Introduction

Importance and Philosophy

Fountains indicate and signal well-being to all. Not only that, they share their Karmic energy with all who see, hear, smell, taste and touch them. They are, and always have been, necessary for permanent settlements. We use them when ever we turn on a tap. Fountains have come to symbolize the generosity of a god, an institution or a person. They indicate abundance and ingenuity. In every culture they play a part in the mythology of life. In Scandinavian mythology, for example, the fountain of Mimir, source of hidden wisdom, lay under the roots of the great world tree and in Islamic culture fountains are found refered to in the Koran, in the garden called Paradise. In the Bible the passage: "It is done, I am Alpha and Omega, the beginning and the end. I will give unto him that is athirst of the fountain of the water of life freely," reflects the importance that fountains symbolised to the writers.

Fountains are infinitely adaptable. They represent ingenuity and life, power and control. They can make you want to laugh and yet we worship at them. We make our offerings to them and entrust to them our wishes and secret joys.

The fact that it has always been so is illustrated by Morton who records that the Jesuit owners of the warm springs at Bagni di Vicarello decided in 1852 to send a gang of workmen from Rome to clean the spring which had become choked up. In draining it they came upon a layer of bronze and silver coins of the fourth century BC, and then layer upon layer until they came upon offerings which were made before the time of minted coins. These were rough scrapes of copper. At the bottom they found stone arrow heads and polished stone implements.

Fountains are places of heightened awareness. They add quality of life throughout the world and are becoming available to more people all the time. They have no enemies. Why water fountains should have this effect nobody knows. Perhaps in part we hearken back to when our ancestors left the seas, or perhaps we are reassured by the presence of an element we cannot survive without. Maybe the ionizing effect of the water fosters a feeling of well being, or perhaps the sound touches some early memories of life within the womb. Sir Geoffrey Jellicoe, the eminent Landscape Architect, believes that "the underlying attraction of the movement of water and sand is biological. If we look more deeply we can see it as the basis of an abstract idea linking ourselves with the limitless mechanics of the universe." Whatever the reasons the fact remains that we will always enjoy and be refreshed by moving water.

Scope of Dissertation

This dissertation tells the story of man's inventiveness and ingenuity to create fountains, using water, energy, technology and available materials.

The development of the fountain has been affected by the same criteria changing in different ways, namely:

- the availability of water,

- the technology available,
- the evolved style of the environment of the feature,
- the topography,
- the wealth and temperament of the builders of the feature.

It is these factors that we shall explore.

The first requirement of any fountain is water. If nature provided no water no fountains could flow and it is from the generosity of nature the first fountains came. Greek culture has been chosen to best illustrate the evolution of "spring" fountains.

The creation of reservoirs, filled by the regular rising of river water, started another breakthrough and affected the gardens of the Ancient Egyptians, Persians and Islamic cultures.

The basics of hydraulic engineering allowed man to develop away from the source using open pipes, then closed pipes, which allowed gravity to feed water under pressure and created the first man made rising jet fountains. These are illustrated using the city of Rome, the Islamic gardens of the Vale of Kashmir, and the gardens of Chatsworth .

All used nature and gravity as the power system which drove the water displays.

Pumps changed all that and the evolution of the pump is used to illustrate the development of the fountain, particularly in modern times, and in the chapter which details each advance in technology.

Because the development of fountains evolved around both style and technology and the two are inseparably mixed it is only towards the end of the dissertation that a clear picture comes into focus. The concluding sections outline available modern technology and ends with a chapter outlining some of the requirements and pitfalls in the creation of sucessful fountains.

Types of Fountains

In fact there are just three types of fountain: those which have rising jets, those with downward falls and those with a combination of the two.

Rising jets are usually considered the extrovert and exhibitionist forms.

Figure 1.
The Emperor Fountain at Chatsworth

The geysers of Iceland and the waves of the sea striking the shore and flying upwards are natural examples of rising fountains. It is rare, however, for nature to supply a consistent rising jet unaided by man's artifice.

Rising jets are most frequently used in public displays and being able to change form quickly they can be adapted for inter active forms with music or people easily. Where there is considerable water flow or advanced technique the water itself becomes the display rather than a part of the display. In Roman fountains, for example, where water is plentiful, the water, dominates the displays, but in Florence, however, on the plains, where pressurised water is a more valued commodity, it adorns and adds to sculptural fountains in a more subtle way. Now, pressure piping, powerful pumps and water projectiles, as well as the micro processor and linear flow techniques have all made possible displays in which the rising jet is used today and many modern display fountaineers rely entirely on the water for total effect.

Changes in lighting can also alter their appearance radically and they may readily be seen at a distance. The combined effect has been described as "never ending fireworks."

However, rising jets can be, and are, used to different effect in small gardens and also in formal gardens drawing from the Persian influence, where water is considered extremely valuable. In these instances it can be illustrated that a small spout of water is used to create a more contemplative humour and an altogether gentler use of the rising jet has evolved.

The cascade or downward fall

fountains have a far greater place in nature. In nature they are all rivers and streams, all waterfalls and all rising springs. Man has contained them, rerouted them, embellished them, miniaturized them and finally emulated them using artificial pumping systems, (figure 2.) and now that we are starting to understand scientifically the good effect that all fountains, and particularly cascades, have on water, we are continuing to use them to purify and revitalize our supplies.

Figure 2. Ira's Fountain, Portland, Oregon, USA.

The earliest surviving carved water basin, dating from around 3000 BC., was discovered at the site of Tello, one of the cities of Mesopotamia. At Mari, another of the most important cities, a stone fountain figure dating from around 2000 BC was discovered. The figure can be considered a prototype for the kind of fountains made in gardens for thousands of years thereafter: a female goddess holding a base into which water is piped to cascade forth, symbolizing the source of all life, the ultimate creative force of the garden.

In the garden a cascade, is usually integrated into a natural arrangement, and often used to develop the introverted, timeless and private aspect of gardens.

Palaces and houses of the powerful have frequently been located to maximize the relationship with cascades. This is particularly so as cascades are very often found at places of great natural beauty and good "Fung Shui" as the Chinese would say, to describe a location with excellent air, light and water.

The cascade is also a symbol of power and wild nature, for example, at Niagara Falls in New York State in America where people, especially the newly wed, assemble to be awed by the might of nature.

