Engineers Australia
Engineering Heritage Victoria

Nomination
Engineering Heritage Australia Heritage Recognition Program

CHAFFEY BROTHERS
IRRIGATION WORKS IN
AUSTRALIA

February 2017
The triple expansion steam engine designed by George Chaffey and built by Tangye Brothers, Birmingham which provided the first stage of pumping from the Murray River to Kings Billabong until replaced by electric pumps.

The engine has been restored and is cared for and run by a group of Mildura volunteers.

The use of marine type triple expansion steam engines direct driving to multiple centrifugal pumps was extremely innovative when George Chaffey designed the engine in the late 1880s however the date of the order on Tangye Brothers is not known.

*Image: Heritage Victoria.*
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1 Introduction

George and William Chaffey made significant contributions to the development of irrigation for agricultural land in dry climates with several successful projects in California and at Mildura and Renmark in Australia.

Their combined skills allowed them to integrate engineering, social, commercial and agricultural techniques to develop irrigation colonies in very aggressive environments. Their work laid down principles which were followed by others enabling large scale irrigation projects which now contribute greatly to agricultural output in many arid and semi-arid parts of the world.

Engineer George Chaffey pushed the limits of the use of centrifugal pumps to achieve efficient, high volume pumping at an affordable cost for irrigation work. He also developed his skills to lay out efficient channel networks to distribute water over large areas with water delivered to the highest point of each block by gravity.

William pioneered the dried fruit industry and the wine-making industry at Mildura and helped to establish Australian excellence in those industries which continues to the present time.

The Chaffey colonies were, however, subject to serious disputation and public ridicule largely because of flaws in the financial models adopted for the colonies. This led to the establishment of Irrigation Trusts to operate, maintain and expand irrigation systems in return for rates from the landowners. This model proved to be more sustainable and brought stability and prosperity to irrigation areas.

The personal characteristics of the brothers are a model for all engineers. They were hard-working, not deterred by the many set-backs they encountered and they took breathtaking engineering and commercial risks in order to innovate. They combined a wide range of skill and high professional ethics in a way we should all admire.

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Early agriculture in Australia centred on the fertile valleys of the east and south coasts whilst grazing of sheep and cattle in the drier areas west of the Great Dividing Range followed close behind. It was not until the 1880s that attention turned to the development of irrigation schemes, primarily in the Murray-Darling Basin. The first such projects were in the Goulburn Valley in Victoria and the Chaffey brothers projects in Mildura in Northern Victoria and Renmark in South Australia.
Whilst there were difficulties in getting early projects operating successfully the legendary persistence of Australian farmers prevailed. Australia now produces about 23% of its gross agricultural product from irrigated farms which together account for only 1% of all land used for agriculture and grazing in Australia ¹. The value of produce from irrigated farms reached A$13.4 billion in 2012/13 ².

The Chaffey brothers George and William came to Australia in the late 1880s with considerable experience from developing irrigation colonies in California in the United States of America. They negotiated arrangements with both the South Australian and Victorian colonial governments and established successful irrigation colonies at Renmark and Mildura.

Others built on their work, the Murray in particular gradually acquired a high level of flow regulation from a series of weirs and locks and large storages were constructed to supply water over the annual cycles and through droughts. Water is now diverted from the eastern slopes of the Snowy Mountains via the Snowy Mountains Hydro-electric Scheme power stations to provide irrigation water along the long course of the Murray River.

2 Heritage Award Nomination Letter

Learned Society Advisor
Engineering Heritage Australia
Engineers Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Name of work: Chaffey Brothers Irrigation Works in Australia

The above-mentioned work is nominated to be awarded an Engineering Heritage National Marker.

The Chaffey Irrigation schemes in Australia were based in Mildura, Victoria and Renmark, South Australia. The grid references for the centre of these towns are:

- Mildura: lat -34.183474° south, long 142.164622° east
- Renmark: lat -34.171646° south, long 140.750591° east

There are no specific owners identifiable as the towns, their, residents, the municipal councils and bodies of state governments are all stakeholders in the irrigation assets of the areas.

The owner of the land where the interpretation panel is proposed to be located has been advised of this nomination and a letter of agreement is attached.

Access to site: Most areas of the town on which significant surviving assets from the early irrigation colony are accessible to the public. Farms lands and food processing factories are only accessible with the permission of the owner.

The Nominating Body for this nomination is Engineering Heritage Victoria with the full support of Engineering Heritage South Australia.

David LeLievre
Chair
Engineering Heritage Victoria

Date: February 2017
3 Heritage Assessment

3.1 Basic Data

Other/Former Names: Mildura Irrigation Colony, Renmark Irrigation Colony

Location: The Chaffey Irrigation schemes in Australia were based in Mildura, Victoria and Renmark, South Australia.

