BOTOND GAÁL

OPENING UP A CLOSED WORLD

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Appendix

Nature, Description of Nature and Mathematics
by
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With deep appreciation and gratitude

to my Alma Maters:

the Debrecen University

and

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which belong together

The author of this book established the
István Hatvani Theological Research Center
in 1993.
The aim of this Center is to help all of the professors and students
at the Debrecen University
in examining and better understanding the relationship between
natural sciences and Christian theology
in order to promote progress in all fields of the human culture.
István Hatvani (1718-1786) was an outstanding
physicist, mathematician,
chemist, physician, philosopher and Calvinist theologian
who,
as a professor of the Reformed College of Debrecen,
embodied a European standard in teaching science and theology.

* * * * *

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CONTENT

FOREWORD

A remarkable event occured on November 3, 1823, and has greatly preoccupied me. This is when the Hungarian mathematician, János Bolyai wrote to his father: "Out of nothing I've created a new, different world!" I have asked myself: what exactly does this actually mean? In what manner did János Bolyai create a new and different world? For this was one of the most magnificent moments in the history of sciences.

I have studied mathematics and physics at the Faculty of Natural Sciences of the Debrecen University, and later theology at the Reformed Theological University. As a theologian I've made the observation also, that on many occasions during its history, the Christianity also had to "create new and different tenets" in order to get nearer to its propagated truths. I have experienced this very same concept in physics also, and here it is sufficient to mention the names of Newton, Maxwell, Planck and Einstein. The question of particular interest to me was the extent in which the method and the spirit of scientific advancement may be utilized in theological thinking. Christianity always emphasizes new life, a different and renewed philosophy compared to a former. This similarity has prompted me to investigate in greater depth the thoughts of János Bolyai: in what way did he create out of nothing a new and different world? At this point I discovered that he sought out the specific element of the Euclidean geometry which rendered it closed, and he simply unlocked this closed world. I have found this to be of value and edifying in all such systems of thought, which claim scientific austerity. Including theology, of course!

A good opportunity has been presented by a prestigious international scientific research grant project, entitled Global Perspectives on Science and Spirituality announced by Elon University of North Carolina and the Université Interdisciplinaire de Paris in 2004, for me to expand upon this subject. I have been awarded the grant! It has been of great interest for me to see, if during the development of religious mores or doctrines the same characteristics have been predominant as it was in mathematics? I came across many similarities, parallels and analogies. Part of my program was the publication of the results of my research in a book. This is the book you have in your hands! To the chapter ten Kálmán Kérdő prepared a practical explanation on the perpectives of modern mathematics. I am grateful for this appendix. The entire book is but a brief introduction to a larger topic of scientific theorem. Therefore, I beg the reader to commit to the further contemplation upon what has been written and continue it without restraint and in good conscience.

I would like to express my thankfulness to the Center of Theological Inquiry (Princeton, New Jersey, USA), the research institute which has accommodated me for three months and made possible for me to research and complete this book. The famous Princeton libraries have presented splendid possibilities for this work. — I owe great thanks to my friends Dávid Pándy-Szekeres and Lehel Deák for the translation.

Autumn 2006, Debrecen/Princeton

Botond Gaál

INTRODUCTION

The natural disposition of man has him at odds with any world which is closed. He prefers, instead, to bask in freedom, a state which offers infinite possibilities for activity, reflection and creativity. It is through these that the world accrues in knowledge, in morals, in arts and in its perspectives for progress. To a certain extent, the feeling of "closedness" —as it is intertwined with a pining after freedom— can be found in practically every culture. The tension between closedness and openness eventually rises to the surface, irregardless of into which of these two conditions man has been born. Given this, the question, simply enough, is reduced to arriving at the point in the evolution of social progress where man becomes aware of this tension and then determining the extent to which he will he be able to resolve this tension. It appears that different civilizations[1] have resolved this tension in different ways and at different stages of their development and the resolutions reached have always played an important role in the advances made in our world. The long train of historical experience shows that civilizations tend to pass on their particular values one to another and in this way embrace the spirit of opening that which is closed. In as far as this process of give and take occurs in favourable circumstances, the different peoples and societies are able to more rapidly discern the reasons for their closedness and, as a

[1] The word „civilization" is most often used in a very general way, often as a synonym of the word „culture". The Anglo-Saxon world generally uses it this way. In Europe, in academic usage, culture consists of the deeply-imbedded values of a society; civilization is whatever is visible of culture. International reference material and usage is not consistent and ever-increasingly overlooks this distinction, thus including the culture of historical peoples within the word „civilization"

consequence, the embracing of freedom can open wide the gates towards further progress. This, however, is not the only mode of progress because in numerous instances peoples, nations or societies discover on their own that which is new in such a way that it results in their breaking out of their closed world. In such cases the paradigm of progress is passed from hand to hand as a virtual free gift. There is no exact explanation of how new perspectives come into being in this way and only ulterior affirmation of their existence is what can be offered. Nonetheless, the mechanism of this transformation can be said to be thus because freedom is an inseparable facet of man's very existence. This will be expanded upon later.

The question of closedness and openness, or rather its origin, can often be found in the problematics of the freedom of man as it is imbedded in the culture of religions, especially as it pertains to the recognizable historical past. Religion has always had a role as a conveyor of culture and this is no different in the twenty-first century. This role, as much as its degree of implication, varies from religion to religion. When taken in a strict sense, normally we do not include Christian theology in the category of religions, nor do we include it in the category of philosophies. General consensus, however, does view it as a religion on the grounds that Christianity uses and appears in religious forms. Academic consensus, on the other hand, in pointing to Christian theology's intellectual content, considers it to be a strain of objective, idealist philosophy.[2] There is

[2] This is one of those oft-disputed questions. The differentiation from religions originates in the fact that religions teach of a path leading from the world to a god whereas Christianity teaches the inverse. The classification of Christianity as a philosophy is most obviously understood from a Marxist perspective which places

little to do against this and it is perhaps more advisable to accept it for the time being, but by no means as a permanent categorization. Our objection for the time being is overridden by the fact that, as a consensual „religion", Christianity bears a major role as a conveyor of culture. This role has appeared and continues to appear in markedly varied forms, but most often these have been and continue to be of a perspective-forming nature. In the first few thousand years of known social history it was the religions which played a predominant role in forming the worldviews of the time. Academic reflection as such had not yet come into its own. The first period of significance of this nature, the subsequently appearing Hellenistic school of academic thought, had undeniably strong ties to Christianity's well-defined worldview. Even though this influence lasted for only two thousand years, it can be considered to be significant. The primary purpose of our investigation is to better understand the influence of the „Christian religion's" worldview on the evolution of academic reflection during this so-called „Christian period". We would also like to cast an in-depth glance at how academic reflection and rigour was of benefit to Christian theology. To further rein in the topic and the different academic disciplines, we shall, for the most part, restrict our study to the field of mathematics and its role in this process. We shall observe that in the midst of the evolution of knowledge —extended even to mathematics— man truly did take steps forward, but at one certain point of this evolution he closeted himself without even realizing it. It is at times like this that man's attempts to break out of this closed-in condition become more visible, yet neither the means nor the direction to be taken are known to him. At times he surrenders

Christianity in the class of objective idealism. It does so because belief in creation presupposes the a prior existence of a spiritual being over matter.

to this seemingly hopeless situation but then along come the subsequent generations and help extricate man from this rut. This rut may at times mean a few hundred years, at times less but in certain cases even two thousand years are needed to usher in a new model. Every new paradigm is the outcome of humanity's natural longing for freedom, and this sense of liberty is mankind's innate idiosyncrasy. Meanwhile we must realize that the human spirit in itself is open. The structure of scientific thinking is "open at the top", — always towards a connection of a higher ranking.

The first major change

THE RELIGIOUS SITUATION OF THE ANCIENT WORLD IN THE MIDDLE EAST

For the most part, the documented historical information we have is from the four millenium preceding Christ. From a history of religions perspective this is also the period of which we already possess significant knowledge. Naturally, the differnt ancient civilizations did not all come about at the same time and this explains why the degree of our familiarity with them differs from one to another, some of them having histories which extend well back into time, while others existed for only shorter periods. Perhaps it is the Egyptian culture which has been studied most thoroughly but we also have generous knowledge of the history of the Babylonian and Far Eastern cultures. Included here are the Chinese, Mongolian, Korean and Japanese cultures which were at the same time religious cultures also. It is interesting to note that it was on the western edge of all these famous religious cultures, which formed peoples and empires, that two particularly different religious cultures struck out in a new direction and it is precisely their new worldview which came to form the foundation of today's „Western" civilization. We are referring here to the „model change" undergone by the Jewish and Greek peoples. In other words, the geographical and chronological roots of European culture lead back here. In order to better understand their situation and assess their significance, let us briefly review the intellectual environment of their early history. Of particular importance to us in this respect would be their relationship to the religious culture of peoples immediately neighbouring them to the east and to the south. This

would be best ascertained by comparing the similarities and the differences involved between them and these neighbours.

The significance of the Jewish people: a new religious perspective

Let us first look at the situation of the Jewish people. According to the Scriptures, the migration of Abraham's father and family from Ur-Kasdim in Babylon can most likely be set in the eighteenth century before Christ. The family consists of a shepherding tribe which increasingly accrues in numbers and sets out to seek Canaan, the land noted in a promise of God. In the midst of their trek this tribe spends four hundred years in Egypt. Under Moses' leadership, they leave this land in approximately 1250 B.C. and after forty years of wandering they arrive in Canaan. They conquer Canaan and settle in it according to their separate tribes bearing the names of Jacob's twelve sons. In this „promised land", their new home, they launch into the organization of the state, their new life form. It is extremely important to note that they established and erected their state on the foundations of their religion, thus creating a *theocracy*.[3]

[3] Historians' stances concerning the credibility of Scriptural accounts of the history of Israel differ. The difficulty lies in the fact that the actual writing of the Scriptures occurred centuries or, in many cases, a thousand years subsequent to the actual events themselves. Until committed to writing, the events and their details were retained and passed on as oral history. At times the interpretation of the "imagined" different periods settled in layers in the common memory and these can often be identified in the historical writings. A further difficulty arises when investigating the historical documents of the neighbouring peoples in that no trace can be found of the majority of the Scriptural histories. The Scriptural writings themselves are not exact and in numerous instances furnish unresolvable information which has kept historians guessing. An oft-cited example of this being the given life ages of Scriptural persons (Gen 5). Cf. J. Maxwell Miller – John H. Hayes: History of Ancient Israel and Juda. Studia Orientalia, Pázmány

For two hundred years there are judges before Saul is chosen as king. The veritable monarchy, however, begins in approximately 1000 B.C. with King David and continues with Solomon. This is Israel's golden age. Being a small nation, its fate is naturally tied to the wanderings, battles and politics of conquest of the larger, neighbouring peoples. In 722 B.C. the larger, northern part of their land is occuppied by the Assyrians and in 587 the remaining independent regions near Jerusalam and Juda are overrun by the Babylonian contingents who march a large part of the Jewish population off to a captivity lasting seventy years.[4] After regaining freedom from captivity in Babylon they re-establish order in their land, they rebuild their temple and lead a normal existence for another two hundred years until they are forcibly incorporated into Alexander the Great's Greek empire. This is then followed by their homeland becoming part of the Roman empire. It is in this phase that we arrive to the period of Christ's life, after which —from a religious perspective— the Christian period follows, in fact, becomes dominant. In the passing of these 1700 years the people of Israel had undergone significant change, having been influenced by countless things. Foremost of these appears to have been the religious influence of the neighbouring peoples and also the

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Péter Catholic University, Piliscsaba, 2003. 54-77.; Cf. Komoróczy Géza: Bezárkózás a nemzeti hagyományba *(Locked into national tradition)*. Osiris, Budapest, 1995. 168-179.

