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0521416175 - Edwin Hubble, the Discoverer of the Big Bang Universe

Alexander S. Sharov and Igor D. Novikov

Excerpt

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## PART ONE

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# Life and work

### Choosing the way

The seventeenth century... Boatloads of new settlers kept coming to the New World from the continent of Europe. They had various reasons for leaving their countries – poverty, hopes for a better future, enterprising or adventurous temperaments, or persecution by the authorities. The astronomer's ancestor, Richard Hubble, an army officer, was among those who left Britain for America. It is not known precisely what made him leave the old country. Once Edwin hinted, though, that the reason was serious, merely saying that 'whenever there was trouble in England, one of the family left in a hurry'. Things were definitely in turmoil at the time King Charles I was executed.

Richard Hubble set up his family home in the state of Kentucky. He was successful and left five thousand dollars to each of his eleven children, which was a considerable sum of money at the time. One of Hubble's ancestors took part in the War of Independence on the side of the colonists. The grandfather of Edwin, Martin Jones Hubble, fought for the North during the Civil War. He later lost his official position for advocating clemency for the former enemy. Other members of the Hubble family fought on the Confederate side.

John Powell Hubble, a son of Martin's, married Virginia Lee James in 1880. Within a few years they had a son Henry and a daughter Lucy. On 20 November 1889, when the Hubbles stayed in the family house

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in Marshfield, a small town in the state of Missouri, a boy was born to them – Edwin Powell Hubble. Later the family steadily grew as Bill, Virginia, Helen, Emma and Elizabeth were born. In fact, it was not rare at the time to have many children in a family. The mother herself was from a family of six children. This generation of Hubbles had very different fates. Virginia, the family's favourite, died when she was still a little girl. Lucy died when she was ninety-three. Two younger sisters of Edwin, Helen and Elizabeth (Betsy) were alive at the time of writing this book. Helen wrote in her reminiscences: 'I suppose that Henry and Edwin would be considered to be of the intelligentsia and the rest of the family was somewhat above the average, so far as standards of living, ideals, ambitions and social graces were concerned'. But only Edwin proved to be an outstanding person in this and subsequent generations of the Hubble family.

John Hubble received an education in law and started a career as a lawyer in Marshfield, but within two years his eyesight deteriorated and he had to look for a more suitable occupation. He moved to Springfield where his father had a successful insurance firm and specialised in fire insurance. He was good at his job and the firm sent him to Chicago. It was a new centre of the grain and cattle trades, of steel mills and machine manufacturing plants, and of the famous Pullman truck plants which were growing at a rate that was fantastic even by American standards. John Hubble was of the opinion that a large industrial city was no place for his children to live, so the family lived in the suburbs – first Evanstone and then Wheaton where many years later Grote Reber built the first parabolic radio-telescope near his home and observed the Milky Way and the Sun. Now these formerly quiet suburbs are inside the busy metropolitan area. John Hubble again suffered a deterioration in his health and the firm gave him a new job in Louisville in the state of Kentucky, where the family lived in the charming suburb of Shelbyville.

The family was well-off and they always had large comfortable houses with a library, drawing room, dining room and a large foyer on the ground floor, bedrooms and bathrooms on the first floor. The basement floor was given to the children; they could rush around and play any games there without fear of breaking something valuable. The house was usually surrounded by a spacious courtyard for children's games and also had a lawn where adults played tennis. Also in these grounds, there were flower beds – nasturtiums, roses and asters – tended by their mother.

The ultimate authority in this happy world was their father, who was unfailingly felicitous towards all his children. After he had returned

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from his office, the dinner gong rang and at half past six the entire family would be at the dinner table. Their father was always very particular that everybody be at dinner on time. The atmosphere at dinner was somewhat formal but the children could always invite their friends if they had warned their mother beforehand. Their father was concerned that his children should get a proper upbringing and grow up as responsible citizens. He was a 'temperance' person and one of his worries was that his sons and their friends might yield to the temptation of drinking alcohol, which he strongly condemned. When Edwin went to study in England he had to vow to his father that he would not touch alcohol. His father was apprehensive that his sons might mix with bad company at the race track a mile from Wheaton.

