Subject Notes

I. RÖNTGEN

Page 9. Röntgen's devoted housekeeper, Kaetchen Fuchs, watched over him constantly. He complained of severe abdominal pain, yet was able to walk to the commode and to wash; he tried to read but was unable to do so. Overnight, he fell from bed and had long bouts of hiccups. Dr. Quenstedt came frequently to administer injections for pain: after the last injection, the doctor had not yet reached the street when he passed away.

II. CURIE

Page 20. Eve Curie, the author of Mme. Curie's best known biography, married Henry Richardson Labouisse (1904–), who became head of UNICEF and received the Nobel Prize of Peace. Mr. and Mrs. Labouisse live in retirement in Manhattan.

Page 20. Mme. Curie kept this gram of radium for research purposes all her life. During the Second World War, her daughter, Irène, smuggled the radium first to southern France and later to Switzerland (see Joliot, Chapter VIII). The original leather container and engraved plaque are preserved in what was Mme. Curie's office at the Radium Institute of Paris.

Page 20. For more details about l'Arcouest and the village of Ploubazlanek, see Joliot, Chapter VIII.

III. PLANCK

Page 28. Einstein referred to the Solvay Conference in private as the *Witches Sabbath.*

Page 30. Visiting in New York, Albert Einstein was asked by a reporter to give a simple explanation of the theory of relativity: "It used to be thought"—he is reported to have answered—"that if all the planets were removed, nothing but space and time will remain; under the theory of relativity, since they have no reality of their own, time and space must also go... ."

Page 34. In former years, Erwin Planck worked in von Papen's office; he was the officer charged on behalf of President von Hindenburg to put a call to Adolf Hitler in Goebels' home in order to make him the formal offer of the Chancellorship of the Reich.

Page 35. The ALSOS mission was formed by a group of American scientists attached to the U.S. Army; they wore uniforms and had ficticious ranks. They were charged with finding what had been known and what was being done in Europe about atomic energy (see Joliot, Chapter VIII). Their name was an unwitting giveaway of their function since *alsos* is the Greek word for *groves.*

IV. RUTHERFORD

Page 41. The felicitous phrase is Gamow's. His is also the "Big Bang" interpretation of the creation of the solar system. For more about Gamow, see Duane, Bohr, and Biographic Notes.

Page 42. A Saturnian atom with electrons uniformly arranged in a ring around a central positive charge, had been suggested previously by Hantaro Nagaoka (1865–1960), a professor of physics at the University of Tokyo.[286] In classical electrodynamics, it was thought that the energy loss that such electrons would suffer from radiation would make them fall to the center of rotation. Nagaoka abandoned his Saturnian model

and took up the study of spectrometry. He was responsible for the development of theoretical and experimental physics in Japan.

Page 45. Peter Howard Fowler (1923–), Rutherford's eldest grandchild, is at present professor of physics at the University of Bristol and was among the first to point at the radiotherapeutic potential of pi-mesons.

Page 48. For details of the Roman group of researchers and their actions, see Fermi, Chapter X.

V. BRAGG

Page 52. In 1851 an Industrial Exhibition took place in the Crystal Palace of London; it drew thousands of exhibitors and six million visitors. It was a financial success. From the monetary surplus that resulted from this international exposition, it was decided to create grants to help the initiation of students in institutions of learning throughout the British Commonwealth. These grants were called "Exhibitions" and permitted the students to show their mettle; capable students were then able to exchange them for more substantial scholarships. Rutherford and Barkla were notable "exhibitioners," Science Research Scholars of the Royal Commission for the Exhibition of 1851. Other scholarships with similar purposes were also called "exhibitions" in the United Kingdom: Bragg received one of these.

Page 52. The newlyweds moved into a house on Lefeore Terrace, North Adelaide, with parklands in front and Mount Lofty Ranges in the distance; Professor Bragg appeared frequently thereafter in the "Lawn Tennis Notes" of *Observer*.[233b]

Page 55. Upon arrival in England, Bragg reported to the Lund Company that during the trip, the ship listed unexplainably. On its next trip, the *S.S. Wartah* was lost between Dunbar and Capetown; the cause was never ascertained.

Page 57. William H. Bragg is credited with the quip that faced with the dilemma of wave or particle, physicists simply used one or the other on alternate days (23rd Robert Boyle Lecture, Oxford University, 1921).[31]

Page 58. The Royal Institution was created in 1799 to encourage scientific study and to disseminate technical knowledge; it combines the characteristics of an academy, a college, a research laboratory, and a club. Bragg's prestigious predecessors included the founder, Benjamin Thompson Runford (1752–1814), a physician born in Massachusetts; Sir Humphrey Davy (1778–1829), inventor of the miner's safety lamp; and Michael Faraday (1791–1867), famous for his electrical research.

