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MEDICAL ETHICS

# Geneticists Debate Eugenics And China's Infant Health Law

**BEIJING**—A freewheeling discussion last week at an international genetics meeting here* may have cleared the air on a controversial Chinese law to reduce infant mortality. The 1994 law, although aimed at improving pre- and postnatal health care, provoked a fierce outcry among some Western scientists because it appeared to forbid individuals with "certain genetic diseases" from marrying unless they agreed to be sterilized or take long-term contraceptive measures, and it also seemed to encourage abortions for fetuses with abnormalities. The provisions triggered a boycott of the meeting by the British, Dutch, and Argentine genetics societies, but several researchers from those countries came anyway. They and others came away from the meeting persuaded that the law is not as Draconian as it seemed and that in any case it is not being enforced.

The focal point of last week's debate was a 2-hour workshop on the science and ethics of eugenics. Officials of the International Genetics Federation (IGF) insisted that Chinese organizers add the session to the group's quadrennial meeting after the new law went into effect in 1995. The informal gathering, moderated by outgoing IGF secretary Anthony Griffiths of the University of British Columbia, drew about 150 scientists, several of whom spoke extemporaneously from microphones scattered around the room. The topic was also explored during an earlier session on ethical issues in genetics research and was an undercurrent in other presentations and in hallway conversation. "I think people are concerned about areas of abuse," says Jonathan Hodgkin, a geneticist at the Medical Research Council's Laboratory of Molecular Biology in Cambridge, U.K., adding that he was "relieved" to learn more about the law and its lack of adverse impact. Ann McLaren, a geneticist at the Wellcome/CRC Institute in Cambridge, U.K., says she was pleasantly surprised "to find areas of general agreement."

PHOTOS: DENNIS NORMILE

**In touch.** Qiu Renzong, left, says authorities have promised to consult with geneticists on revising the law, while Chen Zhu, right, says its effect has been minimal since it has not been enforced.

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> **—Anthony Griffiths**

"The ethical application of genetic technologies is something the entire international community needs to continue to discuss," Griffiths says. Toward that end, the congress adopted an eight-point statement at the close of the meeting supporting the use of genetic technologies and counseling to help individuals make informed and free choices and urging scientists to educate physicians, decision-makers, and the public on the topic.

Chinese scientists at the workshop argued that critics have been misled by a flawed official translation, although most agree the law is rife with ambiguities. For example, a clause requiring consent is missing from the English translation of an article that appears to allow marriage between individuals with serious genetic diseases "only if" the couple agrees to be sterilized. In addition, most Chinese say the wording of the law does not expressly forbid marriage if the couple refuses. In the section on abnormal fetuses, one article reads: "The physician shall … give [the couple] advice on the termination of pregnancy," while another clause stipulates that the written consent of the woman is required for the termination of any pregnancy. "On paper, it's the same as in London," says George Fraser, a geneticist at Britain's Oxford Radcliffe Hospital.

Alec Jeffreys, a geneticist at Leicester University and one of the organizers of the boycott by the British Genetical Society, said from England that he "remains to be convinced" that Chinese couples really have the right to give or withhold consent. "The restriction of one child per family already presents a framework which is not fully free in terms of reproductive rights," he says. And Chen Zhu, director of the Ministry of Public Health's Laboratory of Human Genome Research in Shanghai, notes that the idea of a law to cover such human activities "is something new for the Chinese people." But Chen adds that there have been "few or no negative effects" because the law is not being enforced.

One roadblock to its implementation, says Qiu Renzong, a philosopher at the Chinese Academy of Social Sciences and a member of the ethics committee of the international Human Genome Organization, is the lack of a list of relevant genetic diseases. Until such diseases are defined, he says, local authorities and physicians cannot recommend sterilizations or abortions. Another obstacle, says Mao Xin, a molecular biologist at Britain's Institute of Cancer Research in Surrey, is the small number of facilities for genetic testing and qualified health care personnel. "The wording seems very serious, but there is no real effect from this law," says Mao, who has criticized the law in letters and articles in several English language medical journals.

Several Chinese speakers said they hope the law will be modified to clarify ambigui-

* 18th International Congress of Genetics, 10–15 August, Beijing.

ties and strengthen its provisions on patient rights. Qiu says that the authorities have promised to consult geneticists in defining which genetic diseases should be covered by the law. But Yang Huanming, director of the Human Genome Center at the Chinese Academy of Sciences' Institute of Genetics, is dubious. "Scientists have a small voice in forming such regulations," he says.

