Nutrient Pioneers

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Fifth in Series

Johan Bjorksten, Aging Pioneer

It's hard to realize that 54 years have passed since I first met Johan Bjorksten, in the fall of 1931.1 can see him now as he first appeared: tall, handsome, intelligent, astute, full of enthusiasm. Although a year older at 24, he already had his Ph.D. while I still had several years to go. He had come to the St. Paul Campus of the University of Minnesota on a Rockefeller Fellowship, to work under the late R.A. Gortner, Sr., Head of Biochemistry, a Ph.D. from McGill University who had achieved an international reputation in colloids and proteins. Johan had come for one year only.

During that year we became very well acquainted. Perhaps it was because my lab had the only radio, that several grad students would congregate there in the evening, Johan among them. Times were simpler in those days — most grad students were single, and had few diversions. There was no television. I also had a cheap beach chair, and Johan loved to lie in it and listen *to* the radio, I suspect learning American idiom.

Winter came and went, and soon it would be time for Johan to go. One day he came to me all excited, and said he had just bought a used Model A Ford coupe, for $395. He suggested that the two of us head out west for the summer, exploring the Rockies, the Grand Canyon, the Pacific Coast, *etc.*

Johan didn't return to Finland. At a time when, due to the Great Depression, jobs were not to be had, he set about to obtain a position as chief chemist, no less. He first applied to a number of firms, and then embarked on a leisurely eight-month voyage around the world, changing ship many times. At each port of call, he sent each a post card. All he wrote was, "Having a wonderful time". In this way, by the time he finally reached Los Angeles, he had nine offers waiting from which he could pick and choose.

Several jobs later, each an advancement, Johan became Chief Chemist for Ditto, Inc., a subsidiary of Eastman Kodak. There, he studied the aging of thin protein films due to crosslinking — the formation of new bonds between adjacent molecules. At that time he was struck with the similarity of what he observed with these protein films, and what he observed with aging skin.

From this he originated the theory that aging of humans, like plastics, is due mainly

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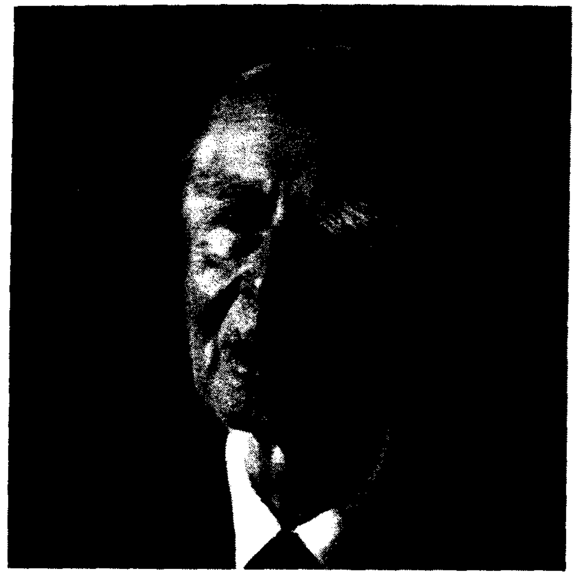
to crosslinking of large molecules (1941). With many years of further research on aging, Dr. Bjorksten has become one of the world's leading gerontologists. But let him describe his discovery in his own words:[1]

Looking at this background from the standpoint of 1940, the medical field then had only a hazy concept of loss of colloidal properties in proteins. On the other hand, the industrial fields had already at that time achieved highly developed practical and theoretical knowledge of the effects of crosslinking agents, both in high and very low concentrations, on a wide range of polymers.

It was inevitable that these two fields of knowledge should be brought together as soon as anyone chanced to become concerned in depth with both, simultaneously. It was my fate to be that 'anyone'. As Chief Chemist of the world's largest manufacturer of hectograph films, I was principally occupied with the problems of improving the hydrothermal properties of protein gels, by means of controlled low-level crosslinkage. It is a monument to myopia that it took four years to realize the connection; however, once this was done, previously disconnected facts fitted together with precision and rapidity.

What happens in crosslink aging can be observed in a short time with a lemon pie, which is a hydrophilic starch gel. Its structure is rigid because all of the water has been hydrogen-bonded to the long, thread-like starch molecules. If allowed to stand at room temperature, aging occurs in a matter of hours. The starch molecules begin to crosslink, attaching starch-to-starch instead of being separated by water. As water is released, the pie appears to sweat, as sweet drops appear on the surface. At the same time, the pie becomes progressively drier, tougher, and less elastic. This process, so similar to human aging, is called syneresis.

A gel's ability to hold water is called imbibition capacity. Fresh lemon pie has a high imbibition capacity. So has the flesh of a healthy young person — the bloom of youth. As years go by, increased crosslinking lowers imbibition capacity, the flesh shrinks, and the skin becomes wrinkled and leathery.



Johan Bjorksten

To test this, pinch a piece of skin on the back of the hand and pull up hard while slowly counting to ten. When released, the time it takes for the skin to subside is a measure of the degree of crosslinkage. This is only a hint of what is going on inside the body — "hardening of the arteries", for instance.

Crosslinking affects not only muscle and skeletal proteins, but enzymes and genetic material (DNA, RNA) as well. The resulting defective molecules can't do their job, and enough of them cause death.

So far, one might ask, "What has this to do with nutrition?" The answer is, it has everything to do with nutrition. It is generally recognized that crosslinkage is caused mainly by free radicals, atoms or molecules with unpaired electrons. They will take electrons out of your living tissues to get what they want. It is in this way that free radicals are major sources of damage that cause the diseases falsely attributed to old age, such as cancer and cardiovascular disease. Free radicals are caused by many environmental factors; cigarette smoke, exposure to heavy metals, radiation, ultraviolet from the sun, and especially products formed by spontaneous oxidation of polyunsaturated fats and oils.

Free radical formation can be largely prevented, and hence the resulting aging prevented, by eating sufficient nutrients which can function as antioxidants, themselves becoming oxidized (loss of electrons) by giving up electrons to reduce the free radicals (reduction is gain of electrons). Such nutrients are called free radical scavengers. I like to say they make free radicals CEASe. I spell it this way because it stands for vitamin C, vitamin E, vitamin A and the mineral element Selenium. Zinc, cysteine and some other nutrients also inhibit free radicals.[2]

The story of Johan Bjorksten would be incomplete if I didn't mention that he was into many other enterprises, among them his Bjorksten Research Labs in Madison, Wisconsin, and his Bee Chemical Company in Chicago. He has sold his business interests now and devotes his energy to aging. Bee Chemical Co. was sold in November, 1984, for U.S. $77 million cash. Among other things it made the paint on your car.

When Dr. Hoffer gave me permission to write this, I tried to get in touch with Johan Bjorksten. The last time we had been together was in Oklahoma City in 1946. I finally caught up with him through the American Chemical Society. He wrote *I am again a world traveller, just now on the fifth trip around. I shall be in Washington, Houston, Scottsdale, Los Angeles, Tokyo, Hong Kong; from there* by *ship to Southampton; two weeks through Europe by Eurail, ending up in Finland where I spend the summer sailing. In September, back to the U.S. It was very good to hear from you again, Rae. Warmly yours, Johan.*

References

1. BJORKSTEN, JOHAN: The Crosslinkage Theory of Aging. J. Am Geriatrics Soc. 16, 408-427, 1968.
2. HOFFER, ABRAM and WALKER, MORTON: Nutrients to Age Without Senility, New Canaan, Connecticut: Keats Publishing, Inc. 1980.