Page 58. Among W. H. Bragg's collaborators and students the following must be counted: William Thomas Astbury (1898–1961), Backhurst, John Desmond Bernal (1901–1971), J. L. Classon, William Ternent Cook (1877–1957), Constance Fligg Elan (Mrs. Tipper) (1895–?), Reginald Edmund Gibbs (1898–1966), R. D. Kleeman (1878–1932), Isabel Ellie Knaggs (1893–?), Sir John Madsen P.V. (1878–1969), Joseph William Mellor (1869–1938), Gilbert Thomas Morgan (1870–1940), Alexander Muller (1889–1967), S. E. Peirce (–1915), S. J. Plinpton, W. G. Plummer (1897–1936), H. J. Porter, Alexander Oliver Rankine (1881–1956), John Monteath Robertson (1900–), George Shearer (1890–1949), Kathleen Yardley (Dame Kathleen Lonsdale) (1903–1971). Bragg had two fine technical assistants and instrument makers who were also his close friends: A. L. Rogers in Adelaide and C. H. Jenkinson (–1939), who joined him at Leeds and followed him to University College and to the Royal Institution.

Page 61. The Royal Society "for the improvement of natural knowledge" is said to be the oldest scientific society in the world; it grew from weekly meetings of Oxford and London scientists, held as early as 1645. Officially chartered (1662) for the promoting of physico-mathematical learning, it was given charge of the Royal Observatory of Greenwich in 1671 and of correcting the calendar in 1752. Isaac Newton (1642–1727), physicist-mathematician, was its president; Robert Boyle (1627–1691), physicist-chemist, and Robert Hooke (1635–1703), astronomer-mathematician, served fruitfully the aims of the Society.

VI. DUANE

Page 67. Charles Lory, later president of Colorado State University at Fort Collins, said of Duane: "He was the finest man I ever worked with."

Page 67. Madame Simone Laborde (1883–1976), Albert's widow, was a pioneer of the use of radium in the treatment of cancer; she had long tenure at the Institute of Cancer of Villejuif, now the Gustave Roussy Institute.

Page 70. Madame Curie held to this gram of radium, for research purposes, for the rest of her life. During the Second World War, her daughter, Irène, and Frédéric Joliot transported it and left it for awhile in a jail cell in Riom; later, the radium was taken to the Alps and to Switzerland. The leather container with its engraved plate is preserved in what was once Mme. Curie's office at the Radium Institute of Paris.

Page 73. That the characteristic molybdenum radiation scattered by lithium was too great to be accounted for by the Compton Effect.

Page 75. The following is a list of graduate students of Professor Duane: Samuel K. Allison (1900–1965), Alice Hall Armstrong (1897–?), Frederic Columbus Blake (1877–1956), George Lindenberg Clark (1882–1969), Robert James Hayhurst (1900–), James Cramer Hudson (1896–1943), Franklin Livingston Hunt (1883–1972), Egon Karl Ferdinand Lorenz (1892–1954), Robert Alexander Patterson (1890–?), Takeo Shimizu (1890–?), Karl Wilhelm Stenstrom (1891–1973), William Warren Stifler (1883–1954), Gerald Louis Wendt (1891–1973). Additional details for all of the above may be found under their name in *Biographic Notes.* Other graduate students on whom we found few or no details are King-Fu Ho (Harvard Ph.D., 1918); K. C. Mazunder, who died in India in 1961; Herbert H. Palmer; Helen N. Sterling; and Chi-Sun Yeh.

VII. BOHR

Page 79. In later years, Bohr repeatedly told this story to his younger associates, emphasizing that this was not the best way to approach an elder.

Page 86. Victor de Broglie's dissertation was defended at the Sorbonne. "*Recherche sur la théorie des quanta*" proposed the extension of the dualistic concept of radiations to all matter. Einstein wrote to Max Born: "Read it! Even though it might look crazy, it is absolutely solid."

Page 94. Addressing a gathering of Los Alamos' scientists in honor of Roosevelt, Oppenheimer said: "He was, in an old unperverted sense, our leader. Many of us felt less certain that our work would be to a good end. Many wept who were unaccustomed to tears."

VIII. JOLIOT

Page 98. The *College of France* is an academic establishment independent of the University of Paris, fostering postgraduate education and research. The College has endured through four centuries and innumerable political regimes, sheltering scientists who were not eligible for university chairs.

