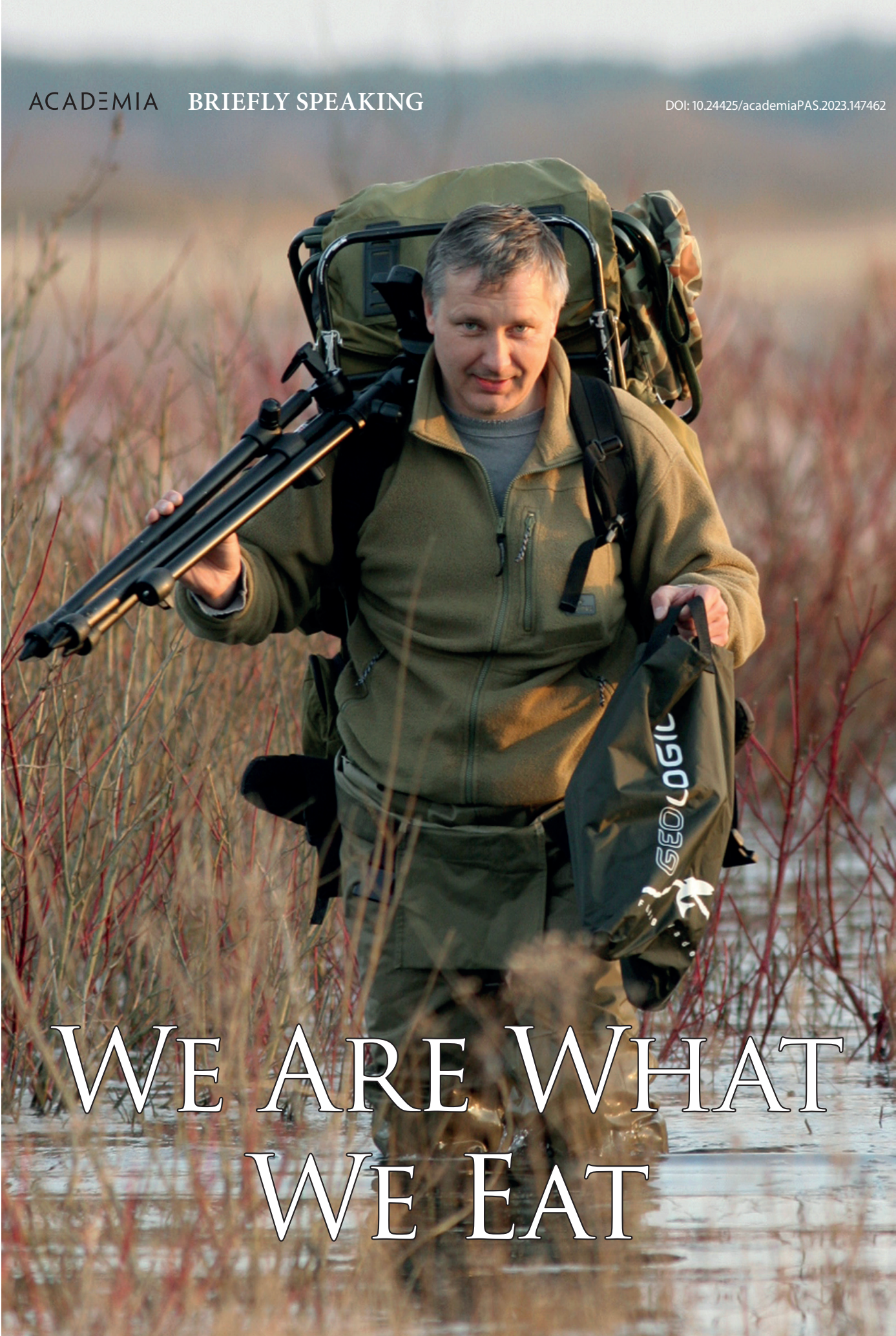




Marek Konarzewski, Professor of Biology at the University of Białystok and President of the Polish Academy of Sciences, talks about how our ancient evolutionary past still affects our eating habits today.

In your work, you have considered evolution from the perspective of diet. Did our diet have an impact on the evolution of our species?