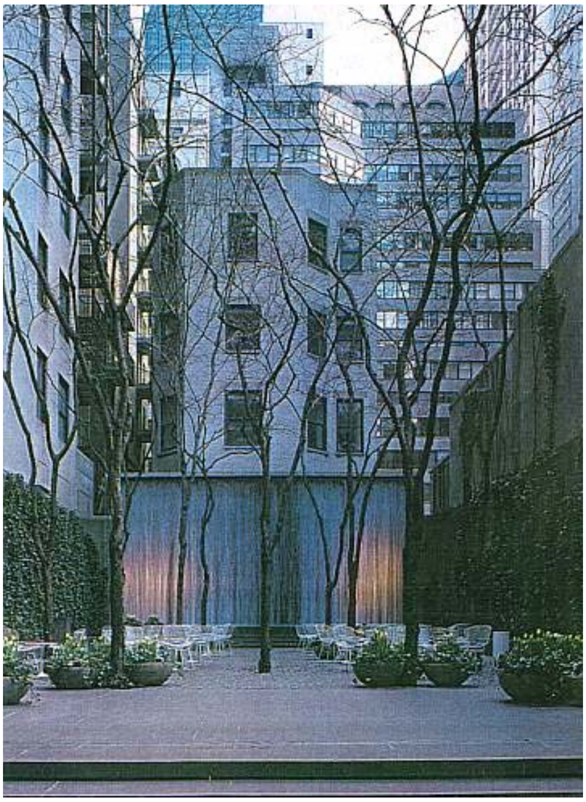

Figure 3. Paley Park, New York

In the writers youth in Hong Kong the annual visit to the overflowing reservoirs not only heralded the end of the annual water restrictions but made a powerful effect with the roar of white water flying through the narrow overflow channels.

In post renaissance Europe Le Notre and his pupils and successors developed the ideas of the Renaissance garden cascade, extending and formalizing it. Cascades of great length evolved all over Europe. These we shall illustrate with examples, including Chatsworth in Derbyshire.

America, which often utilizes new technology more swiftly and effectively than the old world, offers some very exciting examples of cascades utilizing closed water systems and electric pumps. Examples to illustrate this include: Paley Park in New York (Figure 3), with its wall of water and Ira's fountain (Figure 2.) in Portland. Oregon.

The Closed System Fountain

Most modern fountains, be they cascade or rising jet, use this system which grew up with the use of powered pumps. Pumps allow fountains to play where previously they could not. (figure 4.) This has brought pleasure to millions, although, man's artifice has its drawbacks as the water is invariably not drinkable.

Figure 4
Closed Circuit Fountain by Dick Choix in Talbot Square, Canary Wharf, Docklands, London.

To the purists eye there is something contrived about the powered closed circuit fountain. This is probably because nature is uninvolved in the supply of water. The difference lies in the fact that the re circulatory fountains fail to fulfil the primary function that interlocked man and fountain from the beginning, in that they do not provide drinking water. The closed circuit becomes a metaphor of the fountain of Life and not a real one. The grand and generous fountains of Rome or the Vale of Kashmir flow day and night seen and unseen always with clean fresh water in a way that Witley Court or Trafalgar Square never can. It is necessary to move conceptually from a classical tuning of nature to a modern mastery of it to appreciate the closed circuit fountain.

This effect may be and often is offset by careful settings to give the impression that the feature is in fact a result of nature's bounty. A small stream, for example, can have its source disguised to give that effect.

Modern designers use closed circuit fountains which play in shopping malls, plazas, office buildings and gardens, copying an effect that nature rarely gives outside mountains or hills. With the new technology comes a new set of problems.

Generally closed circuit fountains have much higher filtration and maintenance requirements than open system fountains. Because water attracts dust and air borne pollutants it very quickly becomes unattractive to the nose and eye unless it is purified. Also nature and the public habitually throw their debris in the pools, and if fish, plants or livestock use the pool they too add debris and pollutants to the water. Usually swimming pool type technology is used quite satisfactorily to clear the water, but the pools of fountains do not usually have the steep sided profile that many swimming pools do and thus the debris is not as conveniently collected. Where there is public access to the water there is usually a combination of skimmer technology and also water vacuum cleaning facilities which are built into the filtering scheme.

Water evaporates and spills so there are automatic top up systems to stop the water level in the pools and basins dropping. In addition to this it is necessary to incorporate drainage facilities and backwash systems for the filters as the pools and filters will require regular maintenance. The water may also be chemically treated for hardness in order to stop any unsightly deposits forming on the display.

Thus considerable space and expense goes towards making an effective closed circuit fountain. Factors in the design are discussed at the end of this work.

Purposes of Fountains

One of the first requirements for any permanent settlement is potable water from a reliable source. Indeed, without that no settlement can be contemplated. Gardening and ornamentation is not an occupation seriously undertaken in times of war or famine or civil distress. It follows, therefore, that the success of a civilization can be measured by its gardens and water features, which were developed directly as a consequence of the well being of that civilization. In earliest settlements, as now, the fountain took pride of civic place for both citizens and visitors to illustrate the power and civilization of a community. The control of water resources was the first necessity of the well ordered state and the deprivation of those resources one of its most powerful sanctions. In Rome banishment meant depravation of the fire and water of Rome.

The Fountains in early civilization had four principle functions:-

The supply of drinking water

Figure5
A street fountain,
Bayswater Road, London

Fresh spring water is very often better in quality and taste than water stored in reservoirs, tanks and ponds. Although recent research into the characteristics of water indicate that stored water can be rejuvenated, throughout history, where a spring or fountainhead is available to the public, they make use of it. This inevitably made fountains a unofficial meeting point, as the water cooler still is today in the United States and other civilized countries. In Syracuse in Sicily the citizens still take jugs to the springs to collect fresh drinking water.

In certain aspects it is only in the 19th century that we have exceeded the ancient Romans in our supply of domestic water supply. In London and the United Kingdom, drinking water which was controlled by private companies at the end of the 18th century. At that time at least three water companies derived their supply from the Thames. The oldest raised it by water wheels at London Bridge; a second pumped water out near the Strand, a third brought it from the river at Chelsea. It was expensive, often polluted and badly and unreliably supplied at that time. Sewerage arrangements were inadequate and often foul water was fed into the water supply.

In the 19th century the population of London grew rapidly and disease from water borne disease rampant. Many of the working class population drank beer and spirits in considerable quantity as they felt that brewing purified the water. Because of the resultant drunkenness amongst the working population the temperance movement grew up and a nephew of Elizabeth Fry the prison reformer, formed a Metropolitan Society whose aims were to bring fresh pure drinking water to the population at large (Figure 5). This led to fountains all over London for both man and beast . The first fountain installed by the society drew 7000 people per day to its font. Water supply reform followed and the water supply system was taken under public control and massively improved.

In Paris in the early 19th century the situation was similarly dire . When Haussman arrived inthe capital in 1833 the water supply system had not been improved since the turn of the century. In Paris there were close to 2000 public fountains and the water from the Seine was raised by pump at Chaillot and Austerlitz. . Water porters carried the water to homes but the water was very polluted and water filters were on sale. In his design for Paris Haussman was committed to the provision of abundant, pure water to the domestic dwellings. The new systems being installed in London were used as a model.

Water was provided using a new system of masonry aqueducts and metal pipes. At considerable expense, an adequate sewage system was built with excellent sewers leading to land purchased by the city for safe disposal. These works were mainly undertaken between 1860 and 1865. Since then advances in domestic supply to most modern homes have drastically reduced the need for public drinking fountains in cities.

