

BIOCHEMISTRY

Building Blocks of Life Ruled by the Number 288

This Number and Its Multiples Found Everywhere In Groupings of Amino Acids to Form Proteins

By ROBERT D. POTTER

THE BIBLICAL number typifying man's length of life may be three score years and ten but the chemical number which permits him to attain that age is 288.

The chemical bonding of vital protein—basis of all living matter—is bound up with the cryptic number 288, Dr. Max Bergmann, research scientist from the Rockefeller Institute for Medical Research, New York City, disclosed before the recent meetings of the American Chemical Society in Richmond. Not only is 288 a number intimately connected with life itself in the higher animals—including man—but it is a number closely related with heredity and the ability of parents to transmit physical characteristics to their offspring.

On Chemical Basis

Predetermination, said Dr. Bergmann, now takes on a new and understandable chemical basis instead of an interpretation of heredity in terms of chromosomes. Scientists called the chromosomes and the genes they contain, the bearers to posterity of the physical characteristics of those now living. But the names chromosomes and genes were after all but names rather than explanations of why they were endowed with their remarkable abilities.

The tissues of animals and man, besides containing a vast amount of water, consist mainly of proteins. Yet the structure of no single one of these basic, life-bearing proteins is exactly known, said Dr. Bergmann.

The trouble has been, he indicated, that proteins are the giants among chemical molecules. They owe their gigantic size to the complicated assembly of smaller chemical units which somehow form chemical families that are essential to life. The number 288 has recently been discovered, in Dr. Bergmann's laboratory, to enter into the chemical rules which determine how such complex molecular organizations are put together.

Chemical aggregates known as the ami-

no acids for a long time have been known to be members of the huge protein molecules, declared Dr. Bergmann. But the new finding is that in the protein contained in the chicken egg there exist groups of 288 of these amino acids. And in the protein found in the hemoglobin of cattle 576 amino units make up the molecule. This, significantly, is twice the cryptic number 288. Similarly the fiber protein of cattle blood contains 576 amino units, while the fiber protein that makes natural silk contains 2,592 amino units; or nine times the basic number 288.

Protein Specificity

It was formerly thought, said Dr. Bergmann, that an almost infinite variety of proteins could exist. Dr. Emil Fischer, German Nobelist, had advanced such a theory whose implications pictured a protein for the hair of man, a different one for the hair of a dog, another for sheep hair and so on for each species of animal. And then the whole process was repeated for proteins in any other part of the body, again throughout the whole animal and plant kingdoms. By varying the combinations of only 30 amino acids, for example, it was possible to postulate the existence of 1,280,000,000,000,000,000,000,000,000

different proteins; or a number equal to 128 followed by 28 ciphers.

Analysis in Dr. Bergmann's laboratory, however, has brought new order out of this apparently jumbled picture. The only protein combinations permitted to exist in nature consist of those containing 288 amino units, or some simple whole number multiple of 288.

Out of his work, Dr. Bergmann has been able to fashion what might be called a mathematical rule for life, or at least the vital protein part of it.

Formula For a Molecule

Says Dr. Bergmann:

"Proteins appear to contain $2^m \times 3^n$ units per molecule, where m and n are whole positive numbers."

Higher animals, including man, are unable to build up the basic units of protein, but make them available by digesting food proteins by means of enzymes in the gastro-intestinal tract, such as pepsin and trypsin. Plants, in other words, have long been known to fashion the complex protein arrangements and man, by digestion, breaks these larger building blocks into usable pieces.

The first step in the new knowledge was the creation in Dr. Bergmann's laboratory of relatively simple peptide-like substances serving as simple protein models with which could be studied the action of the various enzymes. It was by the study of these synthetic protein models that the amazing regularity of 288 and multiples of 288 appeared.

Gradually it became apparent that enzymes had specific duties to perform and that, in fact, each kind of protein is created by the action of its specific enzyme. This fact, said Dr. Bergmann, is a new understanding of body chemistry for it had previously been supposed



CITIZENS OF THE MOON

It has been suggested that if any life larger than bacteria could exist on the arid, airless face of the moon, alternately baked in sunlight and frozen in darkness, it might be lichens. On earth, these strange plant communities endure where other plants perish, so if there are even crumbs of oxygen and moisture on our satellite, such things as these might conceivably live there.

that the action of the enzymes was to break down complex proteins into those the body could use. Now enzymes take on the new role of permitting—indeed determining—the building up of body proteins.