MAREK KONARZEWSKI: In the Paleolithic transition, we transformed from hunter-gatherer communities into sedentary ones. The problem with today's diet is very complex, because it involves adaptations to the Paleolithic environment which are no longer adequate for the world we now live in. Back in the Paleolithic, in order to get food, one had to work very hard. Moreover, the human diet was qualitatively different from today's. It was poor in simple sugars, as fruit was mostly unavailable. If our ancestors did happen to come upon a fruiting tree, they would eat nothing but fruit for a few days, then once it ran out, longer periods of scarcity would ensue. Now we have a situation in which high-calorie foods are readily available all the time, and we are constantly bombarded with signals urging us to eat them.

To live a healthy life, we need to maintain a balanced energy budget – in other words, we should consume the same number of calories as we need to sustain our vital functions at a constant level. But in modern societies we consume far more than we need, resulting in obesity and all the attendant diseases. Obesity has grown to epic proportions. This includes Poland as well: we have unfortunately “caught up” to the rest of the world in this respect. And this phenomenon does not only affect humans – out on the streets one can encounter many dogs that are quite simply obese.

What causes excessive weight gain in animals?

The very same syndrome that we see in humans. These animals are exposed to an excess of food, but have no physiological signaling to inhibit them from consuming unnecessary calories. Never in the history of humans or other species has there been such a sustained excess of food, so there has never been evolutionary pressure to develop mechanisms to limit food intake because it can harm us.

In other words, we turn out to be prisoners of deeply ingrained biological conditioning, ill adapted to today's world. Is there any way we can make progress on this front: through evolution, or perhaps through medicine?

We definitely cannot count on evolutionary mechanisms working so strongly that at some point

we might develop, for example, a neurophysiological mechanism that will motivate us to refuse another serving of ice cream without remorse. That's out of the question. But we can in a sense count on medicine: in the last few years, drugs have been developed that target the satiety center in the brain. We do know how to influence metabolic pathways in the human body so as to inhibit excessive cravings.

Thanks to medical advances, we are managing to combat type 2 diabetes, cardiovascular disease, and so on, even though we still make poor dietary decisions and eat too much. After all, even a small excess in our energy budget in the long term will cause dramatic consequences. If we overconsume our energy budget every day by the number of calories found just in one medium-sized apple, we will end up with 2 kg of excess body weight after a year. And that's from just one apple a day!

People in modern societies now consume far more than we need, resulting in obesity and all the attendant diseases.

We often feel the greatest desire to snack in the evening. Why is that?

Let's go back some 50,000 years, to the times when our ancestors lived in Africa. In the part of Africa where humans evolved, there are 12 hours of day and 12 hours of night. At nighttime, darkness prevails outside the circle illuminated by the campfire. Throughout the daytime, or 12 hours, people gathered food (seeds, fruits, or roots) in dangerous terrain while being careful not to let anything hunt them, so they had little time to eat. In the evenings, they would bring in everything they had collected and, sitting around a campfire, share the food. This was conducive to social bonding, but it also meant that our physiology adapted to such a rhythm of meals. Therefore, many of us nowadays feel big cravings in the evenings, so we go snooping in the refrigerator then go to bed and digest while we sleep. This leads



the excess calories to be deposited in the form of fat. Then in the morning we are not hungry, but ready to venture out in search of food. Nowadays, unfortunately, even if we don't feel cravings in the first part of the day, we still eat and the fat tissue gets retained.

Humans are opportunistic omnivores. As a species, we have been very successful in the sense that we have colonized every corner of the Earth. But if we instead measure the success of a species in terms of how long it has been in existence, we really do not have any reason to celebrate yet. Humans as a species have been around for about 300,000 years. Relative to many other life forms, we are still in our infancy. We still have to wait, and hopefully during that time we will not destroy ourselves or our planet. In half a billion years or so, we will be able to say that we have achieved evolutionary success as measured by the lifetime of the *Homo sapiens* species. Right now, the only measure we can adopt is our internal well-being, because that is what we are most interested in.

What dietary pattern is good for us?

The nutritional recommendations coming from scientists, unfortunately, are not always clear and consistent.

The overall lesson I have learned from my reading, writing, and own research, is in a nutshell this: absolutely no extremes, because as I said, we are opportunistic omnivores. The second most important factor is exercise. And of course, cutting back on calories is also beneficial. These are the unchanging fundamentals.