The supply of water for animals

Fountains provided an informal meeting point by necessity for drovers and herders marketing their animals. These are best illustrated by the water troughs which were widespread in this country in the late nineteenth and early twentieth century. Many of these have now been removed or are used as planters. They were frequently gifts of prominent citizens. Examples can be seen in London streets as well as small villages such as Pycombe and Cuckfield in Sussex.

The supply of domestic water for washing, cleaning and cooking

This led to an informal meeting point where women in particular met on a frequent basis as it is often impractical to carry the quantity of water required for washing from a fountainhead. Indeed many women in warmer climes very much miss the social gatherings about the washing facilities that they had until recently enjoyed for centuries. The old washing tables can still be seen in the south of France and Majorca.

In this country the arrangements were not so sophisticated and consideration was not always given to other users of the fountain. In the Petworth Archives in the 17th century Lord Leconfield noted fines for washing bullocks entrails at the common tap.

Display and communication centre

Mankind loves to embellish and with the fountain he has had ample scope. In Europe particularly, local authorities have seen fit to improve the fountain as the natural focal points of the town and community and private owners, leaders and kings have seen fit to undertake a wide range of improvements. Fountains demand from the public offerings; currently the Trevi fountain in Rome has coins thrown in it to the value of over 100, 000 Italian lira per week . So a display fountain owner should always check his fountain for valued gifts before declaring him or her self bankrupt.

Most recently the introduction of submersable electic pumps and micro technology have made possible a new form of mobile display which compete with fireworks in public appeal.

The Evolution of Styles of Fountains

The range of fountains that can be created today is vast. In this chapter we look at the principle sources of style of fountain, in what must be a very potted history. Most classical fountains can find their roots in one or more of the gardening styles that follow:

1. The Persian Garden developed in the mountainous plateau which formed the central area of the Persian Empire. There water was a priceless commodity. This was reflected in the traditional Persian Garden which was composed of four essentials: water for irrigation, display and sound, shade trees for shelter, flowers for scent and colour, and music to delight the ears, a typical garden design found from Persia to Spain and in many old carpets and miniture paintings is a quadrant pattern with water channels dividing the garden into four sections (Figure 6).

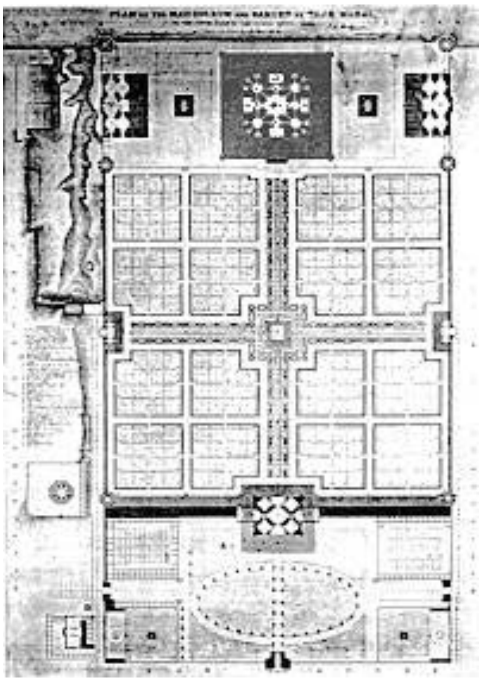

Figure 6.
Plan of Gardens of Taj Mahal

There was usually a pool or small hill with a pavilion at the intersection of the channels.

The Persian Influence is reflected after the Arabs overran the Persian Empire, Traditionally nomads, the Arabs, who were kept on on the move by the constant search for water in the Arabian deserts, journying from one oasis to another. They did not have the integrated and advanced culture that the Persians had developed with their long established settlements. The Arabs developed the Persian style of garden in two principly different ways, namely the Mughul style, best illustrated in the Vale of Kashmere and the Moorish style for which the works at Granada are the most famous.

a. The Mughal Garden.

Developed with the expansion of the Arab Empire in Northern India. The exceptional qualities of these gardens arose because they were developed where water was plentiful and the Mughal designers were able to make use of it in a way that would, no doubt, appear profligate to the Arabs who inhabited less generous climes.

Figure 7.
The Gardens at Shalamar Baghin, Kashmir

At Shalamar Baghin Kashmir, (Figure 7) at the foot hills of the Himalayas, the Persian tradition of severe restraint with water is broken. Here there were large volumes of gravity fed water available and the Mughals laid out gardens which saw "the treatment of water achieve new heights of ingenuity. Within each garden the variation of mood was dictated by changes in the treatment of water with a rarely equalled harmony or movement and contrasting stillness resulting in a complex interplay of sound, light and shade reflection".

These complex and sophisticated gardens made use of the ample water flowing from the Himalayas utilising pools, streams and waterfalls and pavilions. Indeed they were so sophisticated in their use of water and light that they invented a form of waterfall called the chadar, (Figure 8.) which was set and built in such a manner as to maximise the play of sunlight on the water and give an effect directed at a specific area for viewing.

Figure 8.
A Chadar

They also made use of large amounts of standing water. It is interesting to reflect that two years after the completion of the Taj Mahal, (a preeminent Mughal designed garden) and its large reflecting pool, in 1654, Le Notre used for the first time a central pool designed to reflect the whole facade of a building, in this case a chateau, possibly emulating Mughal design ideas.

b. The Moorish Garden.
To the west the Arabs took the Persian Influence and developed the Moorish gardens illustrated by those at Granada in Southern Spain.
To do this they utilized gravity systems which had not been in use since the Romans to ensure a plentiful supply of water. However, where rising jet fountains are used it is done with severe restraint as at the Court of the Canal at the Generalife gardens at Granada. (Figure 9.)

Figure 9.
The Court of the Canal, Genalalife, Granada

It is not difficult either to understand the nomadic Arabs retaining a high respect for water as a valued resource. This was combined with a cultural approach similar to that of China and Japan, by which gardens were designed as places for private meditation and luxury rather than for public sharing as with the Greek and Roman civilizations.

Two great qualities stand out in Islamic gardens and fountains. Firstly the fountains never had any likeness of men, as the Koran forbade it, and secondly they were always more restrained in the quantity of water used (excepting certain Mughal gardens) although this was balanced with a feeling of plenty.

They combined the need for irrigation with channels bowls and fountains to create cool, sweet smelling gardens in the hottest and most hostile of terrain.

The bubble fountain in which the fountain barely disturbs the surface of the water is a good example of that respectful restraint. Basins were designed to be continually full to the brim with water overflowing to secondary channels. The basins were often faceted or carved in a lotus pattern, which makes a small volume of water seem greater.

Islamic fountain basins were invariably mounted close to the ground, often barely extending above the surface of the surrounding plane. They are thought to have served the function of cooling the courts in which they were placed through evaporation, in addition to their religious functions. (Figure 10.)