Address: Suburb/Nearest Town: Mildura & Renmark

State: Victoria & South Australia

Local Govt. Area: Mildura Rural City Council & Renmark Paringa Council

Owner: There are no specific owners identifiable as the towns, their residents, the municipal councils and bodies of state governments are all stakeholders in the irrigation assets of the areas

Current Use: Both towns and their surrounding agricultural lands are primarily involved in irrigated farming of various products

Former Use: Little existed at the town sites prior to the first work on building irrigation systems in the late 1880s

Designers: George Chaffey (1848-1932), irrigation pioneer, engineer, inventor and entrepreneur, and William Benjamin Chaffey (1856-1926)

Maker/Builder: The Chaffey Brothers employed the local Irrigation Communities and external contractors to carry out some works

Year Started:
- Mildura: Indenture with Victorian Government signed May 1887
- Renmark: Agreement with South Australian Government, 1887
- Mildura was certainly operational by December 1890 when the population of Mildura had reached 3300
- Renmark was certainly operational by December 1890 when the population of Mildura had reached 1100

Physical Description: Work followed a master plan laid out by the Chaffeys. Headworks consisted of pumping stations to lift water from the Murray River into channels at various levels to enable gravity delivery to each lot of agricultural land. The master plan also called for community infrastructure such as roads, schools, hospitals and many other community services. Some land levelling and grubbing of scrub from land was also carried out.

Physical Condition: The land remains in use for much the same purposes originally envisaged although crops may have changed in some cases to accommodate to available markets.
3.2 Historical Notes

Refer to the following chapters of ‘Chaffey Brothers Irrigation Works in Australia’ which is reproduced in full at Appendix 2 of this nomination:

- Section 2 – Early life of Chaffey Brothers
- Section 3 - First steps towards irrigation in Mildura
- Section 4 - First steps towards irrigation in Renmark
- Section 5 - Engineering works at Mildura
- Section 6 - Engineering works at Renmark

3.3 Heritage Listings

Name: Psyche Bend Pumping Station
Status: Registered – Victorian Heritage Register
Number: H0548
Date: October 1983

Name: Billabong Pumping Station
Status: Registered – Victorian Heritage Register
Number: H0547
Date: October 1983

Name: Rio Vista
Status: Registered – Victorian Heritage Register
Number: H0729
Date: 3 May 1989

Name: Chaffey Mildura Pumping Scheme
Status: Registered – National Trust of Australia (Victoria)
Number: 68937
Date: not stated

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4 Assessment of Significance

4.1 Historical significance:
Refer to section 3.2 above.

4.2 Historic Individuals or Association:
Appendix 3 contains biographical details of the following key people in the Chaffey Story:

- George Chaffey
- William Benjamin Chaffey
- Alfred Deakin

4.3 Creative or Technical Achievement:
The Chaffey Brothers (and George in particular) showed considerable engineering judgment and innovation in the development of all of their irrigation schemes. The Technical achievements in relation to Mildura and Renmark are outlined in the following chapters of the paper ‘Chaffey Brothers Irrigation Works in Australia’ which is reproduced in full at Appendix 2 of this nomination:

- Section 5 - Engineering works at Mildura
- Section 6 - Engineering works at Renmark
- Section 7 - Engineering Achievements
- Section 8 - Engineering Failures

4.4 Research Potential:
The Chaffey Brothers story is very well documented and there are few details which are not readily accessible.

However those researching the project will undoubtedly find areas where further research could be very useful. The crankshaft failures outlined in Section 7 of this nomination is a good example. It would be interesting to be able to come to a conclusion as to whether the George Chaffey design did contribute to the crankshaft failures or whether their design or manufacture in Tangyes was deficient in some way.

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4.5 Social:

The social and cultural influences from the Chaffey story are quite broad-ranging both within the local communities where the Chaffey's worked and also much further afield in Australia.

Mildura and Renmark have become very successful communities. It is compelling to look back at the community model brought from the United States by the Chaffey's and compare that vision with the actuality of today well over a century later. The vision of fully rounded communities with everybody striving to put their effort into the overall success of the enterprise was quite sophisticated in the way it was implemented in the early days of the communities. Whilst the Chaffey's are long-gone much of that community cohesion and ferment remains. Driving through the towns today it is quite clear that they are prosperous, self-reliant, proud and innovative communities. In many subtle ways they tell us that they have succeeded in ‘making the desert bloom’ and that has built immense community pride.

These communities have also had impacts on other communities. All across the Murray Darling Basin (and beyond to some extent) there are ‘river towns’ which have made a success of growing one product or another based on irrigated agriculture. In one place it might be fresh fruit, in another dried fruit, in another vegetables and in another dairy cattle. They have all made their mark and the nation depends on them. To a great extent that tradition grew out of Mildura and Renmark.

Then there are the national changes which can be traced back to Mildura and Renmark. They were amongst the early advocates of using irrigated land to grow fruit from which ‘dried fruit’ is made. Packing dried fruit in children’s lunch boxes is as Australian as Vegemite sandwiches. As a nation, we would be aghast at having to do without dried fruit. We have William Benjamin Chaffey to thank for that in large part.

William Benjamin Chaffey also believed that he could grow superior grapes in the irrigated desert soils with which to make wine. The ‘river towns’ have been very instrumental on placing wine on the dinner tables of many Australians. It might sound terribly un-Australian but we seem to be in the process of becoming wine drinkers as much as we are beer drinkers. We also have thank William Benjamin Chaffey for his part in that change.