Though the family employed several servants – cooks and parlourmaids – the children were not spoiled. Each of them had to make their own bed and to clean their own room. During summer vacations the father encouraged his sons to earn some pocket money. There were various ways for the boys to earn some money. Horse-driven wagons brought ice to the houses and the boys delivered the boxes of ice. Their father paid them for cutting the grass on the front lawn and in hot weather they could always sell some cold water to the workers building roads near the town.

The most exciting vacation job for Edwin was with a group of land surveyors who mapped the route of a railway line to be constructed in the woods in the region of the Great Lakes. The region was a wilderness at the time and one could have dangerous encounters there. It has been said that once Edwin was attacked by two robbers and was stabbed in the back. He knocked down one of the robbers and the other fled. When the season ended, Edwin arrived at a railway station with the work party but found that it was deserted since the train timetable had been changed and no train was due for a long time. The land surveyors decided not to wait for the train and went on foot through the woods for three days without any food.

Perhaps it is a myth, but Edwin was said to have returned from this adventure as a grown man.

The money Edwin and his friends earned gave them a welcome feeling of independence. Money in their pockets gave them freedom to do a lot of pleasurable things – go to a fair and buy whatever they fancied, pay for their favourite tunes to be played by a nickelodeon, buy ice-cream cones for girls they liked.

Life at home had many pleasant sides, too. The children often congre-

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gated around a large table to do their homework together. They especially liked weekends even though they were obliged to attend church services and Sunday school lessons. Their father was deeply religious and each Sunday morning the entire family and house guests solemnly set out for the church. After that, the children were free to go swimming or riding hay wagons in summer or sledge riding in winter. There were numerous parlour games to play indoors if the weather was bad. They often played a word game in which one had to add a letter to a word so as to avoid being the one on whom it ended. To win, one had to be inventive and look up words in a dictionary. In the evenings they had family concerts. Their father played the violin, Lucy, who had a considerable musical talent, played the piano and Edwin and Bill played mandolins. The smaller children seldom tired of listening to them.

Edwin loved playing with his younger sisters. Betsy's earliest memory is of how Edwin took her to a circus on his shoulders. When Betsy was twelve, she visited her brother when he was already working at the Yerkes Observatory. Telling her to be very quiet, Edwin took her to a telescope and she held her breath, looking for the first time at the heavens through the eye-piece. Once Edwin took his two younger sisters to a performance of *The Blue Bird* by Maeterlinck and it was difficult to say who enjoyed it more – the young man or his charges.

Family life had its dramas, too. When Edwin was six Virginia was just two. She was a nice girl and Edwin and Bill sincerely loved her. But she often destroyed the toy houses, fortresses and bridges the boys built and once they subjected her to a rather painful and severe punishment. Within a few weeks Virginia fell ill and soon died. The brothers thought it was their fault and Edwin had a nervous breakdown. If the parents had been less sensitive and caring there could well have been another family tragedy.

Their mother was especially attentive towards the children. Any dispute, large or small, was quietly resolved by her and she always succeeded in maintaining the spiritual harmony of the family. Mrs Lane remembered that she had seen her mother angry only once, when the eldest children, Henry and Lucy, had pinched nuts from a dessert table specially set for a party. His mother was an attractive, statuesque woman and Edwin inherited her graceful bearing and elegant manners.

Like most boys, Edwin went in for sports. In the last years of high school he grew to six foot three and won prizes for basketball and pole vaulting.

Thus Edwin had a normal childhood in a middle-class family, in a

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kind and well-ordered household. As a grown-up, Edwin said that the family discipline had prepared him for much. There was perhaps one feature that distinguished him among other students, namely that he learned to read and write very early: when his elder brother and sister went to school he was deeply sorry that he was too young to go to school with them. Edwin loved reading and he read numerous adventure books, which were favourite reading for boys of his age at the turn of the century. His favourites were novels by Jules Verne and H. Rider Haggard, particularly *King Solomon's Mines*.