[4] The final demise of Judah or the removal of the population to captivity most likely took place in several waves. One group had already been removed in 595. Cf. J. Maxwell Miller – John H. Hayes: History of Ancient Israel and Juda. Studia Orientalia, Pázmány Péter Catholic University, Piliscsaba, 2003. 368-401. This captivity is referred to as the seventy years of captivity in Babylonia because the period of "captivity" is interpreted as extending to the time until the temple in Jerusalem is rebuilt and consecrated.

struggle mounted to ward these off. And it is from this that the true identity of Israel surfaces and also the role which it will have on the stage of world history.

From a religious environment point of view, three significant factors became decisive in Israel's history. Before anything, we shall need to examine the influence on Israel of Babylonia, Egypt and other smaller and larger, immediately neighbouring peoples. Babylonia and Egypt were the predominant cultures of the two great rivers in the region known today as the Near East.

Both cultures had established state organizations by the end of the 4th millenium B.C. It is more from the 3rd millenium B.C. onward that their history is known to us. In Mesopotamia, in the region where the Tigris and Euphrates Rivers flow, it was first the Sumerians, a people of inner-Asian origins, who settled here close to the river mouth in about 3200 B.C. Then the Semitic Akkadians established a state here in about 2500. Seven or eight hundred years later it was the Amorites who took possession of this fertile region, their civilization becoming renown because of Hammurabi's code of laws. Hammurabi was also the one who fashioned Babylon into a formidable capital. From this time onward the region of the two rivers came to be called Babylonia. But the Amorites were soon conquered by the Assyrians and from the ninth century the latter ruled Babylonia. Circa 620 B.C. the Medes, the Persians, the Egyptians and the, by this time, mixed population of Babylonia joined forces to push the Assyrians out of the region and hence the New Babylonian empire came into being under the leadership of Nebuchadnezzar. This is of interest to us because it was these New Babylonians who deported into captivity those Jews who still

remained in the vicinity of Jerusalem. The Persians, in the meantime, grew so powerful during Cyros' reign that they in turn conquered the New Babylonians and as a result the Jews were able to return to their homeland in 538 B.C.[5]

As can be seen from their history, already Abraham's family could have taken on certain Babylonian religious customs and later, in the period of their exile, the Jews had a high incidence of contacts with the Bablylonian religious culture. These two historical facts play an important role in helping us better understand the Old Testament's situation reports. In itself, Babylonian religious life and its practice was highly complicated. The Sun, Moon and the Morning Star were all attributed human characteristics, or personified, and newer and newer gods were added to the pantheon while the origins and functions of the older gods were constantly interpreted and re-interpreted. Marduk, the best known Babylonian god, was also a variety of sun god and only later did he become the principle god. Their religion included explanations for the origins of the world's existence; it had demons, winged cherubs, sacrificial altars, days of celebration linked to astronomical events and most of all, it had priests who were principally instrumental in forming the collective religious conscience and assured its continuity. In most instances these priests formed the educated class of society.[6] It is worth noting here that connected to the Babylonian culture is a presently well-known but later event, which is the mention of the three wise men in the Christ nativity narrative. In all likelihood these wise men

[5] Cf. Tóth Kálmán: Ószövetségi kortörténet *(Old Testament Period History)*. In: Bibliai atlasz, Református Sajtóosztály, Budapest, without year noted. 10-13.
[6] Cf. Clemens, Ronald E.: Old Testament Theology. Marshall, Morgan and Scott, London, 1978. 157-165.

were Babylonian priests specialized in astronomy, for this discipline was already in full bloom there also.[7]

Other significant influences were absorbed by the Jews during their years of servitude in Egypt and during the period of their kingships, at a time when there were even friendly diplomatic relations between the two peoples. One of Solomon's wives was a daughter of an Egyptian pharoah. The history of Egypt is relatively straighforward in comparison to the tumultuous events of Mesopotamia. Egyptians are most likely of African *hamitic* origins who, as a consequence of the wanderings of peoples in ancient times, mixed with other wandering peoples. For nearly four hundred years they inhabited the region referred to by the Jews as Lower-Egypt Goshen. By this time Egyptian religious life had already evolved to developed detail.[8] Their gods were comprised of heavenly bodies and animals which had been provided human attributes. The system of gods which they assembled was so complicated that it is practically impossible for us today to grasp the exact details of this secretive world. The best known Egyptian god of the early period was Ra, who personified the sun itself and then later the principle god of the city of Thebes, the ram-headed Amon, was elevated to glory. From these two then evolved the even more renown god, Amon-Ra. The circumstances of this story are virtually untraceable. Even more complex is the Egyptians' world of mythology, with the story of Isis and Osiris at the forefront.[9] These

[7] Cf. Teres Ágoston: Biblia és asztronómia *(The Bible and Astronomy)*. Springer, Budapest, Róma, Parizs, 1999. 54-79.
[8] Cf. Tóth Kálmán: Ószövetségi kortörténet (*Old Testament Period History. Biblical Map)*. Bibliai atlasz, Református Sajtóosztály, Budapest, year not noted. 10-13.
[9] Vallástörténeti kislexikon *(Little Encyclopedia of the History of Religions)*, Second expanded edition, Kossuth Könyvkiadó, 1973. 97-100.

myths were then woven to infinite lengths, dipped from the wealth of their imagination and tied to earthly historical events. They practised animal sacrifice, they held celebratory parades, they were interested in the life after and there were times when certain pharoahs could also rise to join the world of the gods. An important element here also was the presence of the priests, from among whose ranks sprung the „learned".

The religions of the sometimes smaller peoples living next to Israel also had a certain influence on Israel and it is worth noting these. Religious elements in varied degrees from the indigenous Canaanites, the Phoenicians, the Moabites, the Edomites, the Ammonites, the Philistines, the Aramaeans, the Persians and from even the Assyrians were absorbed into the religion of the chosen people.[10] The influence of even the Greeks is discernable in the Old Testament.[11] Concrete examples give evidence of how or to what extent any one of these had an influence on the religious life of Israel. History of religion practitioners keep track of these influences and regularly examine them, thus enriching with newer and newer results the present compendium. The facts indicate that certain religions had a strong influence on Israel while others had less of an influence. The Canaanite influence, for example, was very significant in forming Israel's interpretation of deity[12]. The

[10] Significant shifts in peoples and populations in the region of Canaan occurred in the last quarter of 2 B.C. Large numbers of smaller peoples, whose detailed listing we shall forego here, flooded into this region. Israel had many struggles with these peoples.

[11] Clemens, Ronald E.: Old Testament Theology. Marshall, Morgan and Scott, London, 1978. 169.

[12] Dearman, J. Andrew: Religion and Culture in Ancient Israel. Hendricson Publisher, Peabody, Massachusetts, 1992. 35-39.

problematics of idol worship and its rejection has its origins from this people also[13], much as did the learning of Phoenician character-writing, on the basis of which Israel developed its own writing.[14] From this it is to be concluded that the Canaanite influence was more significant than that of the less populous Phoenicians or of the mighty Persians. The newest findings of research shed light on religious customs and currents of thought of both the Aramaeans[15], and Syro-Palestine peoples which are similar or near-identical to elements existing in the religion of the Israelites.[16] These findings have initiated serious reflection for the practitioners of this discipline.

Two things are to be noted with respect to Israel's intellectual processes. One concerns the lack of certain elements, namely that none of the contemporary „sciences" found in both the Babylonian and Egyptian cultures were absorbed. Neither astronomy nor mathematics took root in the Jewish world whereas both existed in

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[13] It is from the Canaanites that Israel took the „El" name for god as well as reviling the Canaanite's cultic practices associated with „Baal". This question is to be viewed as a purifying process in the life of Israel.

[14] Cf. Tóth Kálmán: Ószövetségi kortörténet (*Old Testament Period History)*. In: Bibliai atlasz, Református Sajtóosztály, Budapest, year not noted. 17.

[15] The word „Aramaean" appears to have been a collective name for the different peoples which lived in the region between the Mediterranean Sea in the west and the Euphrates in the east. Later these peoples became the Syrians, the Greeks providing them this name: Op.cit.. J. Maxwell Miller – John H. Hayes: Az ókori Izrael és Juda története (*History of Ancient Israel and Judah)*. Studia Orientalia, Pázmány Péter Katolikus Egyetem, Piliscsaba, 2003. 40.

[16] Cf. Takács Előd: „... Az Úr vezette egymaga ..." *Izrael letelepedése és Józsué honfoglalás-tradíciójának teológiai értelmezése. („... The Lord alone led...." Interpretation of the tradition of Israel's settling and Joshua's conquest of the land).* Dissertationes Theologicae 5. Debrecen, 2002. 115-124.

well-developed versions in Babylonia and Egypt. Upon examining the counting techniques used in the mathematics of these two cultures, their problem-solving abilities are found to be of the first order. The Babylonians used the sixty-based numerical system surprisingly well while the Egyptians used the decimal numerical system and both used a certain amount of algebra and geometry. Algebra was used to „resolve equations", naturally not in today's form. Although they wrote down the mode of resolving the problem, how they actually arrived at the solution remains unknown to us.[17] Worthy mathematical examples from Hammurabi's time have remained, these dating from the time of the historical beginnings of the Jewish peoples. It is also to be noted that although both the sixty-based numerical and the decimal systems can be found in the recesses of the Old Testament, the Jews did not as such cultivate mathematics. They only used certain of its elements.[18] Why was this? And why did they not observe the starry heavens with „studious eyes"? Surely because, in the Babylonian and Egyptian cultures, there was a mysticism associated with the use numbers. The granting of human attributes to the Sun, the Moon and to the stars of the heavens and then designating them as

[17] Cf. Sain Márton: Nincs királyi út! Matematikatörténet *(No Royal Road! History of Mathematics)*. Gondolat, Budapest, 1986. 17-34.

[18] An example which could be brought forward is when, in Genesis 5 the Bible mentions the age of the patriarchs of the period preceding the flood, it does so in the base ten number system. Later when it „adds up" the years leading up to the first procreation and the subsequent years, the sum is given correctly, again in the decimal system. Examples of the use of the sixty-based numerical system are fewer and more difficult. More often multiples of 60 are mentioned, for example in the case of Gideon's 300 men (Judges 7:6-7). This number is used more to express the idea that they were numerous, their numbers not exactly known, because there were even 5 times 60 of them. Numbers often had symbolic meanings for the earliest Jews.

deities was somewhat scandalous to the strongly religious Jews. They were not interested in discovering the future in the position of the stars or through the use of some mysticism tied to numbers, but instead, from the promise which God had given: „I shall be with you" (Exodus 3:12).

