

# Perspectives of Earth and Space Scientists

## FEATURE ARTICLE

10.1029/2020CN000135

### Key Points:

- This article is a brief biographical sketch of Sydney Chapman, who was one of the greatest geophysicists during the last century
- Chapman contributed to the development of the kinetic theory of gases, geomagnetism, ionospheric physics, upper atmospheric physics, and auroral physics
- His works became the foundation of both magnetospheric physics and space physics

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### Citation:

Akasofu, S.-I. (2020). Sydney Chapman: A biographical sketch based on the book “Chapman eighty, from his friends”. *Perspectives of Earth and Space Scientists*, 2, e2020CN000135. <https://doi.org/10.1029/2020CN000135>

Received 7 JUL 2020  
Accepted 5 OCT 2020

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## Sydney Chapman: A Biographical Sketch Based on the Book “Chapman Eighty, From His Friends”

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**Abstract** This is a brief biographical sketch of Sydney Chapman, who was one of the greatest geophysicists in the world during the 20th century and also a pioneer in space physics. It is based on the book “Chapman eighty, from his friends,” together with a few notes by the author. In his early days, Chapman devoted his study on the transport property of gases and wrote “The Mathematical Theory of Non-Uniform Gases” with T. G. Cowling. In the field of geophysics (geomagnetism, ionospheric physics, and auroral physics), Chapman made fundamental contributions in each field, on the basis of rigorous mathematical physics and deep insight. Chapman also wrote the book “Geomagnetism” with J. Bartels. These efforts helped establish the foundation of a new field, *space physics*. Chapman was instrumental and effective in coordinating various international scientific organizations, serving as presidents for the International Union of Geodesy and Geophysics (IUGG), the International Association of Geomagnetism and Aeronomy (IAGA), and the International Geophysical Year (IGY). Present advance in geophysical sciences owes greatly his devotion and accomplishments.

### 1. Introduction

Sydney Chapman was one of the greatest geoscientists in of the last century. He was a Fellow of the Royal Society and was awarded the Gold Medal from the Royal Astronomical Society and the Copley Medal from the Royal Society. Chapman was an honored guest in many scientific societies of the world. Among many honors and prizes, the AGU honored him its highest honor, the Bowie Medal in 1962. AGU’s authorized conferences are called “Chapman Conferences.”

Despite of a great contribution to geosciences, Chapman’s biography has not been published yet. Fortunately, W. O. Roberts, the founder of the National Center of Atmospheric Research (NCAR), in the mid-1960s asked Chapman to give a talk on his life. Chapman delivered it in three parts, two at NCAR and one at the Geophysical Institute, University of Alaska. Both institutions decided to publish the transcribed three talks at the occasion of Chapman’s 80th birthday, under the title “Sydney Chapman, eighty, from his friends.” More than 600 people celebrated him by sending their signatures, and more than 200 people sent their messages, recollecting their association with him. These signatures and messages were compiled and edited in book form by Akasofu et al. (1968) and presented to Chapman on his 80th birthday. Copies are limited.

The book consists of Chapman’s speech (Commencement Address, University of Michigan in January, 1960), a biographical sketch, a testimonial by W. O. Roberts, and reviews of Chapman’s contributions by experts in each field (T. G. Cowling, W. E. Britton, B. Haurwitz and B. Fogle, V. C. A. Ferraro, E. H. Vestine, E. N. Parker, J. A. Ratcliffe, D. R. Bates, M. Nicolet, W. B. Hanson, and H. Odishaw).

This article is an attempt to portray Sydney Chapman on the basis of the book, together with a few notes by the author, who was Chapman’s graduate student and then his colleague. Celebrating Chapman’s 80th birthday, the *Geophysical Journal International* by the Royal Astronomical Society (1968) published a collection of scientific papers by about 20 researchers who were acquainted with him.

Note: Individuals (regrettably not all) mentioned in this paper are briefly mentioned at the end to assist readers in understanding the complex scientific environment of the mid-20th century.



