

try such as the Association of British Travel Agents and the Federation of Tour Operators. Without a proactive approach, tour operators are likely to face increasing risks of legal action. I am grateful to Pauline Allen, Jennifer Roberts, and colleagues from the Communicable Disease Surveillance Centre for helpful comments.

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Patenting gene sequences

Not in the best interests of science or society

The American biotechnology industry was shocked when social activist Jeremy Rifkin organised a petition drive last year to stir religious opposition to any patents on "the rich genetic resources of the Earth's biological commons," including most especially human genes.¹ By September he had secured the signatures of 186 Roman Catholic, Protestant, Jewish, Buddhist, Hindu, and Muslim American religious leaders on a petition calling for a ban on biological patents. The industry responded with a strongly worded white paper on the importance of allowing patents for human genes, which is now being circulated widely among American religious scholars.

But despite the religious battleground, America's discussion of patents, outside theological circles, is notably secular. It is conducted primarily in terms of prior legal precedents and the importance of patent protection to further private sector funding and research. This is reflected in the fight that has erupted between two behemoths in the pharmaceutical community.

SmithKline Beecham has formed a consortium with an American company, Human Genome Sciences, to map, sequence, and patent as much of the human genome as possible.² The consortium has sequenced about 850 000 fragments of DNA drawn from almost 85% of the human genome. Roughly 200 of the 450 applications for human gene patents filed in the United States come from the consortium.

But officials at the pharmaceutical giant Merck do not believe that the basic sequence information of the human genome ought to be patentable. Some suggest that the company's opposition is inspired by the fact that, unlike SmithKline, it has not formed an alliance with another firm that held patents pending on a large number of gene sequences. Whatever the company's motives they have argued persuasively that locking up the basic structural and descriptive elements of the genome by narrowly held patent protections will not ensure that the human genome is maximally exploited for the public good.³

Merck is now sponsoring a group at Washington University in St Louis to sequence the human genome and make the information freely available. Currently 4000 new sequences are being identified each week. As of last month, 355 000 sequences had been identified and placed in a database in the public domain. This has created a remarkable situation in which two corporate giants are engaged in a competition in which one seeks to give away what the other wishes to sell.

Even the United States government cannot quite make up its mind about patenting human genes. In 1991 the National Institutes of Health filed applications for 2375 partial DNA sequences. Uproar ensued, including unfavourable reactions from other governments, and in February 1994 the institutes' director, Harold Varmus, announced the withdrawal of applications for these and other sequence patents.⁴

Meanwhile the government filed and received a patent on

the genes of a member of the Hagahai tribe in Papua New Guinea, some of whom have an unusual resistance to leukaemia. This set off an international contretemps, with Third World nations protesting against exploitation of their national genomic resources by avaricious scientists from economically privileged nations.

The argument that it is immoral to patent human genetic sequences seems unlikely to prevail for two reasons. Firstly, while strong theological reservations exist,⁵ it is hard to equate assigning a patent to a DNA strip with ownership of a human body. Selling bodies into slavery is exploitative, because our personal identity is so intimately tied to our bodies. It is not so obviously a violation of the human spirit to assign rights to exclusive use and development over a segment of chromosome 13 to a government agency or a biotechnology concern.

Secondly, the genetics patent train has long since left the station. It is already widely accepted in America and in many European countries that genes of known function, be they human or otherwise, are patentable. Sequencing of individual genes is seen as being akin to discovering "non-naturally occurring compositions of matter," and therefore meets the criteria for issuance of a patent—being new, useful, and not obvious.

If there is no persuasive reason to forbid the patenting of human genes, the argument must turn to consequences. The issue is no longer whether genes can be patented on principle, but what sort of patents on what sort of genetic information will most encourage the development of useful inventions and products for promoting human health and wellbeing. While a convincing case can be made for the value of patents in securing investment and attention from those who hold them,² limiting access to portions of the human genome to a small set of scientists simply because they identified the sequences first is unlikely to lead to the maximal intellectual exploitation of this resource. Nor does it make moral sense. If government funds have been used to map and sequence the human genome, why should the fruits of that effort be turned over to a single owner? Permitting patents of simple segments of the genome, rather than for products and inventions, would seem to be contrary to the public interest.

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