Victorian Year-Book, 1920-21.

INTRODUCTION.

GEOGRAPHICAL POSITION, AREA, AND CLIMATE.

Area of Victoria.

Victoria is situated at the south-eastern extremity of the Australian continent, of which it occupies about a thirty-fourth part, and it contains about 87,884 square miles, or 56,245,760 acres. It is bounded on the north and north-east by New South Wales, from which it is separated by the River Murray, and by a straight line running in a south-easterly direction from a place near the head-waters of that stream, called The Springs, on Forest Hill, to Cape Howe. On the west it is bounded by South Australia, the dividing line being about 242 geographical miles in length, approximating to the position of the 141st meridian of east longitude, and extending from the River Murray to the sea. On the south and south-east its shores are washed by the Southern Ocean, Bass Strait, and the Pacific Ocean. It lies between the 34th and 39th parallels of south latitude, and the 141st and 150th meridians of east longitude. Its extreme length from east to west is about 420, its greatest breadth about 250, and its extent of coast-line nearly 600 geographical miles. Great Britain, exclusive of the islands in the British Seas, contains 88,756 square miles, and is therefore slightly larger than Victoria.

The southernmost point in Victoria, and in the whole of the Australian continent, is Wilson's Promontory, which lies in latitude 39 deg. 8 min. S., longitude 146 deg. 26 min. E.; the northernmost point is the place where the western boundary of the State meets the Murray, latitude 34 deg. 2 min. S., longitude 140 deg. 58 min. E.; the point furthest east is Cape Howe, situated in latitude 37 deg. 31 min. S., longitude 149 deg. 59 min. E.; the most westerly point is the line of the whole western frontier, which, according to the latest correction, lies upon the meridian 140 deg. 58 min. E., and extends from latitude 34 deg. 2 min. S. to latitude 38 deg. 4 min. S., or 242 geographical miles.

Climate.

From its geographical position, Victoria enjoys a climate more suitable to the European constitution than any other State upon the Continent of Australia. In the sixty-five years ended with 1920 the maximum temperature in the shade recorded at the Melbourne Observatory and the Weather Bureau was 111·2 deg. Fahr., on the 14th January, 1862; the minimum was 27 deg., on the 21st July, 1869; and the mean was 58·4 deg. Upon the average, on four days during the year the thermometer rises above 100 deg. in the shade; and, generally, on about three nights during the year it falls below freezing point. The maximum temperature in the sun ever recorded (*i.e.*, since 1857) was 178·5 deg., on the 4th January, 1862. The mean atmospheric pressure noted first at an Observatory

91 feet above the sea level and later at the Weather Bureau, 115 feet above sea level, was, during the sixty-three years ended with 1920, 30·14 inches; the average number of days on which rain fell each year was 136, and the average yearly rainfall was 25·60 inches.

MOUNTAINS AND HILLS, RIVERS AND LAKES.

Mountains and Hills.

The highest mountain in Victoria is Mount Bogong,* situated in the county of the same name, 6,509 feet above the sea-level; the next highest peaks are—Mount Feathertop, 6,306 feet; Mount Nelson, 6,170 feet; Mount Fainter, 6,160 feet; Mount Hotham, 6,100 feet; Mount McKay, 6,030 feet; and Mount Cope, 6,027 feet; all situated in the same county; also the Cobboras, 6,030 feet, situated between the counties of Benambra and Tambo. These, so far as is known, are the only peaks which exceed 6,000 feet in height; but, according to a list which appears in the *Year-Book* for 1915-16, there are 39 peaks between 5,000 and 6,000 feet high, and 40 between 4,000 and 5,000 feet high; it is known, moreover, that there are many peaks rising to upwards of 4,000 feet above the level of the sea whose actual heights have not yet been determined.

Rivers.

With the exception of the Yarra, on the banks of which the metropolis is situated; the Goulburn, which empties itself into the Murray about eight miles to the eastward of Echuca; the La Trobe and the Mitchell, with, perhaps, a few other of the Gippsland streams; and the Murray itself, the rivers of Victoria are not navigable except by boats. They, however, drain the watershed of large areas of country, and many of the streams are used as feeders to permanent reservoirs for irrigation and water supply purposes. The Murray, which forms the northern boundary of the State, is the largest river in Australia. Its total length is 1,520 miles, for 1,200 of which it flows along the Victorian border. Several of the rivers in the north-western portion of the State have no outlet, but are gradually lost in the absorbent tertiary flat country through which they pass.

Lakes.

Victoria contains numerous salt and fresh-water lakes and lagoons; but many of these are nothing more than swamps during dry seasons. Some of them are craters of extinct volcanoes. Lake Corangamite, the largest inland lake in Victoria, covers 90 square miles, and is quite salt, notwithstanding that it receives the flood waters of several fresh-water streams. It has no visible outlet. Lake Colac, only a few miles distant from Lake Corangamite, is a beautiful sheet of water, 10½ square miles in extent, and quite fresh. Lake Burrumbeet is also a fine sheet of fresh water, embracing 8 square miles. The Gippsland lakes—Victoria, King, and Reeve—are situated close to the coast, and are separated from the sea by only a narrow belt of sand. Lake Wellington, the largest of the Gippsland

* The highest mountain on the Australian Continent is Mount Kosciusko, in New South Wales, one peak of which is 7,328 feet high.

lakes, lies to the westward of Lakes Victoria and King, and is united to the first-named by a narrow channel. South-east of Geelong is Lake Connewarre, connected with the sea at Point Flinders.

A list of mountains and hills, rivers and lakes in Victoria appears in the *Victorian Year-Book* for 1915–16. This was revised by the Surveyor-General, Mr. A. B. Lang, and contains information in regard to heights, lengths, and areas respectively.

PHYSICAL GEOGRAPHY AND GEOLOGY OF VICTORIA.

The following article has been supplied by W. Baragwanath, Esq., Director of Victorian Geological Survey :—

PHYSICAL GEOGRAPHY.

Roughly triangular in outline, with the 141st meridian for a base and Cape Howe for the apex, and the sides formed on the north by the Murray River and on the south by the waters of the Southern Ocean, the State of Victoria occupies the most southerly portion of the Continent of Australia. Its area is approximately 88,000 square miles, and presents a diversity of topographical and geological features, which compares favorably with that of the larger States.