Page 105. Leo Szilard suffered from cancer of the bladder in 1958. He received preoperative radiotherapy and then refused to submit to a cystectomy. He was then given additional external pelvic irradiation by James J. Nickson, M.D. and was cured. Szilard died in his sleep in 1964 of coronary thombosis.

Page 107. The numbered *plis cacheté* was opened at the French Academy, in 1949, at the request of Joliot.

Page 107. M.A.U.D. was not an acronym; the word was adopted from a wartime telegram sent by Bohr, in Copenhagen, to Otto Frisch in England. What was thought to be a code word turned out to be the first name of an English governess who had served the Bohrs! Tube Alloys was the code name of the committee in charge of fission. The Manhattan Engineering was the war designation of the U. S. atomic research; the Metallurgical Laboratory was the Chicago branch of the project.

Page 108. The ALSOS Mission was formed by a group of scientists who, although in uniform and with fictitious ranks, were not actually regular officers of the U.S. Army. Their primary mission was to investigate the status of nuclear research in Europe for General Groves. The mission's name was a giveaway of their secret since *alsos* is the Greek word for *groves.*[218]

Page 111. Jacques Solomon, a physicist, was executed in Paris during the Nazi occupation; he was the son of Iser Solomon, M.D., a naturalized Romanian, who wrote one of the earliest books on radiotherapy (1926) and developed an electrometric dosimetry and a unit

of dose, the Röntgen (R) that was used widely until the international unit (r) was agreed upon. Jacques Solomon's mother and his wife, Helene (Langevin) Solomon were sent to Auschwitz; his mother perished, but Helene Solomon returned and was later elected a communist representative to the French National Assembly.

Page 111. Allan Nunn May served his penalty and received an early discharge for good behavior. He was appointed chairman of the Department of Physics in Legon, Republic of Ghana, where he served until about 1976. He is said to be living in retirement in England.

Page 111. Paul Langevin died in December 1946; he was given a state funeral. His remains were transferred to the Panthéon, where the ashes of other great men of the French Republic are enshrined.

Page 113. References to l'Arcouest's intellectual colony may be found in Eve Curie's biography of her mother and in Marguerite Borel's spicy volume of reminiscences, published under the *nom de plume* of Camille Marbo.[272] Pierre Loti's classical novel describes the people and customs of the community of Ploubazlanec.[270] Youngsters of the families Borel, Perrin, Curie, Gricouroff, Auger, and Langevin met at l'Arcouest year after year, grew together, and later intermarried: Anne Gricouroff married Pierre Joliot, Colette Auger married Francis Perrin, Helene Joliot married Michael Langevin, son of André, second son of Paul.

IX. COMPTON

Page 117. One of Arthur's maternal great-great-grandparents was Daniel Holly (1761–1823), who lived in the valley of Rhine; his son, Peter Holly (1791–1854), came to America on a chartered ship (1832). Arthur's great-grandfather, Christian Augspurger (1782–1848), conducted a group of 36 families who left Saar Basin to settle in the valley of the Greater Miami River in Ohio. His son, Samuel Augspurger, Arthur's grandfather, became a wealthy and influential farmer and mill owner; repeated floods and fire ruined him. Samuel's wife, using her patrimony, bought back their home at Woodsdale, but her husband refused to live under aroof that was no longer his own; they separated. The Hollys and Augspurgers were Mennonites, but they refused to wear the Amish bonnet and failed to see the virtue of the "hook and eye" buttonware; also, they did not share the Amish view against education.

Page 117. Arthur's paternal great-great-grandfather, Azariah Compton (1740–1835), fought in the American Revolutionary War. His son, Elias Compton (1788–1864), left Rosemont, New Jersey in 1817, traveling westward by wagontrain to Pennsylvania and by flatboat to Ohio; he built a stone house in McHealthy, north of Cincinnati, where he lived with his second wife, Abasheba. They had five children, one of whom, Wilson Martindale Compton, bought a farm near Middleton, Ohio and became Arthur's grandfather.

Page 121. During their lifetime, the Comptons were the only three brothers to receive their Ph.D. at Princeton; Karl (1912) in physics, Wilson (1915) in economics, and Arthur (1916) in physics. In 1964 Princeton University recognized their excellence when it dedicated the *Compton Court*, a western quadrangle in the graduate college.

X. FERMI

Page 144. A number of other Italian students followed: Giulio Racah, Giovanni Gentile, Jr., Gilberto Bernardini, Bruno Rossi, Ugo Fano, Eugenio Fugini, Renato Eunaudi, Leo Pincherle, Gian Carlo Wick. They went on to reanimate laboratories in Florence, Turin, Milan, Pisa, and other centers of learning.