Figure 10.
Fountain at the Ismali Centre, London

Moorish design made the most use of water in other ways too, channelling it carefully for use in irrigation when its display functions were fulfilled. This quality was singularly lacking in renaissance and post renaissance Italy where man made profligate use of gravity fed water from the hills.

2. The Western garden

Has its roots in Greece and Ancient Rome. With the coming of the renaissance to Italy, and Rome in particular, the water garden developed, using the plentiful water supply of the hills combined with basic piping and gravity. It was only with the development of the water powered pump that the styles evolved in the Roman hills were able to be used in the gravity fed fountains. Thereafter the styles of water gardens of Rome and Italy were able to spread to greater Europe where they were adapted by the French to reach a formal zenith at Versailles.

An outstanding example of an Italian post renaissance garden is at the Villa Lante at Bagnaio which was built about 1566 by the architect Vignola for a Cardinal Gambara. (Figure 11.)

Figure 11.
Water Table at Villa Lante, Bagnaio

Jellicoe considers that perfection in the Renaissance style garden was reached. "The whole design of the garden is etched in water. From the rock face at the top a little waterfall fills a rough stone pool. the water is then led down the centre of the garden in stages each more sophisticated than the last until it reaches the water-parterre at the bottom. The entrance to the garden is at this level and is reached by steps which pass above a large curved pool with sculpture by Giambologna in the centre. This pool has a crucial function since it links the formal garden with its counter-balance, the half-wild woodland threaded with paths and occasional fountain jets."

In particular the development of the cascade, or downward falling fountain is seen to have flourished in the gravity fed renaissance gardens of Italy. In Rome fountains with statuary and abundant water abound as a consequence of the reinstatement of the earlier water supply systems.

The Trevi Fountain (Figure 12.) is a fine example of a Roman display fountain, and until recently it flowed with potable water. It is probably the world's best known fountain. It was built as the Mostre, or show piece, of the Acqua Vergine Antica water system, which was the first to be rebuild by Nicholas V., about 1453, after the dark ages.

Figure 12.
The Trevi Fountain, Rome

The first Trevi fountain was a plain wall fountain designed by Leone Gattista Alberti, at that time. In 1640 Pope Urban VIII asked Giobanni Bernini to design a new fountain, but Bernini died before his plans were complete. Delay followed delay and it was 122 years later that the fountain was completed to a design by Nicola Salvi. In May 1762. The result was "an imperial gesture, flamboyant and triumphant, the kind of fountain that any Emperor would have erected who desired to impress upon the populace the virtues of new water and his own virtue in introducing it"

"Much of the most beautiful dream architecture of the seventeenth and eighteenth centuries went up in flames in the course of firework displays and the greatest architects of the time were willing to design the ephemeral scenery of masques and public spectacles. Consequentially the Trevi is probably that rare object, a reflection in stone of those fragile splendours. That Neptune should suddenly appear, escorted by Tritons and sea-horses and accompanied by a great waterfall, upon the placid facade of an Italian palace, a display of primitive energy as violent and unexpected as a burst water main in Piccadilly, is typical of the 17 century masque."

Following the advent of water powered pumps, France led the way with new and grand water features. At Verseilles, for example, water gardens were commissioned by Louis XIV and designed by the vastly influential director of Royal gardens, Andre Le Notre, who completed them in 1668. This French style of garden eventually dominated Europe, although perceptibly altered in some ways by each of the countries that it influenced. Most classical fountains has evolved from this route, as can be seen at Witley court and countless other examples in this country.

3. The Oriental garden.

It is in the recreation and exploitation of natural effects with water that the Chinese and Japanese water gardens excelled, In fact they took it to such a pitch that they reproduced the effect of downward flowing water using sand and rocks. The philosophy of oriental gardens evolved around the creation of places of solitude and contemplation, working with, rather than overcoming and taming nature, and it is only in this context that it is relevant to fountains.

It has been argued that the English Landscape gardening of the 18th. century, as practiced by Capability Brown, Humphrey Repton and the like, was taken from the oriental style of gardening. It was seen, unlike the European renaissance movement, to present a more naturalistic, stylized form of gardening. The oriental style, precursor of the English Landscape movement, rarely used rising jet fountains and when using fountains at all relied mainly on natural water flows through dams as the natural overflows to lakes and informal pools.

Power and Pumps

Any study of fountains and the water systems that sustain them must be aware of the importance of pumps. When used successfully they allow settlement away from the original sources of water or away from places which cannot be fed by gravity. They were originally used to force water to storage reservoirs above the distribution points.

Most of the water supply to modern towns is still pumped and supplied in this way. Consider the water towers near most habitations. This method allows water to be pumped to storage reservoirs at a constant rate whilst allowing it to be drawn upon at a constantly changing one. Over history the methods of raising water have evolved broadly as follows:

Man and animal power.
The man powered Shaduf, or well sweep is considered to have been invented by the Egyptians. The Shaduf consists of an upright pole with a cross arm, From one end hangs a basket for collecting water and at the other a counter weight. This method is still in use, a single operator being able to raise five or six hundred gallons of water to a height of 6 feet in a day. For greater heights a series of shadufs lifted the water in small stages into small pools at differing heights up the river bank. These practices are shown in the ancient Egyptian paintings, which also reveal that many of our small fluid handling items were in use thousands of years ago, eg the siphon, the pipette and the syringe.

Water wheels driven by animals were, and are, also extensively used. The Saqiya developed in Syria was in use in Roman times and is still in use in Pakistan today. It utilises two gears meshing at right angles and allows for an animal, in a circular walk, to drive a wheel with a chain of pots which dip into a lower source and discharge into a higher header tank.

The labour required for raising water for gardens, along with the high rates of evaporation in hot countries, probably accounts for the Egyptian, Persian, Islamic and Mughal style of gardens and fountains where small quantities of water are used to great effect.

Wind and water power. It was only because of the development of the water powered wheel as a pumping device that the French were able to develop their style of formal gardens on flat lands.

Although at the time of the doomsday book in 1089, 600 water driven mills were grinding corn in England, water driven pumping devices appear to have been developed firstly in the Islamic culture. In the 13th century AD a water driven pump was built at Damascus and was kept in use until 1960. These ideas were developed in the Middle ages. In 1588 Agostino Ramelli, a military engineer serving Henry III of France, published a work which illiterates a wide range of water driven pumps and devices.

It was the development of these devices that made it possible to develop grand water gardens and fountains away from springs and mountains. The fountains at Versailles, for example, where the French formal style of water garden reached a peak, were only possible because of the development of the water wheel as a water pumping device.

France led the way with new and grand water features, some of which utilized the water wheel. At Versailles water gardens were commissioned by Louis XIV. and designed by the vastly influential director of Royal gardens, Andre Le Notre, who completed them in 1668. (Figure 13.)