4.6 Rarity:

The technologies which the Chaffey’s introduced at Mildura and Renmark are now used through Australia and in fact all around the world. Those technologies have evolved and improved but the basics are still present. Today the channels of earlier days have given way to pipes and flood irrigation to drip feed irrigation but the technologies are still recognisable as fulfilling the same purpose.

In that respect most of the irrigation technology is not rare.

However there are some individual components which have some rarity. The George Chaffey triple expansion steam engines at Mildura were a portent of a trend in technology which put George Chaffey somewhat ahead of the pack in using marine steam engine technology (with which he was very familiar from his younger days on the Great Lakes) to
land-based use driving centrifugal pumps. In that respect the two triple expansion steam engines at Mildura are unique and of extreme heritage value.

### 4.7 Representativeness:

The Mildura and Renmark model of technical solution to aid irrigation has been followed in many places. Therefore most of it is representative of practice elsewhere in Australia and overseas.

### 4.8 Integrity/Intactness:

Overall integrity and intactness are quite high at Mildura and Renmark. Whilst many components have changed in the gradual modernisation of the industry and the more recent goals of increasing water use efficiency what remains is quite recognisable.

The fact that the two big triple expansion engines have survived, along with their respective pump houses is both remarkable and a credit to the people who have worked so hard to achieve that outcome.

### 4.9 Statement of Significance:

Several Statements of Significance have been found relating to this nomination. This listing starts with Statements of Significance from the Victorian Heritage Database (Heritage Victoria and National Trust listings) and ends with a Statement of Significance written specifically for this nomination:

#### 4.9.1 Psyche Bend Pumping Station - Statement of Significance

Last updated on - June 22, 1999

The various pumping stations were constructed by the Chaffey brothers as part of their vast irrigation scheme built after 1887. The brothers had come from North America, with the support of Alfred Deakin, where they had gained experience in California and around the great lakes.

The pumping stations were the beginning of an extensive system of irrigation channels. Psyche bend was the first, pumping the water out of the river. King's billabong was the main pumping station where four centrifugal pumps were capable of raising 32,000 gallons per minute together. The Ninety Foot and Nichol's Point pumping stations were further along the main channel and served most of surrounding land, the highest in the settlement. The Lock Nine Pumping Station is independent of the main system and was built later.

Several buildings at Psyche Bend have been demolished but the pump house remains intact with its engines. The design is very similar to the brick pump houses at Billabong and Nichol's Point where the engines have been removed. Nichol's Point has been substantially altered. The Lock Nine Pumping Station is the most complete with the original boiler.

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surviving as well as the pumps and channelling. This building is constructed of corrugated iron. The pumping stations are considered to be of national significance for their historical associations and as examples of industrial architecture.

4.9.2 Billabong Pumping Station - Statement of Significance

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Several buildings at Psyche Bend have been demolished but the pump house remains intact with its engines. The design is very similar to the brick pump houses at Billabong and Nichol's Point where the engines have been removed. Nichol's point has been substantially altered. The Lock Nine Pumping Station is the most complete with the original boiler surviving as well as the pumps and channelling. This building is constructed of corrugated iron. The pumping stations are considered to be of national significance for their historical associations and as examples of industrial architecture.

4.9.3 Chaffey Mildura Pumping Scheme - Statement of Significance

Last updated on - May 26, 2004

The vision of Alfred Deakin and the legislation which he introduced enabled the development of the Mildura settlement and other major irrigation schemes on the Murray and Murrumbidgee River systems.

The work of George Chaffey enabled the establishment of a large population and extensive


industry in an arid area. The products of Sunraysia over the years, have contributed to the Australian export income, as well as supplying local markets.

The pumping plant in the Psyche Bend Pump house used a triple-expansion steam engine which was still the latest technology of the time. The pumps were the biggest in the world. The fact that four pumps were directly coupled to the crankshaft and engine was an innovation of world significance.

The creative thinking of George Chaffey was important and the application of mathematics, engineering science and the latest technology by Chaffey and other engineers of the period enabled such notable achievement to proceed.

Classified: 28/04/1986
Revised: 22/02/1988
See also B3577 Pump Houses, Psyche Bend, Nicholas Point & Loch Nine, B1643 Cannie Ridge Irrigation Pumps, B1390 Rio Vista & Billabong Primary School.

4.9.4 Rio Vista - Statement of Significance

Last updated on - June 28, 1999

Rio Vista and the former gardener's cottage at the rear at 199-205 Cureton Avenue, Mildura, have historical and architectural significance for the following reasons:

The significance of Rio Vista and the gardener's cottage at the rear can be assessed in terms of their architectural, historical and social importance at the regional, state and national levels.

The complex is of architectural importance as a very early example of the Queen Anne domestic style in Australia. It is preceded in Victoria by Woodlands, North Essendon, of 1888, to the design of Oakden, Addison and Kemp, but precedes the well documented work of Ussher and Kemp, William Beebe, Walter Butler, Christopher Cowper and others who practised in the Queen Anne manner during the post-1890's depression years. In this respect the architecture of Rio Vista was innovative in its day at the state and national levels, and remains distinctive for its use of decorative timberwork which relates directly to contemporary American practice. Rio vista is symbolic if the link with American architectural practice brought about by William Benjamin Chaffey's briefing of Mildura architect EC Sharland and by his importation of a Canadian joiner, W Kells. Although Canadian born, Chaffey had lived in California prior to his arrival in Australia and had first-hand experience...

