schemes involve 10 new power stations, and it is planned to bring at least two new stations into operation, on the average, for each year in the period 1967-1971. Long before 1971, however, the Commission will have had to plan its next scheme so that construction activity can gradually be transferred from the Mersey scheme to a new site, possibly the Pieman or Gordon Rivers on the West Coast.

Generation and Transmission

The system of generation and transmission employed in Tasmania is completely integrated and load control engineers can call upon the capacity of any generator throughout the State. Operation can be viewed in both short term and long term aspects. In the short term, the major consideration is meeting the daily fluctuation in demand (which follows a fairly standard pattern with morning and evening peaks); there is the added responsibility of having stand-by turbines spinning as a precaution against break-down of generators under load.

In the long term, the main consideration is the operation of storages in such a way as to conserve water, to ensure that all water released is exploited to the maximum, and to obtain maximum benefits from rainfall. The more dispersed the Commission's storages become, the greater the opportunity for taking advantage of local rainfall by maximum operation of power stations below the affected catchment since the process of drawing on the storage "makes room" for drainage from the downpour.

The original high voltage transmission in the State was at 88,000 volts. When Tarraleah came into operation, new lines operated at 110,000 volts; main transmission lines built since 1957 operate at 220,000 volts.

Retail Distribution

In the early days of the Commission's operation, consumers of electrical power received it from three sources: from municipalities with their own generating capacity; from municipalities retailing power bought from the Commission; and from the Commission direct. Gradually uniformity was achieved, municipalities stopped generating and retailing and the one authority became the sole supplier, both of bulk power to industry and retail power to

homes, shops, businesses, &c. One effect has been uniformity in tariff charges for retail power so that the farmer on the most remote holding is charged no more than dwellers in the principal cities.

Earlier it was stated that the Commission is supposed to operate as a business organisation and "pay its way". This posed something of a problem in the carrying of power to remote locations with few potential consumers—in such cases, the capital cost of the extension would be a heavy burden on the consumer. Special legislation existed to subsidise the Commission when it made "uneconomic extensions", the State Treasury granting assistance up to 75 per cent of the capital cost, if not exceeding $600 per consumer. (This State subsidy was withdrawn in 1964-65.) The operation of this provision undoubtedly contributed to Tasmania's achieving an Australian record figure for distribution of electrical power—it is estimated that over 98 per cent of homes and farms are now connected.

To complete the picture, it is necessary to deal with electricity supply in the three main islands off the Tasmanian coast. Bruny Island is connected to the major grid by under-sea cable, King Island is supplied from an internal combustion plant operated by the Commission while Flinders Island depends upon an internal combustion plant leased by a private operator.

Growth of Hydro-Electric System

The following table shows the growth of the system in recent years:

Hydro-Electric Commission—Operating Statistics

Year	Total Rating of Turbines H.P.	Total Rating of Alternators K.W.	Peak Loading K.W.	Average Loading K.W.	Average (a) Load Factor Per Cent
1955 ..	542,200	389,700	284,400	184,440	64.9
1956 ..	622,200	447,100	343,300	225,690	65.7
1957 ..	683,700	485,350	372,200	254,100	68.3
1958 ..	683,700	485,350	394,900	266,660	67.5
1959 ..	683,700	485,350	403,600	274,150	67.9
1960 ..	800,700	569,050	415,400	285,250	68.7
1961 ..	800,700	569,050	438,400	297,080	67.8
1962 ..	867,700	617,050	461,600	323,790	70.1
1963 ..	867,700	617,050	550,300	378,000	68.7
1964 ..	1,130,000	806,550	582,000	405,620	69.7
1965 ..	1,133,400	807,550	593,700	427,580	72.0

(a) Average loading as a percentage of peak loading.

Average Load Factor

The alternator rating is necessarily much higher than the peak loading since some generating plant must be held in reserve against the possibility of break-down.

A power system must be designed to meet both the peak loading (the demand component) and the average loading (the energy component). Peak loading tends to represent high demand for relatively short periods, i.e. it has relatively little energy associated with it. The obvious design and operational problem is to create sufficient capacity to meet peak loading and, at the same

time, to encourage the use of power so that the highest possible average loading is obtained. "Off-peak" heating systems are an obvious example of one way in which the average load factor can be maximised; the steady use of power in a continuous industrial production process also has the effect of raising the average loading and lifting the load factor.

All things being equal, the cheapest system, from the consumers' point of view, will be the one with the highest average load factor. By world standards, the average load factors in the previous table indicate a high standard of design and operational efficiency.