Medially dividing the State in an east-west direction is the main watershed which separates the streams flowing north to the Murray from those flowing south towards the ocean. A north and south meridian line from Melbourne at the head of Port Phillip Bay reaches the Murray River near Echuca at the narrowest part of the State, which it subdivides into two areas differing widely in physiographical as well as geological features. Eastwards of this line the area of greatest mean altitude occurs with a well-marked " divide " or watershed line, while westwards the mean elevation is considerably lower and the water-partings often ill-defined, especially where they occupy plateau-like areas. The Lower Ordovician strata, containing the principal gold-fields of the State, occupy three-fourths of the area of exposed rocks westwards of the meridian of Melbourne; eastwards similar strata are only known at a few small and isolated localities. The Older Volcanic rocks of early Tertiary age are more developed in the eastern part of the State, and the underlying and overlying lignitic beds which form extensive deposits eastward of Melbourne are little represented in the western half of the State. The Newer Volcanic rocks, while conspicuous in the western portion of the State, are but little in evidence in the eastern part.

The main physiographical features are :—

(1) Central highlands—
  (*a*) The eastern highlands.
  (*b*) The western uplands.
(2) Southern highlands—
  (*a*) The South Gippsland ranges.
  (*b*) The Otway ranges.

(3) Great valley—
  (*a*) The Gippsland Valley.
  (*b*) The Corangamite Valley.
(4) Murray Valley—
  North-western plains and the Mallee.

The central highlands form the main divide, and the southern highlands are parallel to and 50 to 100 miles distant from it. Between these parallel ridges is the great valley of Victoria; it extends westward from the Gippsland Lakes, and is, with the exception of a volcanic barrier near Warragul separating the waters of the Carrum and Moe swamps, traceable to Port Phillip Bay. Westward of Port Phillip Bay the extension of this valley, filled in part with Newer Volcanic rocks and recent sediments, embraces Lake Corangamite, the largest in the State, and numerous smaller lakes. The northern edge of the great valley passes on south of the Grampians and the Sierra Range to the western boundary of the State.

On the northern side of the main watershed line, the southern edge of an extensive plain embracing the whole of the north-western portion of the State leaves the Murray River about 60 miles eastward of the meridian of Melbourne, and follows a general south-westerly course towards the western boundary of the State to a point about 90 miles from the coast.

The Gippsland Valley ranges from 50 to 450 feet, the Corangamite Valley from 300 to 450 feet, and the Mallee plains from 200 to 450 feet; but, though all three are at about the same level, they differ considerably in geological features. The Gippsland Valley consists of recent deposits of fluviatile, lacustrine, or estuarine origin; the Corangamite basin, almost entirely of lava flows with depressions along the margins of or between the coalescing lava streams and the Mallee plains of sandy ridges of fluviatile or wind-blown origin.

The highlands of the eastern portion of the State are mainly sedimentary and igneous rocks of Ordovician, Silurian, and Devonian age, now forming narrow "razor-back" ridges, at times 2,000 feet above the neighbouring rivers. The main river valleys are of considerable width, and extend to within a comparatively short distance of the main divide. Following the north and south course of the streams, parallel ridges, due to a combination of folding, faulting, igneous intrusion, and unequal weathering, are well developed.

Evidence of peneplanation at several altitudes is pronounced. Plateaux are of small extent, and owe their preservation to a covering of harder rocks, such as the Dargo High Plains, or to areas where the catchment for denudation is relatively small, as at the Baw Baw plateau and the Snowy Plains, between the Wonnangatta and the Macallister rivers.

The general altitude of the eastern highlands ranges from 4,000 feet to over 6,000 feet, prominent peaks being Bogong (6,509 feet), Feathertop (6,306 feet), and Hotham (6,100 feet). The Mount Baw Baw granite

area, the highest isolated plateau south of the main divide, is 30 square miles in area, and has a mean altitude of 4,500 feet, its highest point being 5,130 feet. The Snowy Plains, consisting of Upper Devonian or Carboniferous flat-bedded rocks, has a general altitude of over 4,000 feet and connects Mount Wellington to the main divide.

The western uplands show the same pronounced meridional arrangement of branch spurs, but, with the exception of the Grampians area, the great difference of altitude between the rivers and the spurs does not exist as in the eastern part of the State. The rocks are chiefly of older Palæozoic age, in part metamorphosed, and occasional Newer Volcanic cappings occurring as defined hills and broad plateaux. On the main divide "saddles" occur at relatively low altitudes. One near Kilmore, through which the Melbourne–Sydney railway line passes, is 1,115 feet above sea, and north-west of Ballarat the divide has an altitude of 1,500 feet. Between these two points the watershed line attains an altitude of 3,000 feet. At 5 miles north of Buangor the divide between the head waters of the Wimmera and the Fiery Creek, a tributary of the Hopkins, has an altitude of 1,200 feet; eastward and westward of this saddle an altitude of 3,150 feet is attained. Westward of Stawell, on the eastern edge of the Grampians, which attain an altitude of nearly 4,000 feet, the watershed is only 1,300 feet above sea. In the Victoria Valley, west of the Grampians, the divide between the Glenelg and Wimmera rivers is hardly perceptible.

The South Gippsland and the Otway ranges are composed of rocks of Mesozoic age, and the watersheds show no defined or regular arrangement, steep slopes, narrow ridges, and V-shaped valleys prevailing. In the former area, which comprises two nearly-parallel ridges, an altitude of 1,500 feet is reached along the northern edge, where fault action is evident, within 3 miles of the Gippsland Valley. A general altitude of over 2,000 feet is maintained for a length of 30 miles along the main crests of this range. In the latter area similar conditions prevail; there is no regular stream system, and a coastal range 10 to 15 miles from and parallel to the sea-shore shows steep slopes and elevations of nearly 2,000 feet.

Wilson's Promontory, an isolated granite massif with peaks of 2,400 feet, forms the most southerly point of the State. It is connected to the mainland by sand-dunes slightly above sea-level. Between Wilson's Promontory and Tasmania is a submerged ridge only 200 feet below sea-level.

