The Sigma Xi speaker

1. «OUR CHANGING UNIVERSE»

BY HERMIONE BARKER BRISCOE, '28

ONE of the most famous of living scientists, Dr W. D. MacMillan, noted professor of mathematical astronomy of the University of Chicago, delivered the annual Sigma Xi address at 8 o'clock Monday evening, April 18.

Doctor MacMillan is especially known for his hypothesis concerning the energies of the stars and has been professor of mathematical astronomy in the University of Chicago since 1924. He is the author of a book, *Statistics and Dynamics of a Particle.* Holding membership in the American Mathematical association and the Astronomers and Astrophysicists association, Doctor MacMillan has an international acquaintance in the astronomical field and is recognized as an authority on modern astronomy. Doctor MacMillan was honored with a luncheon given by members of the faculty who are alumni or former students of the University of Chicago, and by Phi Mu Epsilon, honorary mathematics fraternity, which also entertained the scientist during his visit in Norman.

The subject of the formal address delivered by Doctor MacMillan at the third annual Sigma Xi banquet was "Our Changing Universe."

His conception of our changing universe portrays human insignificance in limitless star-filled space, incomprehensible distances and untold energies.

"Although Bishop Usher has declared that the universe was created January 28, 4004 B. C., at 9 o'clock, geologists now estimate it as having been in existence at least 300 million years," Doctor MacMillan said.

Our solar system is approximately in the center of a galaxy, the nearest star of which is 275,000 times as far from the earth as is the sun. In space there are millions of other galaxies like ours, anywhere from one to 150 million light years away, and there are probably more, too distant for our most powerful telescopes to reveal.

Life must exist in at least a few other places in the boundless universe, since there must be several planets very similar to us. This life might not have the same form as human life, but it is plausible to believe that it is life adaptable to the peculiar conditions of its habitat.

There are many opportunities for life of some sort on the billions of planets which surround us. Life of all sorts has a great deal of adjustability. Consider how man has adapted himself to the extreme colds and heats of the earth and how plant life has adapted itself since we have studied its evolution. The earth is in transition. I would not attempt to predict what forms it will take billions of years from now. However there is every evidence to support the belief that many changes will come about in the future. From a study of geology we see the various phases and changes which the earth has undergone. Our continents probably will be reduced to penoplanes—that is conceivable. Later the waters may wash over all the land, and life that exists then must take the form of fish and water life. Man may become extinct, but life of some sort will persist. The type of life in the future will depend entirely upon conditions on the earth at that time.

We study the stars according to the fundamental assumption, the doctrine of uniformity—that the laws of nature are independent of space and time. Billions of stars and many solar systems surround us. We learn from the law of radiation, that the mean temperature of Mars is about forty degrees below zero, while the temperature of the earth is about 60 degrees above zero. Thus, it is probable that no human life exists on Mars. We have every evidence to be able to assume that life of some sort exists there, but we do not know what kind it is. Venus is one hundred degrees hotter than the earth. But it is one hundred per cent cloud-covered, while our planet is only about fifty per cent cloud-covered. Venus has often been referred to as the earth's twin, since the two are approximately the same size.

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In an informal interview following the speech, Doctor MacMillan discussed social problems of the present time in relation with scientific knowledge. He acknowledged that our growing use of scientific principles have wrought great changes in the economic and social lives of our people. Whether or not discriminating use of scientific inventions and knowledge may be appropriated to return balance and a more sane living to inhabitants of the world, is a matter of conjecture with Doctor MacMillan.

Man must control his needs intelligently or else nature will do it unintelligently. The earth has almost reached its maximum population at the present time. It is my belief that man, with the aid of science, must practice intelligent birth control, thus regulating the size of future generations. Science invented machinery has taken labor from man. Perhaps through science, man may learn to safeguard the happiness of future people. However, birth control is a problem to be solved by the sociologists. We scientists see the need for it. The sociologists must bring it about. I predict that it will be a long time before birth control will be universally practiced. Politics control our movements at the present day. Politics in a democracy are controlled by the less intelligent people rather than by the most intelligent ones."

2. SCIENTIFIC ASPECTS OF DR MACMILLAN'S VISIT

BY J. O. HASSLER

TO say that Doctor MacMillan's visit was stimulating to the intellectual life of the university is putting the case very mildly. To summarize and present in a nontechnical manner the impressions he made on university thought is exceedingly difficult. The reaction of various members of the faculty and student body who heard him differ according to the different points of view. All that anyone can do is to present the facts and theories as they appealed to himself.

In general, three things were evident in Doctor MacMillan's frankly stated concepts of the universe.

First, it has no beginning and no end. It will not run down and become inert. Matter contained in it may change form, and energy may be transformed from one state to another in the great processes slowly unfolding before the eyes of the astronomers, but there is no scientific basis for the discovery of the beginning or the prediction of the end.

In his illustrated lecture on Monday evening, Doctor MacMillan showed telescopic photographs of celestial phenomena that reproduced in remarkable detail the delicate tracery of nebula that has the appearance of fine lace. In this nebula he proposes that the process of building up atoms out of radiant energy

is taking place. Other older nebulae shown are like great clouds in which the tiny particles of matter are assembled in a huge glowing mass spread out over such an immense region that the average density is less than that of the best vacuum that can be obtained in the laboratory. Other nebulae are completely devoid of light, screening off the distant stars as would a smoke screen, and acting as a background for the relatively few near stars between us and them. It is impossible to see any of these nebulae with the naked eye and, with the exception of one or two, even moderate sized telescopes fail to show any details.

Other slides showed how the spectroscope reveals the composition of the stars and their velocities toward or from us. The spectroscope also shows the stages in the development of a star from an earlier to a later condition.