Price of Power to Consumers

Hydro-electric power requires heavy initial capital expenditure; actual operating expenses are comparatively low, the major burden on revenue being interest and other associated debt and depreciation charges. Thermal stations do not require such heavy capital outlay but their operating expenses are considerably higher. In considering the data in the table below, it is to be recalled that Tasmania draws its power exclusively from water-driven turbines while the other States rely basically on thermal plants (although the eastern States make limited use of hydro-electric power). The table shows comparative average prices for power in the Commonwealth:

Price of Electric Power—Tasmania and Other States, 1963-64 (a)

(Cents per Kilowatt Hour)

State or Territory	Residential Sales	Commercial Sales	Industrial Sales	Total Sales (d)
New South Wales	2.03	3.17	1.76	2.05
Victoria	1.93	3.12	1.62	1.96
Queensland	2.09	(b)	(b)	2.27
South Australia	1.78	2.98	1.75	2.02
Western Australia	2.46	3.05	1.86	2.40
Tasmania	**1.41**	**2.00**	**0.50**	**0.75**
Commonwealth Territories ..	2.17	(b)	(b)	2.53
Commonwealth (Average) ..	1.97	(c)	(c)	1.91

(a) Source: "Statistics of the Electricity Supply Industry in Australia" (published by Electricity Supply Association of Australia).

(b) Not recorded separately.

(c) Not available.

(d) Includes power for traction, public lighting, &c. not specified in first three columns.

It will be observed that the Tasmanian average is the lowest in all types of sale. The Tasmanian householder pays less per unit on the average than his counterpart on the Australian continent but the difference in residential price gives little indication of the economy of hydro-electric generation; this can be best obtained by comparing the prices charged industrial users and, in this field, Tasmania has a very obvious advantage. The householder may be tempted to ask why industry should not pay more and the residential sale price be reduced. The answer is simple: to diversify the Tasmanian economy and to give employment to an increasing work force, industry has had to be attracted to the island; cheap bulk power has been, and will continue to be, a major attraction.

The following table shows the amount of power sold in the Commonwealth:

Sales of Electric Power—Tasmania and Other States, 1963-64 (*a*)
(Million Kilowatt Hours)

State or Territory	Residential Sales	Commercial Sales	Industrial Sales	Total Sales (*b*)
New South Wales	3,882.5	1,211.2	4,031.1	9,622.3
Victoria	2,582.0	991.0	2,990.1	6,924.0
Queensland	1,136.3	503.9	823.7	2,517.7
South Australia	851.0	250.0	759.5	1,899.1
Western Australia	374.3	220.6	316.1	930.3
Tasmania	**616.2**	**103.6**	**2,251.0**	**2,984.5**
Commonwealth Territories	144.0	(*c*)	(*c*)	324.6
Commonwealth Total	9,586.3	(*c*)	(*c*)	25,202.5

(*a*) Source: "Statistics of the Electricity Supply Industry in Australia" (published by the Electricity Supply Association of Australia).

(*b*) Includes power for traction, public lighting, &c. not specified in first three columns.

(*c*) Not available.

It is noteworthy that Tasmania, despite its small population, ranks third in total sales and third in industrial sales; no other State sells such a large proportion of total power to industrial users.

Industrial Use of Electric Power

One of the chief purposes in developing the State's hydro-electric power has been to attract industry to Tasmania; the advantage of assured supply at relatively low price has been used to offset any disadvantage associated with location on an island separated from the principal continental road and rail systems.

With regard to this policy, it is possible to obtain some indication of the importance of industrial electrical power in Tasmania from the following table:

Industrial Electrical Energy Consumption (*a*)

Commonwealth Total (Six States)	Tasmanian Consumption	
	Total	Proportion of Commonwealth Total
Million KWH	Million KWH	Per Cent
11,170	2,251	20.2

(*a*) Source: Statistics of the Electricity Supply Association of Australia, year ending 30th June, 1964.

When the Tasmanian proportion (20.2 per cent) is compared with Tasmania's share of the Australian population (3.3 per cent), the contribution of electrical power to the island's economy is seen in its correct perspective.

Finances of Hydro-Electric Commission

The table that follows shows the Commission's income and expenditure, and also its total loan debt for the last three years:

Hydro-Electric Commission
Income, Expenditure and Net Loan Debt
($'000)

Particulars	1961-62	1962-63	1963-64
INCOME			
Sales—Bulk Power	4,642	6,252	7,392
Retail Current	13,166	14,002	14,921
Other Income	348	398	429
Total	18,156	20,652	22,742
EXPENDITURE			
Operation, Distribution, Administration.. ..	6,142	6,694	7,252
Interest on Loans and Reserves	9,284	10,002	10,731
Less Interest Capitalised	Cr. 1,470	Cr. 1,488	Cr. 1,828
Depreciation Provision	2,358	2,432	2,625
Superannuation Contribution	834	836	1,271
Other Expenditure	510	540	799
Net Profit	498	1,636	1,892
Total	18,156	20,652	22,742
NET LOAN DEBT AT 30TH JUNE			
Net Loan Indebtedness to State Treasury ..	185,924	197,824	210,311
Other Loans	20,200	21,200	22,001
Total	206,124	219,024	232,312

Operations in 1964-65

For 1964-65, the net profit of the Commission was $1,509,000. At 30th June, 1965, net loan debt was $247,662,000, the liability to the State Treasury standing at $224,961,000.