Figure 13.
The Apollo Basin, Versailles

Water was supplied from a complex of water wheels, known as the machine at Marly. This was the biggest water-wheel installation ever constructed and was completed in 1682. In fact it never was entirely satisfactory ; it is said that the fountains of Versailles were operated only when in the eyesight of the king because of the limited water supply.

The gardens at Versailles, however, were a spectacular success and became the model which garden makers all over Europe aspired to. In each country in Europe the French influence was grafted on to national traditions.

At a more practical level at Petworth in Sussex, the Third Earl Egremont, in 1782 commissioned a beam pump to force water one and a half miles from the river to the town, vastly increasing the supply to the town which hitherto had only been supplied by springs.

The wind driven scoop wheels developed in Holland were a 14 th century invention . Windmills were widely used to pump water in Holland by the end of the 17th century and their use spread to England, especially to the fenlands.

Steam and diesel In 1712 a stationary steam engine was invented and put to work pumping water from the mines of Cornwall. This heralded the industrial revolution and with it the possibility of pumping water cheaply and without natures help. With the new pumping technology industrial and domestic water supplies started to be piped under pressure. In landscaping, water features and fountains could be placed in sites where previously they could not be considered.

The first steam pump was exported to France in 1779 and was used to help pump the Paris water supply from the Seine.

The industrial revolution brought great wealth to some, and as a consequence grand houses, gardens and fountains were commissioned. An outstanding grand example of an ostentatious display of wealth was built a at Whitley Court in Worcestershire, where in 1858, William Andrews Nesfield was commissioned to lay out the gardens and fountains. He utilized steam power to pump water from an ornamental lake at the front of the property up to two newly constructed reservoirs nearly a mile away and some 120 feet above the scheme. The two fountains were massive in proportion and were fed by two pipes, one 15 inch and one 20 inches in internal diameter. The effect was described in the 1920s in his diary by I L Wedeley thus "The great central jet of the fountain sends a vast column of water to a height of 90 feet, while at every conceivable point other streams are issuing, making a huge circle of arched cascades around the group itself, At each end of the long oval basin stand other fountains of considerable size, the basin being surrounded by greensward and having a beautiful walk on the margin. When set playing, the onward coming of the waters can be heard like the rush of a train- until the central jet sends up its huge column, when the sound becomes almost deafening as it rushes into the air, then falls with a mighty roar into the basin itself. . . There are dissolving views of shifting rainbows and with the rush, dash, splash and light feathery spray of the many rising and falling streams or jets one seems riveted to the spot, as by the spell of all the water-nymphs enchantments".

Sadly, these fountains fell into disrepair but are now being restored, however, the intricate pipe work and steam system was broken up for scrap, so the fountains of Whitley Court will now be powered using electrically powered pumps, the technology which now powers most fountains around the world.

Electric powered pumps.
This is the pumping technology that is most widely used today and can in fact be used in reverse, when water power is harnessed to drive turbines which supply electricity in otherwise uninhabitable places, for example Las Vegas. Electrical power and pumps makes closed circuit fountains possible. These fountains, recirculate the same water again and again and are only topped up to counteract the effects of evaporation, or after cleaning. This makes possible fountains where it would be prohibitively expensive and wasteful to build them otherwise, and accounts for the majority of modern fountain schemes. The first alternating current motor was invented in 1888 by Nikola Tesla, and was manufactured in America by Westinghouse.

A grand theatrical fountain complex exploiting the early potential of the electric pump is found in Barcelona where, in 1929, after more than decade of delay, The Magic Fountain flowed. Originally it had been intended to be built for an exhibition extolling the virtues of electricity in 1916. It utilizes four electric motors of 250 horse power and puts between 4 and 8 tons of water in the air when in full play. (Figure 14.) It also represented a revival of the 18 century theatrical fountain display which had prospered in post renaissance Europe, particularly France, where, although much admired, the tradition had fallen in to disuse probably because of the difficulties in providing the necessary large amount of water under pressure .

Figure 14.
The Magic Fountain, Barcelona

Most large fixed fountains systems now use electric power and re-circulate the water. Traffalgar Square, La Place de La Concorde, now even the Trevi fountain are electrically operated, also the vast and growing number of small water features in shopping malls, town centres, and other areas where the public are encouraged to gather.

The submersible electric pump, made practical since the second world war, has brought about, in parallel with the micro processor, a new and mobile form of water display where the water, lights and often accompanying music are quickly set up in a place of public gathering. It is the quick response and high power and portability of these pumps which are in process of bringing us a new and delightful entertainment

Compressed air systems
These have had a long history and been rediscovered at regular intervals.

The most recent use of compressed air systems is illustrated in Tokyo where an innovative American water feature company uses compressed air technology to project precise quantities of water in highly controlled patterns.

Hero of Alexandria utilized and illustrated the same principles in the first century AD when he produced a book called Pneumatica which outlined some sophisticated fountains which utilized steam and compressed air to achieve their amusing effects. In the Renaissance these ideas were reproduced and it is recorded that in 1580 an Heros fountain devise, with an owl and singing birds, was copied and made in working order.

Springs

The original meaning of the word fountain refers to a spring of water.

Throughout history springs have played an important part in the placement of settlements. This is especially so in hot countries, where freshwater rivers or lakes were not present and settlement on a permanent basis could not be contemplated without a reliable source of water.

In the United Kingdom settlements generally grew up on rivers or lakes although hilltop settlements such as Petworth were made possible because of springs.

Research on the water supply of early Greek settlements shows that the principle towns were based around springs which well up in Greece because of the particular geology of that region. These springs, called Karst springs, arise when water is forced to the surface by the underground geological structure. This often happened inland.

Where these springs rose and the other natural requirements of a settlement (including beauty) were fulfilled, settlements grew up around them. We are fortunate in that in Greece, in a manner which is not the case for early Persian water features, there are records and remains still to be found today. Greek culture was the basis of Roman culture which eventually led to the Renaissance water gardens.

Because the Greeks wondered at these water phenonimum they considered that they were gifts from a god or gods and were invariably named after that god. Mythologies grew up around the fountainheads and tales of Gods, Goddesses and water nymphs abound.

At Delphi, for example, at a spring which still exists, water was channeled to flow into the temple of Apollo, the shrine of the Oracle. There the Pythis, a middle aged trance medium dressed as a young girl, would drink the water before uttering prophecies which the priests translated into ambiguous hexameters. Other springs were noted for their healing and other properties. Indeed one at Nauplia annually restored the virginity of the goddess. Here, sadly, mortals who bathed in it were generally only gifted with unusual beauty.

Usually the head of the spring was dug back into the hillside and the source decorated or built around, both to honour the god, and to assure the purity and good management of that source.

The earliest architecturally developed spring on record was the Callirrhoe in Athens, built around 560-510 BC. The water was directed into nine outlets, which consisted of bronze lion heads with water issuing from the mouths.

