

Willis Haviland Carrier

Father of Air Conditioning

VOLUME-1

Willis H Carrier: The Man and His Message



*1.1 The Young Inventor of the
Psychrometric Chart, 1876-1911*

CARRIER - THE MAN AND HIS MESSAGE

CHAPTER ONE

"CARRIER THE YOUNG INVENTOR"

Amongst the thousand Makers of the 20th Century, as designated by the London Times, Willis Carrier (U. S. 1876-1950) is listed as Engineer. The entry goes on to say that

"Carrier was the man who 'invented Air Conditioning'. Before him it was a crude hit and miss affair of ice blocks and punka fans but he made it a scientific progress. The term air conditioning, first suggested by Carrier, meant the process of treating air to control simultaneously its temperature, humidity, cleanliness and distribution to meet the requirements of the conditioned space i.e. the complete control of internal climate. The essence of air conditioning is full humidity control and Carrier showed how this could be achieved in practice. Air conditioning is now indispensable to many industrial processes - and the Q.E. 2's air conditioning was installed by the British firm that Carrier helped to found in 1921."

Presumably those hundred odd words are sufficient

for an encyclopedia but to those who knew Willis Haviland Carrier, it leaves so much unsaid. Those of us, who at different periods worked with him long enough to get to know him, to be awed by his mental mathematics and endless flow of ideas, to be wary of his forthrightness, and to be charmed by his good humour and helpfulness, thought of him as the revered Chief. Yet frequently we were worn down by his ceaseless application to the immediate problem in hand, to the exclusion of all other considerations, and driven to distraction by the sometimes dire results of his absentmindedness.

"Invited to dine at an associates flat in Edwardes Square in London, Carrier proceeded there from the office and it was only after an hour's wait for Mrs. Carrier that it emerged that he was supposed to have picked his wife up from the Savoy !

On another occasion he was being seen off on the boat train from Victoria and Mrs. Carrier was found wandering about on the platform. Willis was finally discovered sitting on the train reading a letter. He had forgotten her."

But while he was in many ways typical of the proverbial absentminded genius, you must not picture any sort of ineffectual looking vagueness. What was misnamed absentmindedness was, in fact, very fierce concentration on the one absorbing matter in hand all other considerations were at that moment, remote and unimportant. He was,

probably "one of the very last of the great technical personalities who built up business and organisations on the foundations of their own genius and enthusiasm and to whom the desire to do the essential thing even better and better was more impelling motive than the mere accumulation of money."

Carrier was born on November 26th, 1876, on a farm near Angola, in the County of Eire, the western part of New York State, USA. His father was D. Williams Carrier and his mother Elizabeth Haviland, which accounts for the Haviland in the Chief's name. As an only child whose immediate family included grandparents and great aunt as well as his parents, he learnt to play alone, made up his own games and these often revolved round the introduction of mechanics and automation. After graduation from Angola Academy, the financial depression hit farm product prices so young Willis had to help out financially instead of going on to College. He took a teacher's training course and for nearly two years he taught in ^aone room school in an adjoining school district though his ambition to enter Cornell University remained unfulfilled. // However, his step-mother arranged for him to attend high school in Buffalo by living with a veterinarian and earning his board and lodging by helping the veterinarian family. So in the fall of 1896, the farm boy entered Central High School in Buffalo, N.Y. and in the following spring after a competitive examination found himself the winner of a state scholarship which paid his tuition at Cornell University for four years. He also entered a tutoring school at Ithaca with the idea of passing competitive examinations for one of the university scholarships which provided funds for worthy students. His luck held because he was the winner of the H. B. Lord Scholarship providing him with two

hundred dollars for each of two years. He never minded his lack of funds, was quite happy to do any odd job, mow lawns, tend furnaces, wait at table, provided he could go on studying engineering.

He does not seem to have been a member of any fraternity but later two honorary engineering societies Sigma Xi (1914) and Tau Beta F (1938) honoured him with membership.

Carrier entered Cornell University in September 1897, his address in Buffalo at that time was 1350 Amherst St. Even though he was a working student, he was on the second freshman crew and participated in intramural crew races. He won laurels in a cross country handicap and was middle-weight boxing champion in his Sophomore year. Classes and sports kept his days and evenings full and Willis H. Carrier was acquiring scientific knowledge and a ruggedness in physique that made possible his achievements in later life. In summer he worked, selling stereoscopic equipment and views that have adorned many library tables.

In his Junior Year, due to recuperation from typhoid fever he missed October and November and despite a late start he continued his scholastic work with success but sports were no longer a part of his activities. He gave up the crew, running and boxing. In his Junior Year he and some class mates bought a laundry concession and combined the services of two laundries - the beginning of the Students Laundry Agency still going strong.