Reading about famous people in whatever field they have distinguished themselves – arts, science or writing – one invariably wishes to know when they started to show interest in their field, when they chose their careers. Edwin apparently became fascinated with astronomy at a very early age, under the influence of his maternal grandfather, William Henderson James. This grandfather was definitely an exceptional person. He was educated as a medical doctor in Virginia but the Gold Rush took him to California, where he spent his youth. Here he married Edwin's grandmother and then returned with her to Missouri. He was enthralled by astronomy. Mrs Lane recalled that their grandfather 'rigged up a telescope that simply charmed Edwin to such extent that he requested that in place of his eighth-year birthday party, he preferred to be allowed to stay up late to look through the instrument to his heart's content. The wish was granted'.

When Edwin was twelve he wrote such an interesting letter to his grandfather answering questions about Mars that it was published in a Springfield newspaper.

At the age of fourteen, Edwin had surgery for appendicitis. Today this is regarded as a simple operation and patients do not have to stay in bed as long as they used to. But Edwin liked being bed-ridden – he had plenty of time to read about stars.

Memoirs are not the most reliable historical source, since human memory is imperfect. Edwin's friend, the famous English author, Aldous Huxley, also mentioned this early fascination with astronomy in his essay *Stars and Man*. The details were different, though. For instance, eight-year-old Edwin was described as dreaming about watching meteor showers and his letter to his grandfather was described as a treatise on Mars. Perhaps that was how Hubble himself told these stories to the author of the essay.

Edwin graduated from high school in 1906. The studies were apparently too easy for him and he never made visible efforts in school. At

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the graduation ceremony, the school principal addressed him with the following words: ‘Edwin Hubble, I have watched you for four years and I have never seen you study for ten minutes’. The principal made an ominous pause and continued, ‘Here is a scholarship to the University of Chicago’. At the age of sixteen Edwin entered the University of Chicago, which had been founded in 1892 and was one of the ten best universities in America at the time. Its faculty at the turn of the century included the astronomer Forrest Moulton who suggested a theory on the formation of the Solar System, and the famous physicists Albert Michelson and Robert Millikan. It has been said that Edwin even worked for a time as an assistant in Millikan’s laboratory. He was particularly drawn to astronomy and mathematics.

Edwin did not leave any notes about his student years. He lived far from his family, so his sisters can remember only very little about this time of his life. They, that is, Mrs Lucy Wasson and Mrs Helen Lane, can only recall that he continued playing basketball. Once his team played against the Wisconsin University team which included his brother Bill. The university football coach Alonzo Stagg wanted Edwin on his team and asked John Hubble to allow his son to join it. The father thought, however, that football was too violent a game and refused to be persuaded. The football-playing friends whom Edwin invited to his family for week-ends failed to impress his father. Edwin’s father’s favourite game was baseball, and the cunning Edwin then started talking at length about injuries suffered by baseball players. His father declared then that Edwin had better stop playing this game, too. Father’s word was law in the family. Edwin switched to boxing, thinking bitterly that his father had ruined his life (this opinion was ventured by Lucy).

Edwin proved to be so good at boxing that the coach thought of making him a professional. Luckily, things never went that far.

Edwin dreamt of winning the Rhodes scholarship (named after Cecil Rhodes, whose name until recently featured on the map of Africa – Rhodesia). This annual scholarship of 200–300 pounds sterling was quite enough for a young single gentleman to lead a comfortable life in England at the time. Professor Ernest Rutherford even suggested a similar salary at his laboratory to Niels Bohr, who was already married. The scholarship was awarded to the best unmarried students of 19–25 years of age who were healthy, excelled in sports and had unblemished character – the latter was of the utmost importance. Edwin, unfortunately, was not always on his best behaviour, and once, with his club-mates, engaged in throwing raw eggs out of their windows at theology students’ suits being

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returned from the cleaners. Plastic bags were not used for packing things at the time and the students took very careful aim.

The incident was overlooked, fortunately, and in September of 1910 Edwin and a number of other young Americans went overseas on a two-year scholarship which was subsequently extended by a further year. In England, Hubble's life underwent its first sharp change. Though he majored in natural sciences in Chicago, in England he had to take law as his subject. Hubble never explained the reasons for this change. Probably, it was the scholarship supervisors who decided it for him. Mrs Wasson related a few facts about this period to a reporter of the town paper in Alexandria where she lived at the time.