The Victorian lakes have been formed by (1) faulting or crust movements, (2) damming of water-courses by lava flows or the coalescing of lava streams, and (3) marine action. Lake Omeo and Lake Karng, near Mount Wellington, fall outside this category; the origin of the former is uncertain, but the latter has been ascribed to a landslip blocking a mountain stream.

Included within the lakes due to faulting is the typical crater lake of Tower Hill, near Koroit, and many of the Western District lakes appear to occupy sunken areas on the lava flows.

Lakes Burrumbeet, Corangamite, and others were formed by coalescing lava flows.

By tidal action a barrier of sand was thrown up, behind which the Gippsland lakes developed; they were originally larger, but siltation by river-borne material is in progress. Lakes now infilled occur as swamps scattered over the State, and were revealed in numerous places during the working of the alluvial leads or buried river systems.

GEOLOGICAL HISTORY.

The oldest fossiliferous strata comprise a series of volcanic tuffs and contemporaneous sediments. These are supposed to have been folded to form troughs, in which thousands of feet in thickness of Ordovician and Silurian strata were deposited. The occasional conglomerates and grit beds represent fluctuations of the conditions of deposition; volcanic tuffs occur in the Silurian beds, and at the close of this period the intrusion of granitic rocks contemporaneous with a general meridional series of main folds took place.

A lengthy period of denudation followed; the exposed outcrops were worn to a general level prior to the extensive volcanic outpourings of the Devonian period, represented by the Snowy River porphyries in the valley of the Snowy and Macallister, which appear to have occurred in valleys or depressed areas, and by the dacites of Dandenong and Macedon. That part of the surface which, prior to the volcanic activity, was a land area, is seen in the north-eastern portion of the State, where a defined river bed occurs beneath a layer of porphyry.

Following the porphyry and dacite outpourings, layers of conglomerate, often hundreds of feet in thickness, were accumulated. No direct evidence of glacial origin of these is yet available, but this has been suggested. Later deposits of limestone in shallow seas took place, and these were followed by alternating layers of conglomerate, sandstones and shales, and in part volcanic flows (melaphyres) in the eastern part of the State, while sandstones and shales alone were deposited to form the present Grampian Range.

There is evidence of warping and faulting subsequent to deposition. The folding was on broad lines, the Grampian–Dundas beds forming portion of a broad syncline, while the Avon River–Mansfield series has a general northerly dip; the fossils in the deeper beds of the series as exposed on the Avon River and Iguana Creek have a Devonian aspect, while those of the upper beds near Mansfield have a Carboniferous aspect.

Climatic changes followed the close of this period, and glacial conglomerates, sandstone, pebbly mudstone, and tillite of Permo-Carboniferous age were deposited. More genial conditions intervened with several successive glacial periods in the accumulation of a few hundred feet of strata, which probably covered much of the western portion of the State. Through subsequent denudation they now only exist in scattered areas, and as remnants faulted against older rocks. These fault movements provided general depressions, in which the

thousands of feet of fresh-water felspathic sandstones and mudstones with coal seams accumulated, now forming the Jurassic coal measures of Gippsland, Otway, Casterton, and probably near Wangaratta.

Extensive faulting in the early part of the Tertiary period resulted in a partial elevation of the Jurassic series and a depression of an area to the north and south of it.

At this period portion of the central highlands was in all probability a land surface, and the deep leads of Dargo High Plains were probably contemporaneous with the period of early Tertiary faulting. The early Tertiary period was marked by the deposition of marine Oligocene beds in the western part of the State, and by the accumulation of brown coal beds and marine strata at Altona, and the sub-basaltic lignites in parts of Gippsland.

Volcanic action (the Older Volcanic of the geological survey) took place during this period, as is indicated by the alternating marine beds and basalt flows near Maude.

Elevation and depression of the surface, subsequent to the Older Volcanic period, has resulted in the marine beds being elevated to a considerable altitude in some places, and in others depressed to a depth only ascertainable by boring. In Gippsland the Older Volcanic rocks, although originally resting on a gentle sloping surface, are now seen to be inclined almost vertically in the vicinity of fault lines, and within short distances they have been found at a depth of several hundreds of feet below the level of the original outcrop.

In these depressions sand, clay, and extensive lignite deposits accumulated in Gippsland and elsewhere. In the Western District the newer volcanic outpourings took place and sealed up the old river systems which contained the alluvial gold deposits.

Faulting, subsequent to the deposition of the lignitic beds and the newer volcanic flows, is revealed by bore sections and mine workings, but the general configuration of the surface has been chiefly affected by the accumulation or removal of superficial deposits.

Founded on sound lines by Dr. A. R. C. Selwyn in 1856, the Victorian Geological Survey has carried out mapping and investigations continuously, except for a few months some 50 years ago. The main geological features of the State have now been mapped out and some areas examined in detail, much assistance having been given by geologists and scientific workers outside the Survey. Much still remains to be done, and many complex problems, which depend upon a detailed examination both in the field and in the laboratory, await solution.

The stratigraphical succession of the geological formations is :—

Cambrian.—An area of regionally metamorphosed rocks, consisting of quartzites, chloritic, talcose, and micaceous schists, and gneisses, in the valley of the Glenelg and Wannon rivers may be of this age or older, but there is no definite evidence available. At Heathcote a series of sedimentary and igneous rocks occur, and much controversy has arisen as to the age and stratigraphical relation of this Heathcotian

series. Certain trilobote-bearing beds have been considered Upper Cambrian, and associated with these beds are cherts and diabases, the latter an altered volcanic tuff, not an intrusive rock. The cherts also are more or less silicified tuffs as evidenced by their contained radiolaria. Interstratified with the cherts there are shales containing graptolites of Lower Ordovician aspect.

At Mansfield an acutely folded series of sandstones, slates, cherts, and phosphate beds have yielded fossils, now proved to be of Upper Cambrian age by Mr. F. Chapman; brachiopods (*Salterella*), crustaceans, and radiolaria occur in the beds. Graptolites of Lower Ordovician type occur with the crustaceans and Salterella.

