Brazilian Journal of Genetics, 18, 4, 641-643 (1995)
(Revista Brasileira de Genética)

The Human Genome Diversity Project and the Peopling of the Americas

Sérgio D.J. Pena

ABSTRACT

The Human Genome Diversity Project (HGDP) is an international collaborative research initiative that is being developed under the supervision of the Human Genome Organization (HUGO). The overall goal of the project is to reconstruct the evolutionary history of the world populations by integrating genetic knowledge, derived by the study of human DNA variation, with knowledge of history, anthropology and linguistics. At the end of 1994 the South American Committee of the HGDP was created. This committee, structured in two levels, will promote and coordinate research into the present genetic structure and origins of South American populations, especially the Amerindians. The first academic activity of the South American Committee of the HGDP consisted in a multidisciplinary symposium on the theme of "Peopling of the Americas."

The question of questions for mankind -- the problem which underlies all others, and is more deeply interesting than any other -- is the ascertainment of the place that Man occupies in nature and of his relations to the universe of things.

Thomas H. Huxley (1863)

I am a member of a fragile species, still new to the earth, the youngest creatures of any scale, here only a few moments as evolutionary time is measured, a juvenile species, a child of a species .... This is a very big place and I do not know how it works nor how I fit in.

Lewis Thomas (1992)

The two statements above were written 130 years apart and obviously they express the same preoccupation. What does it mean to be a human being, living on earth? Yet, the intellectual and cultural backdrop to these statements is widely different. Since Huxley's Victorian times, the human species grew enormously in population, polluted and degraded the environment to apocalyptic levels, killed each other in unprecedented numbers in the name of social equality, racial purity or God, and acquired the technical sophistication necessary to become extinct at the push of a button, leaving behind, in Lewis Thomas' words, only a thin layer of radioactive fossils.

On the other hand, since the times of Huxley, we have also learned fantastic new facts about ourselves. We know now that as biological individuals and as a species we are defined by our genomes, and that these genomes are at the same time extraordinarily conserved and extravagantly diverse. Conserved in the interspecific sense: our genomes are almost identical to those of our Ape brothers and our genes have an uncanny similarity to those of even our very distant relatives, such as the yeasts. Diverse in the intraspecific sense: we know that two human haploid genomes chosen at random differ roughly in one out of every 500 nucleotides. Since the genome is 3×10^9 bases long, this implies 6,000,000 base differences! Furthermore, if we try to partition the variation we will discover that most of it is between individuals, less than 5% remaining between racial groups or between populations. We can thus derive a **"genomic paradigm"** according to which we are unique human beings different from each other to such a degree that collective agglutinating concepts, such as race, do not make much biological sense. However, subjacent to all this diversity we have a common genome that defines us as a species. The sharing of this genome should establish a sense of brotherhood and solidarity. Moreover, this solidarity by kinship should be extended to all the biosphere, with which we share, by descent, the original genome of the first living organisms. In this "fin de siècle", if we could in a näive utopic dream translate this "genomic paradigm" into social

Departamento de Bioquímica e Imunologia, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Caixa Postal 486, 30161-970 Belo Horizonte, MG, Brasil. Fax : (5531) 227-3792. E-mail : spena@dcc.ufmg.br

practices, there would be renewed hope for the coming millenium. Our genetic uniqueness would be a source of pride and dignity. Racism would be replaced by a new slogan: different is beautiful! And maybe we would treat the environment with the respect that emerges from the awareness of kinship.

The Human Genome Diversity Program (HGDP)

The Human Genome Diversity Program, a collaborative research project that is being developed on a global basis under the auspices of the Human Genome Organization (HUGO), arose from this "genomic paradigm." Its origins can be traced to an article published in 1991 (Cavalli-Sforza *et al.*, 1991) where it was proposed that a worldwide and geographically comprehensive survey of human genome variation should be undertaken urgently. Following several preparatory meetings the project was officially launched in a workshop in Alghero, Italy, in September 1993. According to its charter (HGDP, 1994) the overall goal of the project is to arrive at a much more precise definition of the origins of different world populations by integrating genetic knowledge, derived by applying the new techniques for studying genes, with knowledge of history, anthropology and language. More specifically the aims are stated to be:

- To investigate the variation occurring in the human genome by studying samples collected from populations that are representative of all of the world's peoples, and
- Ultimately, to create a resource for the benefit of all humanity and for the scientific community worldwide. The resource will exist as a collection of biological samples that represents the genetic variation in human populations worldwide and also as an open, long-term, genetic and statistical database on variation in the human species that will accumulate as the biological samples are studied by scientists from around the world.

The main value of the HGDP lies in its enormous potential for illuminating our understanding of human history and identity. However, practical benefits will be also achieved. For instance, the resource created by the HGD Project will also provide valuable information on the role played by genetic factors in the predisposition or resistance to disease. Moreover, the HGD Project will bring together people from many countries and disciplines. The work of geneticists will be linked in an unprecedented way with that of anthropologists, archaeologists, biologists, linguists and historians, creating a unique bridge between science and the humanities. Finally, as discussed above, by leading to a greater understanding of the nature of differences between individuals and between human populations, the HGDP will help to combat the widespread popular fear and ignorance of human genetics and will make a significant contribution to the elimination of racism (HGDP, 1994).