The reporter came to interview the sister of a famous man mentioned alongside Copernicus, Galileo, Kepler, Newton, Herschel and Einstein in an article on 'Pioneers in man's search for the Universe' published in the highly popular monthly, *National Geographic*. Talking about her brother, Mrs Wasson remarked that 'he was not assigned to Cambridge, where he could have taken advanced science. Instead, he attended Queen's College in Oxford, where he studied international law'. The universities of Cambridge and Oxford are famous in that they educate the elite of the nation. Over sixty Nobel prize winners have graduated from Cambridge, most British prime ministers after World War I studied in Oxford and most British judges were educated in these universities. At ancient Queen's College, Edwin mixed with future statesmen, sons of the nobility and future prominent authors. Students received a liberal education in Oxford but in addition they learned how to communicate, how to behave in social circles, how to enjoy culture and sports. It was, of course, through his Oxford law studies that Edwin developed his natural talent for precise, expressive, convincing and dramatic presentation of his ideas. He started his book-collecting while in Oxford. A few years after his death his sisters presented El Paso University with two old books bought by him in Oxford – a Latin volume of the 16th century and works of Thomas Robert Malthus.

It was in Oxford that Edwin learned the exceptionally reserved and dignified manner of behaviour that distinguished him throughout his life. There also he learned to smoke a pipe, which became almost his emblem, making him look older and somehow more scholarly. Alan Sandage, who knew Hubble in the last few years of his life, remembered his 'absolute spiritual power, moral integrity, and some air of superiority... In England he would be a genuine nobleman, one of the High Society in all respects'. In the best Oxonian traditions he devoted a great deal of time to sports –

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boxing, rowing and athletics. Edwin also wanted to know Europe better and in his two summer trips to Germany he travelled over 2000 miles, three quarters of them by bicycle.

Having graduated with a BA degree in law, Edwin returned home to Louisville in the summer of 1913. His father did not live to see him return, he died in January of the same year. Edwin and the older children were independent by that time, while the youngest, Elizabeth, was just eight years old.

Most biographies of Hubble state that he practiced law for a year. But a few years ago Kip Thorne and Alan Sandage received information from a historian in Kentucky who claimed he had documents proving that Hubble had taught at a school and had been a coach of the school basketball team. Mrs Lane recalls also that Edwin did German translations for some firms. She claims that he never practiced law. She closely observed his life that year in Louisville. She remembered some small details like her mother treating Edwin's friends to tea and exquisite cinnamon rolls. Edwin and his friend Walter Stanley Campbell played mandolins and one of them sang. Edwin enjoyed the quiet family life that he had been missing in his student years.

Another of Hubble's sisters, Mrs James, finally resolved this question when she contacted the Kentucky authorities and received an official answer that, after checking all their records, they could 'find no evidence that Edwin Powell Hubble was ever admitted to the practice of law in Kentucky'. This is the end of one of the myths about Hubble's life.

Edwin was not satisfied with what he was doing. Astronomy still attracted him. He realised apparently that the three years in England had been a step away from his preordained path. He said once to a newspaper interviewer that 'Astronomy is like ministry. You need a calling. After practicing law for a year in Louisville, I got the calling'. Biographers usually quote his words that he abandoned law for astronomy. He claimed that he 'knew that even if I were second-rate or third-rate, it was astronomy that mattered ...' It is difficult to judge whether Hubble really said something to that effect or whether it is one of the myths about him. If he did say that, it would mean that he was reluctant to admit that the Rhodes scholarship was wasted on him, and he pretended to have tried making use of his studies for a whole year. It is quite possible, though, that he never said anything of the sort and someone who wanted his biography to be prettified invented those words.

The final choice was at last made. Hubble returned to the University of Chicago to work on a PhD thesis at the Yerkes observatory. The



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observatory funded by the Chicago railroad magnate Charles Yerkes soon gained recognition among astronomers of the entire world. It boasted a 40-inch refractor that is still the largest telescope of this type. A 24-inch reflector was built later at the observatory. Hubble's supervisor was the director of the observatory, Professor Edwin Frost, who specialised in astrospectroscopy.

