human comprehension. Swedenborg ascribed the source of all that we can see, or sense with the paraphernalia of modern science, to an infinitely wise and loving Creator who made man in His image and likeness. Shapley admits of the "Unknowable." Perhaps from their separate vantage points they have seen much the same thing, for the universe is so made that man can remain in freedom to accept or reject its Creator.

PHILOSOPHICAL NOTES

The View from a Distant Star. This is the title of a book by Harlow Shapley reviewed in this issue of NEW PHILOSOPHY. Because the reviewer expressed a favorable reaction to the book, I read it. There was one point in the book—not the main theme—that is very interesting for the historical perspectives which it suggests.

Shapley speaks of what was to him a certain "moment of discovery" when he realized that the meaning of certain astronomical evidence—is that the center of the "universe" is some 30,000 light years away—and that even this "center of the universe" is relative to a more inclusive universe that included many galaxies. That extent of astronomical space in which are our planet, solar system, and the milky way constitutes one of these galaxies.

It is difficult to find words to describe the contents of this moment of discovery. For example, what is meant by universe? The meaning of universe grows with time, and as it does so its center moves farther and farther from the earth. But the first move by Copernicus from the earth to the sun was the most critical and it was opposed vehemently by church and science alike.

The move by Copernicus was 93,000,000 miles. The move by twentieth-century astronomers in one case was 30,000 light years. The former distance is piddling as compared to the latter. And yet, as compared to all the noise made at the time of Copernicus, hardly a peep was caused by the latter move.

Evidently both church and science had undergone a change. Was this not because of the way in which people thought rather than because of the nature of scientific data itself?

The Center of the Universe. The center of the universe—where is it? There was a time when this question could be answered

easily and definitely. There is something emotionally satisfying about the expression *terra firma.* And yet when man opened not only his physical eyes but the eyes of his reason he found a world that only appeared as if fixed—as if the center of things.

The sensation of touch told him the earth was fixed—not charging through space in its path about the sun at a speed of eighteen miles per second. The sensation of smell could only tell him what was on this earth—the odor of the sea, the perfumes of vegetation, etc. It could not sense the fire of the suns. His eyes told him that all of these stars as well as the planets were in motion about the earth.

And so it is with appearances—true appearances, that is. They *are* true, but their truth is limited to the degree in creation in which they appear. They become false when applied to other degrees. The center of man's universe in the conduct of his daily life *is* the earth. The perceptions which are the products of reception by his senses from the world in which he lives are truths on the plane of ordinary existence. The sun, for example, does rise in the east and it does settle in the west. This is a truth that man cannot contest while living in the plane of ordinary experience, carrying on as he must the ordinary daily life of his existence.

And yet today, because of the development of scientific ideas and engineering feats, there are a few of the evolved primates of good old *terra firma* who can tell us from their own experiences that the immediate perceptions of our senses are only relative to the immediate world in which we live. To the astronaut, the aspect of the earth, the gravitational sense, the sense of motion through space, the appearance of the earth and the heavens means in each case something different from what it means to us who have remained committed to our small region.

But the experiences of the astronaut can as yet hardly be classified as ordinary. The tremendous planning and organization that makes use of all branches of the sciences, as well as the best combination of wits that man can call upon to develop a team—the teamwork necessary to place a fellow associate "into orbit" —depends upon those eyes of reason which have been opened to consider truth on a plane in creation that is above the plane of ordinary experience.

Years before these scientific and engineering results were accomplished, and even before much of the intellectual substance

which is the foundation that makes these results possible, man became conscious of the existence of a universe far larger than that which could be known to the unaided physical senses. Added knowledges were made possible, first by the extending of the natural power of his eyes by means of the telescope, and later by means of the spectroscope, the camera, and dozens of other instrumental aids. But even these knowledges by themselves do not extend the universe for man unless the eyes of his reason are applied to the myriads of physical scientific data gathered through the application of the instruments.

Approximately four hundred years ago, through the application of reason to the relatively crude scientific data then available, Copernicus moved the center of the known universe from the earth to the sun.

But what is the known universe today?