**Photo 1.** Sydney Chapman at the occasion of the third lecture titled “Science and Scientists” on 30 June 30, 1967 at the Geophysical Institute, University of Alaska Fairbanks (Courtesy of the Geophysical Institute of University of Alaska Fairbanks).

## 2. Personality

The most frequently expressed words by the contributors, regardless of age and scientific status, are a great admiration of his personality: kindness, warmth, sympathetic, polite, honesty, graciousness, modesty, humbleness, competent, inspirational, encouraging, man of integrity, incorruptible, simplicity, and courageous. V. V. Belousov mentioned, “You want to be like him.”

One of the best stories conveying his personality was provided by S. Chandrasekhar. When Chapman was honored by the Royal Society, his friend offered to drive him home after the ceremony, since the evening was dark and foggy. Chapman declined, saying, “I came by bicycle.”

## 3. Chapman’s Life as a Researcher

### 3.1. Student Days

Chapman was born in Eccles, a suburb of Manchester, England, in 1888. When Chapman was 14, his father took him to a builder’s merchant. He told Chapman about a plumber who made a fortune in America. Chapman once jokingly mentioned that he might have also been rich if he had emigrated to America and become a plumber. Then, his father took him to an engineer, who suggested he attends a technical school for 2 years and even go to Manchester University.

The county in which Chapman lived offered 15 university scholarships to attend Manchester University. He received No. 15 and often wondered often what would have happened had he placed one slot lower. I always responded that the progress of space physics would have plodded along without him.

### 3.2. University Days

At Manchester University, there were several eminent professors, such as O. Reynolds (known for the Reynold's number), H. Lamb (the author of the classical treatise "Hydrodynamics.") and A. Schuster (retired physicist) who in turn recruited Rutherford (atomic physicist), who brought Geiger (known for the Geiger counter).

Chapman was wondering if he wanted to be a pure mathematician or applied mathematician: "I'd already begun to have ambitions to do mathematical research, but I did not know how one started." He consulted with J. Larmor (known for the "Larmor radius") in Cambridge. Larmor gave him a paper by a Danish scientist who was working on a flow of rarified gases in a narrow tube. Thus, Chapman decided to work on a similar problem (the kinetic theory of gases) and partially succeeded without knowing it. Maxwell, Boltzman, and Sommerfeld tracked the problem earlier but had failed.

Larmor suggested that Chapman publish his work, but one of the reviewers was astronomer J. Jeans, who seriously criticized it (his words were "hostile" according to Chapman). Larmor asked Lord Rayleigh (known as the author of the classical treatise "Theory of Sound"), who recommended its publication. Chapman remembered Jeans' criticism for a long time and told about it to J. Bartels. Bartels told him, "People who criticize you—at least they read your papers."

On the other hand, Chapman recalled that Jeans' criticism had "a sound basis." It was the beginning of his devotion to the kinetic theory of gases.

Chapman moved to Trinity College and continued to work on the kinetic theory of gases. It so happened that T. G. Cowling in his PhD thesis "demolished" Chapman's theory on solar magnetism. Chapman reacted by giving Cowling a teaching job, recognizing Cowling's mathematical skill. Their intense collaboration produced the classical treatise "The Theory of Non-Uniform Gases" (Chapman & Cowling, 1953).

I had a great difficulty in judging Chapman's place in the history of science. I did not know that A. Eddington (a great astronomer and author of the classic treatise "The Internal Constitution of Stars") worked side by side with him at the Greenwich Royal Observatory. Once I asked him about A. Milne, another great astronomer, Chapman said a little shyly that Milne was his student and he helped him to get a scholarship. Chapman asked most people to call him "Sydney." Originally from Japan, I could not do it, as was the custom there. I called him "Dr. Chapman." Because he asked it so often, I said that when my age reaches half of his, then I would call him by his first name. He died at 81 in 1971, when I was 40.

### 3.3. Greenwich Observatory/University Days

When Chapman was 22 years old, F. W. Dyson, the director of the Greenwich Observatory visited him, introducing himself as the Astronomer Royal and offering Chapman a job as an assistant. It was a very prestigious and promising job, and thus, Chapman reported it proudly to his father.