Near Mount Wellington certain beds in the vicinity of the serpentine area have been identified as Upper Cambrian. Similar lithological associations exist as at Heathcote and near Mansfield. The serpentine of this area is referable to pre-Upper Ordovician age, and may be Cambrian.

Scattered throughout the State there are areas of cherts and diabases regarded on lithological evidence as of similar age, but fossil evidence has not yet been obtained in support of this contention.

In the Howqua Valley, cherts, jaspers, and diabases are associated with Upper Ordovician strata.

From the Heathcotian rocks the alluvial gold of McIvor Creek had its origin. Magnetite, steatite, copper, and manganese occur at Heathcote; corundum, limestone, and chrome iron at Mount Wellington and Heathcote; phosphates of aluminium and calcium near Mansfield and in the Howqua Valley.

Ordovician.—The rocks of this series are chiefly grits, sandstones, and slates. Conglomerates are rare, and limestone occurs in beds only a few inches in thickness. The beds have been intensely folded and in places metamorphosed. Two types of metamorphism, regional and contact, are evident. The former type is widespread. Much of the north-eastern portion of the State is occupied by rocks of this age and character, comprising every gradation from micaceous schists to gneiss and gneissose granite.

At Stawell the metamorphic strata are gneissose, chloritic and graphitic schists, hornblendic gneiss, quartzite, and occasionally thin beds of marble.

The latter type is local, and is confined to areas surrounding intrusive igneous masses.

On fossil evidence the Ordovician strata are subdivided into a lower and an upper series. The Lower Ordovician rocks are confined, with the exception of small areas on the Mornington Peninsula, Boolarra, Knockwood, and Loyola, near Mansfield, to the area west of the meridian of Melbourne. These beds have been subdivided into four zones characterized by typical fossils, and are named after the type localities where they were first examined, *e.g.*, Lancefield, Bendigo, Castlemaine, and Darriwill. The chief gold-fields in the western portion

of the State occur in the three lower zones. Detailed palæontological surveys by R. A. Keble have resulted in the Bendigo and Castlemaine zones being divided into sub-zones at Bendigo and in part also at Daylesford.

The Lancefield zone is characterized by gold occurrences of the Indicator class, a feature present at Dunolly, Tarnagulla, Inglewood, Maryborough, Elaine, and, though fossil evidence is wanting, probably at Ballarat.

The Bendigo zone has quartz lodes either bedded as saddle formations or occurring as fissure lodes; these are well developed on the Bendigo, Spring Gully, Castlemaine, Daylesford, and Steiglitz gold-fields. The Bendigo zone has also been identified at Mornington.

The Castlemaine zone, more especially in its lower portions, is noted for rich spurry quartz formations, from which the rich alluvial gold of the Chewton and Fryerstown gold-fields was derived.

The Darriwill zone has not yet been proved in the auriferous areas of the State.

The Upper Ordovician series occur as meridional belts in the eastern part of the State, outcropping on anticlinal domes, such as exist at Mount Matlock; on the Black River, 12 miles east of Wood's Point; at Phosphate Hill, near Mansfield, resting on Upper Cambrian; Dolodrook River, Mount Wellington; Sandy Creek, west of Bullumwaal; the Upper Murray, through the county of Benambra; and Nowa Nowa.

Besides the rich quartz and alluvial gold the Ordovician strata contain silver, lead, copper, iron, manganese, wolfram, scheelite, bismuth, antimony, lodes of fluorspar, and veins of turquoise.

Silurian.—The rocks of this formation are conglomerate, breccia, grits, quartzites, phyllites, schists, slates, and shales, intercalated limestone and marble, and occasionally volcanic tuff. Like the Ordovician the beds are acutely folded and metamorphosed where intruded by igneous masses. On fossil evidence the Silurian beds are divided into three series—the Melbournian, Yeringian, and Tanjilian; the last named may require revision of evidence. These rocks cover a large part of central eastern Victoria. The gold-fields of Rushworth, Whroo, Walhalla, Wood's Point, Foster, Tanjil, Warrandyte, and Reedy Creek are in Silurian rocks. Gold-antimony ores occur at Costerfield, Ringwood, and Thornton; limestone at Lilydale, Cooper's Creek, Waratah, and Howe's Creek, near Mansfield; and phosphate of lime at Howe's Creek. Copper and small quantities of manganese, nickel, cobalt, and platinum are recorded from dykes intrusive into this series.

Devonian.—Doubt exists with regard to certain calcareous beds in the vicinity of the Wentworth River, which on fossil evidence have been grouped as of Middle Devonian age. These beds are folded and crumpled like the Ordovician and Silurian strata, and as typical Silurian fossils are met with nearly on the strike of the supposed Devonian beds, further investigation may prove that the Taberraberra beds are of Silurian age.

Towards the close of the Devonian period extensive volcanic accumulations, such as tuffs, conglomerates, lavas, and porphyry masses were formed in the Snowy River and Macallister–Wonnangatta valleys, and apparently contemporaneous with them extensive limestone beds were deposited. As these and later beds have not been subjected to the intense folding of the pre-existing formations in which the granites and granodiorites occur, the latter intrusions are classed as of Devonian age. In the Grampians area certain granite intrusions have been assigned to a later period.

Excepting a small rich gold occurrence near Briagolong, the Devonian strata have not proved gold bearing. Silver, lead, copper, manganese, iron, baryta, felspar, and building stones, such as marble, freestone, porphyry, and granite are the chief economic products.

Carboniferous.—The massive sandstones, with occasional shales, forming the Mount William, Sierra, and Dundas ranges in the west, and the purplish-red sandstones, mudstones, conglomerates, and impure limestones at Mansfield and near Whitfield are Lower Carboniferous. On the Avon River the red and yellow sandstones containing the fossil *Lepidodendron* probably belong to this series, although the underlying beds at Iguana Creek have a flora with a Devonian aspect. Both the Mount Wellington and the Grampians areas present a remarkable variety of scenery—canyons, bluffs, and gorges often several hundred feet deep.

In the Grampians a granodiorite-porphyritic intrusion in the Carboniferous sandstones is recorded, while the granitic mass of Mount Hump (Gippsland) is apparently older than the Avon River sandstones.

The Carboniferous formation only provides building stone, some of the freestones being of good quality.