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9 Source: Report to the Minister.
of English Queen Anne domestic architecture as it had been interpreted for over a decade in America.

The design of the interior finishes is important at the state level for its use of local and imported timbers, stained and acid-etched glasswork of the Victorian period, and embossed wallpapers. The wallpapers are particularly intact, while the timber mouldings are noteworthy as sophisticated examples of Queen Anne mouldings and may be unique on account of their early date.

As the home of William Chaffey, Rio Vista attains historic significance for its links with the pioneering work of Chaffey Brothers Limited in establishing Australia’s earliest irrigation colony on the Murray River.

The fabric of the building is important as a reflection of the constructional expertise available within the irrigation colony only two years after its founding in 1887. The joinery, being of local manufacture, is expressive also of the restrictions on importing mouldings from Adelaide and elsewhere, owing to the high cost of duties payable at colonial borders prior to federation.

The former gardener's cottage at the rear, which was probably built in 1889-90, is a two storied structure, strongly influenced by contemporary American Picturesque domestic architecture.

The landscaped grounds of Rio Vista are important as an example of the work of the prestigious local firm of Hughan and Glasson, trading as the Ontario Nursery.

\[4.10 \textbf{Area of Significance:}\]

The Mildura and Renmark irrigation system heritage is clearly of \textbf{State Significance} in Victoria and South Australia respectively.

The position of these two schemes, standing at the very beginning of the irrigation revolution in Australia gives these two sites, along with several other early irrigation schemes in Australia, \textbf{National Significance}.

\textbf{International Significance} comes from the overall influence of the Chaffey Brothers in both the United States and in Australia on the early development of sustainable and successful models for irrigation colonies.
5 Interpretation Plan

5.1 General Approach

The interpretation Plan will be carried out in accordance with the 2012 edition of the Guide to the Heritage Recognition Program which can be found on the EHA web site at www.engineeringheritage.com.au.

This will consist of interpretation developed in liaison with the owner (Mildura Rural City Council) and Engineering Heritage Victoria. The interpretation will be unveiled at a public ceremony probably in October 2017.

The ceremony should be held on Friday October 13 2017. The ceremony should be held Psyche Bend Pumping Station as a part of the 19th Australasian Engineering Heritage Conference.

A standard size 1200 mm wide by 600 mm high interpretation panel should be erected at one of three possible locations:

- Psyche Bend Pumping Station
- Billabong Pumping Engine located on the river bank in central Mildura
- In the vicinity of Rio Vista, the Chaffey house in central Mildura

5.2 The Interpretation Panel:

1. A title “Chaffey irrigation projects in Australia”.
2. Logos of Engineers Australia and Mildura Rural City Council to be incorporated.
3. A small scale representation of the EHA marker plate.
4. The ceremony date, award level and major stake holders names.
5. Text should be 24 point Arial Bold.
6. A map showing the location of the Chaffey irrigation projects.
7. Brief captions for each photograph.
8. Total text should not exceed 500 words excluding headings.
9. The panel to be constructed of vitreous enamel-on-steel plate or vinyl film on aluminium plate with flanges as per drawing at Appendix 6.
10. The panel to be mounted on a steel free-standing frame as per drawing at Appendix 6.
11. The EHA marker to be mounted below the interpretation panel as shown in Appendix 6.
5.3 Possible Interpretation themes for Interpretation Panel

The following subjects have been assessed as possible themes for the interpretation panel:

a) The history of the Chaffey Brothers irrigation works in Australia.

b) Engineering aspects of the Chaffey projects.

c) Brief Biographical material (including images) of the Chaffey Brothers and Alfred Deakin.
6 References:

Note that the bulk of references for this work are contained in the paper at Appendix 2.


7 Acknowledgments, Authorship and General Notes

7.1 Acknowledgments

I wish to acknowledge my colleague Richard Venus who co-authored the conference paper which forms the basis of this nomination. Richard is a long-time enthusiastic supporter of Engineering Heritage Australia (EHA). Richard is an electrical engineer and graphic designer of considerable professional standing. His study subjects have included several works associated with the Murray River.

I also wish to acknowledge the assistance of the Mildura Rural city Council in the arrangements for the 19th Australasian Engineering Heritage Conference and this heritage recognition process.

7.2 Nomination Preparation

This nomination was prepared by:

Owen Peake
FRMIT HonFIEAust CPEng
4 Islington Street
Collingwood Victoria 3066
Phone: +61 3 9419 0820 (home and work)
Email: owen.peake@bigpond.com

7.3 General Notes

This document has been prepared in accordance with the Commonwealth Government Style Manual for authors, editors and printers, Sixth Edition, revised by Snooks & Co, 2002.

The method of citation used in this document is the Vancouver System. See page 190 of the above Style Manual.
Appendix 1: Images with captions

Mildura Wharf in 1892. Whilst this facility was very rudimentary it connected Mildura to the world via the river paddle steamers. *Image: source unknown.*

The Billabong Pumping Station pumping engine during erection.

