HENRY NORRIS RUSSELL
1877—1957

A Biographical Memoir by
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BY HARLOW SHAPLEY

HENRY NORRIS RUSSELL was born on October 25, 1877, in Oyster Bay, New York, the son of a Presbyterian minister. His education was acquired principally at home until the age of twelve, and then at the Princeton Preparatory School and Princeton University; from the latter he was graduated in 1897 with the highest standing ever attained by a Princeton undergraduate. Throughout all of his mature life, as a member of the Princeton faculty, he lived at 79 Alexander Street, but spent many summers on the New England coast or in travel.

Russell was awarded in due course all the formal distinctions that America's leading astronomer merited. He was made a foreign associate of the Royal Societies of London, Edinburgh, and Belgium; Correspondent of the French Academy of Sciences, and Associate of the Royal Astronomical Society of London. His honorary degrees came from Dartmouth, Louvain, Harvard, Chicago, Michoacan (Mexico); his medals and prizes from the Royal Astronomical Society of London, the French Academy (Lalande and Janssen), National Academy of Sciences (Draper), Astronomical Society of the Pacific (Bruce), American Academy of Arts and Sciences (Rumford), Franklin Institute (Franklin), and the American Philosophical Society (John L. Lewis prize). He was the first Henry Norris Russell Lecturer of the American Astronomical Society.

In Russell's brief autobiographical statement for the National
Academy of Sciences two paragraphs report on his natural interest in mathematics and on his early education:

“It may be relevant to record that a strong interest in mathematics appears to 'run in the family.' My maternal grandmother won a mathematical prize on her graduation in 1840 from Rutgers Female Institute in New York (the first institution in that city for the higher education of women). My mother was easily first in a 'ladies class' in mathematics given by professors of the University of Edinburgh about 1868. I was awarded a fellowship in mathematics on my graduation from Princeton. My children, though none of them have followed careers in the mathematical sciences, have all enjoyed their courses in mathematics and done well in them with no great effort.

“I was always interested in astronomy. (I recall my parents showing me the transit of Venus in 1882, when I was five years old.) Specialized interest in it was aroused mainly by C. A. Young of Princeton—a great teacher as well as a great astronomer. My first independent contribution dealt with the atmosphere of Venus.”

My address to the American Astronomical Society in May, 1957, on Russell's scientific work follows:

In Colonel Stratton's obituary of Henry Norris Russell in *Nature* for March 16, 1957, appears this concluding evaluation: “A man of overflowing energy, never sparing himself in his own work or in assisting the researches of others, he was the most eminent and versatile theoretical astrophysicist in the United States if not in the world.”

When I cast back in my memory (before I examine the full bibliography), I pick out the following as Russell's most outstanding contributions:

1. The color magnitude diagram.
2. Eclipsing binary theory and calculations.
3. Spectrum analysis, laboratory and stellar.
4. The masses of stars, including analysis of visual double stars.
5. Popularization of astronomy at a high level.
This last refers to the famous textbook with Dugan and Stewart, to some general lectures, and especially to the monthly contribution, over forty years, to the *Scientific American*—a survey of astronomical problems and progress much like the current series by Otto Struve in *Sky and Telescope*.

In the foregoing five fields Russell did indeed do outstanding work, but picking up the list of about 200 technical papers, I see that I have left out at least five fields that should not have been overlooked:

6. Solar and stellar composition and constitution (for example, the "Russell mixture" so much used in cooking up atmospheric models).
7. The origin of the planets and comets.
9. The contacts of religion with science, and vice versa—and
10. Perhaps the most important of all, general consulting on all astronomical and spectroscopic problems.

Colonel Stratton is right about the unequalled versatility of Russell, who has written modestly of himself that as a boy he was rather acutely studious, "somewhat preferring mathematical studies, and with no marked scholastic dislikes." Going much further, all of us would agree that the word *genius* more rightly applies to him than to any other American astronomer of these or earlier times. And as a genius he was at times pretty hard going for many of us followers who think and talk slowly and raggedly. As one of his first graduate students I quickly learned to use monosyllables—"Yes, No, Yes? So? How's that?" and "Ummmm." That drawling monosyllable "Ummmm" conceals more careful ignorance than any other in the Queen's English. I doubt if I fooled him. We would walk on the Princeton campus, he waving his cane to shoo the inconsequential students off the walks—he calculating and scintillating—I listening, guessing, wondering, trying to de-confuse myself. You may remember that I claim to be the original Russell Mixture.

Of the ten major fields of Russell's interest and activity, I shall choose only three or four for comment. First the happy assignment
and acceptance of being America’s wide-ranging astronomical consultant.

Beginning in the early 1920s Russell was officially a visiting research associate at the Mount Wilson Observatory. When I was shipped East to Harvard, so the rumor goes, they were happy that the released dollars (there were not very many, I assure you) permitted the bringing of Russell to Pasadena. It was indeed a clever bargain arranged by Mr. Hale.

