CHAPTER 1

PROLOGUE
DUBLIN, 1882

Wednesday, 6th December 1882: Dublin awoke with a startled shiver. Snow! A dense curtain of snow, as far as the eye could see. As the morning progressed, conditions became worse. The normally bustling, clanging streets were subdued to a whisper. Along their margins stood forlorn lines of horse-drawn cabs, trapped by the white carpet settling in their midst. The premature arrival of winter had caught the city off-guard.

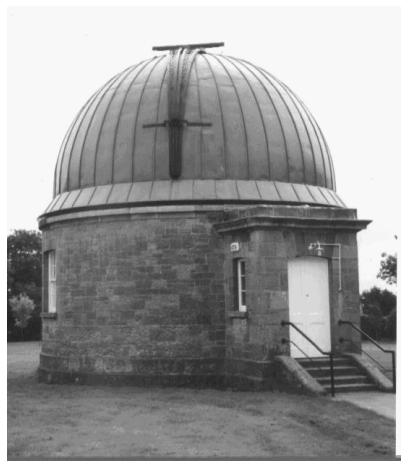
A furious gale swept through the streets, searching out every last yard and alley with its icy fingers, sending citizens scurrying to the warmth and shelter of their workplaces.

To the northwest of the city, exposed on the summit of a hill, was the Dunsink Observatory. Here, by contrast, the chill wind went unnoticed as it wrenched at the garments of a solitary figure who stood absorbed in contemplation. The lawn in front of the Observatory dome was already buried beneath a couple of inches of snow. The steps to the door were hardly discernible under the drifting snowflakes. Robert Ball seemed unaware of the cold grip of the wind and oblivious to the damp discomfort of his feet. His gaze never lingered on the ground. Instead it flitted anxiously between the leaden sky and the dome.

In more clement circumstances, this simple dome, a hemispherical roof perched on a small cylindrical building, had become the focus of his life. Since being appointed Astronomer Royal of Ireland, he had dedicated himself to an exhausting nightly round of observations. Here, on cloud-free occasions, he would often be found at 3 o'clock in the morning, still peering through the telescope. His mission was to detect and chart tiny seasonal changes in the positions of the stars.

This day was to be different. He had been looking forward to it for longer than he cared to remember. So it was with furrowed brow that he paused to glance skyward. The storm clouds looked set to ruin everything. Circumstances could hardly have been less hopeful for the great astronomical event—a 'Transit of Venus'—which he anticipated. In the early hours of the afternoon the planet Venus would begin a very rare passage in front of the Sun. If the skies cleared, Venus would be visible in splendid silhouette against the solar disc. So rare was the event, it had occurred only three times since it was first witnessed by an English youth, Jeremiah Horrocks, two and a half centuries previously. True, Horrocks too had been beset by clouds. Astronomers had long learned to be fatalistic about the weather. But snow? Ball could not believe his bad luck.

Even with clear skies there would be only a brief sight of Venus. The transit would last for several hours, but from Dublin only the commencement would be visible. Shortly afterwards, this curious spectacle would be lost in the sunset.



South Dome at Dunsink

Inside the observatory the equipment lay ready. In the centre stood a superb equatorial telescope. Attached to the eyepiece of the telescope, especially for this day's observations, was a device to dim the expected brilliance of the Sun to viewable proportions. Looking at the undimmed Sun through a telescope would cause instant and permanent blindness. Ball reflected wistfully on the naive optimism embodied in such precautions, which seemed in the event to be a mere mockery. The sky was totally overcast and any hope of seeing the Sun was all but extinguished. Nevertheless, he exhorted his staff to make all their preparations 'precisely as they would have done were the Sun shining with undimmed splendour.' [1]

The previous day he had gone through a 'full-dress rehearsal', pointing the telescope to the Sun, and following it down to the position in which it

would be at the time of the transit on the following day. To his horror, he had found that the Sun, on the transit evening, would set directly behind a tree, situated on neighbouring land. Not every neighbour would have readily agreed this to be a problem, but, happily, the tree's owner, on being told that it stood between the Dunsink Observatory and the transit of Venus, had had it chopped down forthwith.

On the transit day, at 11 o'clock in the morning Ball and his assistants set to work. Six tons of rotating dome rumbled into the correct position. A flurry of snow entered as the shutter was opened. Still the clouds were impenetrable. With an assistant operating the handle, the eighteen-foot long telescope was slowly turned to point at that part of the sky where the Sun should have been. The clockwork mechanism then took over, causing the telescope to lock onto this part of the sky and gradually to revolve as the invisible Sun was doing.

The predicted time of the transit arrived … and passed. Still no sign of the Sun. The tension eased as hope waned. Ball sighed and, rubbing his hands to keep warm, looked sadly at the gleaming instrument before him. At the heart of this telescope was an excellent 12-inch diameter object glass. In his mind's eye, he pictured the crisp image of Venus which could have been offered by it, if only the clouds had cleared. This was no ordinary glass, let it be known. It had previously belonged to the celebrated double-star observer, Sir James South (1785–1867). Made in Paris around 1830, purchased by South, then smuggled out of France, it had been at the centre of a bitter four-year lawsuit between South and the London-based firm who had been commissioned to make the mounting. South lost the case and, in a fit of rage, he had publicly smashed the mounting to pieces and auctioned off the bits. Fortunately, he saved the object glass—at the time, one of the largest in the world—and, shortly before his death, he donated it to the Board of Trinity College Dublin, from where it had found its way to Dunsink.