The second and significantly more important factor coming into play with the Jews was that they brought with them something radically new in the interpretation of their religion. If we have perceived the exceptionally complicated religious environment in which they found themselves and how the religious customs of the different periods settled on them in layers, it is rather amazing that they were able to survive at all. Not only did they survive this but they were able to shift to a diametrically different religious perspective. This meant breaking with the perception of god as it was understood and practised by the surrounding peoples. When the first notions of nationhood begin to appear at the foot of Mount Sinai, when Moses shows the Ten Commandments carved into the stone tablets, it all begins with, „I am the Lord your God.... You shall have no other gods before me" (Exodus 20:2-3). This was not yet pure *monotheism* but it certainly pointed in that direction. In many places in the Old Testament it can be seen that they perceive the presence of *monolatry* within their circles as natural, almost as much as for the peoples neighbouring them.[19] It is as if there is room for other gods at the *side* of the „Lord" but there can no longer be any *before* him.[20] For a period they retain respect for the gods of

[19] Cf. Miller, Patrick D.: The Religion of Ancient Israel. SPCK, London, Westminster John Knox Press, Louisville, Kentucky, 2000. 28-29.
[20] Cf. Clemens, Ronald E.: Old Testament Theology. Marshall, Morgan and Scott, London, 1978. 165.

other peoples but, after a time, even this ceases. There is but one God, Yahweh. In the book of Isaiah, it is in the following way that the people are informed by the prophet: „I am the first and I am the last, apart from me there is no God" (Isaiah 44:6). Israel thus has an evolving concept of god which did not refer to the changes which God might undergo or be subjected to but manifested itself in an ever-increasing perception of the result of faith. This is the most significant step in the intellectual life force of Israel. Today we would refer to this as a model change or paradigm shift. As later the Christians did also, the Jews interpreted this to be a revelation of God, and they clearly understood that they could not belong to a world where gods are created and changed, their histories invented and their actions endlessly complicated because in this way man himself would be tied in intellectual and spiritual knots. In contrast to all other religions, they belong to the One God, who does not dwell in churches erected by men, whom „even the highest heaven cannot contain, much less a temple" (1 Kings 8:27) —as we read in Solomon's famous prayer.[21] Here we can already sense the „theological" interpretation of God's transcendence. No longer, thus, is there a Sun god, a Moon god, no longer can stars be attributed godly powers and no longer can animals or objects be granted human attributes or personified as they were in the religious cultures of the Babylonians, the Egyptians and other neighbouring peoples. In this way Israel „de-mythologizes" every

[21] It is not known in which period either the text from the book of Isaiah or the one from the book of Kings, this latter being Solomon's reflective interpretations of God, took on this form. It is certain, nonetheless, that these were recorded after the exile, but the content of these formulations dates from a much earlier period.

religious thought and idea and bravely declares that the entire visible and sensory world is God's creation. The Biblical story of creation makes the same statement. More precisely, it means confessing a faith which says that this world has a creator who is none other than whom they call Lord. Everything falls into place in Israel's faith-based perspective. In the world painted by the religious practices of the neighbouring peoples man can freely adjust the activities of the gods, he can increase them in number, he can expand their interpretation and he can even worship them but Israel cannot do this. The imagined world of the neighbouring peoples' religions, its customs and their practice, can truly confine man to an ideological system from which there is no escape. In this system man can, at most, endlessly weave his strands of imagination together to form his world of gods or else he can project his own world into the mythological distances. The God of Israel, however, is not dependent on man, and man can grasp of God what God's declares and reveals of himself while intervening in the history of his people. This is a veritable paradigm in the grey sea of religions and it came into being nowhere else but in the intellectual slipstreams of Israel. The explanation is thus given as to why Israel did not embrace contemporary knowledge and practice of astronomy and mathematics: these were so steeped in religious customs and interpretations and they were so profoundly attached to religious practice that in having embraced them, it would have caused great confusion in Israel's concept of a true and respected God and in the faith expressed in Him. From this arises the question, perhaps a bit simplistically: was Israel's religion thus not a religion which promulgated culture? To a certain degree yes, to a certain degree no. *Yes,* in as much that it made use of knowledge accummulated from ancient times right to the contemporary

period; it was familiar with the cultures of different peoples; it developed its own culture of the written word and it guarded its traditions and recorded them in writing. *No,* in as much that it did not develop further the profane disciplines of its time, for two reasons. *On the one hand,* throughout several periods of its history Israel lived in servitude and a people who lives in servitude can hardly have had intellectual problems. To cite a concrete example, it can be said that the concept of numbers could not have developed in their midst as a tool of quantitative comparison because for them it was only expedient for qualitative comparisons of amounts and measurement..[22] This question is related to the evolution of the Hebrew alphabet which came to them from the Phoenicians by way of the Canaanites. According to evidence from the Sinai inscriptions dating from the 1500s B.C., the Hebrews quickly adopted alphabetic writing,[23] and in this they were in advance of both the Egyptians and the Babylonians, who were still using some type of archaic writing.[24] In the case of writing numbers and manipulating with them, it would have been necessary to translate everything into the characters of the new type of writing. This „translation" of a necessarily technical nature never occurred and only those mathematical ideas which proved useful in practice

[22] Cf. Boman, Thorleif: A héber és a görög gondolkodásmód egybevetése. *(Hebrew thought compared with Greek)* Kálvin János Kiadó, Budapest, 1998. 141-145.

[23] Cf. Tóth Kálmán: Ószövetségi kortörténet (*Old Testament Period History)*. In: Bibliai atlasz, Református Sajtóosztály, Budapest, year not noted. 17. – In this sentence we refer the fact that before the exile of the Jews we actually could call them as Hebrews. For the sake of simplicity we generally used the word Jews.

[24] Cf. Biblikus teológiai szótár *(Biblical dictionary of theology)*. Második kiadás. Róma, 1976. 602.

entered into daily usage.[25] *On the other hand,* centuries of Israel's history was spent in seeking its homeland and bearing the weight and worries of the establishment of its state. There were hardly any periods of calm in its history, yet when there were, as in David and Solomon's time, the development of intellectual life force was marked. The literature of the psalms and of proverbs was established, the security of the homeland was set in place, the workings of diplomacy were organized and Israel's religious life was given shape. It was this latter which soon took on exceptional importance for Israel because it was in this way that the call to mission lasting for eternity could be ensured. The clinging to Yahweh, the One God, and the certainty of the fulfillment of God's promise was what placed the religion of this small people on a firm foundation and made it unique, in fact, it can be said that it elevated it high above the religions of other nations. Israel's faith pointed to an assured future which was not foretold from time to time by astrologists on the basis of the position of the stars. Nor was it on the basis of a mysticism in numbers that they deduced the evolution of history, but from Yahweh's previous promises and deeds. All of this was diametrically opposed to the role of contemporary astronomy and mathematics, and as such, as factors abetting confusion, Israel did not embrace these.[26] It is this which, when

[25] They used the decimal and sixty-based numerical system, they used units of measure and proportion in their construction but they did not address theoretical questions such as the ones we find in the algebra of the Egyptians or in Mesopotamia.

[26] Zoltán Kustár observes that mathematics, that is the use of arithmetic, had a more important role in the organization of the larger empires, when the determination and calculating of taxes, the size of the army, the distances and the yields of the crops required the use of larger figures or the use of operations *(in reference to a private conversation).*

revisited from the proper historical perspective, is to be greatly valued.

Before us is a longtime dispute in the history of religion which revolves about some practioners claiming to see a continuity between the religions of Israel's neighbouring peoples and Israel's religion while other practitioners of the discipline emphasize the discontinuity of this. We have not taken sides in this dispute because we see evidence for both stances. Israel's situation in the midst of these people's is decidedly different. Israel is a people entirely like any other people but at the same time it is still different. As the „chosen people" it alone retains God's promise and secret that „through your offspring all nations on earth will be blessed" (Genesis 22:18). This in essence is the new model we had previously mentioned. Although in this period Israel did adopt and use many ideas, rites, customs and practices, it did so only once it had defined its new meaning with respect to Yahweh's revelation. In other words, Israel introduced something decidedly different, it followed entirely different teachings and in this new order everything had its own role and meaning, everything acquired its relative meaning in the whole. This is why it is not advisable to interpret historical evolution on the basis of expressions of continuity and discontinuity. Both approaches are valid independently of each other but also together in a complimentary sense.

The significance of the early Greeks: new perspectives in the field of sciences

Aristotle once pointedly suggested that „theologians" had paved the way for Greek philosophy.[27] The theolgians he was referring to were the individuals who were knowledgeable in the teachings concerning the gods. With this he also inferred that it is not advisable to study Greek academic and scientific thought without including the religious world of the Greeks. Given that this is so, then we must pause to identify the essence and original ideological world of this religiously intellectual life force.

We shall now examine Greek history during the approximately one thousand year period before Christ. Their gods are already in place, endowed with the countless characteristics of nature. These mythical figures living on Mount Olympus were constituted of both earthly and heavenly things. They are of superior rank to man but they behave in a manner identical to man. Nothing stands above them except a type of fate. The mixed Olympian world of these gods is a near-identical projection of life as it is on this earth. These gods possess knowledge but it is not exclusively theirs as men can also acquire these godly values. The true purpose of man in this system is to achieve this perfection. How can this be done? This was the big question. For a long time the sole way for the Greeks to gain contentment and happiness was by reflecting on the myths. In their essence the Greeks thus became one with nature; in some form they lived within nature upon which they reflected in light of their relationship with the gods. The Greeks sought to understand how the gods lived and from this understanding they tried to make deductions about life on earth and about the movements and workings of nature.

[27] Metaphysica XI. 6

We can better understand the situation of the Greeks if we compare it to that of peoples who were their contemporaries but never came into contact with them. Such were the peoples and religions of India and China. In the case of the Indian peoples, especially in the early period of Hinduism, the human soul is in search of some type of Absolute which —or who— is part of the universal spirit. This existence rooted in physical sensation is but a burden for the soul and as such the soul is in a constant search of a means to escape this physical existence. Buddha (563-483 B.C.) also reinforced this aspiration when he introduced his teaching of deliverance from „life-thirst". In the end it is possible for man to attain nirvana, the highest level of liberation. At its height, Buddhism also was strong clerically. But within a few hundred years, Hinduism returned to displace it in a slightly more developed and refined form. Buddhism then took root in China in the first century A.D. and soon had a large number of followers. From here it spread further to Japan and Korea, and even to other parts of Asia. The human intellect in this system is relegated to a secondary role; the most man can hope for in this realm is to order his past experiences. The Indian thinker keeps in touch with the world by actual experience, he observes everything while turned inwards to himself and tries to approach everything through intuitive observation, and in this manner aspires to reach some absolute existence. He will admit that it cannot be fully attained and for this reason the wandering soul has no choice but to return to earth and to begin life anew. It appears that with this ideology man has cloistered himself within an immeasurably complex religion of his own making.[28] The reflection typical in the Chinese religion is not of such an observational character but more

[28] Cf. Kecskés Pál: A bölcselet története *(A History of Wisdom)*, Szent István Társulat, Budapest, 1981. 43-55.

of a practical nature. The underlying and principle notion here is that there is a life in this world and there is a life in the world beyond, and these two form one large whole. Whoever discovers and understands this unity will recognize being on the desirable road. The emerging clergy and the ruling emperor in his role as head priest furthermore deemed this to be morally correct comportment. Confucius' (551-479 B.C.) teachings within his moral code system also included a strong clinging to the gods of the ancients and a call for very strict obedience to parents and to persons in superior positions. This influence can even be felt today but this type of spirituality, in truth, does not rightly belong to the category of religions. Chuang-ci, for instance, who lived at the turn of the 4th and 3rd centuries, came to espouse pantheism,[29] while Tung Chung (179-104) traced a path through Taoism to fatalism.[30] As there was practically no way out of this, already by the first century A.D. an ever-increasing number of Chinese began to lean towards Buddhism. A good thousand years later, out of this line of thinking, evolved the determinist school, an exponent of this being Chu-Hsi (1130-1200).[31]

Two things are to be noted here. In order to understand these examples of intellectual theorizing and religious ideologies we try to engage our modern-day knowledge. Naturally, this will not yield for us perfect clarity in this. It is also to be understood that we have received an education embedded in the „rational" thought patterns

[29] Cf. Kecskés Pál: A bölcselet története *(A History of Wisdom)*, Szent István Társulat, Budapest, 1981. 60.
[30] Cf. Kecskés Pál: A bölcselet története *(A History of Wisdom)*, Szent István Társulat, Budapest, 1981. 60.
[31] Cf. Kecskés Pál: A bölcselet története *(A History of Wisdom)*, Szent István Társulat, Budapest, 1981. 62-63.

of European thinking and this thinking evaluates things differently from the thinking of those born and educated in Indian or Chinese cultures. Having recognized this, we can infer that each of these two world religions perceived the natural world in which man moved. In their interpretation man was one with nature, he immersed himself in it, he identified with it and he counted it a spiritual experience to be interconnected with it via his physical senses. The basic purpose of this imbibing of spiritual pleasure was to become better acquainted with nature. At the same time, this was also its limitation. These cultures of religion locked themselves into the reality which surrounded them. It is also known that these cultures were not always content and undertook efforts to break out of this and introduce new ideas. Unfortunately, these proved to be nothing more than the rekindling of the old ideas by new techniques. In this way the various unsuccessful movements within these societies did little to advance their intellectuo-religious life. What resulted instead was the resigned acceptance of its unchangeability.[32]

Although there is no evidence of either the Indians or the Chinese having had influence on the intellectual evolution of the Greeks, in a certain way, in terms of its tendency, in a period common to their histories, the religious ideology of the Greeks also evolved in a similar way. Their mythology kept expanding and increasing, so much so, that having ultimately become hopelessly tangled it became so dysfunctional that the Greeks began to drift towards a

[32] Already in the centuries before Christ there was a peasant uprising which was put down. Cf. Kecskés Pál: A bölcselet története, Szent István Társulat, Budapest, 1981. 60.

closed world.[33] It was at this stage of the intellectual scene that a change of direction occurred, a change which became a factor in the forming of history. In about the 6th century B.C., a few Greek thinkers stepped out of this closed world and, placing themselves above it all, they began to examine the universe from an objective distance. It was thus no longer necessary for them to study their true situation with the help of myths. This resulted in the laying to rest their dependence on the acquisition of knowledge through their physical senses and brought to the foreground the idea of recognition through intellectual means, now seeking the meaning of life, its essence and its reality. While the thinkers of the East would ask the question, *„what is this world like?"*, the Greeks would ask the question, *„what is this world?*."[34] The latter had discovered the intellect. They had come to the conclusion that knowledge acquired through physical means is not sufficient to understand the world and there is need for the mind and the intellect to particpate in the process. Soon they got to the point where the idea of gaining knowledge through physical experience became secondary and the use of the intellect came to the forefront. The world, as the Greeks' new thinkers avowed, is not what we feel it to be through physical senses but what the intellect interprets it to be. To approach the natural world in this light required clear concepts and deductive thinking on behalf of the intellect. It was this which distinguished them from the thinkers of the East. While those born into the Chinese or Indian cultures became virtual captives of the reality

[33] There are over thirty-five thousand names or individuals which occur in Greek mythology. The most familiar of them already number two or three thousand. Specialized knowledge is needed to navigate among them.