From Russell’s long association with Mount Wilson came many scientific contributions—largely spectroscopic. Some were inspired by his association with Walter S. Adams, A. S. King, and H. D. Babcock. Later he was made an official research associate of the Harvard Observatory. And he also regularly visited the Lick and Lowell Observatories, the National Bureau of Standards, and other research groups. One year he was Morrison Research Associate on Mount Hamilton. The assistance he gave everywhere was immense—criticisms, hunches, and much computational labor. He liked to mess around with numbers.

In the few paragraphs that he has written about himself for the records of the National Academy of Sciences, he says, “I have always enjoyed detailed numerical work,” and such computational work has been used freely in all his investigations. Professor Dugan once remarked, “Russell will spend much more time hunting for ingenious short cuts than would be required to take the long cut.”

Russell’s informal role over three decades as National Astronomical Consultant was supplemented formally by joint authorships of scientific publications. His first collaborator was Arthur R. Hinks at Cambridge, England, where, in his early post-doctorate days, he measured trigonometric parallaxes of stars without too much success.

In 1912 began our joint work on the orbital theory and practice of eclipsing binary stars; and at the same time began the collaboration of Harvard, Yale, and Princeton on the positions of the moon determined photographically. “Harvard makes photographs, Princeton
makes measures, and Yale thinks” was alleged to be the arrange-
ment. The collaborators were E. C. Pickering, E. W. Brown, Russell,
and a philanthropist (George Russell Agassiz) who paid for the
many girl-hours.

I have made a list of subsequent joint authorships—about twenty-
five in number. Here are some of the names: Adams, Joy, Stewart,
Saunders, Dugan, Karl Compton, Boyce, Menzel, Bowen, Shenstone,
Megggers, Arthur King, Robert King, Mrs. Gaposchkin, and, most
frequently collaborating, Charlotte Moore (Sitterly). Many other
contributions could well have carried his name as joint author, but
such credits did not interest Russell. He was casual about credits to
himself, but intense about anybody’s scientific discoveries.

While still a Princeton graduate student, Russell published two
papers that pointed directly to two of his future life-long interests.
The first was “The Atmosphere of Venus,” published in 1899 in the
then young Astrophysical Journal. It makes good reading today; it
shows a distinct maturity. Later that year appeared his paper “The
Densities of Variable Stars of the Algol Type.” Many of his sub-
sequent papers deal with eclipsing stars, and also a large number
with planetary atmospheres.

Other early scientific papers (1897-1900) touched celestial me-
chanics, e.g., “The Great Inequality of Eros and the Earth.” That was
the time of considerable excitement over the highly eccentric orbit
of the newly discovered asteroid. Russell’s last published paper, by
the way, was encouraged by Mrs. Nail and me a couple of years ago.
We tempted him, after he had thought his effective work was com-
pleted, by sending him light curves of some eclipsing stars in the
Magellanic Clouds. (It is well, we argued, to be sure that the grav-
tational laws are the same in those mixed up galaxies as in our own;
it is important also to see if the stars are similar in general respects.)
Russell’s contribution (this last one) was printed, just a week before
his death, in the second volume of Dr. Beer’s Vistas.

Most of Russell’s last decade of work dealt with eclipsing star
orbital theory. He devoted much time to the work of J. E. Merrill and Z. Kopal.

Beginning in the middle of the 1920s he turned his guns on the mysteries of radiation. He devoted more of his time to spectrum analysis, a subject on which he has left an indelible impression. With Saunders, Charlotte Moore Sitterly, Meggers, Lang, Bowen, and others, he brought order out of chaos among the arc and spark spectra of the elements.

From 1925 to 1930 his activity produced twenty papers on line spectra. Some of them were classics, such as “A Calibration of Rowland’s Scale of Intensities for Solar Lines,” “The Arc and Spark Spectra of Titanium” (130 pages in the Astrophysical Journal), and, with F. A. Saunders, “The Spectrum of Ionized Calcium.” This last introduced the famous Russell-Saunders coupling in complex spectra.

That interval of five years yielded also the Russell-Dugan-Stewart two-volume textbook, which reoriented and essentially revolutionized astronomical teaching and astronomical textbook writing in America. Also at that time he gave the Terry lectures at Yale which resulted in the book Fate and Freedom. In this same pentad of activity appeared (with Mrs. Sitterly as joint author) the important catalogue of the dynamical parallaxes of 1,777 double stars.

The 1930s were also furiously active and scientifically enjoyable—the work being more spectroscopic than astronomical. Much more could be said of Russell’s work on laboratory and stellar spectra, but I should devote a little time to some miscellaneous half-forgotten enterprises.

There was the tricky analysis in 1921 of radioactive data which led to his fixing the upper limit to the age of the earth’s crust. He starts with the observation that if the whole crust had been originally composed of uranium it would have decayed to the present terrestrial abundance in 17 half-periods, or $8.5 \times 10^{10}$ years. "But this assumption," he remarked, "would lead to the absurd conclusion that the
crust must now be composed entirely of the products of the radio-
active disintegration of the original uranium." He considers the lead
situation, and the contribution of thorium, and eventually concludes,
"indeed it might be safe to say that the age of the crust is between
two and eight thousand millions of years." That was thirty-five years
ago, and much has since been done in age measurement by tech-
niques then unknown. But he had it right. Now we would prob-
ably say between four and six thousand million years.