*Image: source unknown.*
Rio Vista built by William Benjamin Chaffey in 1890 near the riverfront in Mildura. The house is now part of the Mildura Arts Centre.  
*Image: the Chaffey Trail.*

Psyche Bend Pumping Station in 1915. The boiler house is in the foreground and the pumping station at right rear. Note the stack of timber for the boiler at left.  
*Image: The Chaffey Trail.*
The Psyche Bend boiler in 1915. *Image: source unknown.*

Fruit drying racks in the 1940s. *Image: SLV.*
Mildura main street in 1948. *Image: SLV.*

William Benjamin Chaffey statue, Mildura. *Image: SLV.*
Inspecting irrigation channels at Red Cliffs, Governor Carmichael and Party. *Image: SLV.*

Working on a channel, 1940s. *Image: SLV.*
Psyche Bend Pumping Station. *Image: Heritage Victoria, Victorian Heritage Database.*

Psyche Bend boiler. This is not the original boiler but a more recent ex-Victorian Railways locomotive boiler. *Image: Heritage Victoria, Victorian Heritage Database.*
Psyche Bend engine in steam. *Image: Heritage Victoria, Victorian Heritage Database.*

Billabong Pumping Station. This station no longer contains pumping machinery but the engine, similar to that at Psyche Bend, is now on display in the centre of Mildura. *Image: Heritage Victoria, Victorian Heritage Database.*
Appendix 2: Conference Paper - ‘Chaffey Brothers Irrigation Works in Australia’

Document starts on following page
Abstract:
George and William Chaffey made significant contributions to the development of irrigation for agricultural land in dry climates with several successful project in California and at Mildura and Renmark in Australia.

Their combined skills allowed them to integrate engineering, social, commercial and agricultural techniques to develop irrigation colonies in very aggressive environments. Their work laid down principles which were followed by others enabling large scale irrigation projects which now contribute greatly to agricultural output in many arid and semi-arid parts of the world.

Engineer George Chaffey pushed the limits of the use of centrifugal pumps to achieve efficient, high volume pumping at an affordable cost for irrigation work. He also developed his skills to lay out efficient channel networks to distribute water over large areas with water delivered to the highest point of each block by gravity.

William pioneered the dried fruit industry and the wine-making industry at Mildura and helped to establish Australian excellence in those industries which continues to the present time.

The Chaffey colonies were, however, subject to serious disputation and public ridicule largely because of flaws in the financial models adopted for the colonies. This led to the establishment of Irrigation Trusts to operate, maintain and expand irrigation systems in return for rates from the landowners. This model proved to be more sustainable and brought stability and prosperity to irrigation areas.

The personal characteristic of the brothers are a model for all engineers. They were hard-working, not deterred by the many set-backs they encountered and they took breathtaking engineering and commercial risks in order to innovate. They combined a wide range of skill and high professional ethics in a way we should all admire.

1 Introduction
Early agriculture in Australia centred on the fertile valleys of the east and south coasts whilst grazing of sheep and cattle in the drier areas west of the Great Dividing Range followed close behind. It was not until the 1880s that attention turned to the development of irrigation schemes, primarily in the
Murray-Darling Basin. The first such projects were in the Goulburn Valley in Victoria and the Chaffey brothers projects in Mildura in Northern Victoria and Renmark in South Australia.

Whilst there were difficulties in getting early projects operating successfully the legendary persistence of Australian farmers prevailed. Australia now produces about 23% of its gross agricultural product from irrigated farms which together account for only 1% of all land used for agriculture and grazing in Australia. The value of produce from irrigated farms reached A$13.4 billion in 2012/13.

The Chaffey brothers George and William came to Australia in the late 1880s with considerable experience from developing irrigation colonies in California in the United States of America. They negotiated arrangements with both the South Australian and Victorian colonial governments and established successful irrigation colonies at Renmark and Mildura.

Others built on their work, the Murray in particular gradually acquired a high level of flow regulation from a series of weirs and locks and large storages were constructed to supply water over the annual cycles and through droughts. Water is now diverted from the eastern slopes of the Snowy Mountains via the Snowy Mountains Hydro-electric Scheme power stations to provide irrigation water along the long course of the Murray River.

This paper summarises the work of the Chaffey brothers and examines the engineering challenges they faced.

2 Early Life of Chaffey Brothers

“George Chaffey (1848-1932), irrigation pioneer, engineer, inventor and entrepreneur, and William Benjamin Chaffey (1856-1926), agriculturist and irrigation planner, were born on 28 January 1848 and 21 October 1856 respectively at Brockville, Ontario, Canada, sons of George Chaffey, a Canadian born at Zanesville, Ohio, United States of America, and his wife Anne, née Legoe, of Quebec.”

Both brothers developed a wide range of skills and possessed a strong entrepreneurial drive. They were tireless in whatever enterprises they were involved.

George Chaffey found many men willing to teach him in the workshops of his father’s shipyard. He developed skills as a mariner. “Long before he was twenty he held a master’s and engineer’s ticket.”