[34] Halasy-Nagy József: Az antik filozófia *(Antique Philosophy)*. Danubia kiadás, Budapest, 1934. 47.

which surrounded them, the Greeks were able to divorce themselves from this and were able to observe it from the „outside" while posing questions as to its essence. They had thus opened a closed world. The thinkers of the major cultures of the East saw the fulfillment of the individual to be found in a life state of contemplation and in this way guard hope for peace, repose, inactivity and some kind of eternal equilibrium. The philosophy-historian Béla Tankó expressed this as a spiritual harmony which is „a veritable escape from reality whose indescribably well-extended dialectics is the denial of reality and its degradation to illusion, all elevated to artistic form. There is nothing surprising in observing how the artistic descriptive power of such as that of the Tagore is able to fuel longings after such a unique world, a world in which struggles are no more and peace reigns everywhere. Yet even this amount of artistry cannot conceal from our sight that, beneath the peaceful surface, the shredding of reality into illusion continues unabatedly,...."[35] The philosophy-historian József Halasy-Nagy adds to this that „India's spirit has not been liberated, it has not yet reached the degree of self-confidence whereby it has dared to let the universe stand before the tribunal of the intellect. Only the Greeks were capable of this, whose demand for rational proof laid the foundation for European academic knowledge and for an independent philosophy.[36]

It is worth mentioning an interesting and unusual manifestation in terms of the religious situation of the Greeks. In some of the

[35] Halasy-Nagy József: Az antik filozófia *(Antique Philosophy)*. Danubia kiadás, Budapest, 1934. 44.
[36] Halasy-Nagy József: Az antik filozófia *(Antique Philosophy)*. Danubia kiadás, Budapest, 1934. 44.

different religious cultures already reviewed we noted how the clergy played an important role in expounding, protecting and developing the given religion, philosophy or intellectuality of its society, irregardless what those might be. In practical terms this meant that the clergy was the keeper of the given ideology. The clergy had an exclusive monopoly on all knowledge touching upon religion and culture and in this way the average man in the street received the answers to all of life's big questions in ready-to-use form. The Jewish people did not have such institutionalized clergy in the early years. From the time of the patriarchs onwards the head of the family had authorization to present offerings. Nonetheless, when Moses formed Israel into a nation with the help of the Ten Commandments and also assigned the responsibility for clerical tasks to Aaron and his sons, he established the instititutionalized clergy. Morover, the law had to be innoculated into the people's thinking. If they at any time strayed from this, the prophets immediately warned them and urged a return to the right road. If we are to take either the Chinese, Indians or Jews, we can note a clergy which, in the case of the Greeks, never existed. This meant that the individual was much freer to reflect upon things than his counterpart in any of the societies of the Near and Far East or of the Jews. While the clergy in these latter religious cultures was present as a weighty factor, in the case of the Greeks, it could be said —in terms of a slightly forced parallel— that is was the philosophers who had become the intellectual and spiritual beacons of the people. They had much the similar role in the conscience of the people and also in the forming of the common morality.

After this it is not difficult to note that it is precisely among these philosophers, these Greek thinkers, that can be found those who

pursued mathematics in this same spirit. Well-developed number writing and arithmetic had already evolved by the time of Thales (624-543). In the practice of their commerce, they had the opportunity to become acquainted with Babylonian and Egyptian mathematics and took many tenets from these. Although they were familiar with the sixty-based numerical system of the Babylonians, they much preferred using and thinking in the decimal system they had learned from the Egyptianas. They thus transcribed everything to their own system, using letters to express the numbers and digits. This meant extra „translation" work for them. They adopted much of the Egyptians' geometry and they worked on them and developed them further, wanting to understand everything. They would assign geometrical meaning to the numbers and were thus able to resolve many problems of an algebraic nature. It was in the second century B.C. that —thinking in the base ten system but writing numbers in letters— they introduced the zero, the „nothing", in order to perfect place or digit value calculation learned from the base sixty system and now applied in their base ten system. With this they came very close to the modern invention of place value number writing, yet it ended up being the Hindus who introduced this concept.[37] In returning to the

[37] The introduction of doing calculations in presently known base ten number system was a lengthy process for us also. We can witness, first of all, the simplification of number writing in the Arab and Indian cultures. In the first five centuries A.D. numbers were still written with letter characters but the presently used numerical characters were slowly taking shape. By the beginning of the 6th century the Hindus were already well-versed in using place value arithmetic which had originated in Mesopotamia. Most probably they adopted the zero from the Chinese or Greeks and they quickly developed the base ten place value number writing method. This quickly spread in the Mediterranean world through the intermediary of the Arabs. The Greeks introduced the zero with the

past, in Greece after Thales' time, the period known as the Pythagorean (569-470) period followed, with its uniquely powerful mysticism of numbers dressed in strongly religious overtones. In the midst and as a result of this unusual and playful use of numbers, there are a few worthy thoughts in theoretical mathematics to be found, much like pearls among the pebbles. Pythagoras had many followers and for a long time many of them worked on the interesting behaviour of numbers and with the results obtained from the basic operations.[38] From the case of these Pythagoreans it can be seen that the unique religious life of the Greeks has a very strong culture-carrier character. With whatever peoples of their time they came into contact with, they borrowed from them their knowledge of astronomy and mathematics and they developed

ouden=nothing word's first letter, *omikron* (o) and it is coincidentally interesting that the Chinese also decided to use the circle for this. For this reason, it is not known from which people the Hindus took their zero. It would be all the more interesting if they were to have taken it from neither but they had also coincidentally and independently decided on a circle. The first written and documented Indian digital-charactered and 10 place valued known number is 346 which can be found in a Hindu origin letter of donation. Cf. Sain Márton: Nincs királyi út! Matematikatörténet *(No Royal Road! History of Mathematics)*. Gondolat, Budapest, 1986. 355-359.

[38] The Pythagoreans had an endless number of ideas related to numbers. Let us take one example. They grouped the numbers in categories of even and odd. Because the odd numbers are not evenly divisible by two and thus impose limits on division, they are thus limited in nature and became for them the symbols of the finite. The even numbers are without limits and thus symbolized the infinite. Since things are numbers, these are composed of even and odd numbers. Because they are opposites, it is harmony which keeps them together. For example, the number 6 is perfect because it is the first even-odd number, 2x3, that is, the union of finite and infinite, thus giving perfect harmony. Cf. Adorjáni Zoltán: A therapeuták kontemplatív kegyessége *(The piety of therapeutic contemplation)*. Doctoral thesis, 2004. DRHE. 73., 78-79.

these further in creative ways. It is due to its exposure to the Greek reasoning process that mathematics has become a deductive academic discipline.[39] We thus arrive at approximately 300 B.C. by which time mathematics is in full bloom and Euclides has synthesized all of this in his work entitled *Elements.* This is one of the largest accomplishments of Greek academic thought. The Greek striving for pure concepts and the fact that they dared use their intellect to understand reality brought with it the advent of a new age in the history of academic thought. It is with the help of mathematics that we shall seek orientation within this new age.

[39] Szabó Árpád: Hogyan lett a matematika deduktív tudománnyá? *(How did mathematics become a deductive field of knowledge?)* II. Matematikai Lapok, Bolyai János Matematikai Társulat, Budapest, 1957. 3-4. szám. 247.

The second major change

THE GREEK *MORE GEOMETRICO* PERIOD

Encountering the Christian view of nature

It was the profane disciplines which first noticed that Christianity represented a new perspective. This perspective was not only new but different and thus felt to be a threat by the contemporary Greek „academic" establishment. Greek philosophers always sought to unearth the meaning of everything. They wanted to know how nature worked and to this end they made use of the power of logic and every imaginable creative ability they possessed. In harnessing rationality they had succeeded in vanquishing everything which was secretive. The appearance of Christianity, however, once again filled the world with secrets and the first problem with it was that these secrets were readily available to everyone, everyone could acquire access to them. It was no longer only the privileged, that is, the philosophers who had access. The new perspective was felt most profoundly in the domain of everyday life, in the domain of human relations, and it imparted courage for the future. Man once again became a shaper of history. The Greeks had thought that they had uncovered every existing law of the universe and that they had attained *Logos*, the universal relationship which interconnected, held together and explained everything. From this it followed that man's task was to accept this and integrate himself into this functioning world. This was then the virtue. Yet with this man had closed himself into a self-created world from which, at most, only a few thinkers, that is, philosophers could find the way out, and that only on the strength of their high-flying thoughts. In contrast to this, Christianity conceived of the human fate in a decidedly different way. The world was created by God, He has a

purpose with it and it is precisely this which was demonstrated by the incarnation of Christ, as was avowed by its proponents. The meaning of human life is so that man may be born again in the image of Christ and in this way lead an active live on earth. History thus has meaning because the world is progressing towards a better and more just future. Within this progression man has been given the principle role in which he is to shape the fate of the universe, not according to his own imagination but according to the holy instructions from God. The world is thus moving forward, there is no turning round and round in one spot. This in itself is already a dynamically new perception of history in contrast to the ancient, static-model interpretation, in which man is but a passive observer. It can furthermore be noted that in the early Christian teachings there is not as much emphasis on the definition of concepts as there was in the norms of Greek thinking. Christianity –especially at its outset– was, before anything else, a form of living and not the complicated expression of theoretical truths, to which were veritably indispensable the well-defined and clear concepts of Greek thinking. Christianity brought a new perspective not only to the practice of everyday living but also in its perception of nature. This aspect became more apparent when Christianity was also forced to formulate its teachings and frame them within tenets. The new perception of nature is totally different from that taught by the Greeks. The world, for the Greeks, did not have a beginning nor was it created by the gods but had existed from time eternal. The world did not need to be changed but understood. The Greeks thus saw the reality of the world through the truths created by the mind. They were so convinced of this that they often robed their theories in god-like attributes to better present them. The Christians and the Jews, on the other hand, both avowed that God had created the

world out of nothing and everything is under his power. In interpreting and expressing this concept in other words, we could say that space, time, matter and intellect are all part of God's creation. Human intellect is also part of the created whole and it was given to assist man recognize, understand, „subdue and rule" over the world, that is, to create culture, establish knowledge and to develop civilization all for the good of man. This was, of course, only to be done with the ethical condition that he „cultivate and guard it" (Genesis 2:15). From a Christian standpoint, the laws and larger correlations which the Greeks had carefully thought out were hardly of a godly character but a part of the created world. The laws of the universe are not of an absolute nature which suggest a feeling of fatality; they have, instead, a character peculiar to time and history within which man has the possibility of directing his own fate. With this perception Christianity stripped the Greek ideology of its godly character and relegated them to the ranks of the created world's constitutive elements. This immediately posed a problem for those of the ancient times who had been steeped in the teachings of philosophy. The struggle was thus launched without any particular delay. Christians had to man the struggle on two fronts, first with the gnostics in the second century and then with the neo-Platonists in the third century. Coming out of this, the result was not only that it had been able to claim victory but also that it had been obligated to articulate and formulate its own teachings. In achieving this it could not have done without the array of concepts nor the mode of thinking developed by the Greek system. Christian theology is thus an independent intellectual creation having come into being with the help of Greek academic knowledge. Its cultic practices incorporate, as an inheritance, a great number of elements from the ancient religions. Yet, not only

does it differ from every other religion in its concepts but also in its academic-based intellectualism. It can thank the Greeks for this latter characteristic. The question to pose then becomes: how did Christian thinking evolve as a comprehensive system of teachings? How did it build up its system? In what ways did it express its teachings? We shall be examining the influence of Christianity and mathematics on each other in the context of how Christianity, as a new system of teachings, provided a way out of a closed world. It is exactly its newness which may prove interesting for us.

