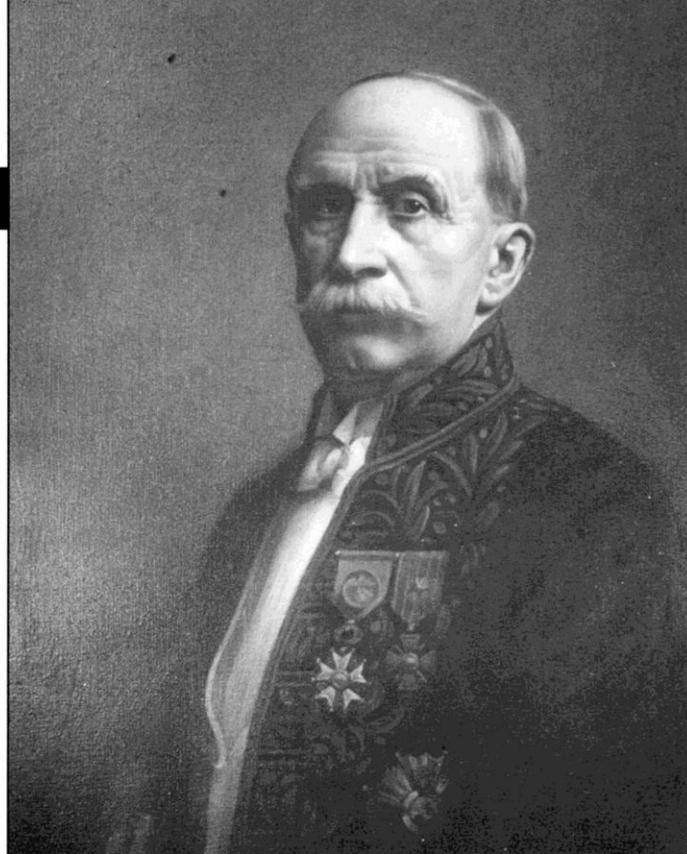




Bruce Medalist Profiles

Henri A. Deslandres: The Sixteenth Bruce Medalist

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Henri Alexandre Deslandres
24 July 1853 — 15 January 1948
1921 Bruce Medalist

Henri Deslandres was a six-year-old Parisian schoolboy when Gustav Kirchoff and Robert Bunsen in Heidelberg discovered that each gas emitted and absorbed its own characteristic set of wavelengths. A number of scientists, including Kirchoff himself, Norman Lockyear in England, and Jules Janssen in France, immediately set out to determine the composition of the Sun, while William Huggins in England attempted the difficult spectroscopic study of more distant stars.¹

It is unlikely that young Henri was aware of this. He probably learned soon enough, however, of more ominous news: while he was growing up, Chancellor Otto von Bismarck was uniting most of the kingdoms, principalities, grand duchies, duchies, and free cities of central Europe into a single powerful and militaristic nation, Germany. The threat to France was real: German armies besieged Paris while Deslandres was in his teens; they were to return twice during his lifetime. Upon graduation from l'École Polytechnique in 1874, the young man chose a military career.

Apparently he was a good soldier, for he rose swiftly to the rank of captain in the

engineers. But his interests were turning toward science, and, in 1881, he resigned his commission to pursue physics in M. A. Cornu's laboratory at l'École Polytechnique. His first publication was in ultraviolet spectroscopy, a careful measure of some bands (sets of closely spaced absorption lines) seen in water vapor, including the discovery of one new band. He pointed out that the wavelengths and relative intensities were the same as those of some of the *telluric* lines, those seen in absorption in the spectrum of the Sun but known to be formed in the Earth's atmosphere. By 1888 he was working in the physics laboratory at the Sorbonne and earning his doctorate with a thesis on the band spectra of molecules.

Deslandres received acclaim in the scientific community for patterns he found in the wavelengths absorbed by such compounds as nitrogen, oxygen, cyanogen, and water vapor. He discovered a single formula containing three integers which would produce the various wavelengths in a band when different sets of integers were inserted. The constants in his formula, which he found from laboratory measure-

ments, yielded such quantities as the masses and separation distances of the atoms in the molecule after the development of quantum mechanics many years later.