It is said that at the age of 13, when his father was not available, he had taken one of his father’s tugs to assist a ship in distress and had brought the ship safely to port. After obtaining his maritime qualifications he was “given command of one of his father’s tugs and later became master of a freighter trading between Chicago and Montreal.” His adventurous spirit led him to some risky undertakings. He nearly became involved in blockade running in the American Civil War but was physically restrained by his father. When he was 20, at his father’s suggestion he went to work for his

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14 Ibid
uncle Elswood in Toronto at the Etna Fire and Life Company. He stayed in Toronto for two years, “and returned to Kingston with a sound knowledge of office methods and with a wife” 16.

William Chaffey’s early years are less certain but in 1878 his father moved to Riverside 17, near Los Angeles in the United States, to join other Canadian families at the Santa Ana River irrigation settlement 18. William accompanied the family and George joined them later. The brothers made investments in new irrigation projects called Etiwanda and Ontario, on the Cucamonga Plain 19. The irrigation settlements “were based on the purchase of land and water-rights by the Chaffey’s at a low price, and resale to settlers in 10 acres (4 Ha) blocks, with a mutual irrigation company to distribute water on a non-profit basis” 20. These developments were successful and provided a model which was later used at Mildura and Renmark.

George Chaffey.  
*Image: State Library of South Australia.*

William Benjamin Chaffey.  
*Image: La Trobe Picture Collection, State Library of Victoria.*

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17 85 km west of Los Angeles.


19 53 km east of Los Angeles Downtown in the San Bernardino Valley.

3 First steps towards irrigation in Mildura

In 1877-84 northern Victoria suffered from drought, and Alfred Deakin, a minister in the Service-Berry government and chairman of a royal commission on water supply, visited the irrigation areas of California in 1885. This was intended to be a fact-finding mission but Deakin was so impressed by the skill and energy of the Chaffey Brothers, who he met at the beginning of his trip in Los Angeles that he was convinced to encourage the brothers to come to Victoria. George Chaffey arrived in Melbourne in February 1886. Chaffey inspected the Murray Valley and was “excited about its potential for irrigation”.

Chaffey selected what he considered to be suitable land of 250,000 acres at Mildura and made an agreement with the Victorian Government to spend at least £300,000 on permanent improvements over twenty years. A bill to validate the agreement was introduced into the Victorian Parliament but was violently opposed. It eventually passed through parliament but required the government to call tenders for the scheme which delayed the start of the project.

John Downer, Premier of South Australia, seized on the opportunity created by the Victorian government delay, travelled to Melbourne and offered the Chaffey Brothers a similar-sized block of land in the Renmark area of South Australia 133 km west of Mildura and also on the Murray River.

As no tenders were received by the Victorian government to counter the Chaffey offer the Chaffey’s signed an indenture with Victoria in May 1887, giving them a total of 500,000 acres of land to develop for irrigation use. George concentrated on the required engineering works whilst William managed the settlement at Mildura and a younger brother, Charles came from California to manage Renmark. A huge amount of work was carried out over the next four years. By December 1890 the population of Mildura was 3300 and Renmark 1100, following an international sales promotion campaign.

Despite the largely successful technical aspects of the settlement at Mildura the Chaffey’s had many detractors and the early days of the project proved arduous for the settlers. There were attacks on the Chaffey’s in the Victorian parliament and the Melbourne newspapers ran a vitriolic campaign against the project. This situation was intensified by the land boom collapse in the early 1890s in Melbourne, which is considered by the Reserve Bank of Australia to have caused a worse depression than the Great Depression of the 1930s.

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22 Ibid.

23 Ibid.

24 Ibid.


26 Ibid.

27 Ibid.

28 Frost Andrew, Kew in the 1890s Depression, Kew Historical Society, paragraph 1, undated.
Taking levels for construction of irrigation channels at Mildura. Image: Victorian Places.

The 90 foot Channel at Mildura. Image: Pictures Victoria.

4 First steps towards irrigation in Renmark

"Avoiding political wrangling in Victoria, George Chaffey was attracted to Renmark and believed he could turn River Murray water onto the arid land and the region would flourish. In 1887 Chaffey signed an agreement with the South Australian government based on an incentive scheme. The Chaffeys invested a fortune into preparing and irrigating blocks of land for sale. Many English settlers were attracted to the irrigation scheme in response to a 'Red' book published by the Chaffeys entitled The Australian Irrigation Colonies, promoting a bountiful future."
But within six years the prospect looked bleak. The Chaffeys fell victim to the Bank Crash of 1893 and like many others, became almost penniless. In addition to this Depression, inexperienced settlers, inappropriate agricultural methods, unsuitable crop varieties, transport difficulties, fruit diseases and extremes of weather, all caused the company to fail. Many people literally fled their holdings.

In 1893 an Act of Parliament transferred the Chaffeys’ rights to the Renmark Irrigation Trust, an elected body which provided the opportunity for settlers to manage their own resources. The Chaffey Brother’s firm then ceased operations in 1895. George Chaffey returned to the United States, while William stayed on in Mildura and without any prospect of recovering his wealth, worked tirelessly to see the irrigation projects continue.

