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THADDEUS HAJEK AND EARLY ATTEMPTS TO MEASURE STELLAR PARALLAX

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When the Copernicus work "De Orbium" was published in the sixteenth century, the heliocentric idea had few followers. With empirical evidence definitely lacking, those who followed the daring view of the great Torun astronomer were the pioneering minds who heralded the age of a new science. Among those pre-Galilean adherents of a revolutionary world view was the Prague astronomer Thaddeus Hajek (1525–1600) better known under his latinized name Hagecius or Nemicus. He was the personal physician of Emperor Rudolph II, but in the field of astronomy his fame spread over Europe. His Italian contemporary, G. B. Riccioli, who was principally responsible for lunar nomenclature, named one crater for Hagecius. Hajek was the younger contemporary of Copernicus and the older contemporary and close friend of Tycho Brahe. When Tycho was compelled to leave his native Denmark, it was Hajek who was instrumental in bringing him to Prague.

With the challenge of Copernican ideas in Hajek's time, the first concern of astronomers was to find any parallactic displacement of celestial objects due to the earth motion. The proximity of the moon evidently yielded the lunar parallax with reasonable facility a considerable time before Copernicus. In pre-telescopic astronomy the problem of parallax was, however, very difficult in the case of comets. Regiomontanus, an outstanding medieval mathematician, measured for the first time the parallax of the comet of 1472, but his value was 6°. For that reason comets were considered a sublunar phenomenon. Sixty years later this was confirmed by Vögelin when he measured the parallax of the comet of 1532 and his results placed the comet again within sublunar regions.

Suddenly, in November 1572, a new star blazed in the constellation of Cassiopeia, and the problem of the parallax arose with all urgency. What today we call a supernova entered the lives of both Hajek and Tycho to the extent of shaping their destiny. Nova Cassiopeiae is rightly called Tycho's star. The burning zeal to determine the accurate location of the nova stemmed from the dogma of the ruling Aristotelian school of thought which demanded immutability and permanency of translunar regions. Thus Hajek was first to write an essay on the strange heavenly appearance, sending "De investigatione loci novae stellae" to Bartholomew Reisacher who published it in the appendix of his "De Mirabili Novae ac splendidissimae Stellae" (Vienna 1573). Hajek later extended this originally brief report with additional details. Under the title "Dialexis de novae et prius incognitae Stellae," he published it as a separate volume in Frankfurt in 1574.

The great importance of Hajek's works on Nova Cassiopeiae consists not only in the accuracy of his observations and analysis of this astronomically most significant phenomenon, but in the method by which he determined the location of this nova. As Vetter (1925) states:

> "Although Hajek's instruments were not adequately accurate, not allowing him to read down to one but only to five minutes of arc, nevertheless his observations, of all his contemporaries, differ least from those of the high quality results obtained by Tycho."

The new method introduced time as an astronomical measure for the difference in longitude. Although efforts to use this method were made by Wilhelm IV of Hessen at his observatory in Kassel, it appears that this method was first suggested by Hajek who, even before Tycho, tried to use it in his observations. The observations. made at Kassel were never published. They were described in the correspondence of Wilhelm of Hessen with Tycho. Tycho as a scrupulous observer was critical of this method only because meridional transits required good clocks, unavailable at that time.

With a certain amount of improvement in technique, measurement of Nova Cassiopeiae indicated no change in its coordinates.

This negative result was startling. From inaccurate cometary parallaxes to now a complete absence of any parallactic displacement was a most revealing step. First, the nova could not be confounded with comets and so turned out to be an entirely unknown phenomenon. Hajek and Tycho were joined in their findings by leading contemporary astronomers such as Cornelius Gemma, Bartholomew Reisacher, and Mastlin, teacher of Kepler; all agreed that the strange nova must be counted among the fixed stars. It was thus shown that the peripatetic view on unchangeability of the starlit heavens was untenable – a conclusion of major importance not only for astronomy but for the entire new evolving natural science.

The results for Nova Cassiopeiae 1572 were soon followed by the improved parallax measurement of accidental major comets which suddenly appeared in 1577 and 1580. Hajek and Tycho again appear on the scientific scene, together with an increasing number of investigators stimulated by the phenomenal nova of 1572. This time sublunar values for comets dwindled to zero, and the Aristotelian dogma on translunar regions was shattered just as it was by the investigation of Nova Cassiopeiae. Despite these empirical results, the authority of Regiomontanus did not allow the unequivocal acceptance of a translunar location of comets. Bound by traditions, only reluctantly did man reconcile himself with the new world view based on extended observational facts. It is significant to note that the absence of any stellar parallax caused Tycho Brahe to formulate his special nonheliocentric Tychonic system while Hajek persisted in his adherence to the Copernican world view. This was evident in Hajek's appreciation and consequential use of Prutenic tables, produced by the Wittenberg mathematician Erasmus Reinhold on the basis of the heliocentric concept of the universe, which replaced the old geocentric Alfonsine tables. Furthermore, as Birkenmaier (1900) maintains, Hajek saved two valuable works of Copernicus and is most probably responsible for the title of the first sketch of the Copernican system "Nicolai Copernici de hypothesibus motuum coelestium a se constitutis Commentariolus."

In conclusion, it is timely to state that Hajek's role in the birth of the new astronomy is of such outstanding value that his name should not be omitted in texts on the history of astronomy. Just as modern astrophysics now penetrates into the confines of the Einsteinian universe, so the earliest efforts to obtain the notion of space with primitive tools is not a mere statistical history. Rather, it reveals the vicissitude and patience which human creativity had to undergo in its search for the key to the riddle of the universe.

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ULTRAVIOLET CONTINUOUS EMISSION IN T TAURI STARS

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The spectra of T Tauri stars are characterized by strong emission lines of hydrogen and ionized calcium superimposed on a stellar spectrum of a late G- or early K-type dwarf. In addition there are often two sources of continuum present. The underlying absorption lines are often completely obliterated by the presence of the so-called "blue" continuum which simply fills in the lines. An example is UZ Tauri, a double star with both components classified as late K by Joy (1945), one of which shows strong absorption features whereas the other is completely "washed out." No satisfactory explanation exists for this phenomenon. (See Herbig 1962 for further details concerning the spectra of T Tauri stars.)

The second type of continuous emission appears in the ultraviolet, setting in around λ 3700 to λ 3800 and increasing to shorter wavelengths. Its distribution with wavelength is not well determined, but its presence certainly serves to contaminate the $(U-B)$ color indices of many T Tauri stars. The present investigation is part of a longer-term study of T Tauri stars and provides some preliminary data concerning the behavior of the ultraviolet continuous emission.

Observations of both line and continuum intensities from λ 3220 to λ 7530 were obtained with the Lick 120-inch reflector using the