One point of scientific consensus is that such laws won't reduce the prevalence of recessive disease genes in the population. "Population genetics shows [that eugenics] doesn't work," says Walter Bodmer, a British geneticist and former director-general of the Imperial Cancer Research Fund. Yet, researchers are concerned that the public, including many health care providers, may not understand that point. Mao, who was formerly at the West China University of Medical Sciences in Chengdu, says a 1994 international survey of genetic counselors found that all Chinese respondents thought the purpose of genetic counseling was to reduce the bad genes in the population, while few Western counselors gave that answer. Government officials quoted in the official Xinhua News Agency about the law echoed those sentiments. But others note that the problem of misunderstanding the possibilities and limitations of genetic technologies is not confined to China. "The overriding responsibility we have as geneticists is public education in genetics and its potential benefits," Bodmer says.

–DENNIS NORMILE

With additional reporting by Li Hui.

EVOLUTIONARY BIOLOGY

## Doubled Genes May Explain Fish Diversity

**MONT ROLLAND, QUEBEC**—Take a dive to visit the rainbow-hued denizens of a coral reef and you will find it easy to accept that the ray-finned fishes—which include everything from goldfish to sea horses to flounder—are the most diverse group of vertebrates. Now, a new study of the genome of the zebrafish may explain how the 25,000 ray-finned species came to evolve such diverse forms.

In an early ancestor of the zebrafish—a common aquarium-dweller and research model—the entire genome doubled, according to John Postlethwait of the University of Oregon in Eugene, who presented his case at a recent evolution meeting.* He suggests that the ray-finned fish put their extra copies of genes to diverse uses and so evolved a wealth of different body shapes, for example, using an extra fin-bud gene to make the stinging fins of the lionfish "mane." The genome duplication also has implications for the zebrafish's role as a model organism, perhaps allowing researchers to spot dual functions of genes that would be hard to discern in species that have only one copy. "It's very exciting," says geneticist and hematologist Leonard Zon of Children's Hospital in Boston. "It's likely that, because of the duplication, otherwise hidden gene functions will be revealed."

**Fishy forms.** Ray-finned fish include pufferfish *(top)*, anglerfish *(middle)*, and butterfly fish *(above)*.

Postlethwait's analysis could upset the common explanation for why ray-finned fish seem to have extra copies of certain proteins and genes when compared to mammals. For years, many biologists have assumed that a mammalian ancestor had lost the extra copies.

Postlethwait and his colleagues focused on the developmental genes called Hox genes, which control some of the earliest patterns in a developing embryo. Most vertebrates, including mammals, have four Hox clusters, suggesting that two genome duplications occurred since these lineages split from the invertebrates, which typically have only one Hox cluster.

But after sequencing and mapping all the Hox genes they could find in zebrafish, Postlethwait, graduate student Allan Force, and postdoc Angel Amores and their colleagues found that the fish have seven Hox clusters on seven different chromosomes. Two clusters closely resemble the mammalian Hoxa, two resemble Hoxb, and two resemble Hoxc. Both mammals and fish have only a single copy of the Hoxd genes. Although zebrafish have two copies of the Hoxd chromosome, one is missing the Hox gene segment. Because the team found duplicates of all four chromosome regions, they believe the extra genes are not simply due to occasional gene duplications but stem from an event in which the entire genome was duplicated, with some genes then lost.

That conclusion is strengthened by the team's reanalysis of the published arrangement of Hox genes in the puffer fish, or fugu. Unlike the zebrafish, the fugu has an especially small genome, apparently with only four groups of Hox genes. The first three look very similar to mammalian Hoxa, -b, and -c, and the researchers who mapped the genes originally thought the fourth might be a much-remodeled Hoxd. But the leader of that effort, developmental geneticist Samuel Aparicio of the Wellcome/CRC Institute for Cancer and Developmental Biology in Cambridge, U.K., says Postlethwait's new analysis makes a clear case that this fourth Hox group is really a second copy of Hoxa. The researchers suspect that a fugu ancestor, too, once duplicated its genome, most of which was later lost.

Since the last common ancestor of fugu and zebrafish lived more than 200 million years ago, Aparicio says, the doubling might have occurred very early in the ray-fin lineage. That fits with having the extra genes power the great fish radiation of about 300 million years ago, he notes.

But geneticist Chris Amemiya of Boston University School of Medicine says he's waiting for more solid evidence. "They are the most successful group of vertebrates on

*The annual meeting of the Canadian Institute for Advanced Research Program in Evolutionary Biology, 25–29 July.