The Greeks were in fact extremely sophisticated in their control of water resources and generally only used the springs for drinking or ritualistic purposes. Water for washing and cooking was generally stored in cisterns which filled in the rainy season and supplied non drinking needs throughout the year. It was the custom to collect drinking water (some 8% of the requirement of Greek households) from the fountains in the town. The remains of some of these fountainheads can still be seen in Greece today, although most of them have stopped working because of alterations to the water table.

The capacity of the springs at the fountainhead limited the size of the community that could grow up around the spring unless other sources of water could be brought to the community. This need brought about the advances in water engineering discussed in the next chapter.

Conduits

Ancient Rome can be used as a prime example of the next major development of man in relation to water, namely conduits or water pipes and troughs. These are used to good effect in Rome to sustain a much larger population than the immediately available water system was capable of supplying.

It is supposed that Rome was founded by Romulus and Remus on Springs near the river Tiber. Because those springs are not capable of supporting a population of more than 50, 000, Rome was only able to develop with the help of applied hydraulic engineering utilizing the local topography and geography.

Rome is surrounded by hills from which it was, and in part still is, fed water by a series of tunnels and aqueducts in bountiful supply. In ancient times these were entirely fed using gravity, enabling Rome to increase its population and grow to be the capital city of the largest Empire the world had seen. These water conduits were considered by the Romans to be the 8th wonder of the world and do illustrate a remarkable knowledge of surveying and engineering.

Interestingly, although we mainly think of the Roman's aqueducts, in fact most of the water was carried through tunnels, many of which survive and are still in use today. Indeed because the behavioural characteristics of water remain the same, much of the engineering techniques possibly pioneered by and certainly used to an extraordinary extent by the Romans both in their capitol city and in their empire, are still valid today.

The Roman empire spread the engineering skills of the Romans across Europe and Roman aqueducts can still be seen in the south of France and Segovia in Spain.

At the time of the first Gothic sacking of Rome in AD. 410 eleven aqueducts were feeding 1, 212 public fountains, 11 great imperial thermae and 926 public baths. Much of the modern water supply of Rome is based on these water engineering feats.

We are very fortunate in that in medieval times the works of the great administrator Frontinus were found.

Frontinus returned to Rome after service overseas including Governorship of England (and the quelling of the Welsh) and was made Chief commissioner of water for Rome whilst in his early sixties. He made his first task to familiarize himself with the wonderful water supply system and also record the facts. It is these records which illuminate the perennial problems of the water supplier. He found the system in disarray, both through corruption and bad maintenance. The water transportation systems leaked badly, particularly where the water travelled in aqueducts. Local landowners were known to create or encourage leaks over their land and to bribe officials not to repair them. Frontinus wrote' the public watercourses are actually brought to a standstill by private citizens just to water their gardens '

Each aqueduct delivered its water to a terminal castellum, which is a settling tank and distribution point, from where it was distributed in lead pipes (many from Britain) around the city. The watermen, often slaves saving to buy their freedom would insert illegal pipes and sell the water privately.

Frontinus restored the wonderful water supply system so that Rome was able to prosper with Potable fresh water for all in abundance. This encouraged the building of many small as well as display fountains.

In Rome it was, and perhaps still is, a matter of civic pride that well off city dwellers built small drinking fountains at the edge of their property to aid and stimulate passers by.

One of the by-products of the water engineering was clean and free flowing sewers which kept the city healthy.

Few examples of the early examples of Roman fountains remain. Almost all were destroyed in the dark ages when the population of Rome was radically reduced, as all the water systems were damaged and fell into disrepair. Indeed it is said that during the dark ages the entire population of Rome was fed by corn grown inside the city wall.

Figure 15.
The Galleon Statue by Jan Van Santen, 1620, Vatican, Rome

With the renaissance of the City from the 14th century and the return of the Popes, the traditions of fountain building were reborn, and many of the fine display fountains playing in Rome today are the result of the desire of Popes or other wealthy patrons to beautify the city. (Figure 15).

Other Gravity Fountains

Places where fountains can be fed by gravity have many advantages, not least the low maintenance and ease with which they can be built and commissioned. They are mainly found in towns and cities which are at the side of hills or mountains, where with the use of aqueducts, tunnels and pipes water can be funnelled to them. Barcelona, like Rome, has these advantages and the streets of Barcelona have hundreds of fountains as a consequence.

In this country the preeminent water gardens are at Chatsworth in Derbyshire, where the best and grandest examples of gravity fed fountains can be seen. Chatsworth benefits from being below a large plateau of country from which water can be collected and stored before being fed through pipes to a wide range of water features in some charming gardens. The present gardens evolved since the 16th century under the directions of the descendants of Bess of Hardwick who had built the original house and gardens.

Figure 16.
The Cascade at Chatsworth

Following the completion of the formal gardens at Verseilles(1668) the Cascade and French Classical garden became popular throughout Europe. Consequentially, the Cascade at Chatsworth (Figure 16.) was designed by a Grillet, a French pupil of the Celebrated Le Notre of Versailles fame.

It was built for the first duke and finished in 1696, however it was rebuilt only 5 years later on a grander scale. The temple or cascade house was added in 1703 to the plans of Thomas Archer, the Warwickshire architect.

(Figure 16.) The length of the paving stones over which the water flows and the numbers and widths of the 24 groups of steps are all different, so the sound of the falling water varies. At the base of the cascade the water disappears underground, passes through a pipe and works the sea horse fountain on the south lawn in front of the house, goes underground again to work the fountain in the west garden below the house, and is finally piped to the river. The cascade house and its watery forecourt contain a series of fountains and jets from which the cascade is fed. Even the dome of the house can be turned into a waterfall and the interior is pierced with holes to soak the surprised visitor.

We are fortunate that the cascade at Chatsworth remains intact (Figure 16). Other examples of the grand cascade in the United Kingdom have succumbed to time, for example, at Stanway House in Gloucesteshire, where work has started on the restoration of another gravity fed cascade. Originally built in 1725-35 it was twice the length of the one at Chatsworth. When the French Classical garden fell out of fashion following the arrival of the English Landscape movement in the 18th century cascades and other expensive to maintain water features often fell into disrepair.

Figure 16a.
The Palazzo Reale, Caserta

The most extreme example of the formal cascade is to be found at The Palazzo Reale, Caserta, near Naples. It is nearly 3 kilometres long. It was completed in 1775 by Carlo, the son of the original architect Luigi Vanvitelli (Figure. 16a)

Various other delightful fountains and waterfalls are found at Chatsworth, these include the world highest gravity fed fountain.

The Emperor Fountain at Chatsworth (Figure 1.) was commissioned by the 6th Duke who decided to outdo the Czars great fountain at Peterhof . He commissioned Sir Joseph Paxton to build the new feature. Paxton used a catchment area of 5 square miles and build the Emperor lakes holding some 50 million litres of water. Perhaps not large enough. Mr. John Oliver the Assistant Controller at Chatsworth explained that only 2% of the water available during the winter of 1993-4 was retained.

