Chapter 2. The Making of a Scientific Maverick

From the British Protectorate of Palestine, Joe Moyal took the Higher School Certificate examination, part of the British matriculation system, and, gaining distinctions in his results, enrolled at Magdalene College, Cambridge in 1927. Coming from a modest school in Tel Aviv, he had little knowledge of the academic world and no mentors to guide him in his search. Yet, by 1927, he had made the independent choice of a scientific career. He would study mathematics. He was, however, soon confronted by an unanticipated barrier — the cost, without a scholarship, of education at Cambridge. Realizing that he must make his own way in life and acquire a practical profession, he turned after several months to what he heard to be a good school of electrical engineering at the Institut D'Electrotechnique at Grenoble in the Massif Centrale of France and moved there early in 1928. Here the boy from Palestine spent two lively years, combining his studies with the pleasures of walking and winter skiing in the mountains, ice hockey, and an active student life that made him a ready Francophile. Although he took no degree, he gained the solid grounding in electrical engineering that would become the base for his later fruitful integration of engineering in his scientific career.

Joe returned to Tel Aviv in 1930 to work as an electrical engineer. But he was soon back in France enrolled in an advanced course at the Ecole Supérieure d'Electricité in Paris from which he gained his Diploma, an equivalent of the British system's first degree. Again his choices were self-guided and their consequences key shapers of his professional vocation. They were the expression of an enabling thrust for self-assertion that would be a hallmark of his scientific career.

For an enquiring young man, living in Paris in the early 1930s was an education and a delight. Here amid the art galleries and theatres, the suave young women, the brasseries, and the vivid student life, Joe underwent a metamorphosis from the intelligent, outdoor Israeli[1] to an enculturation as a sophisticated and cultivated European. 'It was not my

studies that I remember', he recalled gaily of this time,`they were conducted somewhat negligently; but the social life I had, the circle of friends who were all French and older than me'.[2] A Russian student first introduced him to an amusing group made up of a cluster of graduates from the Ecole de Science Politique, future diplomats and civil servants taking a higher degree of some kind, studying the history of art or literature, delaying the day when they would have to earn a living. 'We clicked for some reason or other although they were all graduate students and I was just in my second year, still quite childish really'.

They would meet regularly at the small bistros or cheap brasseries where students could eat their fill on a small purse, exploring ideas, and stocking up on food and wine and the prevailing currents of philosophy, politics and art. Occasionally he might lunch with these friends at `Les Deux Magots' around the corner from his lodgings, the meeting place of artists and literati, and haunt of Simone de Beauvoir and Jean Paul Sartre — heady stuff for the young man from Tel Aviv.

Joe also had access to the world of art through his uncle Paul Calmé, a widely connected collector and dealer whose walls were cluttered with the works of promising young artists, many later to make famous names. He was, too, imbibing the gaiety and ambience of a Paris which Pierre Bonnard was capturing at the time in his romantic paintings, 'Conversation' and 'The Promenade', and in his street scenes of young women decked in chic pink caps and jaunty jackets and the dreamy movement of the crowd. It was an ambience that lingered for Joe all his life, relived in the lasting pleasure he found in the colours and scenes of this artist's work.

He was also captivated by the charms and elegance of French women. Good looking himself, with a lithe figure, enquiring face and a clear eagerness for new knowledge and experience, he found a welcoming access into French society, became a fluent French speaker, and developed a lifelong admiration for the feminine culture of France and the civilizing role that women played in that society.

Experienced older women were not averse to his charms. But he found a tender relationship with a French girl, a charming *poule de luxe*, well

trained in the arts of pleasure by her experienced mother, whom her rich, older absentee lover maintained in high and independent style. Together they tasted the joys of the city, its restaurants, its racecourse, its galleries and parks, and its youthful fun. It was a relationship, fresh and enchanting, that remained warm in Joe's memory for many years.

It was, perhaps, the more surprising then that, towards the end of his stay, Joe met and married Suse, the daughter of a German Jewish refugee family from Heidelberg who, educated in England and France, was working in Paris as a translator. With his additional professional qualification and a wife, he returned to Tel Aviv to resume his life as an electrical engineer.

Little information survives concerning Joe's life and occupation in this period. He had returned to his homeland at a time of marked political upheaval and social change. In 1935, with deteriorating conditions for Jews in Europe, some 62,000 immigrants arrived in Palestine and an Arab rebellion and a general strike were proclaimed the following year. With this, Palestine remained in a condition of virtual insurrection until the outbreak of World War II. Restrictions were placed by the British High Commissioner on the numbers of Jewish immigrants allowed to enter the country and Ben-Gurion emerged prominently to form his own political party for the defence of the Jews and to adopt the role of spokesman for World Zionism.