Permo-Carboniferous.—Glacial conglomerate, pebbly mudstone, and tillite occur near Bacchus Marsh, in the valley of the Werribee, at Greendale, Wild Duck Creek (near Heathcote), near Kyneton, Coleraine, Carisbrook, Pitfield, Poseidon, Wangaratta, and other localities in the north-east district, and are apparently scattered remnants of glaciation more or less directly connected. At Bacchus Marsh several species of the fossil *Gangamopteris* were discovered in shale, intercalated with the glacial conglomerates, and on this evidence the beds have been provisionally classed as of Permo-Carboniferous age; recent observations by Mr. F. Chapman have revealed Triassic fossils in the uppermost beds of the series. In a small outcrop of strata near Yandoit fossils of Triassic age have also been identified.

Jurassic.—A thick bed of conglomerate, glacial in part, forms the base of the Jurassic formations, and is followed by a series of felspathic sandstones, thick beds of mudstone, and thin seams of coal; these occur in South Gippsland, on the Latrobe River, in the Otway Ranges, and the valley of the Wannon. The black-coal seams, though small, furnish portion of the supplies of the State. The coal seams are much faulted and frequently intersected by doleritic dykes. Quartz reefs

occur in the Jurassic strata of the Otway District, but so far they have not proved auriferous. Freestones, dyke stones useful for road material, shales suitable for tile manufacture, calcite, baryta, and black coal are the chief economic products of the Jurassics.

Lower Tertiary.—Marls and limestones of Oligocene age, containing a representative molluscan fauna outcrop at Mornington and Muddy Creek, Hamilton, and occur at a depth at Altona and Sorrento. At Altona they rest on brown coal, which in turn rests on sands. At Mornington they are either in contact with or in close proximity to the Older Basalt.

Fluviatile deposits underlying the Older Basalt at Berwick contain an abundant fossil flora, including such genera as *Eucalyptus*, *Lomatia*, *Fagus*, &c. In the fluviatile beds, under the Older Basalt at Dargo, *Gingko* is found The predominant species in the brown coal deposits appears to be a *Cupressinoxylon*, or cypress wood.

Middle Tertiary.—Miocene marls and polyzoal limestone of Miocene age are represented by a considerable thickness of beds at various localities. They outcrop at several places in the western portion of the State, and the main water-bearing beds of the Mallee–Riverina basin are of this age. At Pitfield, during mining operations, fossil fruit were found in fluviatile beds, which seemed to merge into estuarine and ultimately into marine beds, containing a molluscan fauna. At Maude and Curlewis there are two flows of basalt with a marine bed between them, and another resting below the lower lava flow. The lower marine bed is regarded by Mr. Chapman as Miocene, and by the late Dr. T. S. Hall and Dr. Pritchard as Eocene. The brown coal phase, which commenced in the Lower Tertiary, probably extends upwards into the Miocene.

Upper Tertiary.—Lower Pliocene shell marls and sands occur at the Gippsland Lakes, on the shores of Port Phillip Bay, Muddy Creek, Hamilton, and the Mallee. The period is characterized by coarse marine and freshwater sedimentation. In the fossil fauna the remains of some gigantic mammals are found. Upper Pliocene clays, sands, and limestones outcrop at the Glenelg and Moorabool rivers, and are known to exist at a depth in the Mallee. The extensive volcanic plains of Western Victoria, comprised of lavas and tuffs, range in age from the Pliocene to within comparatively recent times. Many of the craters are perfect.

Recent.—Loam and sand deposits, dune sands, recent beaches, lake sediments, &c., in process of formation comprise the Recent deposits.

Tertiary deposits have been responsible for a large quantity of the gold found in Victoria, particularly for the large nuggets which have made Victorian gold-fields famous. Stream tin, a moderate amount of wolfram and monazite, a considerable tonnage of pottery clays, sands for a variety of purposes, building stone, including basalt (much used locally for construction, paving, and macadam), lime, bauxite, iron ore

pigments, paper clays, jarosite, and chalk occur in the Tertiary deposits of the State. The vast deposits of brown coal promise to play an important part in the industrial development of Victoria.

The following addendum by Mr. R. A. Keble gives an outline of the difficulties encountered in definitely correlating the geological sequence in Victoria, on palæontological data, with those proved elsewhere :—

" The stratigraphical relation of the beds containing *Dinesus ida*, Eth., and *Notasaphus fergusoni*, Eth., to the graptolite zones is a problem necessitating careful field work in the vicinity of Heathcote. *D. ida* and *N. fergusoni* are closely related to Upper Cambrian forms in North America and China. The equivalents of the Bendigo zone in North America and Europe are invariably placed in the Lower Ordovician. Between the Upper Cambrian series with *Dictyonema flabelliforme*, Eich., of Europe, and equivalent forms found in Victoria in basal Lancefieldian there is here a considerable thickness of beds with several graptolite faunas or zones. The question arises whether some of these zones should be grouped with the Upper Cambrian, but the present difficulty is the fixing of a line of demarcation.

If the beds containing *D. ida* and *N. fergusoni* were found to be intercalated with the graptolite subzones, those beds below should be regarded as Upper Cambrian. That the geologists of North America refer all the beds above their typical Cambrian to the Ordovician, eases the position, but there is still the necessity of fixing the base of the Lower Ordovician.

Redlichia, a genus distinctly Upper Cambrian, is found with the Mount Wellington trilobites. There, field relations are very complicated, and although palæontological unconformity obviously exists between the Upper Cambrian and Upper Ordovician, no evidence of it appears in the field sections. At Mansfield the surface sections were similarly indefinite in regard to the relationship of beds containing *Tetragraptus approximatus*, Nich., and Cambrian ostracoda, with a definite Upper Ordovician graptolite fauna. Excavations have since shown that small inliers of the upper beds have been wedged into the lower beds by intense folding.

The passage beds from the Lower to the Upper Ordovician and from the Upper Ordovician to the Silurian will ultimately be identified largely on graptolite evidence. The work of Mr. W. Harris at Sunbury has thrown considerable light on these problems.