The principles of irrigation engineering are the legacy of the Chaffey Brothers’ enterprise in Australia. Their innovation has had far reaching effects and pioneered the techniques that now allow for food to be grown year round in some of the driest settled land in Australia. Today, the River Murray sustains orchards, vineyards and vegetable crops, supported by canneries, wineries and food-processing factories.”

The land for the Chaffey enterprise at Renmark comprises “30,000 acres from the Bookmark Station lease was granted to the Chaffey’s on which to build the new colony. Vineyards and fruit blocks slowly emerged throughout the district”.

Whilst George and William Benjamin Chaffey were fully occupied at Mildura who was running the enterprise at Renmark? “Charles Chaffey, a younger brother of George and W.B. Chaffey arrived in April 1888 and agreed to take over the Renmark operation. He selected land and gave plans for the building of his home to former Goolwa shipwright and carpenter A.F. Matulick. Charles returned to America and in October 1888 brought out his pregnant wife Ella and son. Ella remained in Adelaide to give birth to their second son and in January 1889 the family and servants travelled by the PS Corowa to Paringa. Here they resided in the Paringa Station Homestead situated on a hill close by the Paringa Bridge today, until they moved into their new home in the last months of 1889.

Charles Chaffey chose a Canadian log-cabin style for his home; the walls of Murray pine logs had been laid horizontally supported by vertical pine posts slotted to receive them with deep shady verandahs added later. The kitchen was separated from the main house by a breezeway.

The inside of the house was lined an sealed with lath and plaster and has wooden floors. There were also numerous cellars only one being still in use. "Olivewood" was classified by the National Trust of SA and is on the State Heritage List as well as the Commonwealth List.

The original selection had an extensive olive grove planted in 1890 (with complete building and olive mill processing olive oil), and lemon and orange orchards including the first naval orange tree brought to Australia and later on grapefruit. there were vineyards and zante currants and muscat grapes and orchards of peaches, apricots and pears. Then there were fields of wheat, alfalfa and lucerne for stock - the "Olivewood" dairy was a noted one - and windbreaks of eucalyptus to protect crops from wind and dust storms.

The family consisted of 6 children: George (1886 California), Charles (1888), Margaret (1889), Francis (1891), Harriet (1892) and Olive (1900). The home was run with the help of a cook, housemaid and a very competent governess; when the children were old enough they attended boarding school in Adelaide.

Ella Chaffey was an authoress of children's books. In 1896 The Youngsters of Murray Home was published and was based on here own children's lives at "Olivewood". The newspaper reviews of the day compared her favourably to the popular Ethel Turner.

The Chaffeys were well respected and involved in all aspects of the new settlement. In 1904 the family left to visit British Columbia, Canada and in their absence the mortgage over "Olivewood" was foreclosed due to crop failure. Household furnishings and personal property was sold by public auction. The furniture in the house, at present, has been provided by the National Trust of SA, as well as gifts from local people.

5 Engineering works at Mildura

George Chaffey was faced with a significant engineering challenge at Mildura. He knew that the red soil of the Mallee would be highly productive if enough water was available and at Mildura the Mallee soils came up to the river bank. However the river bank in the area was approaching 90 feet (27 m) above summer river level whilst the land sloped gently away from the river towards the south. The maximum reliable lift of centrifugal pumps of the era was about 35 feet (11 m) meaning that pumping would have to be done in several stages.

Chaffey selected King’s Billabong to be developed as a storage reservoir for the scheme and the first lift from the river to the irrigation channels above. King’s Billabong would be dammed at each end to provide a storage about 20 feet (6 m) above summer river level.

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The Psyche Bend steam pumping engine being erected.  
*Image: source unknown.*
To raise water from the river to King’s Billabong Chaffey designed a large triple expansion steam engine with a maximum power of 1000 IHP to be located at a place called Psyche Bend on the south bank of the Murray River about 7 miles (11 km) upstream from the centre of Mildura. The pumps required to deliver a peak output of 150,000 gallons per minute (2 ML/s) and the engine was configured to drive two 40 inch (1 m) diameter pumps at each end of the crankshaft driven at engine speed directly connected to the crankshaft. The engine would run at 160 revolutions per minute and use a steam pressure of 140 pounds per square inch (965 kPa). “For the first time in engineering history, direct-acting triple expansion engines were to be used for driving centrifugal pumps”.

A second pumping station called Billabong was constructed to pump from King’s Billabong to the 50 foot (15 m) channel. The engine in this station was identical to the Psyche Bend engine however the four pumps were of 20 inch (508 mm) diameter and delivered 40,000 gallons per minute (528 kL/s).

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34 IHP = Indicated Horsepower, the measured output of a steam engine.
The delivery head of Billabong pumping station varied between about 30 to 35 feet (9.2 m to 10.7 m) depending on the water level in King’s Billabong. The construction of these engines was entrusted to Tangyes Limited of Birmingham, England. The company might have had some concerns about the Chaffey design as the names plates read “Chaffey’s Improved Pumping Engine Made by Tangyes for Mildura Irrigation Colony” suggesting some attempt to minimise their liability. The design of the engines caused a storm in Australian and English engineering circles at the time. However Chaffey was vindicated by the long life of the engines. The Psyche Bend engine is still in operation and is demonstrated working on steam and pumping water periodically. The King’s Billabong engine has been preserved and is now located in a park in central Mildura.

