

The human brain project

Dear Reader,

In a recent editorial (D'Angelo, 2012), we remarked that, with neuroscience now entering the *connectomic era*, important projects were expected to be launched in this field by major funding agencies. Now, hot on the heels of confirmation of the EU's approval of the *Human Brain Project (HBP)*, comes the news that the NIH has approved the *Brain Activity Map* project. Thus, on both sides of the Atlantic, efforts are being launched to meet what is one of the biggest challenges facing science in the new millennium: understanding the principles of brain functioning. Quite apart from their aims, these projects are exceptional in three respects: they are among the longest ever approved in the field of neuroscience (having a duration of 10 years), the most heavily financed (the HBP will receive about 1.1 billion euros in funding and *Brain Activity Map* about 3 billion dollars), and the most trans-disciplinary in nature. Overall, these projects offer unprecedented potential, not just for advancing understanding of the human brain, mind and behavior, but also for providing crucial information about the nature and therefore treatment of brain diseases and for driving future technological developments.

The uniqueness of the HBP lies in its use of electrophysiological techniques alongside advanced magnetic resonance imaging and neural modeling, neuroinformatics and neural engineering to gather data on cellular neurophysiology. The main aim of the HBP is to lay the foundations for understanding brain functions through the use of extensive computational resources. Computer simulations will respect the principle of realistic modeling, i.e. modeling based on extensive data sets derived from biology rather than from theoretical abstractions. Realistic neuronal and circuit modeling has advanced considerably in recent decades: ionic channels and receptors, membranes, neurons, synapses and local circuits have been modeled in great detail, improving our knowledge of how these structures operate. Now the challenge is to reconnect these elements into a large assembly mimicking the whole brain. This will necessitate improvements in science and technology at all levels, and will ultimately see the HBP developing over several platforms, including cellular neurophysiology, structural and functional connectivity, single neuron and circuit modeling, databasing of brain diseases, development of neuromorphic hardware, and improvement of computer technology, data communication and analysis, with special attention to the ethical and social implications that can be carried by investigations of this kind.

The HBP will evolve over two phases: a three-year start-up followed by seven years of full implementation. In the initial phase, the HBP will involve 84 laboratories mostly located in Europe and will generate a "CERN of the brain" based in Lausanne (CH), which will host the supercomputing systems and the coordination center for simulating brain activity. Besides its intrinsic potential to produce high-level research, it is hoped that the HBP will open the way for a large-scale development of the whole neuroscience field, both in Europe and worldwide.

Editor-in-Chief
Egidio D'Angelo (Pavia, Italy)

References

D'Angelo E (2012). Toward the connectomic era. *Funct Neurol* 27:77.

APPENDIX. The Italian group.

Italy has five units participating in the Human Brain Project: the University of Pavia will develop neuronal and circuit models, the University of Florence (LENS) will elaborate high-resolution connectomic maps, the Polytechnic University of Turin (Politecnico di Torino) will develop neuromorphic hardware, Fatebenefratelli (Brescia) will elaborate databases for neurodegenerative diseases, and CINECA (Bologna) will provide supercomputing facilities.

The main themes of the Human Brain Project (HBP) will be illustrated in a special issue (n. 3 2013) of *Functional Neurology* which will be published to coincide with the joint HBP - OTTORINO ROSSI AWARD meeting, 17-18 October 2013 (Pavia, Italy). Details will be available at: www.functionalneurology.com