But the specific conclusions promoted by nutritionists about what we should eat and how we should eat it have indeed changed over time. Back in the early 2000s, there was a debate about how harmful fats are, especially saturated fats. Nearly 20 years have passed since then, and fats are basically no longer being discussed. They have disappeared from the agenda, and

instead we talk about carbohydrates. Why so? This unfortunately also illustrates certain shortcomings of science as a way of explaining the world. The world is complicated, but scientists, especially nutritionists, tend to communicate an oversimplified message to the broader public. They assume – somewhat rightly – that the recommendations that go out to the public need to be simple, because if they are complicated, they will be ineffective.

And so, while trying to formulate such simple recommendations, scientists promoted the idea that the biggest threat was fat, especially saturated fat, and people needed to be persuaded to lower the fat content in their meals. Then, the thinking was, the whole problem regarding obesity, and the diseases associated with it, especially cardiovascular disease, would disappear. Societies, especially in the United States, even largely complied. But nature abhors a vacuum – and so carbohydrates simply took the place of fats in people's diets. When their consumption is increased, our bodies effectively convert them into fats.

What is the “microbiome” in our bodies, what role does it play?

This is a discovery of the last 15 years. It turns out there is more DNA from other organisms inside our bodies than our own. Each of us carries about 1–1.5 kg of foreign organisms in us – bacteria that we cooperate with to control our digestive processes. If for some reason the microbiome is disrupted and the wrong bacteria begin to proliferate inside our body (as happens especially when we are off somewhere on vacation), we start to get sick. These conditions are not only unpleasant but can also be life-threatening, associated with rapid dehydration.

The microbiome not only helps us with digestion, but also has many other functions. By altering the molecules that diffuse from the lumen of our intestine



MAREK KONARZEWSKI (3)

into the bloodstream, it sends signals that reach the brain, which means that the bacteria that coexist with us can actually influence our behavior, what we eat, our preferences. We are adapted not only to coexist with symbionts (i.e. the bacteria we cannot do without), but also to tolerate parasites inside us, something we are simply disgusted to even think about today.

In other words, we used to have to perpetually deal with parasites living in our bodies?

Historically speaking, the concept of hygiene – literally just washing our hands, etc. – only started to become widespread at the turn of the nineteenth and twentieth centuries. It all began after Pasteur's discoveries and it is still culturally very European. In nature, there is no animal that is free from parasites.

But we have greatly cleansed our bodies and eliminated all parasites around us. Our immune system is still adapted to constantly combatting such threats, and in their absence, it starts seeking something else to fight. This has led to a surge in autoimmune diseases, associated with allergies.

This is excellently illustrated by research that studied the incidence of allergies among populations of children from Karelia. Geographically, this is the very same population, but the region was split into two parts the 1940s in the aftermath of the Winter War. It turned out that households on the Russian side typically have pets, especially cats. On the Finnish side, on the other hand, cats turn out to be rare. The relationship between the occurrence of food allergies and dust allergies in children in those households proved to be exactly the opposite. Children on the Russian side, who live with cats, tend not to have allergies, while those on the Finnish side have them much more frequently. Of course, this is only a correlation, but we can find many more such relationships in different places. This study shows that we have gone so far in trying to create a pristine environment around us – pursuing what is essentially a cultural vision, not a natural one – we have gone so far that we are creating new problems for ourselves, which we then have to try to solve.

Could lab-grown meat be the answer to humanity's protein needs?

Lab-grown meat, or synthetic meat, as it is called, is a fascinating topic. Just 10 years ago, in 2013, Prof. Mark Post from Maastricht University produced the first synthetic hamburger. It was eaten by Sergey Brin, one of the founders of Google, who paid 250,000 euros for the honor. Today, this technology has already developed to the extent that, for instance, it is already being demonstrated at the Copernicus Science Center here in Warsaw; there is no talk of 250,000 euros anymore and essentially such meat will soon be available in stores. There are already many startups trying to bring lab-grown meat to market, mainly in the United States but also in Poland, Israel, and a few other places.

However, this is not a method to reduce global hunger; it is more like a cultural stunt. Initially, a biopsy of a particular animal's muscles, such as chicken, is taken to collect its cells. Then, these cells are multiplied and developed into a form similar to what we see on store shelves. This offers a certain solution for people who have ethical doubts, because the animal from which the cells originated can continue to live out its life, meaning we remove the stigma of killing from eating meat.