Sequence of Reactions

The mechanism of creating the complex proteins, said Dr. Bergmann, now appears to be a sequence of many, many reactions wherein a simple protein is turned, by specific enzymes, into a more complex protein.

The whole chain of reactions therefore goes on until finally a protein is created which does not have present the specific enzyme that can build it higher, and there the chain stops.

“Thus the specificity of an individual enzyme predetermines the molecular pattern of the protein synthesized by this enzyme. The numerical rules governing a protein molecule have their basis in the specificity of the enzyme involved,” declared Dr. Bergmann. “Here we arrive, for the first time, at a physico-chemical concept of the predetermination which is an inherent attribute of many phenomena of life.

Set of Chemical Tools

“The question has frequently been discussed whether hereditary phenomena are connected with, and explained by, a transmission of individual proteins and in particular, whether the chromosomes are proteins. On the basis of the conclusion which we have reached I think you will agree that the essential substances transmitted from one generation of cells to the next, from parents to children, must be enzymes and that they have to be enzymes with the capability of synthesizing individual proteins by predetermined sequences of specific reactions.”

What Dr. Bergmann is saying here—to use an analogy—is that heredity consists of passing on, from one generation to another, a set of chemical tools which permit the offspring to fashion the proteins they will encounter in life in only certain ways. These chemical tools, of course, are specific sets of enzymes.

If you, for example, have red hair it means that heredity handed on to you the enzymes which permit your body to change the food you eat into proteins that occur in red hair pigment. Dark-haired people have a different set of enzyme tools which enables them to fashion dark hair pigment out of the same foods which you both eat. Similar examples can be found in the color of

the eyes and other physical characteristics.

“Will we ever be able to copy in life the synthesis of natural proteins?” asks Dr. Bergman. “I do not know whether we shall succeed sooner or later (probably later) in synthesizing proteins without the cooperation of living cells and only with the aid of enzymes. However, I am doubtful how much a synthesis

PSYCHOLOGY

More Intelligent Men Not Always Best Citizens

AMONG humans, a certain amount of intelligence appears to be essential to good citizenship. The idiot cannot become a satisfactory member of the social group.

At the other end of the intellectual scale, the genius contributes greatly to social life. But in between these two extremes, the level of intelligence does not seem to parallel the level of socialization.

Human social organization depends upon intelligence and not upon instinct as does the social life of ants or termites, it is pointed out by a psychologist, Dr. F. L. Wells of Harvard, but, he explains, beyond that certain minimum needed to learn how to get on in the world, a higher average intelligence does not necessarily mean less crime or less anti-social conduct.

Modern technological developments have made possible the automobile, the telephone, and the airplane serving to bring men closer together. But they have also made possible the instruments of modern warfare and crime. The automobile may serve as a weapon of crime as well as a socializing influence.

Against Restraints

The individual who is mentally alert and of inventive mind is likely to chafe against the restraints of society and discover means of escaping them.

The more mentally gifted, if also possessed of a lust for power, are apt to exploit the less intelligent members of the community.

Humanity would benefit most, Dr. Wells believes, not from a raising of the average of the intelligence, but from a more equable distribution of all human traits with fewer extremes in ability to adjust to the general pattern of life.

Men need ability to restrain and subli-

mate their emotional and animal desires. With a proper balance between natural drives, intelligence, and sublimation, great individuals and great communities can develop.

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ARCHAEOLOGY

Indian Chiefs Protest Uncivilized Pot-Hunting

INDIAN CHIEFS don't like the robbing of Indian graves by white men. It's "uncivilized."

In a protest, drawn up in formal fashion, a group of Seneca chiefs have expressed forthright ideas on what is proper in archaeology, and what is not.

Summed up briefly, they approve of scientific excavations by trained experts, who are seeking prehistory.

They do not approve of ignorant and commercial relic hunting in their state, which happens to be New York.

The Indians themselves put it this way: "We have no objection to the scientific examinations of qualified museums known to and approved by the National Research Council or of the Society for American Archaeology, or to individual scientists who keep careful records of a type having the approval of scientific bodies. Methodical and purposeful work adds to the sum of the world's knowledge, but the grave robbery of 'pot-hunters' and relic diggers is repugnant to every person understanding