His assigned task was to plan for a new magnetic observatory and some stellar observations, although Chapman said he had no knowledge on Earth's magnetism at that time. Dyson and coworker Eddington tried to persuade him to be an astronomer, but he mentioned that Chapman was not interested in astronomy.

At the Observatory, he had many important opportunities to meet prominent scientists. Among them was G. E. Hale, who initiated a study of solar magnetism, sunspots, and the general solar field and also established the Mount Wilson Observatory. Chapman admired him greatly and mentioned how Hale tried to explain the formation of a pair of sunspots in terms of a vortex forming around the edge of coffee cup with a teaspoon of milk.

It seems that his scientific life at the Greenwich Observatory was crucial in many ways, because his life-long works in various fields began at Greenwich, although he went back and forth between the Observatory and Trinity College in Cambridge, Manchester University, Imperial University, and finally Oxford University (1953). Chapman had a great affection for Trinity College. He took me there once and showed me the corridor, in which Newton had measured the speed of sound.



**Photo 2.** Sydney Chapman, when he was the president of the Royal Astronomical Society, London. In about 1970 in Cambridge, Chapman came back home, saying that he chose the photograph to be used for his obituary (since he said he did not like his old age photo for the occasion), but we could not locate it at his death. (Courtesy of the Royal Astronomical Society, London).

#### **4. Chapman's Contributions as a Researcher**

It may be appropriate to mention here Chapman's major works in geosciences.

##### **4.1. Lunar Atmospheric Tide**

Chapman was the first to succeed in detecting an extremely weak signal (1/1,000 in. of Mercury) on the hourly atmospheric pressure data recorded at the Observatory for 64 years (Chapman, 1935). This must have been an extremely laborious work. His work determining the tide at many locations in the world, such as Madras, Batavia, Apia, Buenos Aires, Honolulu, and Melbourne, lasted until about 1945. I recall that he used to have a package containing tables of atmospheric pressure data; he told me that he had to work on the tide more.

##### **4.2. Solar Quiet Day Magnetic Variation**

Schuster was a board member of the Observatory, who was working on the solar quiet-day daily magnetic variation ( $Sq$ ), which is caused by the tidal motion of the ionized upper atmosphere (the ionosphere) across the Earth's magnetic field. Chapman (1919) developed Schuster's idea to completion.

##### **4.3. Ionosphere**

Chapman theorized the formation of the ionosphere, namely, the ionization of the upper atmosphere by solar ultraviolet (monochromatic) radiation (Chapman, 1931). This work is well known as "Chapman's layer formation." His students (including me) memorized his elegant and simple formulation. His theory is now the standard one on the formation of the  $E$  layer of the ionosphere.

#### 4.4. Formation of Ozone Molecules And Atmospheric Emission

Chapman made a unique contribution on the formation of ozone molecules in the upper atmosphere (Chapman, 1930). H. S. W. Massey mentioned that it is indeed remarkable that Chapman came up the three-body collision of oxygen atoms.

J. Kaplan had a story to tell his friends and also contributed it to the book. After picking up Chapman at the LA airport, they were intensely discussing the green line of the aurora emitted by atomic oxygen. They were so intense that Kaplan drove through a red light. Kaplan told police they were discussing the green line but got the ticket anyway. Chapman told him to go straight to the police station to pay.

#### 4.5. Geomagnetic Storms

It is not certain if Chapman had a chance to meet E. W. Maunder who was an assistant of the Observatory. Maunder drew the famous Butterfly Diagram of sunspots. He is also known for the Maunder minimum.

On the basis of his study of the 27-day recurrence tendency of geomagnetic disturbances, Maunder (1905) claimed, “The origin of our magnetic disturbances lies in the Sun: not anybody or bodies affecting both. This is clear from the manner, in which those disturbances mark out the solar rotation period ....”

Chapman told me that he was interested in Maunder's work but there was no theoretical discussion in his work, so that it was an interesting problem he wanted to pursue.