A long-standing problem awaiting solution is the relation of the Silurian to the Devonian. The passage beds are of considerable thickness, and must be examined in the field by both the geologist and the palæontologist. The key to the problem may be found in an extensive shale series containing a well-defined flora found in the Centennial Mine, near Walhalla. In what is thought to be the uppermost Silurian, an interesting fauna, comprising several types of bivalves and pteropods, elsewhere regarded as Devonian, has been referred to as Tanjilian.

Mr. F. Chapman is working out a collection of plants from the Upper (*Schizoneua*) beds from Bald Hill, Bacchus Marsh. This work establishes the fact that they are partly equivalent to the Queensland Ipswich beds, the lower part of the Trias-jura series. This is all the more interesting, in view of a corresponding relation between the Gippsland series and Walloon clay shales of Queensland.

The results of Mr. F. Chapman's palæontological work on the Mallee bores, published in the Records of the Geological Survey, are being confirmed throughout that region, especially in the location of water-bearing strata. As suggested by him, the chief water-bearing beds are the Middle or Miocene Tertiary (polyzoal bed). If there were more collaboration by those who put down private bores, in preserving and forwarding any bore cores obtained, an exact knowledge of conditions likely to be met with would be gained and much expense saved.

It is interesting to note that at the base of the polyzoal beds within the South Australian border payable lignite beds have been discovered, suggesting the possibility that similar beds may be discovered in the north-western portion of Victoria.

The zoning of Victorian formations, especially the Silurian and Jurassic, is of paramount importance, and local workers could do good work in this direction."

FLORA OF VICTORIA.

Articles on "The Flora of Victoria" appeared in the *Year-Books* for 1916–17 to 1919–20.

Addendum to the above Articles.

By J. R. Tovey, Esq., Officer in Charge of the National Herbarium, Melbourne.

(Received March, 1921.)

During the period 1920–21 the following species were added to the list of the native flora :—

Acacia triptera, Benth. (*Leguminosæ*); *Calochilus paludosus*, R. Br. (*Orchidaceæ*)—both the preceding species have been recorded from New South Wales and Queensland only; *Logania longifolia*, R. Br. (*Loganiaceæ*), previously recorded from South and Western Australia only; *Prasophyllum gracile*, Rogers (*Orchidaceæ*)—this orchid was hitherto known from South Australia only; *Thelymitra megcalyptra*, Fitzg. (*Orchidaceæ*), previously recorded from New South Wales only.

The following species new to science have been added :—

Acacia Havilandi, Maiden (*Leguminosæ*)—it is also found in New South Wales and South Australia; *Caladenia cordiformis*, Rogers; *Caladenia iridescens*, Rogers; *Prasophyllum Braineanum*, Rogers. These three are members of the *Orchidaceæ*, and, so far as is at present

known, are confined to Victoria. In addition, the following species, which have hitherto been considered varieties or synonyms, have been raised to specific rank :—*Caladenia alba*, R. Br., *Caladenia reticulata*, Fitzg.—both are members of the *Orchidaceæ*; *Calandrinia pusilla*, Lindl. (*Portulacaceæ*); *Dodonæa attenuata*, Cunn.; *Dodonæa cuneata*, Rudge (*Sapindaceæ*); *Tetratheca subaphylla*, Benth. (*Tremandraceæ*); whilst *Caladenia Cairnsiana*, F. v. M. (*Orchidaceæ*), has been deleted from the Victorian Flora, as it occurs in Western Australia only. The Victorian specimens which have hitherto been placed under *Caladenia Cairnsiana* have been found to be distinct, and have been described as a new species under the name of *Caladenia cordiformis*, Rogers. Several new records have also been made to the regional distribution of various native plants.

During the period four foreign plants were recorded as naturalized aliens; these are :—

Carthamus glaucus, Bieb. (*Compositæ*), a native of Egypt, Asia Minor, and Persia; *Cirsium syriacum*, Gaertn. (*Compositæ*), a native of the Mediterranean regions; *Erica lusitanica*, Rud. (*Ericaceæ*), a native of Western Europe; *Medicago Echinus*, D.C. (*Leguminosæ*), a native of the Mediterranean regions. *Carthamus glaucus* and *Cirsium syriacum* will no doubt become troublesome pests if left unchecked; in fact, the former has already become so troublesome in the Shire of Kowree that it has been brought under the provisions of the Thistle Act for that shire. *Medicago Echinus* has a slight pasture value. *Erica lusitanica* is a garden plant, but takes up the place of useful vegetation when growing wild. Besides the foregoing, four other exotics have been recorded for the first time as growing wild, viz. :—*Muscari botryoides*, Mill.; *Muscari racemosum*, Mill. (*Liliaceæ*); *Sclerochloa dura*, Beauv. (*Gramineæ*); *Selaginella stolonifera*, Spring (*Selaginellaceæ*). None of them are likely to prove troublesome weeds, whereas *Sclerochloa dura* has a slight pasture value.

THE FAUNA OF VICTORIA.

An article on the "Fauna of Victoria," by the late T. S. Hall, M.A., D.Sc. (University of Melbourne), and Mr. J. A. Kershaw, F.Z.S., Curator of the National Museum, Melbourne, appeared in the *Year-Book* for 1916–17, and an addendum thereto by Mr. Kershaw in the *Year-Book* for 1918–19.

Addendum to Above Article.

Supplied by Mr. J. A. Kershaw, in May, 1921.

Since the publication of the addendum to the above article in 1919, no additions of importance have been made to the Victorian vertebrate fauna. The possibility of adding to the species already recorded from the State is now very remote, except perhaps among the smaller reptiles and marine fishes.

Numerous additions, however, continue to be made to the invertebrate fauna, among which the Coleoptera and blood-sucking flies (Diptera) have received most attention.

THE HISTORY OF VICTORIA.

An article on this subject contributed by Ernest Scott, Professor of History in the University of Melbourne, appeared in the *Year-Book* for 1916–17, pages 1 to 31.

CHRONOLOGICAL TABLE OF LEADING EVENTS.

The *Year-Book* for 1916–17 contained, on pages 31 to 50, a chronological table of leading events in Victorian history for the years 1770 to 1900 inclusive, and of leading events in Victorian and other history for the years 1901 to 1916 inclusive. The leading events in 1917, 1918, and 1919 were given in the volumes relating to those years.