George Chaffey designed the channel system at Mildura with the objective of providing water at the highest point on every block of land by gravity from an irrigation channel. By 1893 there were four systems in operation serving a total of 29,950 acres (12,130 ha). The systems were: Billabong system, 26,020 acres (10,538 ha); Homestead system, 1630 acres (660 ha); Ranfurly system, 450 acres (182 ha) and Town system, 1850 acres (749 ha). The channel systems were at various elevations however the principal channels in the larger Billabong system were at the 50 foot (15 m), 70 foot (21 m) and 75 foot (23 m) elevations above summer river level. This required a total of 10 pumping stations (including the two large stations at Psyche Bend and Billabong, already discussed). All these stations were steam powered and various manufacturers supplied engines and pumping plant including W H Allan, Sons & Co of Bedford, Tangyes Limited of Birmingham and Blake. All the pumping engines drove centrifugal pumps except the Blake engines which drove duplex plunger pumps.

With pumping stations and the channel system in place and the township of Mildura established and thriving the future of the Chaffey project and the Mildura community appeared secure. The fortunes of the project and community would change in the mid-1890s when “internal dissensions brought the growth of the colony to a standstill”.

6 Engineering works at Renmark

Little has been discovered about the engineering side at Renmark. It is clear that it was on a much smaller scale than Mildura and that it followed similar principles. Steam pumping from the river was employed and a steam engine and centrifugal pump is mounted outside the Irrigation Trust Office in Murray Street, Renmark.

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40 Grace’s Guide uses this company name at the time when the Mildura plant was manufactured.
41 Ibid.
42 The name of Blake as referred to by Alexander J A is not found in Watkins George, Stationary Steam Engine Makers, Volume 1, Landmark Publishing Limited, contents page 5, 2006.
This engine is considerably smaller than the two triple expansion engines at Mildura and of a more conventional Tangye design being a compound design (steam is used twice in each cycle).

The image below shows workers preparing an irrigation channel by hand. Very little machinery would have been used on this kind of project in the late 19th century era. This channel seems to be very similar in construction to the channels at Mildura. The inside of the channel is not lined which proved to be a weakness at Mildura and probably also at Renmark.

Building an irrigation channel at Renmark. Note that the heaviest earthmoving appliance in the image is a shovel. *Image: State Library of South Australia, Catalogue number B53443.*
7 Engineering Achievements

George Chaffey showed considerable bravery in much of his engineering design and repeatedly pushed the boundaries of engineering practice of the day to achieve his objectives. Furthermore he carried out much of his engineering design away from the engineering resources of large cities whilst working in the wilderness.

His adoption of marine-type triple expansion steam engines to drive the pumps at Psyche Bend and Billabong is an example. He adopted an unusual cylinder configuration with a three-crank engine with the high pressure and intermediate pressure cylinders driving the centre crank and the two low pressure cylinders driving the outer cranks. The configuration, whilst mechanically symmetrical places a larger load on the centre crank than out the outer cranks. Many engineers of the day regarded this as grossly bad practice and said so loudly.

Steam engines, relying on many features developed in marine practice, became the standard configuration for pumping engine in the years after the Chaffey engines were built and remained the best available technology until reticulated electricity saw a change to electric pumping plant.

Whilst it is true that, in the long career of the two identical engines, the Psyche Bend engine suffered two crankshaft breakages we need to look carefully at the circumstances before jumping to the conclusion that Chaffey had erred in his design. The engine was commissioned in 1891 and the first crankshaft breakage occurred in 1902 after 11 years of service. The second crankshaft did not actually fail but showed cracking in 1932, was strapped and the replacement crankshaft was fitted in 1934. The third crankshaft was not supplied by Tangyes Ltd but was forged in Australia by the Commonwealth Steel Co Ltd at Port Waratah in New South Wales and machined by Robison Brothers in Melbourne, Victoria. This crankshaft has now been in service for 82 years and has outlived its two predecessors combined by some 39 years and is still in service. So the question remains: were the two Tangye crankshafts in some way deficient in design or manufacture or was the Australian replacement crankshaft different in some details of design or manufacture? Whatever we may now conclude it would be brave to suggest that Chaffey’s original design was faulty given the duty which the engine performed.

Whilst the Tangyes Ltd engines were being manufactured and shipped to Australia George Chaffey devised a clever way to provide water for irrigation in the short term. “He purchased an old river boat, the Jane Eliza, and converted her into a pumping barge, fitted with two 20-inch centrifugal pumps. This kept King’s Billabong full in the early days of Mildura, and thus the Jane Eliza advanced the Mildura irrigation era by nearly two years.”

George Chaffey had a particular skill for the efficient layout of irrigation channels. He had developed this skill in California and is known to have used it at Mildura. “A few days driving through the scrub

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45 Approximately 75% of the engine’s horsepower was generated on the centre crank with the outer cranks accounting for approximately 12.5% of the horsepower each.
48 The authors concede that the engine has been in semi-retirement for much of the 82 year life of its third crankshaft however it was in active irrigation service for 25 years after the Australian crankshaft was fitted. In 1959 the pumping duty was taken over by electrically driven pumps.