In August of 1914, Hubble visited the 17th Meeting of the American Astronomical Society in Evanstone, where he met personally, for the first time, many American astronomers. He was elected to the Society together with other astronomers who would be well-known in the future, such as F. G. Pease, H. H. Plackett, A. van Maanen, Loise Jenkins (who compiled famous catalogues of stellar parallaxes and bright stars), and many others. The participants of the Meeting were photographed together, with the Society President Edward Pickering at the centre, surrounded by well-known astronomers. The tall figure of young Hubble is seen in the right-hand corner of the photograph.

Perhaps, it was at this meeting that Hubble learned for the first time that Slipher had determined the radial velocities of thirteen nebulae. The measurement results were quite unexpected. In contrast to stars, many nebulae had very high velocities, and many of them were receding. These observations probably made a lasting impression on Hubble.

Hubble started his work at the observatory by photographing with the reflector. His first published paper was concerned with stars exhibiting appreciable proper motion. When Hubble used a blink comparator to compare his negatives with those made by his colleagues approximately ten years earlier, he found fairly large displacements – from  $0.2''$  to  $1.5''$  a year – for twelve stars. Four of these stars were of magnitude  $15^m$  or fainter. He wrote:

So far as I am aware, these are the faintest stars in which appreciable motion has been found... In view of the small number of fields examined ... it is reasonable to suppose that considerable numbers of such faint stars exist in the immediate neighborhood of our Sun.

Indeed, all these numerous stars proved to be dwarfs of late-type spectral classes located at distances of several tens of parsecs from the Sun.

Using Barnard's plates, Hubble discovered twelve unknown variable stars. He failed to complete this study because of World War I; he managed to publish a short report on the new variable stars only in 1920 when he was already on the staff of the Mount Wilson Observatory.

Later Hubble became interested in the cometary nebula NGC 2261 with the well-known irregular variable star R Monocerotis. When he

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compared the photograph he made on 8 March 1916 with a plate exposed by Jordan in 1908, he realised that the structure of the nebula had changed. He compared his results with five negatives photographed at different times at the Yerkes and Lick observatories and he managed to obtain a copy of the photograph made by Isaac Roberts in England. The variability of the nebula was verified. In spring of the next year Hubble found new changes in the nebula. He suggested that the most probable explanation of these changes was motion of portions of the nebulosity relative to the nebula as a whole and the ejection of matter from its nucleus. This nebula kept drawing Hubble's attention. He continued studying it for several years and studied it again thirty years later, at the end of his life.

But neither stars nor cometary nebulae were the subject of his doctoral dissertation. It was entitled *Photographic Investigations of Faint Nebulae*.

About two thousand nebulae had been discovered by that time but their nature remained unknown. The term 'nebula' was applied to various objects – the gaseous formations in our stellar system, diffuse and planetary nebulae, and the distant galaxies. To observers, they looked alike in that their photographic images could not be resolved into stars. Some astronomers had guessed already that the spiral nebulae with unusually high radial velocities and immeasurably small proper motions were outside our galaxy. The nature of numerous small and faint galaxies was quite unclear. They had to be studied statistically and the first step was to conduct systematic observations with a sufficiently powerful telescope.

Hubble photographed seven fields far from the Milky Way, using a reflector telescope. A careful analysis of the photographs revealed 512 new nebulae in addition to the 76 detected before. He measured their coordinates and described them, noting their shape, brightness and size. In one field the nebulae were apparently grouped together: a region of the size of the full Moon contained 75 objects out of 186 recorded in the entire field. Hubble concluded: 'Suppose them to be extra-sidereal and perhaps we see clusters of galaxies; suppose them within our system, their nature becomes a mystery'.

After making this conclusion, Hubble presented some shaky proof that the spiral nebulae were indeed distant stellar systems or galaxies. Although the initial data and calculation methods were questionable, the results still tended to show that 'the spirals are stellar systems at distances to be measured often in millions of light years'. Hubble noted that the same conclusion followed from the results on the motion of the Sun