Some of the principal events in Victorian and other history during 1920 are given in the table which follows :—

1920.	7th	January.—Death of the Right Hon. Sir Edmund Barton, P.C., senior puisne Judge of the Federal High Court and first Prime Minister of the Commonwealth, aged 71 years.
,,	10th	January.—Declaration of peace with Germany.
,,	16th	January.—Announced by the Supreme Allied Commission that the League of Nations came into force from that date.
,,	17th	January.—Last detachment of the A.I.F. left the United Kingdom.
,,	20th	January.—Arrival in Melbourne of General Sir William R. Birdwood.
,,	27th	January.—Appointment of Mr. W. G. S. McArthur, K.C., as a puisne Judge of the Supreme Court of Victoria.
,,	2nd	February.—Under the provisions of the Melbourne and Metropolitan Tramways Act the Board appointed under that Act assumed control of the various electric tramway systems in the metropolis.
,,	3rd	February.—Appointment of Mr. H. E. Starke, K.C., as a Judge of the Federal High Court.
,,	21st	February.—Marine strike terminated.
,,	25th	February.—Aviator Sir Ross Smith and party reached Melbourne after an eventful flight from England to Australia, this being the first occasion on which such a flight had been made.
,,	10th	March.—Departure for England of Dr. Lowther Clarke, Anglican Archbishop of Melbourne.
,,	17th	March.—The Hon. W. A. Watt, Federal Treasurer, left for London.
,,	4th	April.—A large gas holder, owned by the Metropolitan Gas Company, burst at Port Melbourne.
,,	18th	April.—Death of Colonel D. McLeish, C.M.G., who commanded the first contingent from Victoria sent to the South African war.
,,	11th	May.—Death of Sir George Steward, Chief Commissioner of Police, aged 54 years.
,,	13th	May.—Salaries of the members of the Federal Parliament increased from £600 to £1,000 per annum.

1920.	21st	May.—Conference of State Premiers.
,,	26th	May.—Arrival of H.R.H. the Prince of Wales in Melbourne.
,,	12th	June.—Repatriation Commission appointed with Lieutenant-Colonel J. M. Semmens as chairman.
,,	15th	June.—Announced that the resignation of the Federal Treasurer (Hon. W. A. Watt) had been accepted by the Federal Cabinet.
,,	19th	June.—The appointment of the Right Hon. Lord Forster, P.C., to the position of Governor-General of the Commonwealth announced.
,,	2nd	August.—Arrival of Lieutenants Parer and McIntosh at Darwin, this being the second flight from England to Australia.
,,	9th	August.—Death of the Right Hon. Sir Samuel Griffith, P.C., first Chief Justice of the Federal High Court, aged 75 years.
,,	10th	August.—Appointment of Sir John Gellibrand, K.C.B., D.S.O., as Chief Commissioner of Police.
,,	19th	August.—Departure of H.R.H. the Prince of Wales from Australia.
,,	23rd	August.—Announced that the Right Hon. the Earl of Stradbroke had been appointed Governor of Victoria.
,,	2nd	September.—Death of Mr. W. Davidson, I.S.O., formerly Inspector-General of Public Works, aged 76 years.
,,	14th	September.—Second Peace Loan of £25,000,000 over subscribed.
,,	17th	September.—Mr. H. W. Clapp, formerly vice-president of the St. Louis Railway Co., Ohio, United States, assumed office as Chief Commissioner of the Victorian Railways.
,,	30th	September.—Departure of Senator Millen from Melbourne to represent Australia at the Assembly of the League of Nations.
,,	5th	October.—Departure from Australia of the Right Hon. Sir Ronald Munro Ferguson, P.C., Governor-General.
,,	6th	October.—Arrival in Melbourne of the Right Hon. Lord Forster, P.C., who assumed the office of Governor-General of the Commonwealth.
,,	7th	October.—Decided by public meeting at Town Hall that Villers-Bretonneux be adopted by the citizens of Melbourne in memory of the great Australian victory of 8th August, 1918.
,,	21st	October.—Elections for the Legislative Assembly held. At the same time a liquor referendum was taken, when a majority of 30,428 votes was recorded in favour of continuance.
,,	10th	November.—Treaties of peace with Austria and Bulgaria declared effective in the Commonwealth.
,,	11th	November.—Armistice Day celebrated throughout Australia. All city traffic and work stopped for two minutes at 11 a.m. in honour of the illustrious dead.
,,	22nd	November.—Report of Basic Wage Commission made public.

PROGRESS OF STATE SINCE 1842.

The following table has been prepared to illustrate the advance made by the State since 1842, the year of the introduction of representative government into New South Wales, which then included the Port Phillip district. The years 1850 and 1855 have been chosen —the former as being the year immediately preceding the separation of the Colony from New South Wales, and the latter as the date of

STATISTICS OF VICTORIAN PROGRESS, 1842 TO 1920.

