there are enough of the genes to explain most or all of antibody diversity or whether somatic mutation, which is known to occur, is the primary mechanism underlying the diversity. Whole antibody molecules are formed of two identical light plus two identical heavy chains. If the combination is random, then 1000 different genes for light chain variable regions plus another 1000 for the heavy chains would be sufficient to produce 1 million different antibody molecules, which is usually cited as the minimum number that an individual animal is capable of producing.

Speaking of Science

Soviet Science: A Wonder Water from Kazakhstan

Soviet scientists seem to have an unusual fascination with abnormal states of water. Only 5 years ago, Soviet physicist Boris V. Derjaguin resolved a controversy he had helped to create by demonstrating that "polywater"—an anomalous form of water then considered to be polymeric—was simply water containing a large concentration of dissolved minerals. Now, according to the Information Office of the Soviet embassy, twin brothers at a relatively obscure research institute in Kazakhstan have identified another form of water that appears to have a greater biological activity than ordinary tap water.

The brothers, Vadim and Igor Zelepukhin of the Institute of Fruit-Growing and Vine-Growing of Kazakhstan, made their discovery while investigating the biological properties of freshly melted snow. Soviet scientists have known for some time that fresh meltwater has the capacity to stimulate some biological processes. It has been theorized that the meltwater retains some of the order that is characteristic of frozen water and that this increased order alters vital reaction rates within cells; some American investigators have theorized, similarly, that water within cells is more highly ordered than ordinary water and that this increased order is essential to proper control of enzymes.

The brothers Zelepukhin were studying this phenomenon by observing the uptake of water by cut leaves. They would weigh leaves, place them in tap water, boiled water, or fresh meltwater for 1 hour, and then reweigh them to determine their water uptake. Typically, they found that the leaves absorb two to three times as much meltwater as either tap water or boiled water. In one series of experiments, however, Vadim inadvertently overturned several boxes containing boiled water. To save the experiment, he quickly boiled more water and cooled it under the tap to the required temperature of 20°C. Suprisingly, the Zelepukhins found that leaves absorbed five to six times as much of this water as of ordinary tap water and two to three times as much as meltwater.

After confirming this result in other types of leaves, they tried other experiments, such as using the "bioactive" water in place of tap water to soak seeds before they were planted. In one study, for example, they found that cotton plants grown from such seeds yielded 10 to 12 percent more cotton than the farm's average. In all stages of the plants' development, Vadim Zelepukhin says, "the experimental plants were superior to the control plants in all physiological characteristics. There was a more intensive chlorophyll formation in the leaves, a more active water exchange, and so forth." The quality of the fiber was also better.

Greater yields were also obtained when they soaked tomato, potato, maize, and wheat seeds in the water. Particularly responsive, Zelepukhin says, were sugar beets. Root weight increased 40 percent and sugar content 1.5 percent. They also observed that bioactive water stimulates root formation in fruit tree cuttings better than either tap water or water containing the root stimulant heteroauxin.

After many experiments, the brothers finally concluded that the activity of the water results from the fact that it has been thoroughly degassed. Boiling removes dissolved gases and the quick cooling prevents them from redissolving immediately. They were thus able to reproduce their results by degassing water with a saturation syringe. They were also able to show that water prepared either with the syringe or by boiling and quick cooling loses its stimulatory power if it is exposed to the atmosphere for more than an hour or two, but retains the activity if it is stored in a sealed container. The biological activity of meltwater can be explained in much the same fashion: Freezing degasses water, although to a lesser extent than boiling. The biological activity of meltwater is thus not as great as that of water boiled and quickly cooled.

Degassed water differs considerably from tap water in its physicochemical properties, says Igor Zelepukhin. Its conductivity is decreased considerably and there are increases in its density, viscosity, surface tension, energy of intermolecular interaction, and internal pressure. Degassed water thus bears a closer resemblance to the fluid in cells than does tap water, he adds, and this could account for its effects.

In some other experiments conducted at the Kazakhstan branch of the Research Institute of Dietotherapy of the Academy of Medical Sciences of the U.S.S.R., the Zelepukhins gave degassed water to white rats for a month and tap water to a control group. The most striking difference between the groups, they say, was an increase in the average hemoglobin level from 75.8 units in controls to 93.4 units in the experimental animals. The test animals also exhibited enhanced activity for most enzymes and had only insignificant quantities of lactic acid in their muscles—an indication, Zelepukhin says, of their greater viability and decreased fatigability under equal working conditions. They are currently experimenting with farm livestock and expect to achieve good results since other investigators have already shown that cattle, for example, gain weight faster when given fresh meltwater.

In one other application of note, the construction industry of the Soviet Union has begun to use degassed water on an experimental basis. They have observed that concrete prepared with it is 8 to 10 percent stronger than concrete prepared with ordinary water. The water is obtained relatively easily by use of a mobile milk-pasteurizing unit, in which milk is heated and then quickly cooled in a special radiator. Soviet investigators predict that a variety of other uses will soon be found for this "magical" material.

—THOMAS H. MAUGH II

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