At that time, Birkeland (1918) and Störmer (1955) were developing a theory which assumed a beam of electrons were ejected from the Sun. Chapman (1918) had also an electron beam (or a proton beam) theory, titled “An outline of a theory of magnetic storms.” Chapman called his theory “quite phony” in his talk. His paper was criticized by Lindemann (1919) on the grounds that an electron beam would disperse itself by electrostatic force and could not reach the Earth. Lindemann suggested that the dispersion can be avoided if the beam consists of an equal number of protons and electrons. Chapman took his criticism and suggestion seriously and started to work how such a gas (now called *plasma*) flow interacts with the Earth's dipole magnetic field. With his graduate student, V. C. A. Ferraro, this work was completed in 1931 with much struggle (Chapman & Ferraro, 1931). Chapman mentioned, “I felt I was doing a dangerous thing in giving Ferraro this difficult problem.”



**Photo 3.** Sydney Chapman with Carl Störmer at the occasion of the aurora conference in Canada in 1952, organized by the U.S. Air Force Cambridge Research Center. During the conference, Störmer criticized Chapman, stating that he could explain details of the aurora, but Chapman's theory did not explain much (Courtesy of the U.S. Air Force Cambridge Research Center, Boston).

Their theory was successful in explain a step function like magnetic change, when the plasma reaches the Earth at the onset of geomagnetic storms (called the storm sudden commencement).

Further, their theory is the first theory on the formation of a comet-shaped magnetosphere, which is formed in the solar wind, so that their theory established the foundation of space physics.

Chapman continued to work on geomagnetic disturbances and summarized the work in “Geomagnetism” with Bartels in 1940 (Chapman & Bartels, 1940). He mentioned to me that this collaborative work was difficult and was finished just before World War II began. This book was the only guide for those who had worked in the field of geomagnetism and ionospheric physics and auroral physics (including me) for many years after the war.

I worked very closely with Chapman on geomagnetic storms based on abundant data obtained during the IGY (compared with the data he used in the 1920s). He and I shared an office at the Geophysical Institute of the University of Alaska. In many ways, Chapman's earlier work had to be corrected or revised. Nevertheless, he was very happy that the IGY data were fully used in advancing space physics.

Among many discussions in those works, the most memorable one was about the “unknown factor” in the solar wind. At that time, it had been firmly believed (including by Chapman) that an intense solar wind was the only cause of a strong geomagnetic storm. After examining a large number of geomagnetic storm records, I found that there must be “unknown factor” in determining the intensity of geomagnetic storms, even more than the intensity of the solar wind.

Chapman and I had many discussions on my finding. After he was convinced, Chapman became a very strong supporter (Akasofu & Chapman, 1963). A few said I was not qualified to be Chapman's student (not knowing the obvious fact that the solar wind consisted of only protons and electrons). However, Chapman presented this finding during the First Solar Wind Conference on the Solar Wind held at JPL in Pasadena in 1966. Although many doubted the presence of the “unknown factor,” J. W. Dungey (1966) suggested after Chapman's talk that the unknown factor might be the southward component of the interplanetary magnetic field. Soon afterward, a satellite observation confirmed Dungey's suggestion.

On the other hand, Chapman was not particularly interested in the origin of the Earth's magnetic field (the dynamo theory), although he had a chance to talk about it with S. K. Runcorn and E. Bullard; Bullard, who became the Chapman Chair professor of the University of Alaska Fairbanks, and the author once wondered why, without specific solution.

Runcorn, one of the pioneers in observationally proving continental drift and a Chapman Chair professor, mentioned that Chapman helped to make his work more rigorous in the book. Actually, Chapman was greatly interested in Wegener's continental drift theory when he was on travel in Norway and told about it to W. L. Bragg. Bragg got Wegener's papers and gave them to local geologists. Bragg mentioned in his contribution to the book, “The local geologists were furious; words cannot describe their utter scorn of anything so ridiculous as this theory, which has now proved so abundantly to be right.”



**Photo 4.** Sydney Chapman with the leaders of the IGY, from the left, J. Coulomb, M. Nicolet, S. Chapman, L. Berkner, and V. Belousov at the occasion of the IGY review conference in about 1959 (personally given to the author by Chapman).