There is no record that can establish whether Carrier learned to play bridge at the university but he certainly loved the game and in later life would frequently comment with a ^{wry} smile after losing a hand of bridge, "If I were smarter, I'd have made that."

In June 1901 Willis Haviland Carrier received the degree of Mechanical Engineer in Electrical Engineering. He had plans for specialising in electricity but, as a result of contacts by the Buffalo Forge Company, (office address: Buffalo Forge Co.,

Broadway, Mortimer, Buffalo), decided to join them. On his way to the office, he enquired of a young man on the streetcar where Mortimer St. was. It seemed the young man was also going to Buffalo Forge Co. and could show him the way. The young man was Irvine Lyle, who became a friend, a partner and a great collaborator throughout Carrier's life. One year after joining Buffalo Forge, Carrier's suggestion to establish a research department was accepted in June 1902. The research was primarily to give better customer service on fans and heaters, but at this time Lyle brought to Carrier a problem involving humidity in the plan of S. Wilhems Lithographic & Publishing Co. of Brooklyn. In the first month of the research's department life on July 17th, 1902, drawings were completed for what came to be recognised as the world's first scientific air conditioning system.

On the 29th August, 1902, Carrier married Edith Clair Seymour in Buffalo - the marriage was to last only ten years because she died in 1912. Later in 1902 Carrier was busy at work trying to produce his artificial gas, the basis of which was, of course, a moisturising nozzle. By September 1904 he was applying for a patent called operators for treating air, and described the first spray type air conditioning equipment. The first sale of which made in 1904 to the LaCross National Bank of LaCross Wisconsin. In 1905 Carrier was producing a catalogue for the Buffalo Air Washer and Humidifier. From then Carrier was designing and supervising installations of a large number of installations for cotton mills, chemical factories, all of which included his patented humidifying equipment and, of course, air cooling anti-humidifying. Also in 1905, he was elected as an Associate Member of the American Society of Mechanical Engineers.

In 1906 Carrier published in the Textile World Record 'Fan System for Humidifying, Ventilating and Heating Mills'. The following year he was publishing an article 'New Departure in Cooling and Humidifying Textile Mills', and in 1908 Carrier and Lyle together published an article 'Positive and Accurate Humidity Control' at the National Association of Cotton Manufacturers. // In 1910 at the Engineers' Society of Western Pennsylvania Carrier gave a talk 'Air Conditioning Apparatus, Its Construction and Application', and in the same year he published in the Heating and Ventilating Magazine 'Notes on the Theory and Present Practice of Humidifying'. These were all forerunners of the final achievement of this young inventor when in 1911 in the American Society of Mechanical Engineers Willis H. Carrier published his 'Rational Psychrometric Formulae'. // This momentous publication was carried also in November 1911 in the A.S.M.E. Journal. It was abstracted in December 1911 in the Heating and Ventilating Magazine, also in Engineering News Volume 66, and in Volume 11 of the Industrial Engineering and in Volume 138, and in the following year, 1912, in the Institution of Civil Engineers. Thus in this widespread publicity was heralded the basic theories that was to sustain the science of air conditioning through a century of achievement. After the death in 1912 of his first wife, the Chief married Jennie Martin, a graduate of Cornell University. She was active in community and social affairs and a member of the Women's Cornell Club of Syracuse until her death in 1939.

The degree of detail which Willis H. Carrier put into this initial study shows how concentrated could be his thought process. He was able to eliminate everything else from his mind and keep the one fact, the one problem so isolated that he

could bring to bear the whole weight of his intelligence onto it. This enormous concentration of will and purpose was here so completely apparent in 1911 when he was only thirty five years old. //It was an enormous scientific achievement as will be seen by any study of the original presentation. Admittedly one or two members of the learned societies tried to pooh-pooh-this young man's ideas, but others were quick to see the far reaching effects that this psychrometric theory would have, and to praise the young man for his perception.

Carrier in his presentation of Rational Psychrometric Formulae and their relation to the problem of air conditioning was establishing the evaporative or psychrometric method as an absolute means of moisture determination and demonstrated that it is independent of and preferable to all other methods in scope and accuracy. He proceeded to state the need for an accurate psychrometric formula for vapor pressures and showed in detail how he arrived at

$$e = e - \frac{(P-e)(t-t')}{2800-1.3t}$$

He then declared that this formula will give values of e for all wet and dry bulb temperatures and all barometric pressures with an error of less than 0.5 per cent, assuming the chosen value of C_{pa} to be correct.

The careful logic of his arguments, the painstaking charts that supported his words, were coupled with a massive display of mathematical precision of each step in the establishment of the formula.

It is astonishing to read today the paper as presented at the Annual Meeting 1911 of the American Society of Mechanical Engineers and to realize that this was largely the result of original thought since at that date accepted data was based largely on empirical formula. It stands as a fitting testament to Carrier's creative ability and tenacity of purpose.