This *Atlas of Galactic Neutral Hydrogen* contains maps showing the distribution of emission from atomic hydrogen, the principal component of the interstellar medium in the Milky Way, as measured over a five-year period with the 25-meter radio telescope of the Netherlands Foundation for Research in Astronomy. Each map corresponds to a particular velocity interval. The maps are displayed in several projections.

The Leiden/Dwingeloo survey covers the entire sky above declination $-30^\circ$, on a half-degree grid, over a velocity range of 1000 kilometers per second at a resolution of 1 kilometer per second. The limiting brightness temperature sensitivity is less than 0.07 K.
Atlas of Galactic Neutral Hydrogen
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Dap Hartmann & W. B. Burton
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Preface

Hydrogen in its neutral atomic state is the principal component of the interstellar medium in our Galaxy. It is also probably the most easily observed interstellar constituent. But the sky is large, and the thought of surveying the entire accessible sky was a daunting one. We were fully aware that we were embarking on a half-decade voyage when the Netherlands Foundation for Research in Astronomy (NFRA) granted us the use of its Dwingeloo 25-meter radio telescope in 1988.

The Dwingeloo telescope is a venerable one. In fact, it is the oldest radio telescope in the world still operating. With this instrument the 3-kpc arm and other vagaries in the center of our Galaxy had been found, shortly after its dedication in 1956. The discovery of the still puzzling High-Velocity Clouds and subsequently of the Intermediate-Velocity Clouds followed in the early 1960s. But discussions on the future of the telescope, as it ended its 30th productive year, included the possibility of demolition. We accepted the Foundation’s provision that use the telescope was granted on a do-it-yourself basis. Such use of a facility, indeed survey work in general, may not appeal to all. But we found the prospect of an all-sky survey of the fun one.

Operating out of a shed with a leaking roof, we would begin each observing session by emptying the strategically placed plastic buckets, mopping the floor, and adjusting the makeshift tents draped over the antiquated but adequate computer and pen plotters. (The punched-card readers, paper-tape devices, and Brown recorders had long since been abandoned to their watery fate). The out-dated data-acquisition software was rewritten as the survey began. The data-pipeline software had to be designed for an early-generation PC; all of the data manipulation (with the exception of the stray-radiation calculations) and most of the maps displayed in this Atlas were generated with this home-brewed software operating on a single PC.

Although we enjoyed an interlude of doing science in a way more common in an earlier era, we would be exaggerating if we implied that the NFRA interpreted their do-it-yourself terms as leaving us entirely to our own devices. The Foundation supported our efforts in a variety of ways. Most importantly, although the mechanical structure had not changed fundamentally since the late 1950s, the telescope had been outfitted with modern electronics. The receiver we used was similar to those currently in operation on the Westerbork Synthesis Telescope. Particularly important to the kinematic coverage of the survey was the Dwingeloo Autocorrelation Spectrometer (DAS), developed by Albert Bos as a prototype for the DAS now the workhorse spectrometer at the James Clerk Maxwell Telescope on Mauna Kea, Hawaii. The NFRA staff carried out all heavy maintenance on the telescope structure and ensured that the electronics remained in good order. The data-acquisition program was debugged and modified where needed, and routine checks on the vitality of the observing program were done in our absence. During the five-year observing run (the entire first year was devoted to observations which helped debugging the autocorrelator and data-acquisition software), the telescope wore out several pairs of bearings, had a cryogenic compressor replaced, was abused by vandals who placed coins, cans, and tree branches on the azimuth track, and was visited by burglars who stole and destroyed some non-essential equipment, which cluttered up the telescope cabin in greater amounts than the essential equipment.
The final quality of the survey depends crucially on the success of the correction for stray radiation. Most astronomical instruments map a point source as a blurred or somewhat distorted image. The antenna pattern, the response of the antenna to the radiation presented to it, is the radio-astronomy analogue to the point-spread function, more familiar to optical astronomers. A telescope like the Dwingeloo 25-m is sensitive not just in the direction in which it is pointed, but also to emission from all over the sky, as well as to radiation reflected off the ground. The radiation thus spuriously recorded accounts for as much as half of the total emission measured in some directions.

Not only was the telescope sensitive to 21-cm line radiation coming from all directions on the sky, but its response was furthermore different for different times of day and year, and changed as the telescope pointed to different directions on the sky, and also depended on the orientation of the telescope with respect to the ground. Because the antenna was sensitive to the entire hydrogen sky, we had to measure the complete sky first, before this spurious emission could be calculated and subtracted. This meant that we had to sail blindly during four full years of observing. During that time, diligently repeated observations of single directions differed substantially, and the extensive series of standard calibration fields showed bewildering scatter. Only after the entire northern sky had been observed could the stability of the system be verified.

Before the survey commenced, we had established contact with our colleagues Peter Kalberla and Ulrich Mebold at the University of Bonn. They are the acknowledged authorities on the problems of stray radiation in a parabolic antenna like that in Dwingeloo. After the final spectrum had been recorded in Dwingeloo, the Bonn algorithm was adjusted to the Dwingeloo telescope, and applied to the observations. The repeated spectra now matched to within the specifications; the calibration spectra showed that the system had been stable over the entire period of the survey. We are grateful to our Bonn colleagues for their efforts in this crucial matter.

We wish also to record our gratitude to our colleagues Harvey Liszt, Thomas Bania, and Gerrit Verschuur, whose early advice and subsequent interest in the progress of the survey was a source of valued encouragement.

The geographical latitude (+53°) of Dwingeloo in the astronomical far north restricted our efforts to declinations above −30°. At the Instituto Argentino de Radioastronomia near Buenos Aires, Esteban Bajaja and his group are now engaged in observing the southern sky in order to fill the gaps so obvious in the maps in this Atlas. They are using the 100-foot IAR radio telescope, equipped with a receiver and a spectrometer quite similar to what we used in Dwingeloo. When their work is completed the combined material will cover the sky fully in a quite homogeneous manner.

The Dwingeloo telescope has recently entered its fifth decade of full-time observing, operating with modest means and exploiting its principal, in fact probably only, advantage over more modern facilities, namely time. There remain a number of survey and monitoring projects for which this instrument, which we regard with great affection, may well continue to make useful contributions.

Dap Hartmann, Center for Astrophysics, Harvard University
W.B. Burton, Sterrewacht, Leiden University