The Galactocentric Hypothesis. "The sun is no longer thought to be in a central position. Rather, the center of the Milky Way galaxy is now known to be some 30,000 light-years distant." So says Shapley in his book. The reason for this conclusion is outlined in the first chapter. The above quoted statement is made in Chapter 3. The concept of the astronomical system consisting of our galaxy and its center can be called the "galactocentric hypotheses."

If we think for a moment about the consequences of this statement, and while associating the name of Ptolemy with the geocentric hypothesis and then name of Copernicus with the heliocentric hypothesis—then a sequence opens up through the names of Ptolemy, Copernicus, and Shapley and other twentieth-century astronomers.

Without apparent dogma one can surmise that the galactocentric hypothesis will hold for a long while. It appears to contain the seeds for further expansion of thought based upon future scientific discoveries.

Notice for example on Shapley's statement that he speaks not of the center of the universe but of the center of our galaxy. And there are many galaxies—how many? The "center of the universe," it seems, would have to take account of all these galaxies. This leads to a Metagalaxy! In Shapley's view the events leading to the statement of the galactocentric hypothesis

was for him "a moment of discovery." All of the astronomical data from the time of Copernicus up to and including that of the twentieth century was laying the foundation not only for the galactocentric hypothesis but also for a much, much larger meaning of the concept "universe"—the concept of a metagalaxy. Let us read a bit from Shapley about the dawning of these ideas.

A Moment of Discovery. Not to reproduce the whole of Shapley's first chapter but only some of the flavor, I select the following remarks. He says:

> Talking to myself and to . . . [a] colleague . . . I was explaining: "And now, from the plot of the positions of these globular star clusters, projected on the galactic plane, you can see this peculiar asymmetry—this lop-sided distribution, which probably means . . . Good Heavens! It means that the center of the universe may be away off in the Sagittarius direction tens of thousands of light-years distant. Wonderful! Or is it?"
>
> It was a shocking thought—this sudden realization that the center of our universe was not where we stood but far off in space, that our heliocentric picture of the universe must be replaced by a strange sort of eccentric universe.

Shapley describes something of the nature of the evidence and the nature of the thinking which ultimately led to his stating

> That the center of our "universe"—our galaxy among the myriads of galaxies—is apparently more than 30,000 light-years from our little local abode.

Note that by now "universe" is in quotes for Shapley. He goes on to describe something about the universe (unquote) or a complex called the Metagalaxy. An interesting comparison can be made with the size of this complex in relation to our galaxy, which includes the Milky Way, by the unit of measurement used in assigning distances in the Metagalaxy. This unit is known as a mega-light-year. It is the distance light would travel in one million years.

Moving the Center of the Universe. When a few years after the publication of Copernicus' book it was fully realized that he had moved the center of the universe as it was then known from the earth to the sun, a mighty upheaval in thinking resulted. Later writers have busied themselves to write about the "martyrs of science" although it can be reasonably doubted that Galileo Galilei, for example, was a martyr in any sense of that word. And

although Bruno was burned at the stake, his martyrdom seems somewhat removed from the history of science.

And yet it appears that history teaches us the truth of Shapley's reflections as he speaks of the nature of thinking back in the sixteenth century. He says:

> But the large-scale handiworks of Omnipotence have always troubled our self-esteem. (I am speaking here for the more educated primates.) Years ago we Romans did not like to give up the idea that Rome was the center of the world. Later we resisted in spirit and argument the shift of the cosmic center from the earth to the sun. We had cherished that geocentric theory of the universe, and the importance it had given us (*The View from a Distant Star*, p. 3).

Later Shapley would have us believe that the removal of the center of the "universe" 30,000 light years away is unsettling today. I doubt if this is generally so. The only people to whom it can be unsettling are of Shapley's own kind—that is, those who are capable of forming some idea of what 30,000 light years means —those who can appreciate what a paltry thing 93,000,000 miles, the distance Copernicus moved the center, really is!

The Church vs. Copernicus. There seems to be no doubt that established institutions often oppose and set up barriers to the creation of new movements. For example, just as the Christian Church during the days of its origin was opposed in Rome with bloody ferocity, so later the Church opposed movements that might spread the responsibility of learning beyond the Church's control. Nevertheless the common condemnation of the Church in this regard seems to be an incomplete picture of the history of human thought.