If we would wish to discover how Christianity in general was able to establish its own novel spirituality, or how it was able to influence public morale, we would be able to answer that it could only do this slowly. Although the practice of living in a Christian way spread quickly, its teachings were much slower to become general knowledge. It is thus all the more surprising that the first few hundred years provided unusually many privileges for Christian theology. The most recent results of the research of the last few years in the question dealing with the encounters between Christian theology and contemporary knowledge show that this debate involved only a small number of theologians and philosophers but that the practice of worship, especially by means of its liturgy, eventually extended the Christian teachings to an ever-increasing number of levels of society. From these levels an ever-increasing number of people entered the debate, and as the number of theologians increased, beginning especially from the advent of the fourth century, a lengthy clarifying process ensued both within the church and society. Step by step, that is, progressing from one

synod meeting to the next, the church fathers[40] left a legacy of very important work completed. All of them were highly trained in philosophical questions, in fact, a good many of them were philosophers who had become theologians. Not only for this, but in general, Christian theology has much to be thankful for to Greek academic knowledge despite the fact that the two diverged greatly on the spirituality which they followed or that they had developed different modes of thinking. Christianity had taken the route to a more open mode which served it well in its further development. In this era they produced the teachings regarding creation, the Holy Trinity, incarnation and the dual nature of Christ, and many other tenets of Christian theology have been contemplated in great detail. Testimony of this is the Nicene Creed of the year 381, as well as the doctrinal decisions of the major synods.

At this point we need to raise a most vital question: equipped with its own openness and assisted in finding the correct path by Greek intellectual might, was Christian theology in this way able to find the ultimately correct way in a permanent manner? Hardly. But we could raise other questions also. What path did Christianity take after divesting itself of the practices of the Jewish religion? This is of interest mostly from a theoretical perspective. Therefore, in this case, we shall examine the type of closed world which Christianity opened. We have yet to divulge this.[41] Before that, however, it is worth examining the eternal values which Hellenistic thinking

[40] The church fathers and the church's authors were very knowledgeable theologians who played a very important role in the life of their given societies, especially from the second century A.D. onwards. Their situation and authority was similar to the role of the great philosophers of the Hellenistic period.

[41] An entire chapter will be consecrated to this. Details are to be found in the following chapter.

spawned in its use of mathematics and how this affected Christian theology. The question which needs to be clarified is: what did Christianity not like about Greek academic thinking? Was it not open enough? Or, asked inversely: was it too closed? How closed was it? If Hellenistic thinking and knowledge proved to be closed, what in it was of everlasting value? What caused it to be closed? Could it have been corrected or improved? If yes, then what should have been changed? It is to these questions that we shall seek answers and not in a general sense but in only one typical field, with the help of mathematics. For there are enigmatic things somewhere in the deep in this question which are worth bringing to the surface, even though it will not be easy.

The Greeks were prepared to learn from every earlier civilization and whatever was worthwhile they adopted and creatively developed further. Such were mathematics and astronomy. To the Jewish mind these disciplines were not of any interest, or rather the Jews thought it preferable to not mix these with their own religious world. The Greeks, in contrast, welcomed both mathematics and astronomy, which as disciplines were closely related. It is not to be thought that the Greeks did not have any mathematics of their own and simply adopted someone else's. Without a doubt they took much mathematical knowledge from the Egyptians and Babylonians but they already had something to which to add the worthy acquisition. It seems certain that the Greeks adopted writing only later, taking it indirectly from the Phoenicians.[42] On

[42] There is no evidence that the Greeks of the antique period used place values when counting in spite of the fact that in some form they used the base 10 system. At that time they still used the letters of the alphabet to indicate numbers. The Jews used the same logic. Counting with letters, however, was

the basis of available historical artifacts it cannot be determined how evolved Greek calculations were or how they dealt with numbers. Despite the assumption that the Greeks absorbed some Babylonian and Egyptian mathematics, everyone was, nonetheless, surprised to see how quickly independent Greek mathematics broke to the forefront, in step with the period and with a spirit of coherence. This causes us to surmise that some mathematics of their own must have already existed.[43] The Greek fascination for proofs simply pops up out of the unknown. Surely this is not a simple coincidence. Later we shall see that irregardless of what they ingest, with their spirit and intellect they work it over thoroughly, squeeze out of it whatever is worthwhile, fit it into a larger correlation and in this way find its place and meaning in the bigger picture.

The first trace of recognizable counting and calculating done by the Greeks dates from about 1000 B.C. Traces and diagrams suggesting the practice of counting have also been found from the earlier Cretian and Mycenaean period but few conclusions can be drawn from these. This culture of the ancient Greeks disappeared in its entirety and everything had to be started anew. The early Greeks already used letters to indicate numbers and they distinguished these from written words by drawing a line above the former.[44] This

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extremely ponderous. We can only guess at how they carried out a multiplication because no evidence of this has been found. Cf. Sain Márton: Nincs királyi út! Matematikatörténet *(No Royal Road! History of Mathematics)*. Gondolat, Budapest, 1986. 70-71.

[43] Cf. Sain Márton: Nincs királyi út! Matematikatörténet *(No Royal Road! History of Mathematics)*. Gondolat, Budapest, 1986. 69.

[44] At first the early Greeks used the first letter of the numbers' names as their character. From the 5th century onwards they introduced an alphabetical system

so-called alphabetical writing of numbers was practised by the Jews and other peoples also but in all cases the common trait was the difficulties arising from this. All things said and done, if we wish to identify the beginning of mathematics, everyone points to Thales (624-543) despite the fact that he operated in the period of alphabetical numbers. Pythagoras (569-470) came in the following century, treading like a juggler in the world of numbers while raising many questions on the side in the field of geomety. These men were mathematicians who already worked out proofs and organized their knowledge into a precisely defined system. Perhaps even more praiseworthy in this respect were Euclid (365?-300?), Archimedes (287?-212) and Apollonius (260?-190?) who represented the peak of Greek mathematics. At this stage the Pythagoreans had no qualms with the numbers as first they defined „one", and then they defined the rest of the numbers as units which appear in sets. This meant that the numbers were also divisible. They also worked with proportions. Nonetheless, when they assigned a number to the side of a rectangle and wanted to express the value of the diagonal, they ran into difficulty. Proportions would not yield the solution for them either. They eventually concluded that the side of the rectangle and its diagonal could not be related to one another by measure, it could not be expressed in the fractional form of two whole numbers. If, for instance, the side of the rectangle is one unit in length, then the length of the diagonal is „inexpressible", „indescribable", that is „arrheton" in Greek. Here the Greek thinker

of characters. They took the letters of the alphabet in order and from 1 to 9 these were used to represent the natural numbers. From 10 on they could only represent the tens and hundreds with letters. Thousands were represented by a separate stroke or comma which they placed before the letter. Cf. Sain Márton: Nincs királyi út! Matematikatörténet *(No Royal Road! History of Mathematics).* Gondolat, Budapest, 1986. 70.

faltered but he also imagined that, as a geometrical problem, it could be solved readily enough, simply because it could be construed in space. The „undescribable" number thus has an equivalent in space. From hereon the study of space, geometry, began to come to the forefront. From hereon they tried to solve every algebraic problem by geometric means and this technique persisted right up to the time of Descartes. We could call this a type of „geometric calculation" because they could do nothing more that „geometrize" the numbers. But geometry cannot be done without the appropriate preciseness. According to the strict regulations of the Elea school, the first thing to do was to define the form, right to the point, to the straight line and to the plane. Following this, they set up the postulates and the axioms, and beginning from these they set about proving, by deduction, a great number of assertions. This mode of operation was widely used and, as a result, a large part of geometry was established. Even today it is this geometry which is taught in practically all the schools in the world, at most using a different approach.

In Alexandria in approximately 300 B.C., Euclid gathered together all the pratical knowledge of geometry as used and established by the Greek thinkers.[45] This is the renown Stoikheia, that is, Elements. It is renown because, among other things, even today everyone is familiar with it despite the fact that the original work was lost. Its content was imprinted on the memories of his disciples

[45] The title of Euclid's work in Greek is *Stoikheia.* Even today it is one of the most renown works in the world. In Hungarian it appeared with the title *Elemek (Elements)* in 1865 in a translation by Samu Brassai. In 1905 a translation rendered by Alajos Baumgarten was published (only the first six books). A translation of the entire work by Gyula Mayer was published in 1983.

and passed on from generation to generation through several centuries until more than six hundred years later an Alexandrian, Theon (?-?), began to concern himself with it in approximately 370 A.D. Later, Proklos (410-485) of Xanthos put in writing the contents of a first book and added a commentary to it. Theon surely must have made a very good copy. It is very probable that others also recorded certain parts of the Elements.

After the fifth century these important copies again slipped out of sight. They were, in fact, parts of the Elements which were kept in memory before finally being put in writing. All we know after this, is that, somewhere in the East, Arab thinkers somehow got hold of these fragments, convinced their leaders to translate them into Arabic and then arrived in Europe by way of the Iberian peninsula. This Arabic translation was then translated into Latin. In the renaissance period copies of the Greek script based on Theon's copy were found.[46] As such there was no longer any reason to prevent the translation into Latin of a relatively complete work as garnered from the different salvaged script remnants in the different Arabic, Latin and Greek translations. After the Latin translation was published, it then was published in different national languages, first in German and French, but later into practically all the modern languages.[47]

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[46] Cf. Euclides: Elemek *(Elements)*. Gondolat, 1983. Ford.: Mayer Gyula. 506-510. In his *Translator's Notes*, Gyula Mayer points to the Alexandrian Theon's important role and presents an excellent overview of the fragment writings from a professional viewpoint.

[47] Cf. Euclides: Az elemek első hat könyve *(The first six volumes of the Elements)*. Translated by Alajos Baumgartner. Franklin Társulat, Budapest, 1905. 16-20., and Cf. Euclides: Elemek *(Elements)*. Gondolat, 1983. Ford.: Mayer Gyula. 506-510. Gyula Mayer recounts that one piece of the Boethius-type partial translation was

Elements is an exceptional work. Only parts of the original survived the very difficult circumstances encountered during the centuries and it was from these parts from which the book was assembled. The contents of this book is what is considered to most likely be Euclid' original work. Everyone clearly understands its academic significance so that questions concerning its origins, authenticity and ensuing life history have now become secondary. The work consists of fifteen volumes of which the first thirteen are considered to of Euclid' creation.[48] Our primary interest is the first volume, the one which contains the foundational basics of geometry as a discipline. With this we have now accordingly narrowed our topic and from hereon we shall direct our attention only to the theoretical significance of this topic. Within the volume we encounter, first of all, twenty-three definitions, then five postulates and nine axioms, followed by proofs of twenty-three theorems of which the second last one is the renown Pythagorean theory. It was necessary to formulate the definitions, or rather place them at the beginning, because the dialectical method of the Elea school required this. The debate was only considered to prove productive if it were to be irreproachable in every respect. It is thus at the outset that all the basic and constitutive elements of the topic at hand are clarified. Although today it is thought that Euclid's definitions lead to an over-preciseness, we shall accept Euclid' method and his good

in the possession of the Dominican order in Buda in the 15th century. János Apáczai Csere worked on translating it into Hungarian but only fragments were published in his Encyclopedia.