Page 144. In the 1930s, a number of foreign physicists worked at the *Instituto della Fisica*; most of them were fugitives of Nazi racial persecution: Felix Bloch (1905–), Hans Albrecht Bethe (1906–), Fritz Wolfgang London (1900–1954), Lothar Nordheim, Rudolf Peierls (1907–), George Placzek (1905–1955), Edward Teller (1908–), and Homi Jehangir Bhabha (1909–1966), as well as Eugene Feenberg.

Page 144. There were Jews in Rome in the second century B.C., mostly brought there as prisoners of war. As Jews were being expelled from England and France (13th century A.D.), Rome remained a quiet retreat where their own worship, judiciary, etc. were allowed. *Ashkenazi*, a rationalistic ideology that fostered Jewish coherence

and guided relations with Christians, was developed in Italy. The Spanish *Marranos* and *Sephardim* came with a different language and ideology that other Jews considered as tainted with Christian culture. Catholic Counter Reformation (16th century) weighed heavily on Italian Jews, bringing degradation. In Venice, Jews were expected to confine themselves to an area called the foundry, "il Ghetto"; the word was to gain an unpredictable connotation. Jews rallied around their synagogues and were forced into limited occupations. including usury. Eventually, Franciscans introduced the *Monte di Pietà*, offering interest-free loans to counter the "pound of flesh" lenders. Italian Jews gave birth to *Haskalah,* a reform movement aspiring to liberate the individual from a religious framework. In 1870 as Rome became the capital of the unified Italy, Jews were granted equality, and in the early 1930s Mussolini had emphatically stated that in Italy "antisemitismo non esiste." In 1938 there were approximately 47,000 Italian Jews.

Page 145. The Reale Accademia Nazionale Dei Lincei was founded on August 17, 1603 by four friends who enjoyed their exchange of information on astronomy, mathematics, and natural history as they met periodically for other pleasurable social activities. The lynx, because of its proverbial acute vision, was chosen as the symbol of their originally informal organization. In 1870 the academy was given royal status; it possessed an excellent library, the *Biblioteca Corsicana*. Because as a whole the academy did not favor fascism, it was bypassed when Mussolini created the Real Accademia d'Italia (1929) with appointed academicians and eventual suppression of the old academy (1939). After the war (1945), the Accademia dei Lincei was restituted to its patrimony and functions and the Academia d'Italia was terminated.

Page 146. Fermi's own early appraisal of this work made him feel that he would be remembered by it. Yet, as it was offered for publication to *Nature*, it was refused by the editor because the work contained "speculations too remote from physical reality." It is perhaps too much to expect from editors that they may be judges of gentle genius.

Page 148. The Italian patent 324,458 was held by Fermi, Amaldi, Pontecorvo, Rasetti, and Segrè: they agreed to extend equal shares to d'Agostino and Trabacchi, *who had an important role in their work.* Another share was offered to Gabriele Maria Giannini (1905–), an Italian physicist who emigrated to the United States; holding the patent,he was expected to enlist the interest of an American company. The General Electric Company was not interested: the Philips Company of The Netherlands agreed to pay the necessary legal expenses for extension of the patent to other countries, and it was offered an equal share. After the war, the patent holder's claim against the U. S. Government suffered considerable legalistic delays. Fermi, who had voluntarily and gratuitously given up other patents, was particularly discouraged by the delayed settlement in which others than he were involved. In 1953 a settlement of $400,000 was finally reached: after deduction of litigation fees, each one of the shareholders received $30,000. Giannini now resides in Hacienda Valmaria in Indio, California. In an hour of need, Pontecorvo, now a Soviet citizen, had sold half of his share to Eugene Ghiron Fubini (1913–); his remaining asset is kept in escrow for his claim (U. S. patent 2.206,634, July 2, 1940).

Page 148. As early as 1935, Ida Noddack had suggested the phenomenon of nuclear fragmentation[289]: she wrote letters to call attention to her paper, which was was thus known to Fermi, Hahn, Meitner, Joliot, and others. Her explanation was not appreciated, and she failed to carry out the simple experiment that would have substantiated her views.

Page 149. There were about 2000 Italians killed and 4000 wounded in Guadalajara. About 5000 Italians, most of them in the Garibaldi Battalion, fought on the side of the Spanish Republic. Carlo Rosselli (1895–1935), a cousin of the Capons, led an Italian column in Huesca.