Meanwhile Janssen, after observing an 1868 eclipse in India, had succeeded in viewing solar prominences without an eclipse and showing that they contained hydrogen.² The new field of astrophysics was recognized as important. A report to the French Academy of Sciences stated bluntly, "It is no longer geometry and mechanics which dominate [in astronomy], but physics and chemistry." This was heresy to the director of the Paris Observatory, Urbain Le Verrier, who "considered the establishment to be his personal property." To Le Verrier, whose calculations had led to the discovery of Neptune, real astronomy was measuring positions in the

2. By an amazing coincidence, Lockyear made the same discovery in London at the same time. The two reports reached the French Academy of Sciences the same day.

1. For more on Huggins, see the Sep/Oct 1990 issue of *Mercury*.

sky and computing orbits. The Academy's wise recommendation, to construct a new, separate observatory for astrophysics, was taken by the French government, which awarded Janssen more than a million Francs to establish an astrophysical observatory in a ruined castle at Meudon, on a hill just outside Paris. Starting with his laboratory in the stables, the only buildings not severely damaged in the Franco-Prussian war, Janssen built an observatory specializing in photography and spectroscopy of the Sun. For two decades he was the sole astronomer on its staff.

In 1889, Admiral Ernest Mouchez, a hydrographer and able administrator who had succeeded Le Verrier as director of the Paris Observatory, hired Deslandres to bring astrophysics into that venerable institution. At 36, Deslandres began a new career. He attached a spectroscope to the Paris 1.2-meter reflector, the largest telescope in the world to be used for spectroscopy at the time, and measured radial velocities of stars. He determined the difference in Doppler shifts between one side of Jupiter and the other and found the planet's rotational speed. He made the surprising discovery that Uranus' rotation is retrograde. He also measured the rotation speeds of Saturn's rings, but this time he lost the race to two Americans. James E. Keeler at the Allegheny Observatory was first to show that the outer rings rotate more slowly than the inner ones,³ and W. Wallace Campbell at Lick Observatory measured the actual speeds of the ring particles before Deslandres.⁴

Like many astronomers then and now, Deslandres designed and built much of his own instrumentation. In attempts to obtain radial velocities in quantity with an objective prism, he exposed a comparison spectrum from a gas in a discharge tube through the same slit and collimator as the starlight, but he found that the objective prism would not yield precise wavelengths. His idea of circulating water in the hollow walls of his spectrograph to keep it at a uniform temperature was a more successful innovation.

Harold Zirin begins his book *Astrophysics of the Sun* with the poetic words,

3. For more information, see "James E. Keeler's 'Prettiest Application of Doppler's Principle'" in the Mar/Apr 1985 issue of *Mercury*.

4. See *Mercury*, Mar/Apr 1992, for more on Campbell.

"There is a star, a real star, that is only 140 million kilometers from us, that we can study with small telescopes, even, and see the most wondrous things." This was even truer a century ago, when detectors were so much feebler than today's. It is not surprising that many of the ablest astrophysicists of the time concentrated on the only star for which there is no shortage of light. Janssen, Lockyear, Deslandres, and George E. Hale, were the most successful solar astronomers of the 1890s.

When young Hale, just 23 and proprietor of his own private observatory at Kenwood, first came to call, Deslandres, fifteen years older, graciously received him, showed him his instruments and photographs, and took him to dinner and the opera. Hale had come dashing over from England after reading one of Deslandres' papers, showing that the Frenchman had found a way much like his own to photograph solar prominences in the light of ionized calcium. As Hale wrote a friend, Deslandres' paper "knocked my socks off." When he saw that Deslandres was on the verge of surpassing his own results, he "at once decided that unless I wanted to lose the whole field of work I had better come home, and sail in again." While awaiting the first ship home, Hale made a quick tour of European observatories, and called again at Paris, to discover that "Deslandres fixed up a grating and using it as I had told him we did, got 7 hyd[rogen] lines. He had 2 before, and we have 4, so he is a little ahead. But I am inclined to think he will have to hustle to keep ahead, if I know myself!"