## 5. International Geophysical Year (IGY)

It so happened that J. A. Van Allen invited Chapman, Berkner, and others at his home for a dinner. They planned to stage the Third Polar Year, 25 years after the Second Polar Year (in which Chapman was an organizing committee member). For detail, see Foerstner (2007, chapter 9). It eventually became known as the International Geophysical Year.

The IGY was one of the great scientific enterprises of the past. Chapman served as the president by working closely with leaders in each field, including Belousov, Berkner, Nicolet, and J. Coulomb. He encouraged many researchers, including B. Bednarova-Novakova, R. L. Classon, G. Lang-Hasse, A. P. Mitra, W. Stoffregen, A. A. Tube, H. E. Hinteregger, A. Lebednsky, Stoffregen, O. Scheider, and others. All of them thanked Chapman for his help and encouragement in the book.

Chapman and C. T. Elvey worked closely together in establishing the IGY network of all-sky cameras in both the Arctic and anti-Arctic. Without their efforts, the new field of auroral substorms would never have been developed (Akasofu, 1964).

He visited many magnetic observatories, including Alibar (S. L. Malarkar), Huancayo (A. A. Gieseke; Chapman coined the term “electrojet” for a very concentrated  $S_q$  current along the magnetic equator), Sodankyla (W. Stoffregen), and many others, although he was basically a mathematical physicist.

## 6. Physical Feats

More than 20 people mentioned Chapman's physical activities.

### 6.1. Bicycling

J. P. Wild mentioned, “I first met Sydney Chapman when he came to Sydney by bicycle from Canberra (200 miles) in 1950; later I was told that several accompanying students had a difficulty of catching up.” Chapman was 62 years old at that time.

Chapman's bicycle stories were contributed by C. W. Allen, H. G. Booker, W. L. Bragg, K. E. Bullen, S. Charndrasekhar, T. G. Cowling, W. H. Pickering, O. Sutton, G. I. Taylor, and others.

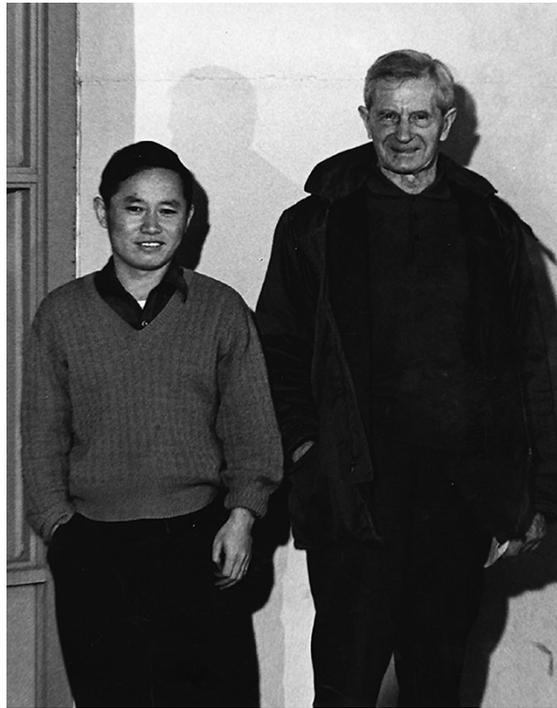
### 6.2. Walks

Elvey mentioned, “Another exploit of his was every Saturday afternoon to walk from the University to Fairbanks, a distance of about 4 miles, for a steam bath, regardless of the temperature. Often the temperature would be 40 below zero (Fahrenheit or Centigrade since they are equal at this point).” L. A. Allredge, E. V. Ashburn, A. A. Giesecke, and many others contributed the walk stories. I recall that during walks with me, he told me about his view of world affairs, his friends, the history of science, and many other subjects.

### 6.3. Swimming

Chapman used to swim 25 laps most days possible at the pool of the University of Alaska. When I swam with him, he wanted to be ahead of me always. In many international conferences, the responsible organization reserved a hotel for him, only to find in panic that he was not there; they asked me where he might be. My response was always that you will find him in a pool at YMCA. V. V. Belousov, Y. Kato, J. H. Piddington, and others contributed their stories.