The Terry lectures in Yale in 1927 resulted as remarked above in
the small book *Fate and Freedom*. The three chapters are: "Fate
and Freedom," "God and Man," "Body and Soul." I recommend
the book to those of you who are wondering about human fate, as
doomed by the stars and solaced by the comforts of religion.

On page 132 of *Fate and Freedom* I find a rather satisfactory per-
sonal definition of that evasive concept "soul." Russell says: "By soul
I mean here the personality, the conscious individual who under-
stands, feels, remembers, responds to us." Soul equals personality.
I rather like that. But Russell states, "When the body dies the soul
vanishes utterly." I do not agree with that view. He is inconsistent.
I always intended to point out to him the obvious error. For the
personality (therefore soul) survives. His personality, in a sense, is
here at the present time and will continue to survive. But he and I
didn't get to argue such things—eclipsing stars and the iron multi-
plets always got in the way. Perhaps it is just as well.

Russell's proper field of science was astronomy and spectroscopy,
but on the side he was interested in poetry, geology, archaeology,
botany, and travel. He knew the Princeton countryside and the
deserts of the Southwest; he knew the North Cape and the Nile
Valley with its monuments.

In those early Princeton days, I, as an uncouth Missourian, was
accepted with some reservations, but gradually I improved, and at
last became aware of my arrival when Russell very privately told me
a deep secret; that is, he told me just where in the woods four miles
north of Princeton I could find the rare and precious fringed gentian. I had indeed made good!

To report a little further on his miscellaneous scholarly interests, I note in the bibliography the following: “Determinism and Responsibility,” “A Planetary Date for Chaucer’s Troilus,” “The Borders of the Humanities.” During the First World War there appeared a paper “On the Navigation of Airplanes.”

Of more professional concern were the following contributions: “Dark Nebulae,” “On Majorana’s Theory of Gravitation,” “Model Stars,” “On the Origin of Periodic Comets,” “The Probable Diameter of Stars,” “The Solar Spectrum and the Earth’s Crust,” “The Masses of the Stars” (an important monograph), and the highly useful “List of Ultimate and Penultimate Lines of Astrophysical Interest.” We do not have space here to explore these contributions, but conclude by coming back to the planets, where Russell began his scientific thinking.

His book entitled The Solar System and Its Origin has been a guide and inspiration to the many recent workers in this important field. Research and speculations have gone far since Russell’s University of Virginia lectures. Later contributions have come from Alfven, ter Haar, Kuiper, Lyttleton, Urey, von Weizsaecker, Whipple, and others, but Russell’s contribution of more than twenty years ago was distinctly the guiding pioneer work, both as a survey of the then current thought and as a rich source of suggestion.

In retrospect we note that Russell never seemed to interest himself in Milky Way structure, or in the many problems of the star clusters and galaxies, possibly because I talked too fast about them and he had little chance to contribute. Also he did not get deeply into the field of meteors. But he appeared to cover about all other astronomical fields in lively interest and many of them in original research. And he enjoyed his researches immensely, especially those where he must calculate the consequences of this and that. One of my clearest pictures of him shows his eager thoughtful gaze at the ceiling, or
the horizon, with a 10-inch slide rule in his hands. He carried the logarithm tables in his phenomenal memory.

A few weeks ago I stood alone, with bared head, in the front yard at 79 Alexander Street, when his body was taken into the study from which I had so often come out inspired and determined; and I thought: "His interval out of infinite time is nobly concluded; it is now our continuing responsibility to pay interest on the investment he made in us."
KEY TO ABBREVIATIONS

A. J. = Astronomical Journal
Annals, H. C. O. = Annals of Harvard College Observatory
B. A. A. J. = British Astronomical Association Journal
H. C. O. Bull. = Harvard College Observatory Bulletin
H. C. O. Circ. = Circulars of the Harvard College Observatory
Harv. Reprint = Reprints from the Harvard College Observatory
Helwan Publ. = Publications of the Helwan Observatory
J. Franklin Inst. = Journal of the Franklin Institute
Lick Obs. Cont. = Contributions from Lick Observatory
M. N. = Monthly Notices of the Royal Astronomical Society
Mt. Wilson Cont. = Mount Wilson Contributions
Nat. Hist. = Natural History
Obs. = Observatory
P. A. = Popular Astronomy
P. U. Obs. Cont. = Princeton University Observatory Contributions
Phys. Rev. = Physical Review
Pr. Alumni Weekly = Princeton Alumni Weekly
Pr. Univ. Bull = Princeton University Bulletin
Proc. N. A. S. = Proceedings of the National Academy of Sciences
Sci. Am. = Scientific American
Sci. Mo. = Scientific Monthly
Sci. Pa. B. S. = Scientific Papers of the Bureau of Standards
Tech. Rev. = Technology Review
Trans. Amer. Phil. Soc. = Transactions of the American Philosophical Society
Trans. I. A. U. = Transactions of the International Astronomical Union
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