——	1842.	1850.	1855.	1861.	1871.	1881.	1891.	1901.	1919–20.
Population, 31st December ..	23,799	76,162	364,324	541,800	747,412	879,886	1,157,678	1,210,882	1,519,835
Revenue .. .. £	87,296	259,433	2,728,656	2,592,101	3,734,422	5,186,011	8,343,588	7,712,099	15,866,184
Expenditure from Revenue £	124,631	196,440	2,612,807	3,092,021	3,659,534	5,108,642	9,128,699	7,672,780	15,752,459
Public Funded Debt £	..	..	480,000	6,345,060	11,994,800	22,426,502	43,638,897	49,546,275	86,394,454
Gold produced .. oz.	..	..	2,793,065	1,967,453	1,355,477	858,850	576,400	789,562	165,118
Wool produced .. lbs.	2,752,330	16,345,468	22,470,443	22,640,745	37,177,646	45,970,560	76,503,635	73,235,138	132,847,167
Butter produced .. „	..	..	..	..	..	..	16,703,786	46,857,572	60,218,945
Agriculture—									
Land in cultivation acres	8,124	52,341	115,060	427,241	793,918	1,582,998	2,512,593	3,647,459	5,358,351
Wheat .. .. bushels	55,360	556,167	1,148,011	3,607,727	4,500,795	8,714,377	13,679,268	12,127,382	14,858,380
Oats .. .. „	66,100	99,535	614,614	2,136,430	3,299,889	3,612,111	4,455,551	6,724,900	6,603,067
Wine .. .. gallons	..	4,621	9,372	47,568	713,589	539,191	1,554,130	1,981,475	1,634,680
Live Stock—Horses No.	4,065	21,219	33,430	84,057	181,643	278,195	440,696	392,237	513,500
„ Cattle „	100,792	378,806	534,113	628,092	799,509	1,286,677	1,812,104	1,602,384	1,631,120
„ Sheep „	1,404,333	6,032,783	4,577,872	6,239,258	10,002,381	10,267,265	12,928,148	10,841,790	14,422,745
„ Pigs .. „		9,260	20,686	43,480	177,447	239,926	286,780	350,370	186,810
Total Imports—Value £	277,427	744,925	12,007,939	13,532,452	12,341,995	16,718,521	21,711,608	18,927,340	*
„ Exports—Value £	198,783	1,041,796	13,493,338	13,828,606	14,557,820	16,252,103	16,006,743	18,646,097	*
Imports, Oversea—Value £	..	..	..	10,991,377	9,201,942	11,481,567	13,802,598	12,686,880	33,788,187
Exports „ „ £	..	..	..	12,209,794	12,843,451	12,318,128	11,403,922	13,075,259	42,996,652
Shipping .. .. tonnage	78,025	195,117	1,133,283	1,090,002	1,355,025	2,411,902	4,715,109	6,715,491	8,008,450
Railways open .. miles	..	..	..	214	276	1,247	2,764	3,238	4,222
Telegraph wire .. „	..	..	..	2,586	3,472	6,626	13,989	15,356	29,955
Postal business—Letters No.	97,490	381,651	2,990,992	6,109,929	11,716,166	26,308,347	62,526,448	83,973,499	197,080,463
„ Newspapers „	147,160	381,158	2,349,656	4,277,179	5,172,970	11,440,732	22,729,005	27,104,344	31,756,907
Savings Bank Deposits £	..	52,697	173,090	582,796	1,117,761	2,569,438	5,715,687	9,662,006	44,357,000†
Factories—									
Number of	..	..	278	531	1,740	2,488	3,141	3,249	6,038
Hands employed ..	..	..	..	4,395	19,468	43,209	52,225	66,529	136,522
Value of machinery, plant, land, and buildings £	..	..	..	..	4,725,125	8,044,296	16,472,859	12,298,500	30,804,520
Value of articles produced £	..	..	..	..	..	13,370,836	22,390,251	19,478,780	101,475,363
State Education—									
Number of Primary schools ..		61	370	671	988	1,757	2,233	1,967	2,272
Expenditure on Education £	..	..	115,099	162,547	274,384	546,285	726,711	701,034	1,678,763
Total value of rateable property in municipalities .. £	..	..	..	29,638,091	50,166,078	87,642,459	203,351,360	185,101,993	357,437,822
Friendly Societies—									
Number of Members ..	..	..	1,698	7,166	35,706	47,908	89,269	101,045	146,919
Total funds .. £	..	..	..	..	213,004	475,954	961,933	1,370,604	3,056,666

NOTE.—In a few instances in the earlier years, where it is not possible to give figures for the exact date or period shown, those for the nearest dates or periods are given. Gold was discovered in 1851, in which year the return was 145,137 oz. Butter figures were not collected prior to 1891.

* Owing to the Commonwealth authorities having discontinued the keeping of records of Inter-State trade, the value of the total imports and exports of the State are not available for a later year than 1909. For that year the imports were valued at £28,150,198 and the exports at £29,896,275.

† Including deposits in the Commonwealth Savings Bank.

the introduction of responsible government for Victoria. The subsequent years are census years, except the last :—

The population of the State at the end of 1842 was 23,799; at the census of 1921 it had increased to 1,530,114. During the period 1842–1920 the revenue steadily increased from £87,296 to £15,866,184. There was no public debt until after separation. In 1855 the State indebtedness was £480,000; in 1920 the funded debt had reached £83,394,454, which has been spent on revenue-yielding and other works of a permanent character. The land in cultivation in 1842 was slightly over 8,000 acres; it now amounts to 5,358,351 acres. The value of oversea imports in 1861 was £10,991,377; in 1919–20 it was £33,788,187. Oversea exports amounted to £12,209,794 in 1861, and to £42,996,652 in 1919–20. No railways or telegraphs were in existence up to the end of 1855; in 1861 there were 214 miles of railway open, and in 1920 there were 4,222 miles; 2,586 miles of telegraph wires had been erected up to 1861, and 29,955 miles up to the 30th June, 1920. Postal business in letters and newspapers has expanded rapidly during the period covered by the table, and there has also been a large increase in Savings Bank deposits, which rose from £52,697 in 1850 to £44,337,000 in 1920.

The expenditure on education amounted to £115,000 in 1855, and had increased to £1,678,763 in 1919–20. Members of friendly societies numbered 1,698 in 1856, and 146,919 in 1919—the funds amounting to £213,000 in 1871 and £3,056,666 in 1919. Hands employed in factories rose from 19,468 in 1871 to 136,522 in 1919–20. The total value of rateable property in municipalities, which was £29,600,000 in 1861, was £357,437,822 in 1919–20.

CONSTITUTION AND GOVERNMENT.

The Present Constitution.

Reform Act 1903.

After the establishment of the Federal Government it became evident that the representation of the States in the States Houses was excessive, and steps were taken to reform the States Constitutions. Accordingly an Act "to provide for the Reform of the Constitution" was passed in Victoria and reserved for the Royal assent on 7th April, 1903. After an interval of some months the Royal assent was proclaimed on 26th November, 1903. This Act, entitled *The Constitution Act* 1903, provided for a reduction in the number of responsible Ministers from ten to eight, and in their salaries from £10,400 to £8,400; and decreased the number of members of the Legislative Council from 48 to 35, including one special representative for the State railways and public servants; but increased the number of electoral provinces from fourteen to seventeen, each being now represented by two members elected for six years—one retiring every three years by rotation, except at a general election, when one-half of the members are to be elected for only three years. The