Joe, secular and a non-joiner of political parties across his career, was nonetheless a keen observer of the chequered evolution of the new Palestine. It was impossible not to be intrigued by a polyglot Jewish immigrant population drawn from wide educational and national backgrounds and refugees from Hitler's Germany eagerly throwing their labour into the construction of new infrastructures and developments in his country. His recollection of a line of dignified, well-dressed men passing bricks to each other on a building site, uttering the repetitive refrain, `Danke shoen, Herr Doktor; Bitte, Herr Doktor' at each transfer, caught the changing tenor of the times. Yet he also entertained a strong personal liking and sense of familiarity with the village Arabs and

admired their dignity and stoicism and their sense of deep historical connection with the land.

It was, however, during this uneasy national period of growing open conflict between the two cultures, working as an electrical engineer, that his interest in science sharpened. He began reading widely — Einstein's special theory of relativity, and Bernhard Riemann and Weber's *The Partial Differential Equations of Mathematical Physics*.

By the end of 1937, having, as he put it, 'got fed up with engineering … and becoming more and more interested in science, reading it up by myself,' he returned with his family, now extended by a daughter, to Paris, and registered for a year's course in mathematical statistics at the Institut de Statistique.

He was now exposed to the major stepping stones of modern statistics, Darmoi's *Statistique Mathématique* (1928), the first important French work on modern statistical theory; Borel's many-volumed treatise on probability, and that lightning rod for research statisticians — A.N. Kolmogorov's book of 1933, which established probability theory as a branch of rigorous mathematics. Joe gathered a further Diploma and, most crucially, acquired the foundations of his wide knowledge of European studies of stochastic processes that would underlie his own far-reaching research. A year later, extending across disciplines, he followed this with an advanced course in theoretical physics at the Institut Poincaré at the University of Paris.

His two years in Paris in the late 1930s would prove a scientific turning-point for Joe. Well versed in mathematical statistics, it was significant that he now opted for the new Institut named for Henri Poincaré 'the ruler of French mathematics'. For Joe, Poincaré's career had a special interest. Dubbed 'the last universalist', he was the last man to bring all mathematics, pure and applied, within his province and hence sat on the crest of a wave in mathematics that gave rise to a flood of mathematical advance.[3]

Joe's year at the Institut in 1939 held ingredients that were particularly formative in his career. One of the pioneers of the wave-duality concept

in quantum mechanics, the physicist Louis de Broglie, a lecturer at the Sorbonne, had taken up a joint appointment at the Institut the previous year and offered a close encounter with the foundations of quantum theory. At the same time,he was introduced by a Palestinian doctoral student in science at the Collége de France to a series of lectures given by Frédéric Joliot-Curie, Professor of Nuclear Chemistry at the College, on new research developments in nuclear physics. Joliot-Curie's research (independently of the work of Lise Meitner and Otto Hahn) proved the reality of nuclear fission. Joliot-Curie was also experimenting at the time with heavy water, estimating the amount to be used in building an atomic reactor, subsequently used in the making of the atomic bomb. From such outstanding lectures, Joe gained access to the most advanced knowledge in nuclear research.

It was towards the end of his courses in mathematics and theoretical physics at the Institut Poincaré that he became acquainted with the Director of Research of the Meteorological Branch of the French Ministère de l'Air, G. Debedant, and his assistant, P. Wehrlé, who were attending some special seminars at the Institut. Their mutual discussions and shared interests led Debendant to invite Joe to join his Research Division in a temporary capacity and to take up his first research opportunity.

With the outbreak of war in September 1939, Joe was invited to stay on at the Meteorological Research Branch and, as a British citizen, to set up a formal liaison with the Air Ministry in Britain. Backed by Britain's Embassy in Paris, he returned briefly to London to formalize the connection.

'I was working on the theory of the diffusion of gases due to turbulence', he revealed in a private interview in 1988.[4] 'The French were interested in the diffusion of poison gases and of smoke screens. Nobody knew anything about it, but the director, and his assistant and I had heard lectures from the British workers on turbulence and we became interested and tried to apply it to their problems. But there was no other work done; there was no expertise; the work on turbulence was still very primitive, and there was very little of it. It was very highly classified.'

Despite the plethora of public outpourings on secret scientific research, wartime code breaking, strategic planning, and MI5 operations that spilled into world print from the 1960s, Joe maintained a strict public silence about his research on this weapon of mass destruction. In collaboration with Debendant and Wehrlé, however, in 1940 he published two papers outside the classified data in *Comptes Rendus de l'Académie de Sciences*, `Sur les équations aux dérivées partielles que vérifient les fonctions de distribution d'un champ aléatoire [random]' and `Sur l'équivalent hydrodynamique d'un corpuscule aléatoire. Applications à l'établissement des équations aux valeurs probables d'un fluide turbulent', which were foundation works in the field.

Events, however, were moving swiftly in France in 1940, a country divided amongst and against itself. Holland capitulated to the German Army in May, Belgium followed quickly, while the British Expeditionary Force fighting in Normandy staggered to Dunkirk. They reached the beaches on the 29th of May and, by the night of the 4th of June, 300,000 men had been evacuated to England. At the same time, the German armies were pouring into Brittany, some to clear the Loire, others to drive down the Maginot Line to Lyons, while the French Government fled to Tours and from Tours to Bordeaux. By early June, the Germans were on the outskirts of Paris.