[48] The 14th and 15th volumes were somehow added in the general chaos of the translations, most likely by Johannes Campanus in roughly mid-13th century. Cf. Euclides: Az elemek első hat könyve *(The first six volumes of the Elements)*. Translated by Alajos Baumgartner. Franklin Társulat, Budapest, 1905. 16.

intentions and not comment on the difficulties it may produce. Mixing axioms with postulates is a puzzling thing to do nowadays. The basic theorem of parallelism is said to be the 11th axiom or 5th postulate and this is basically correct. What probably happened here was that, at some point in time, the last two assertions of the original five postulates, including the parallelism postulate also, were moved to the nine axioms because they were thought to fit there better.[49] We have so far mentioned eleven axioms. The 5th postulate became the 11th axiom. Recognizing the two different labels and having understood the reasons for this, we shall use, for the sake of clarity, the 11th axiom label when referring to this concept.

A postulate to Euclid' mind was something which was an *a priori* or prerequisite principle in the given debate. An axiom was a basic precept which was accepted on the basis of the perception at hand, whose validity was never in question and which could be invoked in the proof of every further assertion. Euclid' nine axioms share the common characteristic that they are all, in some way or other, commensurable.[50] Viewed in this light, transferring the 4th and 5th

[49] Theon was most probably among the first who noticed these problems and in a creative way modified the already familiar system of postulates and axioms. Proklos did the same in the following century and he transferred the 4th and 5th postulates to the axiom category. Cf. Euclides: Az elemek első hat könyve *(The first six volumes of the Elements)*. Translated by Alajos Baumgartner. Franklin Társulat, Budapest, 1905. 12., 10.

[50] Others had also noticed this but became uncertain. Cf. Euclides: Az elemek első hat könyve *(The first six volumes of the Elements)*. Translated by Alajos Baumgartner. Franklin Társulat, Budapest, 1905. 12., 10. It needs to be noted here that axiom 9, which says that „two straight lines do not enclose an area", points to something which can be measured. That is, according to the Greek thinking of this period, the world was finite and could thus not continue without end. Thus

postulates to the axioms category was a valid move. The thesis found in the first volume of *Stoikheia* elegantly demonstrate how geometry and its system can be built up, beginning from the simplest assertions to highly complicated theorems. The number of these theorems greatly increased as time passed and geometry as a discipline took on greater girth. This itself did not cause any difficulties as long as staying within the limits defined by the axioms provided solutions to all the problems which were encountered. But soon geometric problems came up for which Euclid' axioms were not readily applicable, such were the area enclosed by curved lines and the question of conical surfaces. The Greeks, however, did not realize this. They were convinced that the thought-process system which they had built up in the theoretical world of geometry worked wonderfully. They acquired newer and newer insights and they were so taken by these that they considered their theories to be the epitome of perfection. They were of the belief that no better thought-process system than theirs existed, nor could one ever be created. Seeing that this geometry proved to be valid for centuries, the Greeks concluded that this had to be the only worthwhile model of thought-process to emulate. Everything was thus to be built up according to the model used for geometry, that is, every discipline of knowledge was to be developed by the method of *more geometrico*.[51] The axiomatic geometry of the Greeks, by itself,

when the axiom mentions area, in fact it envisions a finite section of plane which in the case of two straight lines is obviously not possible. Axiom 9 is thus in its rightful place and as an assertion possesses a character of quantity or measurement.

[51] The exact origin of the expression *more geometrico* is unknown. It appears to be from long ago but its exact entry into usage is not known. Several authors mention it in connection with Spinoza as the basic notions or the definitions or even the proven tenets are concerned in his ethics.

uncovered and recorded an important field of knowledge and in such a way that its validity was independent of cultures. It also shed light on a model for the developing of knowledge which appeared to be the sole mode of operation for a period extending over two thousand years. This was the most significant achievement of Greek academic thought.

Once we become acquainted with the basis of doing geometry by Euclid' method, we shall better understand why it was in the intellectual milieu of the Greeks that European academic thought evolved to such heights.[52] Let us first look at a few examples taken from the twenty-three definitions:

1. A point is that which has no parts.
2. A line is a length without any width.
3. The end of a line consists of points.
4. A straight line is that which lies equally relative to the points upon it
5. A surface is that which has only a length and a width
6. ....
7. A plane is that which lies equally relative to the straight lines upon it
8. ....
23. Parellel are those straight lines which are in the same plane; even if the two sides of this plane are lengthened to infinity, the straight lines will never meet on either plane

Postulates

[52] Euclides: Elemek *(Elements)*. Gondolat, 1983. Ford.: Mayer Gyula. 45-47.

Let it be required

1. that from every point to every other point a straight line be able to be drawn
2. And that a finite straight line be able to be extended as a continuation of the same straight line
3. And that with every centre point and distance a circle be able to be drawn
4. And that all right angles be equal to one another
5. And that if two straight lines are intersected by a straight line so that the sum of the resulting inner angles on the one side is less than the sum of two right angles, then the two straight lines, when extended to infinity, meet on the side where the angles be less than the sum of two right angles

Axioms

1. Those which are equal to the same value, are equal to each other.
2. If we add equivalencies to equivalencies, the sums are equivalencies.
3. If we deduct equivalencies from equivalencies, the results are equivalencies.
4. If we add inequivalencies to equivalencies, the sums are inequivalencies.
5. Things which are double of the same thing are equal to one another.
6. The half parts of any value are equal
7. Magnitudes which coincide with one another, that is, which exactly fill the same space, are equal to one another.
8. The whole is greater than the part

9. Two straight lines do not enclose an area.

Later we shall see, particularly in the case of János Bolyai, how much these Euclidian thoughts determined academic thought in Europe. These thoughts were the basis of what served as a model for more than two thousand years. They appear very simple, in fact, redundant or trivial, even primitive. Yet it was these „primitive" conventions which provided work for European thinkers for two thousand years. Surely Márton Sain, Hungarian historian of mathematics, reflected on this when he penned these uplifting thoughts: „The Greek spirit —and not only its mathematics— had a strong influence on me because I sense in it an openness in two directions: it opens gates to the past and it builds the road of the future. It has no qualms taking up its heritage from its predecessors which it greatly esteems but it is already seeking new possibilities. It builds the future by respecting traditions. It innovates but not at all cost. It is ready to learn but not only by passively absorbing but by establishing, transforming and developing further. It learns, instructs and creates all at once. It „does" science and the arts not like a journeyman but by putting its heart, soul and faith into its act of creating. In the fever, joy and pain of its creating it perhaps does not even notice that it has breathed life into its creation, a life which influences, encourages, procreates, that is, a life which is eternal."[53]

We has already said that the Greeks adopted a model different from other cultures of the period 2-4 thousand years B.C., different from even their own religious kulture. They dared apply their intellect and by striving for clear concepts they proved all which the intellect

[53] Sain Márton: Nincs királyi út! Matematikatörténet *(No Royal Road! History of Mathematics)*. Gondolat, Budapest, 1986. 292.

had proposed. In the 6th and 7th century B.C. this model was markedly new; furthermore, it was a creation which was no longer dependent on the cultural setting nor was it tied to any period in time. It was true then as it is today and as it will be in the future also. Yet there remains a question: to what degree is its truth valid? Or: to which circles is it applicable? The Greeks believed that all knowledge was accessible in this way. We now know differently. Curiosity, however, urges us on and we raise the question whether all new systems resulting from the opening up of a closed system always carry within themselves the potential of eventually closing?

The third major change

JEWISH MONOTHEISM AND THE CHRISTIAN TRINITARIAN PERSPECTIVE

The monotheism of the Jewish people was markedly new relative to the religions of the neighbouring peoples. This is best understood when viewed as a type of paradigma change. We have already seen how the religions of the world, all of them neighbouring on Israel, had gods who were created by man's fantasy. In having the facility to infinitely expand the pantheon of such gods, man enclosed himself in an inextricable and impossible-to-fathom world. It was monotheism which liberated Israel from the closed system. Its evolution to its final form occurred in degrees. In fact, Israel's faith could be perceived as one which underwent growth and thus evolved.[54] As a first step, the Jewish people de-mythologized nature. Then they identifed Jahve, the self-revealing, revelatory and liberating God as the Creating God. Since creation occurred in the very beginning, and everything which came to be came from God, it followed that the whole of creation was under his authority. This God is already a living and personal God who not only summmons the members of his chosen people but is, at the same time, the giver of life and the lord of history (Psalms 36:5-9). He also acts in their daily lives. This type of uncluttered monotheism became discernable in Israel in the period after the return from exile, before that there being various monolatric elements mixed into the whole. No doubt the many miraculous events which they witnessed or experienced under Moses' leadership induced them to steer attention to the God who directed fate and history. If we take the ten plagues, the opening of the sea, the quail, manna, the water

[54] Cf. M. Eugene Osterhaven: The Faith of the Church. Eerdmans, Grand Rapids, MI., 1982. 22.

and the pillar of fire we recognized these to be good examples of God's acts of providence. At this point in time there is no hint of the religions Jews expecting obvious signs from God. They only seemed to realize after the fact that God had led them in a miraculous way and they laud this event in an epical narrative, projecting the vision of their faith into the past.[55] Because man has direct contact with this living God, and this contact is expressed most visibly and effectively through prayer –either on the lips of kings or in the lap of the people– a grand poetry of psalms is slowly born and becomes the prayer-book of the Bible. To live life wisely, wisdom is needed and thus a body of literature espousing this wisdom is born, its best examples being the books of Job, Ecclesiastes, Proverbs and the book entitled as the Wisdom of Solomon. And the Song of Songs provides hope concerning the future for youth who say yes to life.

All of this had to be taught. It can be noticed that teaching bore particular significance in Israel's thinking. Passing traditions from the older to the younger generation was an unbending requirement, much as we read in the book of Deuteronomy (4:10): „...and teach them to their children". This teaching consisted of much more than the memorization of various sacred writings, namely, the passing on of faith. Whatever the father taught his son it was always something which he strongly believed. Not only did he believe what he taught but passed it on accompanied with an intelligent explanation. The essence of the story of how God liberated his people is not only retaining the details of the event but also in the listener being able to live the sacred tradition in his daily existence.

[55] J. Maxwell Miller – John H. Hayes: Az ókori Izrael és Juda története *(History of Ancient Israel and Judah)*. Studia Orientalia, Pázmány Péter Katolikus Egyetem, Piliscsaba, 2003. 76-77.

The basis of all teaching was the Torah which is found in the first five books of the Bible, these being known as the Pentateuch. It is here that are found all the teachings and regulations of ethics and faith which had to be followed rigourously. The Torah itself is the result of an evolutionary process, but even more so were the Misna and Talmud which were built onto the Torah and which were put into writing after the 2nd century.[56] Going beyond even this, it can be noted that the son also learned a method from his father whereby he himself would know in his time how to pass on the interpreted and understood tradition. The family retained a central role in the educative process. The result for Israel was a system of education which was unmatched in that part of the world. The Torah was the basis of all education and, as the first book to be canonized, other books written in its spirit were added to it and the beginnings of the canon slowly began to take shape. The primacy of the Torah, however, gave birth to a new caste, that being the interpreters of the law, and soon this caste acquired more significance than that of the priests who were left with little more responsibility than carrying out their tasks pertaining to cultic practice.[57] The role of the Levites had thus greatly paled.