Not only the common man but the learned man of his day was quite unprepared for the Copernican view of things. Unfortunately much of what happened in the reaction to the Copernican theory has been obscured by a web of stories about the relation of the church and theology to these matters. Certain historical facts in this regard cannot be denied. But these facts are only a part of the larger true story of the growth of man's concept of the universe. And as one glances through the various commentaries of the historians, and as one reads the words of the main actors in the creation of modern science, Copernicus, Kepler, Galileo, Newton, etc., one wonders if the full story—the true story—will

ever be told. Indeed, one wonders, even if it could be told, who would understand?

Scientific Thinkers Against Copernicus. E. A. Burtt in his *Metaphysical Foundations of Modern Science* gives four classifications of experimental reasons why the thoughtful of Copernicus' day could not easily accept the idea of moving the center of man's universe from the earth to the sun. Burtt says,

> We are so accustomed to think of the opposition to the great astronomer as being founded primarily on theological considerations (which was, of course, largely true at the time) that we are apt to forget the solid scientific objections that could have been, and were, urged against it. (p. 36)

In summary these four classifications (each containing a number of elements) were:

1. Without modern instrumentation the Ptolemaic system accounted for astronomical events with an accuracy as great as that of the Copernican theory. Why therefore should any sensible thinker abandon a "time-tested theory" for "a new-fangled scheme" unless important advantages were to be gained?

2. So far as the senses could determine, the earth is the solid and stable thing, fixed in position, whereas the contents of the heavens made up the "tenuous, the unresisting, the mobile thing."

3. Burtt says,

> The four elements of earth, water, air, fire, in their ascending scale not only as to actual spatial relations, but also in dignity and value, were the categories in which men's thinking about the inanimate realm had become accustomed to proceed. There was necessarily involved in this mode of thinking the assumption that the heavenly bodies were more noble in quality and more mobile in fact than the earth, and when these prepossessions were added to the other fundamentals of the Aristotelian metaphysics, which brought this astronomical conception into general harmony with the totality of human experience to date, the suggestion of a widely different theory in astronomy would inevitably appear in the light of a contradiction of every important item of knowledge man had gained about his world. (p. 37)

4. There were experimental objections to the heliocentric theory. Burtt mentions two of these. If, for example, the earth is rotating daily on its axis toward the East then a body projected vertically ought to fall trailing to the west of the point from which it is launched. Furthermore the annual parallax of stars as predicted by the heliocentric theory could not be observed. The explanation of the failure of the trail to exist had "to await Galileo" (as Burtt

says—but I wonder if it did not have to await the more general dynamical principles of Newton?). Star parallax does exist but it was not observed until 1838 by Bessel whereas the *De Revolutionibus Orbium Coelestium* of Nicolas Copernicus was published in 1543.

As a result of these things Burtt says,

> In the light of these considerations it is safe to say that even had there been no religious scruples whatever against the Copernican astronomy, sensible men all over Europe, especially the most empirically minded, would have pronounced it a wild appeal to accept the premature fruits of an uncontrolled imagination, in preference to the solid inductions, built up gradually through the ages, of men's confirmed sense experience. In the strong stress of empiricism, so characteristic of present-day philosophy, it is well to remind ourselves of this fact. Contemporary empiricists, had they lived in the sixteenth century, would have been first to scoff out of court the new philosophy of the universe. (p. 38)

Burtt is not alone in this appraisal of this portion of history of thought. His work originally was published in 1924. The above quotations are from the revised 1931 edition. He refers to another work, a doctoral thesis (Columbia University), published in 1917 by Dorothy Stimson, *Gradual Acceptance of the Copernican Theory of the Universe.*

(I had an interesting experience concerning Burtt. One day during the last year I had just come at noontime from a meeting on a university campus where we had discussed some things in Burtt's book. As I went through the line in the campus cafeteria I carried my copy of this book. The person next to me was a well known mathematical physicist who said to me, "Say, is that old so-and-so still around?" The implication seemed to be that Burtt's studies in the metaphysical origins of modern science and some of the broader views of his historical considerations did not sit well with the more naturalistic presuppositions of some modern scientists.)

It is interesting to read about the scientific and religious reaction of the times as it was written.