Page 149. Laura Fermi's parents were Rear Admiral Augusto Capon (1872–1943) and Costanza Romanelli (1873–1936); Costanza was the daughter of Laura Zabban and Allessandro Romanelli. The Admiral was one of 11 children of Nina Levi, of Trieste, and Abramo Capon (1821–1886), of Venice. Admiral Capon was *Cavaliere* of the Cross of Italy and *Commendatore* of the Crown and received

the Cross of Merit in the First World War. On October 16, 1943, the retired Admiral was one of the first 1000 Italian Jews deported by order of German authority; he died in Auschwitz, Poland on October 25, 1943. [We are indebted to Liliana Picciotto Fargion (Centro di Documentazione Ebraica) of Milan, and to Captain A. Zanoni, Naval Attaché of the Italian Embassy, Washington, D.C. for these confirmed details.]

Page 151. As late as April 1942, Sengier wrote to Finletter, "As I told you previously during our conversations, the ores containing radium and uranium are very valuable." By then the I. G. Farben Company of Germany had requisitioned uranium ore in Belgium, and Heisinger had been put in charge of atomic research in Berlin. However, the U.S. State Department was not informed of the atomic bomb project, nor of the strategic value of uranium until three years later, in the spring of 1945. It is interesting to surmise that, unaware of Sengier's actions, Szilard, who had first sought to keep Belgian uranium from Nazi grasp, was innocent of his proximity to the hoard.

Page 153. General Nichols has kindly provided us (October 1981), in his own handwriting, with this authentic version of their dialogue; it is at some variance with other hearsay versions printed. The Congolese ore was considerably richer than others. On the day of Japan's surrender, General Leslie R. Groves bestowed on Sengier, in the name of the President, the *Medal of Merit* in a private ceremony at the White House. At a luncheon that followed in the Army-Navy Club, Sengier was heard to say, "*...aux Etats Unis, plus qu'ailleurs, la gloire est ephemère.*"

Page 155. Present at Stagg Field for the first sustained chain reaction were Harold Melvin Agnew (1921–), Samuel Kong Allison (1900–1965), Herbert Lawrence Anderson (1914–), Wayne Arnold (–1956), Delbert Lenley Ball (1913–), Hugh Mitchel Barton, Jr. (1918–), Thomas Brill (1920–), Robert Frederick Christy (1916–), Arthur Holly Compton (1892–1962), Enrico Fermi (1901–1954), Richard Jonathan Fox (1918–), Stewart Allen Fox (1925–), Darold Kenneth Froman (1906–), Carl Christian Gamertsfelder (1913–), Alvin Cushman Graves (1909–1965), Crawford Hallock Greenewalt (1902–), Norman Hilberry (1899–?), David Lawrence Hill (1919–), William Harry Hinch (1919–), Robert E. Johnson, William Rudolph Kanne (1913–), August Charles Knuth (1899–?), Phillip Grant Koontz (1903–), Herbert Ernest Kubitschek (1921–), Harold V. Lichtenberger (1920–), George Marvin Maronde (1897–1966), Anthony J. Metz, George Miller (1920–), George Davies Monk, Jr. (1916–1973), Henry Winston Newson (1909–1978), Robert George Nobles (1917–), Warren Edwin Nyer (1921–), Wilcox Pratt Overbeck (1911–1980), John Howard Parsons (1920–), Gerard Stanley Pawlicki (1921–), Theodore Petry, David Piet Rudolph (1919–), Leon Sayvetz (1922–), Leo Seren (1918–), Louis A. Slotin (1912–1946), Frank Harold Spedding (1902–), William James Sturm (1917–), Leo Szilard (1898–1964), Albert Wattenberg (1917–), Richard John Watts (1913–), George Leon Weil (1907–), Eugene Paul Wigner (1902–), Marvin Hubert Wilkening (1918–), Volney Colvin Wilson (1910–), Ernest Omar Wollan (1902–), Leona Harriet Woods Marshall Libby (1919–), and Walter Henry Zinn (1906–).

Page 159. Members of the General Advisory Committee of the AEC were J. Robert Oppenheimer (1904–1967), Princeton; James Bryant Conant (1893–?), Harvard; Lee Alvin Du Bridge (1901–), California Institute of Technology; Isador Isaac Rabi (1898–), Columbia University; Hartley Rowe (1882–1967), United Fruit Company; Cyril Smith (1903–), University of Chicago; Oliver Ellsworth Buckley (1887–1959), Bell Telephone Laboratories;, Glenn Theodore Seaborg (1912–), University of California; and Enrico Fermi (1901–1954), University of Chicago.