The two became rivals. While the idea of the spectroheliograph dates back to Janssen, Hale was the first to build a working model, and Deslandres independently built his own.⁵ With both claiming priority, their relations became strained. Hale wrote his wife after a 1909 meeting of the Paris Academy of Sciences, to which he had been elected a foreign associate with Deslandres' support, "I had no idea of speaking (though I may give a paper next week). But Deslandres read a paper in which he intimated that he had just made a more thorough study of the hydrogen flocculi than I (he has not yet photographed any

5. See *Mercury*, May/June 1992, for more on Hale and the spectroheliograph.

vortices). As I had done all he has, and much more, I did not care to have it appear that I had done the work in an incomplete way, so I made an extemporaneous reply, which contained many mistakes, but seemed to accomplish my purpose."

Yet, a few years later, Hale chaired the committee of the National Academy of Sciences which awarded a medal to Deslandres. The Frenchman replied graciously, "I was happy to learn the news of your intervention, as, for a long time, we have worked in the same direction and we have so many common interests."

There were plenty of discoveries to be made. Deslandres found that the strong lines of ionized calcium (the H and K lines) consisted of outer dark (absorption) lines, inner bright (emission) lines, and a central dark line. He interpreted these as coming from different levels in the Sun's atmosphere: from the lower level in which other Fraunhofer lines are produced (the photosphere), from incandescent vapor at a somewhat higher level (the chromosphere), and from cooler calcium vapor at still higher elevations, respectively. By centering the slit of his spectroheliograph on different portions of the line, Deslandres was able to obtain pictures of the solar atmosphere at different levels.

Deslandres invented the spectrographic velocity recorder, an extension of the spectroheliograph, which allowed measurements of the Doppler shift at each thin section across the Sun. He made numerous discoveries regarding the relations between energetic events in the corona, such as prominences, and the sunspots below them. He named the bright areas around sunspots *plages* (French for beaches), while Hale called them *flocculi*. Deslandres' term is the one used today. He also named filaments and showed that they were the same structures as prominences. Looking down on the Sun's disk, we see them as filaments which are darker than their surroundings. The same rivers of hot gas seen silhouetted above the Sun's limb are called prominences.

In 1898 Deslandres moved to the astrophysical observatory at Meudon where he became the junior half of the scientific staff under Janssen. He took his own instruments with him, and with government

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grants built larger and better ones. He photographed the Sun in the red light of hydrogen and showed that the filaments in its upper atmosphere played a role similar to that of the sunspots in the lower levels. He found great vortex motions and attempted a theory involving convection currents. Like Hale, he correctly understood that all of the atmospheric phenomena involved magnetic fields, and in 1902 he suggested that activity on the Sun should be a source of radio waves. He was proved right forty years later, when British radar receivers accidentally detected those emissions.

He hired a fifteen-year-old orphan, Lucien d'Azambuja, as his assistant in 1899, and with the young man's help built a powerful spectroheliograph and began a program of daily photography of the Sun's surface that has continued to the present. Deslandres encouraged and helped d'Azambuja to complete his education (he earned his doctorate at 46) and to continue the program long after Deslandres' retirement.

In addition to the solar work, which

included four eclipse expeditions, Deslandres found nitrogen in comet tails and studied the chromosphere of a dozen other stars. He and V. Burso found a relation between the intensity of a star's chromospheric lines and the luminosity of the star. Much later, Olin C. Wilson and M. K. Vainu Bappu at Mt. Wilson quantified this relation and used it to determine distances to late-type stars.

Upon Janssen's death, in 1907, Deslandres was appointed director of the astrophysical observatory at Meudon. According to d'Azambuja, he so greatly expanded the observatory's staff and instruments, that he could be said to have recreated it.

Deslandres was in his sixties during the first World War, but he returned to active service as a major and later, lieutenant colonel, in the technical section of the army engineers. He and another officer invented a cannon which was widely used.

The Paris and Meudon Observatories were united administratively when Paris director Benjamin Baillaud retired in 1926, and Deslandres was made director of both. After his official retirement three years

later, he returned to research on molecular spectra. In his last publication, submitted just days before his 94th birthday, he conceded that he had done all he could with available data, but he promised that the investigations would continue as soon as more precise measurements were made and the study of organic chemistry made significant progress.

Astronomer Raymond Michard recalled that, "In his bearing, his character, and his style of life Deslandres always remained more akin to the soldier (and the officer) than to the scholar." His loyal protégé, d'Azambuja, conceded that his approach was "sometimes a little brusque." All agreed that when he died, long after his contemporaries and even the much younger Hale, he was the last of the pioneers. ■

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