Were we to return to the point in time when Christians first appeared and tried to take a snapshot of the spiritual countenance of the Jewish people, two characteristic streaks of the coloured picture would catch our attention. The one would be the deeply

[56] The history of the origins and recording of the entirety of Jewish tradition is very complicated. We shall thus forego entering into the details here.
[57] Bright, John: Izrael története *(The History of Israel).* MORE Zsinati Iroda, Budapest, 1977. 425.

ingrained –and well-developed in its method– resolve to teach, it being with which they pass on from generation to generation their religious culture of thousands of years. Foremost among that which is passed on is writing, history, wisdom and prayer. By all measure, this is Israel's grand achievement and, by all evidence, also its fountain of strength during close to two thousand years of their scattered existence. The other thing which we might notice is the realist religious thinking of the Jewish people. They are increasingly of the view that an act of God is that which God himself deems legitimate, or, in other words, that which God in some way also corroborates by means of a „sign". This, however, by its very nature, contradicts the principal of God's sovereignty. This is further reflected well in the „let him come down from the cross and then we shall believe him" (Mark 15:32) type of logic. Most probably all of this arises from the overextended, detailed parsing of the law, which was characteristic of Jews of that time. It was this type of perception and intellectual exercise which gave birth to the extensive extra-canonical Jewish religious literature of which both the Misna and Talmud are already cited examples. If one, for example, were to study the bulky volumes of the Talmud, one might well come to the conclusion that it is near impossible to grasp the entire content of the Talmud, simply because of its sheer wealth and size. This has both a positive and negative aspect. The positive aspect is that it teaches the young to appropriate a broad perspective and a wise and sober-minded life, and this has proved, to the present, to provide the Jewish people the necessary life sustenance. This can be observed in Judaism as a strand which continues throughout Israel's history. The negative aspect of this, however, appears when the intellect is increasingly invoked and an exaggerated importance is attributed to „signs" given by God as

indisputable proof, for this leads to the situation where the summoning word of God herewith loses its significance. As a consequence, human directives move to the forefront and the covenant becomes secondary to the law, something which falls far afield of the living faith invested in the God of Abraham, Isaac and Jacob. The more this line was pursued, the paler became the eschatalogical character of Israel's faith, something which had always been its prinicipal aspect. In the eyes of the outsider it may appear that, in taking this step, Jewish religious thinking had closed itself into its own inner world.

Christianity continued to guard the Jewish monotheistic heritage and, in emphasizing the teaching of a single God, it began to shift its interpretation in the direction of the trinitarian concept. Christianity did not follow the teaching practices of Judaism and although it did adopt Judaism's intent or aspect of instruction, it was less successful than the Jews had been in realizing this. The trinitarian interpretation of god, however, meant a more open world. Christianity laid claim to theology as its own field of knowledge and in within this, it expended great amounts of energy on the clear interpretation of its teachings. Among these one of the most significant was the teaching concerning the trinity. *Unus est Deus in essentia, trinus in personis* was how the church fathers formulated this teaching. *God,* therefore, *in His essence is one and in His person He is three.* The church fathers clearly understood that the concept of the trinity could not be perfectly expressed by means of human language. After much deliberation it was this formulation which they judged to be the most acceptable in this matter. Their most difficult moments in this process were caused by trying to express what the Scriptures stated: within Christ „dwellt all of God's

fullness" (Colossians 1:19 and 2:9). The first Christian theologians resolved this question rather well and provided the best possible supporting explanations. Of particular worth is the formulation of the confession of faith linked to Athanasius which places emphasis on the concept of *aequalitas. „The Father is one and not three; the Son is one and not three; the Holy Spirit is one and not three. And within this trinity there is no primacy, there is no secondariness, there is nothing which is greater nor which is less."* Later the so-called *trinitarian perichoresis* mode of interpretation, which builds on the thesis that the persons of the trinity can all shift from one to another and all have an influence on one another, became widespread. And as we shall later see, it was the mathematical concept of infinity which makes the tenet of trinity more palatable but this will only happen two thousand years later. In the meantime, we can marvel at Hegel's observation which lauds the trinitarian interpretation of God: „In the Christian religion ... God is revealed as spirit. The spirit, first of all, is father, power, abstract and general, that which is still shrouded; secondly, it is object for itself, likeness of itself, divisible in itself, the son. This likeness of itself, however, is likewise directly He Himself; he recognizes Himself within this likeness and observes Himself within it –and it is this knowledge of self and observation of self which is thirdly the spirit, the whole spirit, neither one nor the other by itself. .... It is on the strength of this Trinity that the Christian religion stands above the other religions. Were it not to include this concept, it is possible that the intellect would be better served in other religions."[58] Hegel perceived the concept of the trinity as a new model in theology which retained Jewish monotheism and, in taking into account the

[58] Hegel: Előadások a világtörténet filozófiájáról *(Lectures in the philosophies of world history)*. Akadémiai Kiadó, Budapest, 1966. 39-40.

incarnation of Christ, was able to expound at a higher level the essence of God. The Christian faith was able to regain its eschatological character open to infinity, which is interpreted by means of the parousia of the investment of the entire godhead in Christ. This gave new purpose and a program to man both in the intellectual and everyday realms of life.

The fourth major change

PTOLEMY CLOSES, COPERNICUS OPENS

Claudius Ptolemy (100-170) gathered all the ancient world's knowledge of cosmology in his work entitled Almagest.[59] The advanced mathematical skills and knowledge he already possessed helped him establish the existence of a geocentric world. He observed that everything revolved around the earth, for, in good Greek style, this is what he was supposed to believe. He presented his argument very well. For more than a thousand years no one ever questioned this. Inherent in this was the interdependence of astronomy and mathematics. His descriptions of the different phenomena were of the first order, everything agreed with „visible" experience. No doubt this is why the the astronomers, astrologers and calendar-makers accepted this at face value. To explain the movement of the sun and moon he imagined a circular orbit path; for the five known planets he introduced so-called epicycles. Imaginatively said, our astronomer postulated further circular movement on a so-called earth-circling orbit. Wherever this postulate did not work well, he introduced the so-called equant, that being, that a planet does in fact move in a circular orbit but the centre of this orbit's circle falls slightly beyond the earth. That the heavenly bodies follow some type of physical law while moving in

[59] It was not Ptolemy who gave this title to his work. This is originally a Greek word which underwent Arabization, its history being rather complicated. Cf.. Sain Márton: Nincs királyi út! Matematikatörténet *(No Royal Road! History of Mathematics*. Gondolat, Budapest, 1986. 263.

their orbit was something that never occurred to him.[60] Ptolemy believed, as for many, many centuries did those who came after him, that this model accurately described reality. And man of the ancient times as well as man of the middle ages was satisfied with this. It was not until much later that Nicolaus Copernicus (1473-1543) brought change with his heliocentric concept. His famous work, *De Revolutionibus Orbium Coelestium (On the Revolutions of the Heavenly Spheres)* appeared in 1543. Copernicus did not do much other than —with basically the same mathematical logic but used a bit differently— propose that it was the sun and not the earth which was the centre of the world. He eliminated the bothersome equants as they did not fit the Platonic idea of perfect orbital motion. With this the explanation was simplified somewhat but he also had to introduce double epicycles in order to obtain an explanation which was compatible with the „visible" evidence.[61] Ptolemy had recorded a result compatible with the „visible" evidence and Copernicus had also made efforts to retain this compatability. So what is the Copernican turning-point in this? The change is what Copernicus himself believed, that behind a certain „'visible' reality there is a more real reality, which does not negate experience but in fact reinforces it. A simple empirical description is not certain to represent true reality. A certain intelligence is also required. ..."[62] If we have described something mathematically, it is

[60] Cf. Simonyi Károly: A fizika kultúrtörténete a kezdetektől 1990-ig *(The cultural history of physics from the beginnings to 1990)*. Akadémiai Kiadó, Negyedik Kiadás, Budapest, 1998. 97-99.

[61] Cf. Simonyi Károly: A fizika kultúrtörténete a kezdetektől 1990-ig *(The cultural history of physics from the beginnings to 1990)*. Akadémiai Kiadó, Negyedik Kiadás, Budapest, 1998. 180-181.

[62] Gaál Botond: Az ész igazsága és a világ valósága. Az egzakt tudományok történelmi fejlődése keresztyén nézőpontból. *(The truth of reason and the reality*

not certain that we have attained the ultimate truth. For close to fourteen centuries no one even dared to criticize Ptolemy's system because it was compatable enough with experience and it was supported by mathematical descriptions. The equants certainly went a long way to ensure the longevity of his model. Copernicus' gaze, however, got caught up on the mathematics of it. The equants were so much part of the Ptolemaic system that they made it impossible to step out of the system. It was exactly this which Copernicus put aside and this resulted in him gaining a new insight to truth. There is no evidence yet of a vision of openness by a mathematically principled perception but like the method used in the description, this certainly begins to point towards an openness.

of the world. The historical development of the exact sciences from a Christian viewpoint). Hatvani István Teológiai Kutatóközpont, DRHE, Debrecen, 2003. 90-91.

ILLUSTRATIONS →

The next three pages are from the original book of Nicolaus Copernicus entitled *De revolutionibus orbium coelestium* published in Nürnberg in 1543. Illustration Nr. I is the title page of the book, illustration Nr. II contains a part of the explanation of the epicycles, illustration Nr. III describes Copernicus' concept of the heliocentric world.

This original copy of Copernicus' book was bought by the Hungarian János Zsámboky in 1560. Above the year 1560 in the title page the three words, which have been crossed out, are certainly the name of János Zsámboky in Latin: *Joannes Sambucus Pannonius* (*Joan.[nis] Sambucj Pannonij)*. The hand-

writing above it comes from the next owners, who were the Jesuits in Nagyszombat. Completing the abbreviations in the Latin text it reads: *Coll[egii] Soc[ietatis] Jesu Catalogo inscriptus Tyrnaviae 1667 30 Martij*. Below a handwritten note by Professor István Hatvani can be seen: It already belongs to the Reformed College of Debrecen; *Iam Collegii Helv[eticae] Conf[essioni] addictorum Debrecinensis.* This famous book by Copernicus was probably bought by Professor Miklós Sinai between 1749-1786. Its catalog number is O1218tt in the Great Library of the Debrecen Reformed College in Hungary.

The fifth major change

EUROPE ESTABLISHES A NEW MATHEMATICS

The mathematical historian Márton Sain noted that the baroque period, from 1600 to 1750, coincided with an unusual evolution in mathematics. It is of this period which he says, „Europe establishes a new mathematics".[63] Dynamic development began on four major fronts. These were: projective geometry, analytical geometry, mathematical analysis and the theory of numbers.[64] Projective geometry, which is also called synthetic geometry, is the study of the general description of geometrical forms originating from transformations and whose specialty is Euclidean geometry. In certain cases it dips into Bolyai-Lobacsevszky geometry. Analytical geometry denotes the points of a plane or a space with numbers and then establishes algebraic correlations between these points.[65] An example to cite here is the equation of a circle or of an ellipse. Synthetic and analytical geometry function together in harmony. The theory of numbers is a partial discipline dealing with the behaviour of numbers resulting from the application of some rule. From ancient times to the present this field has constantly offered imaginative and challenging problems. Our interest in the question

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[63] Cf. Sain Márton: Nincs királyi út! Matematikatörténet *(No Royal Road!, History of Mathematics)*. Gondolat, Budapest, 1986. 527.

[64] Cf. Sain Márton: Nincs királyi út! Matematikatörténet *(No Royal Road!, History of Mathematics)*. Gondolat, Budapest, 1986. 537.

[65] It was perhaps Descartes who took the most initiative in this field. It is worth noting to his credit that the difficulties arising from the application of geometrical methods to algebra, which we have already mentioned, were eliminated by Descartes. Cf. Ladislav Kvasz: The Mathematisation of Nature and Cartesian Physics. Philosophia naturalis. Vittorio Klostermann, Frankfurt am Main, Band 40, Heft 2, 2003. 157-182.

of the closed or open world directs us towards the examination of the development of mathematical analysis. This is where the role of infinity steps into the picture, followed by the introduction of infinitesimal quantities and limits and the operations which they can be subjected to, the „discovery" of functions"[66], the question of continuity and the discovery of differential and integral calculation. Another new field evolved within mathematics itself which helped clarify certain phenomena which up until then, even for physics, proved problematic. It meant that from hereon it was possible to precisely describe the state of motion changes of different bodies, the acceleration and the deceleration. But this is the juncture where the paths diverge in two directions and so with this in mind we must choose the mode of negotiation.