Chapman spent every summer month at the High Altitude Observatory, University of Colorado, Boulder, Colorado, for many years. We used to climb Green Mountain there. One year, he was exhausted and could not reach the top. On the next day, I asked him to follow me, so that I could control the speed of the climb. After reaching the top, he was so happy that he challenged me to run back to the university pool to swim.



**Photo 5.** Sydney Chapman and the author during a daily walk in Fairbanks in about 1962 (Courtesy of the Geophysical Institute, University of Alaska Fairbanks).

**Many people mentioned in the text (regrettably not all because of difficulties finding information)**

**L. R. Aldredge** (1917-2010): Radio physicist. Worked as a radio engineer for Carnegie Institute of Washington, D.T.M.

**C. W. Allen** (1904-1987): Astrophysicist. Worked as director of the University of London Observatory and authored *Astrophysical Quantities*.

**E. V. Ashburn** (1910-1999): Geophysicist and was Head of the Atmospheric Laboratory (1969).

**D. R. Bates** (1916-1994): a Northern Ireland mathematician and physicist, was awarded the Chree medal: a Fellow of the Royal Society.

**B. Bednářová-Nováková** (1904-1985): a Czech astronomer and geophysicist, was one of the founders of the Geophysical Institute of the Czechoslovak.

**V. V. Belousov** (1907-1990): Solid earth physicist. In 1960 he was elected President of the International Union of Geodesy and Geophysics (IUGG).

**L. V. Berkner** (1905-1967): Ionospheric physicist. Wrote several books, including *Rockets and Satellites* (1958), *Science in Space* (1961).

**H. G. Booker** (1910-1988): Ionospheric physicist. Member of the National Academy of Sciences. Awarded the American Meteorological Society medal.

**W. L. Bragg** (1890-1971): Physicist. a Fellow of the Royal Society, and in 1915 he became the youngest ever winner of the Nobel Prize in Physics.

**K. E. Bullen** (1906-1976): Solid earth physicist. Awards included: Gold Medal of the Royal Astronomical Society.

**S. Chandrasekhar** (1910-1995): Astrophysicist. Won the Nobel Prize in Physics in 1983 and the Copley Medal of the Royal Society in 1984.

- R. L. Chasson** (1919-1990): The Vice Chairman of the UCAR Board of Trustees from 1963-1984.
- J. Coulomb** (1904-1999): a French geophysicist and mathematician. Served as president of the IUGG.
- T. G. Cowling** (1906-1990): Physicist: an English astrophysicist and awarded the Gold Medal of the Royal Astronomical Society in 1956.
- F. Dyson** (1923-2020): Astronomer. Freeman J. Dyson's many awards included: Fellow of the Royal Society, 1952.
- C. T. Elvey** (1899-1970): Auroral physicist. The C. T. Elvey Building is home to the Geophysical Institute at the University of Alaska Fairbanks.
- V. C. A. Ferraro** (1907-1974): Physicist: A Fellow of the Royal Astronomical Society and a joint author of the Chapman-Ferraro theory.
- B. Fogle** (1935): A graduate student of Dr. Chapman at the Geophysical Institute, UAF, specialized in noctilucent clouds
- A. A. Giesecke** (1918-2016): Geophysicist (geomagnetism). The first director and president of the Geophysical Institute of Peru (1947 -- 1982).
- W. B. Hanson** (1923-1994): Ionospheric physicist. Awarded the John Adam Fleming Medal by the American Geophysical Union.
- B. Haurwitz** (1905-1986): Atmospheric physicist. Received the American Geophysical Union's Bowie Medal in 1972.
- H. E. Hinteregger** (1919-1997): Ionospheric physicist. Award for outstanding research contributions from the Air Force Cambridge Research Laboratory
- J. Kaplan** (1902-1991): Physicist (aurora). Awards included: Received AGU's John Adams Fleming Award and the Hodgkins Medal.
- Y. Kato** (unknown): Yoshio Kato was a professor in geomagnetism at Geophysical Institute, Tohoku University, Sendai, Japan.
- G. Lange-Hesse** (1917-1988): Ionospheric physicist. Worked at the Max-Planck-Institut für Aeronomie; between the years 1952-1973.
- A. Lebedinsky** (1913-1967): Astrophysicist. A member of several international scientific organizations, including the IUGG and COSPAR.
- R. A. Lyttleton** (1911-1995): Astrophysicist. British mathematician and theoretical astronomer. Awarded a Royal Medal of the Royal Society.
- S. L. Malurkar** (1903-1984): Geophysicist (geomagnetism). served as director of Colaba and Alibagh Observatories, Mumbai.
- D. F. Martyn** (1906-1970): Ionospheric physicist. Received many honors for his ionospheric research, including the Lyle Medal.
- H. S. W. Massey** (1908-1983): Physicist (atomic physics). Awards included: Hughes Medal, 1955; he was knighted in 1960.
- K. Mather** (1922-2003): Served as director of the Geophysical Institute at University of Alaska Fairbanks from 1963-1976.
- A. P. Mitra** (1927-2007): Ionospheric physicist. Awarded Fellow of Royal Society of London in 1988.
- M. Nicolet** (1912-1996): A Belgian physicist and meteorologist; received the American Geophysical Union's William Bowie Medal in 1984.
- H. Odishaw** (1916-1984): A fellow of both the American Geophysical Union and the Royal Society of Arts.
- E. N. Parker** (1927): Astrophysicist. Awarded the National Medal of Science in 1989 and the James Clerk Maxwell Prize for Plasma Physics.