The Nature of Seventeenth-Century Opposition to Copernicus. Anyone interested in pursuing further the opposition to Copernicus is referred to the thesis by Dorothy Stimson mentioned above. Included in the thesis is a translation of a letter written by Thomas Feyens in February, 1619. (Miss Stimson suggests that Feyens

probably refers to a certain Francesco Patrizzi, appointed by Clement VIII to a chair of philosophy in Rome. There is an error somewhere in dates, as the date of his death is given as 1597.) This letter is over five pages long, and in a delightful manner recites numerous objections to Copernicus on various grounds. A set of quotations to give the flavor follows:

ON THE QUESTION: IS IT TRUE THAT THE HEAVENS ARE MOVED AND THE EARTH IS AT REST? . . .

It is proved that the heavens are moved and the earth is stationary:

First, . . . by authority; for besides the fact that this is asserted by Aristotle and Ptolemy, whom well nigh all philosophers and Mathematicians have followed by unanimous consent, except for Copernicus, Bernardus Patricius and a very few others. . . ."

Also Joshua 10: 13–14 and Ecclesiastes 1 : 4 are quoted.

Secondly, it is proved by reason. All the heavens and stars were made in man's behalf and, with other terrestrial bodies, are the servants of man to warm, light, and vivify him. . . . And it is more likely that they would apply themselves by their own movement to man and the place in which man lives, than that man should come to them by the movements of his own seat or habitation. . . .

Thirdly; no probable argument can be thought out from philosophy to prove that the earth is moved and the heavens are at rest. Nor can it be done by mathematics, etc. . . .

Fourthly; the earth is the center of the universe; all the heavenly bodies are observed to be moved around it; therefore it itself ought to be motionless, for anything that moves, it seems, should move around or above something that is motionless.

"Fifthly"; consists in an argument that if the earth moves, it does so either "by its own nature or by the nature of another." Each of these alternatives is disputed and "Finally, if the earth is moved by another, its motion would be violent; but this is absurd, for no violence can be regular and perpetual."

"Sixthly"; is an argument depending upon the history of concepts. The argument opposes the idea that that which moves the planets (*primum mobile*) is at rest and instead the earth is moved. The argument concludes: "For if movement were ascribed to all the rest, why for that same reason is not diurnal rotation ascribed rather to the *primum mobile* than to the earth, particularly when our senses seem to decide this?" And now follows the wonderful appeal to historical necessity: "Although one may well be mistaken, sometimes, concerning other similar move-

ments; yet it is not probable that all ages could be at fault, or should be, about the movements of its most important objects, of course the celestial luminaries."

"Seventhly; it is proved by experience." An arrow shot straight up into the air from a place would not fall back to the same place, and arguments from the lack of motion of the air are also given *in extensio.*

"Eighthly"; calls attention to the common experiences that falling objects do fall vertically and not with a drag angle. The primitive argument that is later handled nicely by Newtonian mechanics is taken care of as follows:

> You will say: if the earth is moved in a circle, so are all its parts; wherefore that stone in falling not only moves in a circle by carrying of the air, but also in a circle because of its own nature as being part of the earth and having the same motion with it.
>
> Verily this answer is worthless. For although the stone is turned in a circle by its own nature like the earth, yet its own natural gravity impeded it so that it is borne along that much the less swiftly, unlike the air or the earth, both of which are in their natural places and which in consequence have no gravity as a stone falling from on high has." (p. 128)

And so it goes for two other reasons based upon experience. And the letter concludes:

> Similarly not a few other arguments can be worked out, but there are none as valuable for proof as the foregoing ones. Though these were written by me with a flying pen far from books and sick in bed with a broken leg, yet they seem to me to have so much value that I do not see any way by which they could rightly be refuted. These I have written for your gracious lordships in gratitude for your goodwill on the occasion of our conversation at your dinner four days ago; and I ask for them that you meditate on them justly and well.

Harvard vs. Copernicus. Shapley in his book says

> . . . in its early days Harvard College stood by the geocentric interpretation for more than a century after the appearance of *De Revolutionibus Orbium Coelestium.* (pp. 33–34)

Certainly Harvard was not a representative of the Roman Church. And so one may well ask: even if the Church opposed the treatment in Copernicus' *De Revolutionibus Orbium Coelestium* because it moved the center of the universe from the earth to the sun, why did Harvard oppose the new theory?