The pictured forms of celestial matter in the various early or late states of change enable an astronomer to look backward or forward in time. To illustrate this I will use the following analogy suggested by an eminent astronomer of the last century. If one walks through a forest, he is able by means of the examination of the trees as they exist for a period of perhaps half an hour, to describe the life history of a tree from the seed to the decaying log, not because he has seen one tree pass through all these stages of existence, but because in different trees he has seen all stages in the existence of a tree. So can the astronomer read the life history of a star over untold millions of years by observing among the thousands of millions of stars the various stages or conditions in the existence of a star. He may also interpret in the records revealed to him by the telescope and spectroscope the whole cycle in the existence of matter, which Doctor MacMillan finds to be periodic and recurring. Thus he sees no end and no beginning.

In the second place, Doctor MacMillan stated frankly that he is not a relativist. He has not been swept off his feet by the Einstein Theory. Neither does he oppose it. He merely adheres to Euclidean space (the space defined by the geometry, familiar to all of us) as being a sufficient foundation for the mathematical part of his astronomical theories and regards the Newtonian law of gravitation (that the attraction of two bodies for each other varies inversely as the square of the distance) as an approximate statement of conditions which is sufficiently accurate (with some modification for some special cases) for his purposes. He made it clear that in the development of a cosmology, these are to be regarded merely as postulates. Another postulate expressed by Doctor MacMillan is that space is infinite in extent. He said, "You cannot know if you reach the boundary of space. Even when you think you have reached it, you may have only found a partition."

A third notable attitude taken by Doctor McMillan was the complete separation of his scientific researches, hypotheses, and theories from religion. He makes no attempt to prove or disprove the existence of an infinite power guiding all things and prevading all things. His purpose seems to be to study conditions as revealed, make such postulates as our institutions demands, observe the various changes in the act of taking place, and find out if possible the great processes which cause the observed phenomena. Origins are left for others to determine. If a man's aesthetic nature leads him to interpret these in terms of the spiritual, it is that individual's own business. It is not necessarily in the realm of science.

Doctor MacMillan made the pointed remark that the title of his lecture is "Our Expanding Ideas of the Universe" rather than "Our Ideas of the Expanding Universe." This remark epitomized his opposition to the recently published theories of Jeans and Eddington that the universe is exploding, which is their interpretation of the apparent outward rush of the distant galaxies of stars in space (some of them at the rate of 15,000 miles per second) as shown by the shift of the lines in the spectrum. Doctor MacMillan shows by mathematical computation, based on the new physical theories of the nature of light, that this shift of the spectral lines can be explained by his theory of "light leakage" or loss of energy by radiant light as it travels through space.

In his public lecture Doctor MacMillan traced the development of man's ideas of the extent of the universe around him from ancient times to the present. First was the notion of a small sphere of fixed stars rotating about the earth as the center of all things. Except for a possible extension in the size of the sphere, this notion dominated astronomic thought until the time of Copernicus (fifteenth century), though a few bold thinkers as early as the fourth century B. C. suggested that the earth's rotation on its axis could just as easily explain the daily apparent motion of the sun, moon, and stars. Aristarchus, in the third century B. C., held that the earth also revolved about the sun. These men were unable to obtain a following. The elaborate "epicycle" theory of Hipparchus (second century B. C.) and Ptolemy (four centuries later) based on a fixed earth at the center of the universe, was considered sufficient for the astronomers for more than a thousand years.

The heliocentric theory of Copernicus was the stimulus that kindled the imagination of those who studied the heavens. The wonders revealed in the seventeenth century by Galileo's telescope gave tremendous impetus to scientific thought. The discovery of mountains and plains on the moon showed it to be a body like the earth instead of a disk of light set up to "rule the night." It was found that there were bodies (moons) revolving about Jupiter in a manner analogous to the revolution of the planets about the sun as proposed by Copernicus. Venus and Mercury were seen to take on phases like the moon, providing that they pass between the earth and the sun.

In 1837 Bessel was able to detect a periodic difference in the direction of some of the stars due to the different positions of the earth in its orbit during the course of the year. This furnished more evidence that the earth revolved about the sun and at the same time showed that the stars were further than had been supposed, for only a few are close enough that a measurable difference in direction can be observed from opposite points in the earth's orbit 186 million miles apart. Investigations with modern high-powered telescopes, and with the spectroscope, pushed the boundaries of our galaxy farther and farther out into space. The nearest bright star was discovered to be 275,000 times as far as the sun from the earth. The next nearest that can be seen with the naked eye is twice that far. Using the light-year (the distance traveled by a ray of light in one year—nearly six million million miles) as a unit, the distance to the nearest star is 4.3, while the distance to the outer stars in our galaxy is many thousands of times that far. In our biscuit-shaped galaxy of some thousands of millions of suns (stars), stretching about 300,000 light-years from edge to edge (in the direction of the milky way), there are stars ten thousand times as bright as our sun and some many million times its volume. And the volume of our sun is more than a million times that of the earth!

Hubble, with the 100-inch telescope at Mountain Wilson, near Pasadena, California, has recently located thousands of "nebulae" out in space beyond our galaxy at distances from one million to 150 million light-years. These faintly glowing spots of light are other galaxies of stars similar to our own, so far away that, except for the closest of them, no telescope can resolve them into individual stars.

While his audience was trying in vain to grasp the immensity of it all, Doctor MacMillan concluded with the suggestion that among the billions of suns there must be hundreds of thousands with planetary systems like our own, and among those planetary systems it is only reasonable to suppose that there may be planets like the earth with life on them. Truly this is getting far away from the ancient homocentric idea of the universe.