

external galaxies. It was only after an accurate determination of the Galaxy's true motion from the microwave background radiation that their results were interpreted (by a few) as showing a large-scale motion. The Rubin results and mine were disbelieved by most astronomers for over a decade. It is thus nice to see the recent flurry of interest in peculiar velocities and the birth of new buzzwords.

Work on cluster luminosity functions carried out at McGraw-Hill Observatory with an imaging charge-coupled diode system built by Dennis Hegyi and me⁶ indicates⁷ that m^* can yield relative cluster distances to $\pm 3\%$. Thus clusters at redshifts greater than that of A1367 can be tested. The data from my 1978 paper yield peculiar velocities of -8 km/sec for Coma and -504 km/sec for cluster A2199. I have plotted the longitudinal positions and peculiar motions of the four clusters projected on the best-fitting plane through their positions on the sky, adding to each cluster a tangential velocity equal to the Galaxy's projected motion relative to the microwave background in order to reference the clusters' velocities to the microwave background. The vector sum of these motions points toward Galactic longitude 258° and Galactic latitude 17° , not far from the constellation Hydra. In 1978, I obtained at Cerro Tololo data on the Hydra I cluster, from which I had hoped to obtain a new m^* and a new peculiar velocity. Unfortunately, these data have still not been analyzed; I hope they will receive more attention in the coming months.

References

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RUBIN REPLIES: It was with pleasure that I read Donald Gudehus's letter concerning his 1973 work on the Virgo cluster. As we are all aware, assigning credit in science can be a complex, subjective and often distasteful procedure. Discoveries are

rarely independent; what matters is that each study should advance the field. Even Gudehus would agree that there were earlier studies of large-scale motions, some referenced in his own work.

Strikingly early is the brilliant insight of William Herschel, based on a knowledge of the motions of a dozen stars. He wrote in 1783 in the *Philosophical Transactions of the Royal Society* that "there is not, in strictness of speaking, one fixed star in the heavens... when once it is known that some of them are in motion: for the change that must arise by such motion, in the value of a power which acts inversely as the squares of the distances, must be felt in all the neighbouring stars; and if these be influenced by the motion of the former, they will again affect those that are next to them, and so on till all are in motion."

Even earlier, perhaps 300 BC, Aristotle wrote in his *Metaphysics* that "the search for truth is in one way hard and in another easy. For it is evident that no one can master it fully nor miss it wholly. But each adds a little to our knowledge of nature, and from all the facts assembled there arises a certain grandeur." It is this certain grandeur, not the credit for being first, that we seek.

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Shevchenko on Soviet Science

In a public lecture on "The Future of American-Soviet Relations," given at Los Alamos on 15 September 1987, Arkady Shevchenko made several informative points. Three are of particular interest to physicists:

▷ Speaking of Soviet scientists traveling abroad, Shevchenko stated, "One thing I do know is that any scientist allowed to leave the Soviet Union will be instructed to collect specific information" from his scientific hosts. Shevchenko said that scientists had one chance to come back from a trip abroad without the information requested. However, if a second trip abroad also turned up empty, the scientist would never be permitted to leave the Soviet Union again. "This is not an assumption or a guess. I know."

▷ In respect to the Soviet version of the Strategic Defense Initiative, Shevchenko noted: "I can assure you that the Soviets have been working on lasers and other defensive systems long before the United States. The

estimates are they've spent \$150 billion on strategic defense."

▷ Shevchenko said that any nuclear arms control agreement made now between the United States and the Soviet Union would just be a starting point. He stated that it would be "absolutely impossible" to expect total nuclear disarmament. "Relations will never be that stable. The United States and the Soviet Union don't trust or understand each other and are not the world's only nuclear powers."

It is important to note briefly Shevchenko's wide knowledge and experience in these matters. He graduated in 1954 from the Moscow State Institute of International Relations, where he later earned a doctorate in international law. Shevchenko is a 22-year veteran of the Soviet foreign service. He rose to become actively involved in a number of sensitive issues, including disarmament and Soviet-American relations. He worked for Andrei Gromyko, Nikita Khrushchev and Leonid Brezhnev, and also knew Yuri Andropov, Konstantin Chernenko and Mikhail Gorbachev. He was a UN under secretary general, stationed in New York. He is the author of many Soviet publications on international affairs. He broke with the Soviets in 1978 and became a US citizen in 1986.

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An Educational Knotion from Knudsen

One of the delights in examining the letters section in certain physics journals used to be the possibility of encountering a letter written by Julius Sumner Miller. In a letter in the issue of *PHYSICS TODAY* devoted to the Michelson-Morley centennial (May 1987, page 132), Miller referred to "the essential ingredient in the education of a physicist... learning how to think physics." An Opinion column by Donald F. Holcomb, Robert Resnick and John S. Rigden that also appeared in the issue (page 87) focused on the longevity of the concepts and ideas of physics as a testimony not only to their basic nature but also to the fundamental nature of physics itself. Those authors also observed that "revolutions in physics, such as those that occurred during the 20th century, seldom invalidate older ideas" but tend to "establish boundary regions for older theories and open up new areas of physical investigation. Old physics does not die... It is simply integrated into a more