The South American Committees of the HGDP

The creation of the South American Committee of the Human Diversity Genome Project started with an invitation by Prof. L. L. Cavalli-Sforza early in 1994. Formal discussions were initiated during the Latin American Congress of Genetics in Puerto Vallarta in October and finalized in a special session of the III Latin American Congress of Biological Anthropology in Rio de Janeiro in November 1994. It was decided to create two committees: an Executive Committee with seven members and a Multi-National Committee made up of 10 representatives of South American countries (Table I). In May 1995 the Executive Committee, with the financial support of UNESCO, met in Ouro Preto, Brazil, established the Statutes and ratified the constitution of the Committees as shown in Table I. It was decided that during the next year, the Societies of Genetics and Anthropology of the several countries of South America will be consulted for nominations of the members (3 for each country) for the formation of a new Multi-National Committee, which will then elect a new Executive Committee. Copies of the statutes as well as more detailed information on the South American Committees of the HGDP can be obtained with the Latin American Office of HUGO, on the following address: HUGO Latin America, Av. Afonso Pena 3111/9, 30130-909 Belo Horizonte, MG, Brazil.

In keeping with the overall objectives of the HGDP, the South American Committees of the HGDP will endeavor to study the present distribution and evolutionary history of all the human populations of the continent. It has been proposed that the agenda of the South American Committees should include the following:

1. To make a complete inventory of existing samples of blood, leukocytes, red cells, plasma or serum already in stock in the several laboratories of South America.
2. To define the populations that should be sampled for studies of migration and origins, for investigations of microdifferentiation and for the analysis of diseases.
3. To study the possibility of establishing in South America banks of DNA and transformed lymphocytes from indigenous populations.

A major focus of the attention of the South American HGDP will be the study of the native Amerindian populations of South American, original inhabitants of the continent. Despite intensive investigation, the details of this original peopling of the Americas remain a mystery. Only two facts appear settled: (1) migration occurred from Asia through a land bridge in Beringia and (2) the first peopling occurred sometime in the Pleistocene. The nature of the ancestral populations and the number and timing of the migrations remain to be established. On the opportunity of the first meeting of the South American Committee of HUGO's Human Genome Diversity Program, a multidisciplinary symposium was held to discuss the available data. This proved to be a very useful debate, from which our ignorance

Table I - South American Committees of the Human Genome Diversity Project.

1) Executive Committee	
Sérgio D.J. Pena, President	Universidade Federal de Minas Gerais, Brazil
Néstor O. Bianchi, Vice-President	Instituto Multidisciplinar de Biologia Celular (IMBICE) , Argentina
Andres Ruiz Linares, Secretary	Universidad de Antioquia, Colombia
Francisco R. Carnese	Universidad de Buenos Aires, Argentina
Francisco Rothhammer	Universidad de Chile, Chile
Francisco Salzano	Universidade Federal do Rio Grande do Sul, Brazil
Walter Neves	Universidade de São Paulo, Brazil
2) Multi-National Committee	
Argentina	Francisco R. Carnese, Universidad de Buenos Aires
Bolivia	Gonzalo Taboada, Universidad Mayor de San Andres
Brazil	Francisco Salzano, Universidade Federal do Rio Grande do Sul
Chile	Francisco Rothhammer, Universidad de Chile
Colombia	Andres Ruiz Linares, Universidad de Antioquia
Equador	Cesar Paz y Mino, Universidad Catolica del Ecuador
Paraguay	Ricardo Moreno, Universidad Nacional de Asuncion
Peru	Beatriz Lizarraga, Universidad de San Marcos
Uruguay	Monica Sans, Universidad de la República
Venezuela	Dinorah Castro de Guerra, Inst. Venezolano de Investigaciones Cientificas

was mapped and important methodological pitfalls identified, thus establishing bases for future collaborative research in the South American HGDP. From the presentations of the symposium emerged the articles that follow this introduction. They speak for themselves.

RESUMO

O Projeto de Diversidade Genômica Humana (PDGH) é um programa de pesquisas colaborativo internacional que está sendo desenvolvido sob a supervisão da Human Genome Organization (HUGO). O objetivo geral do projeto é reconstruir a história evolucionária das populações humanas pela integração de dados genéticos, obtidos pelo estudo da variação humana ao nível do DNA, com conhecimentos de história, antropologia e lingüística. No final de 1994 foi criado o Comitê Sul-Americano do PDGH. Este comitê, estruturado em dois níveis, promoverá e coordenará a pesquisa sobre a estrutura genética e as origens das populações sul-americanas, especialmente os amerín- dios. A primeira atividade acadêmica do Comitê Sul-Americano do PDGH consistiu em um simpósio multidisciplinar sobre o "Povoamento das Américas."

REFERENCES

Cavalli-Sforza, L.L., Wilson, A.C., Cantor, C.R., Cook-Deegan, R.M. and **King, M.-C.** (1991). Call for a worldwide survey of human genetic diversity: a vanishing opportunity for the human genome project. *Genomics 11*: 490-491.

HGDP (1994). *Human Genome Diversity (HGD) Project - Summary Document.* London, HUGO Europe, pp. 40.

Huxley, T. H. (1863). *Man's Place in Nature.* First American Edition. 1880, D. Appleton & Co., New York, pp. 77.

Thomas, L. (1992). *The Fragile Species.* New York, MacMillan Publishing Co., pp. 25.

(Received October 9, 1995)