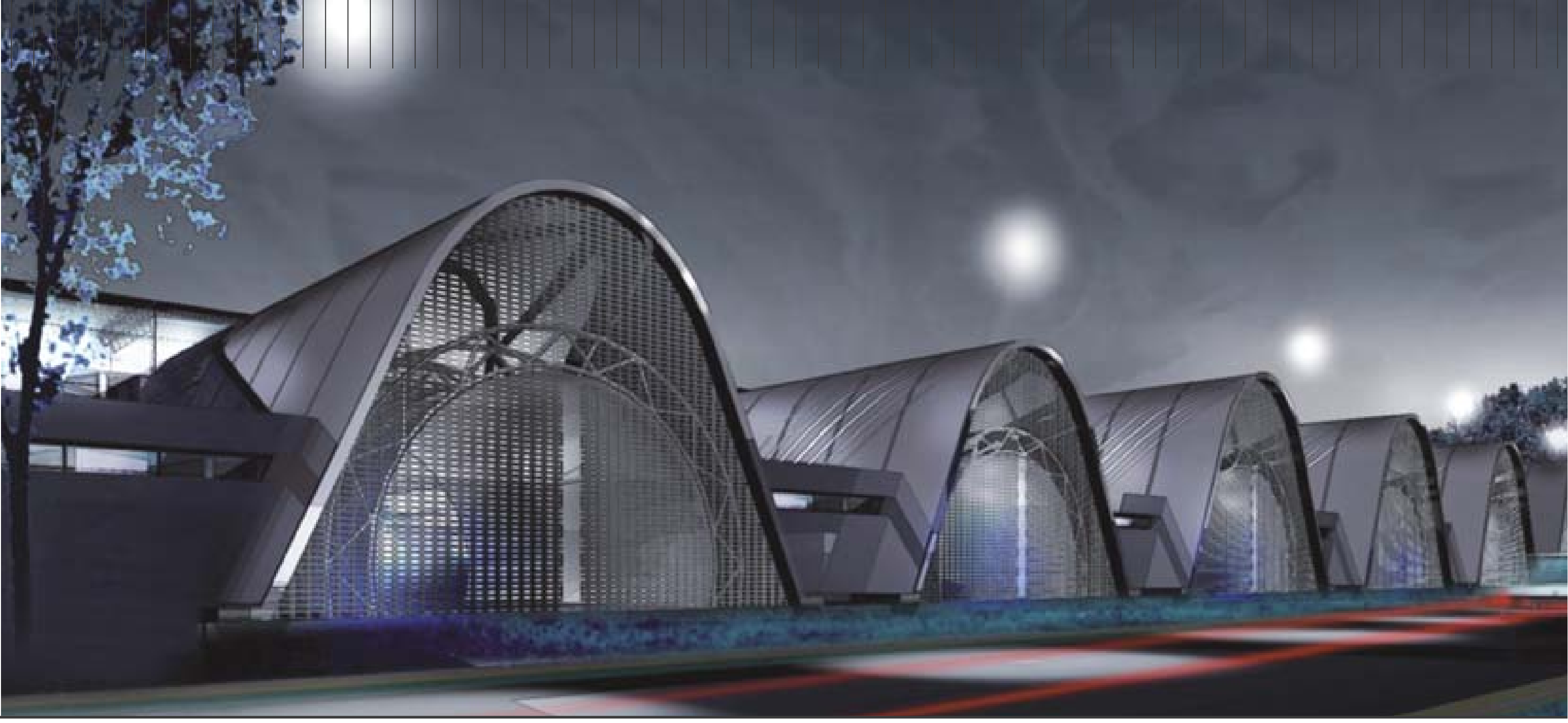

Vasconi Associés Architectes

The NeuroSpin facility building, at CEA Saclay (Essonne). This facility was set up for research in brain imaging by nuclear magnetic resonance. It houses a series of superconducting magnets producing intense magnetic fields.

II. NMR, MAGNETISM AND HEALTHCARE

Nuclear magnetic resonance imaging offers a typical example of a system in which magnetism plays a determinant role at all levels. It has revolutionised medical imaging, and its developments will assist the further advancement of scientific knowledge. Not only will diagnostics benefit, but also therapeutics, through a more detailed knowledge of underlying processes. This is particularly true in brain imaging, where the resources mobilised at the NeuroSpin facility are expected to allow far-reaching progress in the years to come.

A fuller understanding of many human functional health disorders such as aphasia, dyslexia, acalculia and schizophrenia, etc. requires a direct exploration of the normal and diseased human brain, as animal models are essentially irrelevant. For this purpose, NeuroSpin is equipped with powerful magnetic resonance imaging (MRI) tools (3- and 7-tesla instruments for humans and16.65-tesla systems for small animals). It will soon be operating an 11.7-tesla instrument for humans, one of the first of its kind in the world.

The principle of MRI is to create a very strong homogeneous magnetic field of sufficient volume for all the protons in the subject's body to be able to 'precess' at the same frequency. This is the first technical difficulty, which is overcome by superconduction but which researchers at the CEA have also addressed using permanent magnets. When the imager uses superconductor technology, the static magnetism necessary is created via an electric current flowing in coils cooled in liquid nitrogen, which lends them almost nil resistance. The next step is to 'encode' the volume so the protons that 'precess' can be spatially located. A magnetic field that varies linearly in space is created by further coils. Designing these is a second technical difficulty. The protons have to be excited to undergo precession. Again, coils are used to create a field, this time a radiofrequency field, at the precession frequency. This frequency in turn depends on the static field. It draws the protons away from their equilibrium position and then releases them so that they 'precess' at the frequency corresponding to the local magnetic field. Lastly, the electromagnetic flux created by the proton precession must be collected. This again is achieved using coils (by Lentz's law).

Imaging is not the only area in which NMR will bring further progress. It will also help us gain a better understanding of the structure and function of proteins. This is looked at in another article in this section.