Ball's attention returned to the weather. At first it appeared unchanged, but suddenly his most earnest hopes were gratified: 'Just as I had begun to despair, an almost miraculous improvement took place in the weather. The sky lightened, the Sun burst forth behind that very place where the tree had stood the day before, and then, to my delight, I beheld the globe of the planet Venus standing out on the solar disc.' [2]

It was almost two o'clock in the afternoon. A small notch in the margin of the Sun showed that the transit had commenced and a full third of the planet was already upon the Sun.

The observers stood transfixed. Meanwhile, the snow continued. 'While steadily looking at the exquisitely beautiful sight of the gradual advance of the planet', Ball recounted, 'I became aware that there were other objects besides Venus between me and the sun. They were the snowflakes: which again began to fall rapidly. I will admit the phenomenon was singularly beautiful. The telescopic effect of a snowstorm with the sun as a background I had never seen before.' [3]

Amidst the swirling snow, the image faded in and out of view. The observers were surprised by their own reaction to the sight. 'We had only obtained a brief view', said Ball, 'and we had not yet been able to make any measurements or other observations that could be of service. Still, to have seen even a part of a transit of Venus is an event to remember for a lifetime, and we felt more delight than can easily be expressed at even this slight gleam of success.' [4]

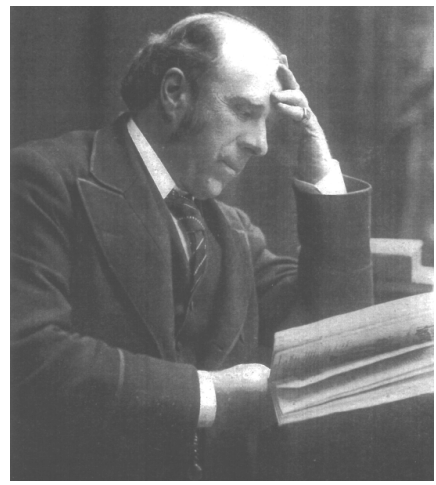
The poor weather conditions mercifully abated and the clarity of the round silhouette, now starkly visible part way across the Sun, steadily improved. The professional astronomer in Ball took over. He and his assistants made repeated measurements of the changing position of Venus. Each measurement, taken against cross-wires in the eyepiece of the telescope, was carefully timed with the observatory clock.

They were fortunate. The day of the transit coincided with violent gales from the northeast, accompanied by snowstorms throughout Britain. Places as far apart as Dublin, Aberdeen and the Channel Islands were all affected. Telegraphic communications were severed. Tramways and trains ceased to run. At least three ships were sunk off the English coast. At the Royal Greenwich Observatory the whole of the staff was ready at the instruments, but, due to cloud, not even the Sun could be discerned, let alone Venus. Hardly anyone in the country made such extensive observations as the Dunsink observers.

They did not have long to enjoy the spectacle. It was wintertime: days were short. Before the afternoon was through, Ball reluctantly conceded that '… the sun was now getting low, the clouds again began to interfere, and

we saw that the pursuit of the transit must be left to the thousands of astronomers in happier climes who had been eagerly awaiting it…The sun was already beginning to put on the ruddy hues of sunset, and there, far in on its face, was the sharp, round, black disc of Venus. It was then easy to sympathise with the supreme joy of Horrocks, when, in 1639, he for the first time witnessed this spectacle. The intrinsic interest of the phenomenon, its rarity, the fulfillment of the prediction, the noble problem which the transit of Venus helps us to solve, are all present to our thoughts when we look at this pleasing picture, a repetition of which will not occur again until the flowers are blooming in the June of AD 2004.' [5]

In the quiet isolation of the Dunsink Observatory, Robert Ball knew that he was not alone in observing the transit. His expectation that 'thousands of astronomers in happier climes' would be watching, however, understated the situation. The transit of Venus had captured the imagination of astronomers and public alike. Ball's professional counterparts observed with expensive telescopes, but many people watched through fragments of smoked glass. Across the entire sunlit portion of the Earth the sight of the transit was eagerly awaited and, once under way, it engendered the same awe in all who watched. This was the sight, which in the previous century had lured intrepid expeditions, including the famous one of Captain Cook, to far-flung corners of the globe. Now, in a more enlightened age, millions had been alerted to the event.



Robert Ball

The 'noble problem which the transit of Venus helps us to solve' was nothing less than the determination of the distance to the Sun, the sizing of the Solar System and the measurement of the Universe itself. By 1882, more effective ways had been found to gauge the distance of the Sun, but in the eighteenth century the transit of Venus had been the key which unlocked the secret of the Sun's distance for the first time.

Almost every educated person *knows* that the Sun is 93 million miles (or 150 million kilometres) away. This is an immense distance: so immense that it is virtually beyond comprehension. Perhaps it is precisely *because* the figure is so incredible that most people are prepared to take it on trust, without batting an eyelid: a pity, because *how* we know is often far more fascinating than *what* we know.

The quest to find the Sun's distance—the so-called 'Astronomical Unit'—runs like a bright thread through the entire tapestry of astronomical history. Its story spans two millennia and reveals the extraordinary efforts which have been devoted to discovering the true place of our earthly home in the solar system. It also shows the crucial role played by the transit of Venus in this endeavour. This rare and spectacular event did not occur at all during the twentieth century and when it occurs in 2004, not one soul will be living who observed the last one in 1882.