Shapley does not give the reasons given by Harvard for its position, but gives the incident as an example of what he calls

"man's inherent incompetence," or as he also says, "There (is) even a bit of resistance on the part of the thoughtful, because change naturally incites resistance." So even the thoughtful resist change! Is this only because they are human or because the thoughtful have reasons? Who are the thoughtful? members of the church? others? Apparently "others" include at least some of those who went to make up what is called "Harvard" of that period.

Copernicus vs. Copernicus. The case of Harvard against Copernicus is but a single example of a non-Catholic institution against the new ideas. Somewhere there is a record that the University of Pennsylvania also maintained a stout resistance along with Harvard. But over and above all these, one may ask, What did Copernicus himself believe?

H. Butterfield, in his *Origins of Modern Science, 1300–1800* has a chapter entitled "The Conservatism of Copernicus." Wherein does this conservatism show itself? One of the most important of his conservative ideas was the retention by Copernicus of the mechanical system based upon uniform circular motion. In this sense his theory was merely a revision of Ptolemy, using a complicated system of spheres and epicycles. ". . . however," Butterfield says, "he could claim that his hypothesis reduced the total number of wheels from eighty to thirty-four."

Not all of the arguments used by Copernicus can be referred to as "modern," and the following comment by Butterfield serves to indicate the dependence of Copernicus upon the past for his scientific argument:

> . . . it is necessary to remember the way in which Copernicus rises to lyricism and almost to worship when he writes about the regal nature and the central position of the sun. . . . He held a view which has been associated with Platonic and Pythagorean speculations to the effect that immobility was a nobler thing than movement, and this affected his attitude to both the sun and the fixed stars. (p. 26)

Butterfield further comments on the position of Copernicus in history as follows:

> In general, it is important not to overlook the fact that the teaching of Copernicus is entangled (in a way that was customary with the older type of science) with concepts of value, teleological explanations and forms of what we should call animism. He closes an old epoch much more clearly than he opens any new one. He is himself one of those individual makers

of world-systems, like Aristotle and Ptolemy, who astonish us by the power which they showed in producing a synthesis so mythical—and so irrelevant to the present day—that we should regard their work almost as a matter for aesthetic judgment alone. Once we have discovered the real character of Copernican thinking, we can hardly help recognising the fact that the genuine revolution was still to come. (p. 32)

The Importance of the History of Thought. The above notes indicate that much remains to be done in the study of the history of thought to straighten us out, not just as to who thought what, but also as to what these thoughts meant.

To take the series on those who opposed Copernicus one step further, the significant point is made by Butterfield that Copernicus was not a great observer. Butterfield says, "This passion came into astronomy later in the century (*i.e.*, after Copernicus), particularly with Tycho Brahe, *who himself refused to become a follower of Copernicus . . .*" (italics added). (*The Origins of Modern Science,* p. 24)

By now one wonders, Who did support Copernicus? In 1920 a little book was published concerning one who did support the heliocentric theory. His name was Aristarchus of Samos. (See *The Copernicus of Antiquity,* Sir Thomas Heath, London 1920.)

Some dates: Aristarchus, *circa* 310–330 B.C.
De Revolutionibus Orbium, Copernicus, published A.D. 1543
Tycho Brahe A.D. 1546–1601

Scipio Chairamonti vs. Copernicus. Although it may be anticlimactic, the following from the *Antioch Review* (Spring, 1964) was just called to my attention by Miss Lyris Hyatt. The original was published shortly after the condemnation of Galileo.

Animals which move have limbs and muscles; the earth has no limbs and muscles, therefore it does not move. It is angels who make Saturn, Jupiter, the sun, etc., turn round. If the earth revolves, it must also have an angel in the centre to set it in motion; but only devils live there; it would therefore be a devil who would impart motion to the earth. . . .

The planets, the sun, the fixed stars, all belong to one species—namely, that of the stars. It seems therefore to be a grievous wrong to place the earth, which is a sink of impurity, amongst these heavenly bodies, which are pure and divine things.

Scipio Chairamonti

E. F. A.