The water enters the pipe having been through a mesh with a strain under 1 inch and is fed through a 15 inch internal diameter cast iron pipe 800 metres in length down some 120 metres to the fountain where at full running it expends 15000 litres of water per minute and has been recorded as achieving 296 feet. The Czar, after whom it was named, alas, never saw it.

The fountain requires little maintenance. When a cast iron "pig" was run through the 15 inch pipe recently it was found to be entirely satisfactory. The estate plumber outlined the care with which the supply had to be started and stopped for fear of vibrations being sent up the pipe he also stressed the importance of quality rubber edged valves and pressure relief valves.

Lighting

Until recently, most fountains were made purely to be seen in the daylight, and hopefully, to sparkle in the sunlight which adds magic to the water garden, and is further enhanced by the water mists that can arise. Sunlight and its effects have always been in the thinking of the fountain designer. Mogul gardens of Kashmir, for example, have a particular narrow sloping water shute called a Chadar which was angled to reflect sunlight to the maximum possible degree.

Man's ingenuity has evolved other ways for fountains to be seen as well, in the 17 century torch light tours of the fountains of Rome were arranged. However it was the introduction of electric lamps that revolutionized the pleasure potential of the fountain at night. An early example of the is "The Magic fountain" at Barcelona which was built in 1929 and originally intended to be an exhibition to electricity. The display there the reflects the designers intention's "plicar la lui simplement para ahuyentar los tinieblas, sino para embellecerias" and his application showed what electrical light with filters could do. The display utilised 4700 lamps using 3000 kilo watts of power and harmonized with the play of water to give an astonishing effect. Since then the effect of artificial lighting is one of the primary inputs that the designer will consider. (Figure 18.)

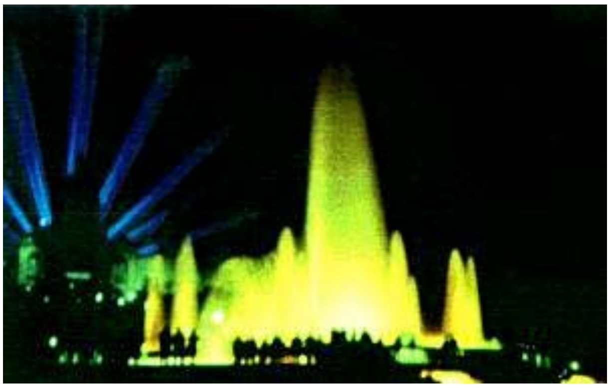

Figure 18.
The Magic Fountain, Barcelona

Illuminating water is an art in itself. Generally illumination using underwater lamps is most effective when these are placed at the base of fountains and cascades. Hightly aerated white water displays are the most impressive as light diffuses up through the water above. Currently the range of lights both for submersion and dry use is vast and this range has been recently added to with the optic fibre which allows a light source to play from a location which would previously been impractical. The Optic fibre can also be further enhanced in use when the newest laminar flow jet are played. These jets recently developed by a California based display fountain specialist firm alter the characteristics of the water and light flow through jets to create remarkable effects.

In another innovation the combination of powerful submersable lamps, with micro processer control worked in conjunction with portable submersable pumps and sound recordings to such remarkable effect that displays are set up quickly and easily almost any where and are successfully competing with firework displays at public meetings. These displays have the advantage that unlike fireworks they are not potentially dangerous, as there is no danger of fire getting out of control and spreading nor of the public being hurt by solid projectiles returning towards the ground. Although the capital costs of these displays is high they are not expencive to run and as such are finding favour with public bodies charged with entertaining the public on high days and holidays.

At another level large windows with double glazing encourage householders to illuminate their gardens and water features at night, especially during the short days of the winter months. Fountains and water features can be lit and controlled from inside the house encouraging the householder to give sound and light shows to his guests, whilst they remain warm and comfortable within the house.

Figure 17.
The Willow Tree Fountain, Chatsworth

Other notable fountains include the famous willow tree fountain which was first built in 1692. The original tree was made of copper and lead. It spurts water from its branches and leaves, and in winter looks so much like the other leafless tees that its trick of wetting the unwary is doubly effective. It has been replaced twice and was last restored in 1983. (Figure 17.)

The ring pond contains a much gentler fountain where water spouts from the mouth of an anchient lead duck.

Discussion

Designers have integrated flowing water and cascades into their schemes in a way that would have been inconcievable until very reciently. Illistrated colour books published for the landscape industry show the use of water world wide, and technology has made it possible for us to enjoy fountains in most locations. Fountains can be bought ranging from the portable table top self contained units that are sold at garden centres, to self contained rising jet free floating units which can be placed in an existing pond or lake and require only a power supply to become operational, these can be supplied with a large range of manifolds and jets which are able to bring about a wide range of effects.

Manufacturers offer pre-manufactured modular units with self contained lighting and filtration units, these are offered as suitable for plazas, offices, and any size site where a fountain can be fitted in, these offer noveties such as rotating spheres cubes and pyramids.

Water playground fountains for young people to play inhave been developed expecially for use in the south of France and other warmer climes. In colder countries the effect of water freezing in the winter is built into the design.

Another step foward are display fountains which features the changes of water and light only and are operated with computer controls, utilising optic fibre lighting, with laminar flow techniques as well as patented compressed air activated jets.

Inovations have been achieved utilising research on the characteristic behavior of water when treated as an organism, it pulsates when the right conditions occur in an effect that has been described as the very pulse of life.

Artists have made "chuckle fountains" which use the weight of water to drive amusing effects.

To describe or illistrate the enormous range of fountains that have been or are being built using all the tools that the modern fountain designer has at his or her disposal is not possible; however, all of them can find their roots in the outline of the evolution of the fountain that this disseertation attempts to offer. One can only hope that the use of water for display purposes will continue to thrive.

Conclusions

I would advise any garden or landscape designer to consider including the extraordinary magical focus of water in his or her scheme. However, many fountains and water features are not successful either in the short or long term. It is hoped that in this chapter the main reasons for this will become evident, allowing for a check-list to be drawn up before the creation of a fountain, or in the reinstatement of one that has fallen into disrepair.

Firstly, a fountain is, like a luxury lawn, a beautiful home or an expensive car, an object that will require maintenance, protection and upkeep throughout its working life. The further from nature it is, the more work will be required to maintain it in peak condition. This is especially so when artifice is used to make it look as if it were a gift from God, as any flaw, no matter how minor, destroys the illusion.