But from an evolutionary standpoint, not eating meat has no justification. To some extent, we are definitely carnivores. The structure of our digestive



UNIVERSYTET W BIAŁYMSTOKU

Prof. Marek Konarzewski

is a Professor of Biology at the University of Białystok and a Corresponding Member of the Polish Academy of Sciences. He has been President of the Polish Academy of Sciences since 2023.

His research work lies at the intersection of ecology, evolutionary biology, physiology, and animal evolution. He is also an avid popularizer of science, having authored the popular-science book *Na początku był głód* [In the Beginning There Was Hunger].

marek.konarzewski@pan.pl

system, the composition of enzymes it produces, indicates that it is designed specifically for breaking down certain bonds in the structure of meat, thereby proving that we have always eaten it.

The major problem related to meat production is actually different, as it concerns water usage. Animal production requires ten times more water than plant production. But lab-grown meat production unfortunately puts even more strain on the natural environment.

The water demand for meat production is incredibly high. So, will the human race be able to sustain itself in the future?

That's a poorly phrased question because we have to consider where the limits of population growth are. If we continue to multiply at the same rates as we have, no matter what we want to put on our plates we will still not have enough. Population growth in developing countries, which produce too little food, is very high, whereas in rich countries, which have excess food, population growth is negative. So, the balance is out of whack.

It is possible that, in a few decades, Poland will have a very different population than it does today. Hence, the question is, what dietary norms will these people want to adhere to? The example of changes in dietary preferences in China and India – societies that are developing and becoming richer – illustrates this perfectly. India, traditionally a vegetarian country, is shifting its consumption pattern as it becomes wealthier, and more meat is appearing in the Indian diet. So, culturally conditioned vegetarianism is giving way to a more Western model. China, in turn, is the world's largest consumer of pork, and this consumption is still on the rise.

So what alternatives do we have for feeding ourselves, with such a rapidly growing world population?

It's possible that our nutritional future lies in a different source of protein: insects. They are eaten a lot in South America, but the Chinese have truly made them an accepted part of their diet. There was recently a public discussion in Poland about consuming insects; there were even attempts to make this into a political issue, because eating insects is considered repulsive in this part of the world. However, insect farming does have enormous advantages. They are much more efficient at protein production than the animals whose meat we eat every day. The animals we consume – poultry or cattle – are warm-blooded, and so as they grow, they also have to simultaneously keep their bodies warm. Their body temperature is much higher than the ambient temperature, entailing an additional energy cost. Whereas animals such as insects (and also fish), whose body temperature is

equal to the ambient temperature, do not incur this additional thermoregulatory cost. Relatively speaking, they can therefore devote much more energy to growth. Their meat productivity is much higher.

Today, however, insect farming is not at all that much more efficient than cattle farming. Beef essentially makes the world go round, because cows are animals that can essentially eat anything as long as they have access to water. They really can pass quite a lot through their digestive tracts, and do so efficiently. However, it's not the cattle themselves that actually digest the plant food, but rather their microbiomes, the bacteria living inside them. Cows are basically huge fermentation vats – that's why they don't have particularly elegant shapes.

You have touched on many interesting issues related to the energy budget of organisms. To what extent has your way of thinking and scientific career been influenced by Jared Diamond, the well-known scholar from the United States?

I was fortunate enough to have had a postdoctoral fellowship in a very inspiring place under a great team leader, Jared Diamond. To a large extent, my thinking

If humans continue to multiply as fast as we have,, no matter what we want to put on our plates we will still not have enough.

about biology is indeed a consequence of the many discussions I had with him. For Jared, science was an intellectual adventure. And for me, science is also an adventure and a way of life, trying to explain the world to myself and others. It's about sharing knowledge as soon as you have managed to understand something, because that's what brings joy. I am very fond of Jared and, like him, I try very hard to share knowledge and a certain way of looking at the world.

I benefited greatly, in the intellectual sense, from my time on this post-doc, so I always encourage the younger portion of our Polish scientific community to go away for longer stays, especially where they can have direct contact with maestros like Jared. In such an environment, every conversation is enlightening and inspiring, whether it's just a friendly exchange of thoughts or a formal conference.

INTERVIEWED BY
JOLANTA IWAŃCZUK, DANIEL J. SAX