The Meteorological Branch of the Ministère de l'Air was a small establishment located some 20–30 kilometres from Paris. When Paris fell, the whole unit transferred to the south, just north of Bordeaux. 'They all went,' Joe recalled, 'and I followed up with my car with one or two of the workers.' It was rough going. Hundreds of refugees choked the dusty roads to the south, gunned by Third Reich airplanes. Their own course was punctuated by enemy fire and intervals of seeking cover in the roadside ditches. Their new premises and quickly assembled laboratory were in some disarray. News flew that the German army was driving south from Paris. One memorable morning Joe arrived at work to discover that the director and his assistant were poised for flight. 'I went to look them up,' he said, 'and found that they were just evacuating

themselves and leaving everything behind.' The rest of the staff 'appeared to be just sitting there waiting to be captured'.[5]

Tough-minded, Joe chose action. Rounding up a non-commissioned officer from the military personnel who had been attached to the section, they drove by truck to the laboratory and applied themselves vigorously to smashing and destroying all the research instruments. Joe also filled his suitcase with papers and classified material relating to their research. Packing the vital suitcase in his car, he drove to Bordeaux and to the British Consulate where he showed them the rescued papers which he hoped he might take back to England.

Certain chaos prevailed at Bordeaux. A British cruiser was standing by at Point de Grave, a small port close to Bordeaux, ready to evacuate the British Ambassador. Two tramp steamers, the last shipping available, were also waiting there to embark a growing crowd including a British parliamentary party who had been visiting the Paris parliament immediately before the city's collapse and members of the War Graves Commission. Clutching his precious cargo, Joe was despatched by train to Point de Grave and, at evening, arrived at a beach scattered with refugees in hastily made shelters. As darkness fell German planes arrived to target the cruiser. One dive-bomber dropped from the sky to the cruiser's fire, but one of the tramp steamers fell victim to the aerial assault.

As morning dawned, attempts were made to put the British refugees on the remaining Dutch steamer, despite numbers that far exceeded those the captain was allowed to carry. At his refusal, the British Consul displayed verve. He was rowed to the British cruiser, gained the requisite order, and peremptorily commandeered the Dutch vessel. The refugees, Joe among them, clambered aboard. But his trials were hardly over. After a long traverse to avoid U-boats in the Atlantic Ocean, the crowded ship disgorged her passengers at New Haven and he was sternly interrogated by two bureaucrats who treated him with considerable suspicion. Relieved of the secret papers, he was sent to authorities in London. There too he was closely questioned. 'These authorities,' he reported, 'felt that I had taken matters into my own hands; that my action was strictly

illegal! They asked what permission did I have. What was my rank in the organization? I had no rank, I was just an attaché, a liaison.'

This lean, bespectacled, now rather bedraggled young man was also Jewish and from Palestine and, while he carried a British passport, he was clearly suspect. 'Would they have preferred you to have left the classified material to the Germans?' he was asked. 'No', Joe laughed, 'but they didn't congratulate me!'[6]

Expecting to go on with his crucial meteorological research, Joe was instead asked during his debriefing to make a summary of the lectures he had attended on nuclear physics, which he had mentioned in the interview. This was clearly of singular interest and he was quickly brought before a special scientific group. There he was quizzed in detail on the French research and enjoined to silence. Hence, his second hope of being drawn directly into the area of nuclear research was also abruptly closed to him.

Joe Moyal, clearly, was an outsider and confronted challenges in interesting the British authorities in his broad scientific knowledge. He had the good fortune, however, to be sent to be interviewed by C.P. Snow, head of the recently formed Scientific Manpower Section of the Ministry of Labor. A large, shambling man, already a novelist, Snow had conceived his passion for science in that great period in Cambridge in the late 1920s when he studied for a Ph.D. in physical chemistry. Yet, a man of foresight, he had also seen the need as war loomed to prevent the waste of scientific manpower that had sent so many brilliant British scientists to their deaths on the battlefields of World War I. He had accordingly set up a `Scientific Manpower Register', drawn from records of the Royal Society of London to organize the relevant information. Now in charge of this important Section, and focusing on Joe's engineering background and his research capacity demonstrated at the French Ministère de l'Air, Snow despatched him to work at the De Havilland Aircraft Company at Hatfield, Hampshire.

Joe's career in Britain as a many-faceted researcher had begun.

ENDNOTES

[1] Although Israel was not constituted as a State until 1948, 'Israeli' is adopted as Joe Moyal's national description in the text.

[2] Interview with Ann Moyal, 1979.

[3] E.T. Bell, *Men of Mathematics,* Melbourne, Penguin, 1953.

[4] Interview with Ann Moyal, 1988.

[5] Interview, 1988 *op. cit*.

[6] Ibid.