1. WATER SUPPLY Unless a natural supply is to be utilised, as in the Greek and Roman examples cited in earlier chapters, an artificial supply must be provided. However, fountains attract pollutants, such as traffic fumes and tobacco smoke from the air, and recirculating water can quickly become impure. Add to this the effects of evaporation exacerbated by the aeration of the water, and the water in a closed supply system can very quickly become a concentrated, foul, ill smelling, poisonous, corrosive, visually unattractive soup as well as this the water level will drop, removing any illusion of abundance that the fountain is there to provide and selected plant and animal life will suffer. Add again the detritus left by passing human, zoological and biological organisms, and problems become evident.
   The remedy to all these ills is an adequate water supply, drainage facility and a filtration system(which is discussed later). The supply will ideally have an automatic stop cock, like the system in a WC. This will close off the water supply when the required level is achieved.

2. QUALITY OF CONSTRUCTION The creation of a fountain is a specialist job and only those experienced in the task are fully aware of the perfidious nature of water and its ability to escape or leak from the fountains system. When leaks do arise difficulties in detecting where they have arisen can be, and often are, legion. Water can travel some distance from the leak before becoming evident, and because of capillary action can actually appear above the leak or leaks. It is not unknown for a fountain to be completely dismantled in an attempt to find a leak, creating an expense greater than the building of the fountain itself.

   The pressures of the weight of the water and the fountain may cause movement underneath the fountain, or indeed the alteration to the water table underneath the fountain can cause water or gas bubbles to erupt in the most improbable places. The fabric of the fountain may be attacked by wildlife or environmental factors during construction, leading to problems which only become evident in the fullness of time. Occasionally further works are considered in the basin of a water feature and when this happens the additional materials can and may cause damage. This is particularly difficult to detect and can create costs greater that the original cost of the feature.

   The avoidance of these problems can only be achieved by experience, first class specifications and with the work guaranteed by the builder.

3. VANDALISM. Whenever the public has access to water features they are particularly prone to damage either intentional or otherwise. On one end of the scale is the prank, for example, washing up liquid was recently poured into a fountain in Guildford. The bubbles not only looked unattractive, but also extended beyond the fountain pond and caused temporary closure of the Portsmouth Road. On the other end of the scale is the malicious smashing of the statuary at the York House Fountain at Twickenham prior to its recent restoration.

   Vulnerability to vandalism must be gauged and considered at the design stage. The amount of security readily present or how much required must be considered. Fortunately most fountains are placed for maximum visual effect which renders secret vandalism difficult. However, if public access is available for 24 hours a day (unlike say a shopping mall) consideration must be given to late night revellers.

   Where liners are employed they must be adequately protected and hidden. A vandal with a Stanley knife can render thousands of pounds of damage to a pool in seconds if the protection is inadequate. Animals entering the water can also damage inadequately protected liners.

   Most dangers can be minimised by the design. The fountain at Canary Wharf has no unhidden parts which could be damaged (except with a sledge hammer), and is also is protected from attack by constant vigilance when public access is possible.

   At the Tortion fountain by Naum Gabo at St Thomas's hospital there is a large pool of water surrounding the fountain offering only the determined an opportunity to physically attack the installation.

4. NOISE. The sound effects of water falling may not always be welcome. Whilst the writer was working for a firm who constructed fountains and water features he heard of an exotic, cascading water feature which was installed at a cost of £50,000.00. The neighbours, who could not see the feature, objected to the sound it made and were able, with legal backing, to effectively disable the feature. Another example is a new office building in the city which has a magnificent internal waterfall offering visual delight to office workers of six stories. Unfortunately in the foyer and where the reception is located

the noise of the waterfall made it impossible to conduct telephone conversations: consequently the design of the waterfall had to be modified significantly.

When sound is a problem it is very expensive and difficult to reduce, therefore consideration should be given at the outset. However, in most settings sound is not a problem.

5. WATER ESCAPE. Water or spray can escape the basin designed for collecting it. This usually occurs in windy or urban settings and can arise unpredictably in cities where high rise building is undertaken, as any change to the nearby architecture can alter the wind flow and create high wind speeds and eddies. The consequences will become evident both immediately and over time.

   Passers by may not be pleased to become wetted by the spray and may react suddenly. In addition the material on which they are walking or standing is similarly wetted. This may result in it becoming slippery, encouraging falls and accidents. Expensive lawsuits may follow. The wetting of surrounding materials may not only become visually unattractive but also be damaged by it. Pools of water may form and damage may be caused to services beneath the wearing course. Electrical and service ducting is particularly prone to these problems. Another cause of damage may result from growth of algae and other plant life. This makes the wearing course slippery and prone to decay. Any leaks from the basin may be difficult to detect.

   The remedy in design to these problems may be by increasing the planned size of the water receptacle (in windy situations the radius of the receptacle should be up to twice the height of water play) or a wind detector may be utilised which will reduce or stop play when adverse conditions are detected.

6. VISUAL IMPACT. Drivers of motor vehicles or pedestrians may have there line of sight impaired or their eye be distracted by the magnificence or surprise of a water feature. In certain instances this may bring a dangerous result. Clearly due consideration must be given to the suitability of the site for a major fountain.

7. MAINTAINANCE. In drawing up a maintenance schedule and budget for a fountain or water feature, water type, location and construction will all play a part.

   Where wind borne materials such as leaves or street rubbish are present these should be removed at frequent intervals with a net. This will help to minimise blockage to the filtration system, if there is one. The filtration unit should be easily accessible and should be maintained at or above the manufactureres specifications. When relevant water samples should be analysed to ensure that the required purity is maintained. These requirements are mainly similar to a modern outdoor swimming pool.

   In instances where clear water is to be maintained it may be considered advantageous to empty the pool and scrub it down on a regular basis, as is done at the Trevi fountain in Rome. There, early on a Wednesday morning, the basin is emptied and scrubbed. Whether this is done principally to collect the thousands of lira and other currency that is thrown into the basin, or for the good of the basin is unclear. However a scrubbing regime may be considered when salts and limestone deposits form and where algae grows in uncirculated and untreated fresh water.

   The pump will need constant maintenance according to manufactures requirements and if the fountain is susceptible to frost damage the system may be drained down during the winter months. The fountain's demand for water should be monitored in order to give an early indication of leaks, and the fabric of the fountain repaired immediately should any damage be evident.

Recent studies in the United States have indicated that when property is seen to be damaged and not repaired this acts as a catalyst to vandals to do further damage. If a window on a property is broken and not repaired this encourages the breaking of further windows. Thus with fountains; any sign of neglect excacerbates the problem.

All of the above factors, when ill judged, can cause the rapid de-commissioning of fountains.

London has many examples of dry fountains, where the unhappy instigator of what was intended to be a joy, is out of pocket both for the initial creating of the water feature, for any law suits that it may have spawned, and for the ultimate removal of an eyesore.

Woe betide the unwary!

(It is at this stage that the writer suggests that the reader returns to the opening chapter of this dissertation and reviews the many factors that more than justify the potential difficulties in creating and maintaining that most glorious and wonderful device The Fountain.)

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