- W. H. Pickering** (1910-2004): Served the longest term as a Director of JPL and NASA's Distinguished Service Medal and the National Medal of Science.
- J. H. Piddington** (1910-1997): Space physicist. A Fellow of the Royal Astronomical Society and Fellow of the Australian Academy of Science.
- A. T. Price** (1903-1978): Awarded the Gold Medal of the Royal Astronomical Society in 1969.
- J. A. Ratcliffe** (1902-1987): Ionospheric physicist. Awarded the Gold Medal of the Royal Astronomical Society in 1976.
- W. O. Roberts** (1915-1990): Creation of the High Altitude Observatory (HAO) and the National Center of Atmospheric Research (NCAR).
- S. K. Runcorn** (1922-1995): Solid earth physicist (geomagnetism). Received Gold Medal from the Royal Astronomical Society.
- O. Schneider** (unknown): Geophysicist. Chief scientist. Elected president of the Asociacion Argentina de Geofisicos y Geodestas in 1967.
- W. Stoffregen** (1909-1987): Auroral physicist. Director of the Uppsala Ionospheric Observatory.
- O. G. Sutton** (1903-1977): A Welsh mathematician and meteorologist; his awards included: International Meteorological Organization Prize.
- G. I. Taylor** (1886-1975): British physicist and mathematician, awards included: Royal Medal (1933) and Copley Medal.
- M. A. Tuve** (1901-1982): Ionospheric physicist. Received the Presidential Medal for Merit from President Harry S. Truman.
- J. A. Van Allen** (1914-2006): Physicist. The discoverer of the radiation belts. Awards include *the* Bowie Medal and National Medal of Science.
- E. H. Vestine** (1906-1986): Geophysicist (geomagnetism). Professor of Meteorology at University of California, Los Angeles.
- J. P. Wild** (1923-2008): Radio physicist. Received Balthasar van der Pol Gold Medal and International Union of Radio Science.

#### Acknowledgments

The book celebrating Chapman's 80th would not have materialized without the efforts of W. O. Roberts and K. Mather, Director of the Geophysical Institute of the University of Alaska, and the two coauthors of the book. The help from Chapman's family, particularly Katharine, Chapman's wife, was essential. The book project was supposed to be a "surprise" present on his birthday; the author needed Katharine's help on the list of contributors, but she once left the list on her table, so that it also became Chapman's project. Mary Tessler, Chapman's daughter, read the draft of this article. I would like to thank also Mr. N. Rozell, Science Writer of the Geophysical Institute, for his assistance in editing this article.

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