The one path moved mathematics in the direction of function analysis. Differential and integral calculation was worked out to the very last detail and this led to differential equations, differential geometry and to a thousand and one consequences of continuity theory. The establishment of differential and integral calculation is generally associated with the names of Newton and Leibniz. It would be unfair to not mention the fact that mathematicians preceding these two had already done a great deal of work in this field but the crown of course was awarded to these two intellectual giants. Yet the crown was not as polished as we might think and there were more than enough tasks in this field to work on for the mathematicians who followed them. Among these was Leonhard

[66] The concept of function in roughly today's sense was first used by Johann and Daniel Bernoulli. Johann Bernoulli chose to designate it by using the Greek ϕ letter followed by an „x". Euler took this over from him but he used only the *f* letter to designate a function.

Euler (1707-1783) who was perhaps the most productive mathematician of all time. It is all the more necessary to mention his name because he played a significant role in explaining Newtonian physics to Europe with the help of mathematics. This happened in mid 18th century. Newton discovered differential and integral calculation but did not use it when formulating his laws of physics. Leibniz was not much at home in mechanics and concentrated more on precisely working out the rules of form for using the new modes of calculation. Euler was the one who seized on how it was possible to blend dynamics with kinetics with the use of differential and integral calculation. Given this added send-off, Newtonian mechanics proceeded on its given path.

There remained another problematic question in this period, it being the fact that Newton had designed his famous Principles[67] entirely on the basis of the *more geometrico* model. In his work, he had endeavoured to define with precison, first, all the concepts and then the axioms and theorems, all followed by notes and explanations. The section dealing with the laws of motion is entitled *Axiomata sive leges motus*. Here are found the renown three axioms. Just before this are the famous so-called *absolute space* and *absolute time* definitions. He was not considered about what philosophy with its own authority would say. He was not interested in appealing to any of the schools of philosophy. In his mind, motion was a relative state. How a body moves is a question of relativity. If we look at it from one point it is in motion, but if we compare the state of motion of the static body to the body in motion, then it is the former which is in motion. Where then is the first cause of motion? Nowhere. Something, however, was needed

[67] Philosophiae Naturalis Principia Mathematica. London, 1687.

relative to which the state of motion or of rest could be established. Here enters absolute space which he formulated in a way whereby it was identical to the omnipresence of God.[68] Absolute time he linked to the eternity of God. Thus came into existence a motionless space and an entirely indenpendent and an evenly passing time. The system functioned well. Everyone marvelled how Newton had grasped something of God's thoughts and they looked upon him worshipfully. For two hundred years this set the mode of general thought. Adding support to this was Kant's recognition of absolute space and time as being of the *a priori* category. The consequence of this is that one can never get to know the world in its essence. More precisely, it means that there exist areas which are not accessible. The Newtonian thoughts were later incarnated in deism and, unfortunately, Christian theology was far too late in recognizing its detrimental effects. By the second half of the 19th century strong criticism of it had surfaced.[69] The problem in the matter was that Newton had not used mathematics where he should have and instead he formulated the laws of nature in the old way. Having established correctly that which he had, there should have been no real need for the old-style prinicple of *more geometrico*. It all functioned well because he had ultimately correctly identified and formulated the basic truths of motion. He obviously did not know at the time that his deductions were only valid for a small set of spaces and the space fragments which we wish to examine belong to this set.

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[68] The *omnipresentia* expression is equally well-known both in philosophy and in theology.

[69] If we look at Herman Bavinck's theology, the famous Dutch theologian, we can see him extending a great effort to expurge deism from Christian thinking. Cf. Herman Bavinck: Reformed Dogmatics. Vol. 2: God and Craetion. Baker Academic, Grand Rapids, MI., 2004.

In truth, Kepler was the first who realized that the motion of the planets on their orbits around the sun could be expressed by mathematical correlations. Three renown laws of his give evidence of this. We could also say that he was the first thinker who believed that there existed a reality behind his mathematics. Galileo took this reality and confessed it by means of experiments. Through his measurements he discovered the existence of rule-like behaviour and then he himself formulated written laws using the support of mathematics. Such was the squared path-time law describing freefall. Kepler and Galileo, it can be said, thoroughly laid the groundwork for modern physics. Newton, of course, created it. Despite having done so by both the traditional path and method, Newton truly did open the closed Aristotlean world. He realized that there was no need for the initial motionless mover. The force causes its effect either at the mover or through direct contact, or perhaps it is a question of only „a distance effect" which means that there is nothing other than distance between the two bodeis. This they called *action-at-a-distance.* He saw that if the initial mover remained within the theory it would not be possible to step out of the system. This is what the first axiom is about, describing constant linear motion or the state of the motionless body. Newton, however, did not fully grasp the possibilities hidden in the mathematics which he also had discovered and thus his theory remained a potential exponent of closedness.

It is worth proceeding along these lines and noting that by the second half of the 18th century an every increasing number of people were working with electrical and magnetic phenomena. At this time it was mostly through experiment that they guessed at the

secrets, meaning and essence of the incredible phenomena. By the first half of the 19th century even more people were conducting such experiments, among these was the Englishman Michael Faraday (1791-1867). He was not a trained mathematician but he was extremely adept experimental physicist. He discovered the existence of electromagnetic force but he did not know what to do with it. German physicists and mathematicians like Wilhelm E. Weber (1804-1891), Carl G. Neumann (1832-1925), G. F. Bernhard Riemann (1826-1866) and the aging Gauss set about seeking the interpretation of these phenomena and building on traditional priniciples of newtonian mechanics they constructed the new theory of electromagnetism. This was accepted in Europe by all except the Scotsman James Clerk Maxwell (1831-1879). Having an excellenet knowledge of mathematics he quickly realized that the Germans' theory had been constructed according to mechanical models on the basis of the so-called *action-at-a-distance* principles. There was no mention of fields of force yet, for neither Newton nor the best German thinkers had thought of it. Maxwell realized that Faraday, in his own way, had correctly described the phenomenon of electromagnetism and to this he contributed his mathematical perception. He thus was able to describe electromagnetic fields using partial differential equations. The four renown Maxwell equations came about in this way, bringing with them a new perception. Maxwell was an extremely devout person who perceived God's love as some perfect force, compared to which our human love is but a partial expression. He arrived to the conclusion that to arrive at a correct and fitting perception it is necessary to begin from the whole to approach the partial. In Maxwell's view the German solution was reached by using the partial as the starting point to approach the whole and the exceptional to approach the

general. This is why he found the German solution unacceptable. And he was proved to be correct, and even Einstein —going totally against the Newtonian perception— used the Maxwell equations in describing the nature of the phenomenon in exact form.

What was in fact the difficulty? Nothing more than that the *more geometrico* principle was present in some form in the Germans' theory. Already in Newton's work there was difficulty with this, which took form in his concept of *action-at-a-distance.* Gravitation for him at this point was not yet a spatial force. Two bodies attract each other when there is nothing between them except distance. Even the Germans respected this concept and prolonged its relevance. Maxwell, however, seeing that this is what prevented him from stepping out of the system, pushed it aside, and in its place „created" spatial force. With this he opened a closed world and created a new one. About this Einstein said that, before Maxwell's work, reality could only be perceived or imagined with the help of some material point. After Maxwell a new reality appeared, the reality of a constant spatial force.[70]

To resume what had veritably happened, the following can be said: Newton and Leibniz discovered and worked out differential and integral calculation, and then, in the hands of Euler and Maxwell, with the help of differential and integral calculation, academic

[70] „Before Maxwell people thought of physical reality — in so far as it represented events in nature — as material points, whose changes consist only in motions which are subject to total differential equations. After Maxwell they thought of physical reality as represented by continuous fields, not mechanically explicable, which are subject to partial differential equations." In: *James Clerk Maxwell — A Dynamical Theory of the Electromagnetic Field*. Edited by T. F. Torrance, Scottish Academic Press, Edinburgh, 1982. 31.)

thinking began to take on the purpose of always unveiling newer and newer realities of the natural world. Mathematics thus contributed to helping thinkers recognize the closedness of any given thought or theory and to open up the same to gain access to a newer bit of knowledge. The perception-forming role of mathematics at these crucial junctures is readily obvious.

The sixth major change

„OUT OF NOTHING I HAVE CREATED A NEW AND DIFFERENT WORLD"

This sentence, which János Bolyai formulated in a letter which he wrote to his father on 3 November 1823, signifies the closing of a period of two thousand one hundred years duration. It is thus a long history. Before anything, we must return to Euclid. The 5th postulate or 11th axiom proved to be a decidedly stubborn problem. We had seen that, already in the 4th and 5th centuries, knowing where to place this axiom had provoked serious reflection for Theon and Proklos. It truly has the character of a theorem, which in itself seemed suspicious to many. Perhaps it is not even an axiom?! The mathematician András Prékopa notes that, according to Proklos, Ptolemy also delved into this question in the 2nd century, then the 9th century Arab thinker, Al-Nirizi, wrote commentaries for the entirety of Euclid' first book, and then „Naszir Eddin (1201-1279) provided the following whimsical reformulation of the 5th postulate: 'if every point of a curve is of equal distance from a given straight line, then that curve itself is a straight line.'"[71] Ultimately, it was János Bolyai and Nikolai Lobachevsky who succeeded in resolving the issue. The event is termed by many as the Copernican turning-point of mathematics.[72] But what had happened before this?

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[71] Prékopa András: Bolyai János forradalma *(János Bolyai's Revolution)*. Természet világa. 2003. I. Special edition. 10.

[72] Cf. Prékopa András: Bolyai János forradalma *(János Bolyai's Revolution)*. Természet világa. 2003. I. Special edition. 3.

Let us then recall the 11th axiom: Let it be required … that if two straight lines are intersected by a straight line so that the sum of the resulting inner angles on the one side is less than the sum of two right angles, then the two straight lines, when extended to infinity, meet on the side where the angles be less than the sum of two right angles

This truly is a simple assertion but it is not a simple formulation. One gets the feeling that this is an argument requiring a proof. Many mathematicians for many years pondered on this. To recapitulate all this, it can be said that the examination of this axiom was undertaken by two different methods. One part of the mathematicians hoped to prove that this axiom was the logical consequence of the other axioms and postulates. Other thinkers approached the question by trying to prove the axiom's necessity, that is, whether omitting it would lead to contradictions of logic or not. All this proved to be an onerous task. The 11th axiom „would not permit" itself to be omitted from among the other axioms. It is to the credit of Greek intellectual achievement that neither group succeeded in its purpose. During the many attempts to prove this axiom by one means or the other, it was often reformulated to yield an equivalent assertion and it was these reformulations which were examined instead of the original. Of more than a dozen reformulations, we shall mention, as examples, the three most known variations:[73]

a) only one parallel line can be drawn from a straight line to a point [and through it] which is not on the straight line [the

[73] Gábos Zoltán: Mit adott a fizikának Bolyai János? *(What was János Bolyai's contribution to physics?)* Bolyai memorial volume. Vincze Kiadó, 2004. 268. The three examples were taken from here.

parallel, the straight lines and the point being all in the same plane]

b) he sum of the angles of a triangle are equal to two right-angled angles

c) similar triangles exist: if each side of a triangle is modified in the same proportion, then the angles of the triangle do not change

The first formulation became the most preferred variation of the 11th axiom, and this is, no doubt, why it was called the axiom of parallelism. Yet even in this formulation it did not have the appearance of a veritable axiom, because, ultimately, it is not controllable in practice. Mathematicians of the 18th century began once again to examine the question of parallelism. Giovanni G. Saccheri (1667-1733) in 1733, Johann H. Lambert (1728-1777) in 1766 and Adrien M. Legendre (1752-1833) in 1800 all made important contributions to these sphere of thought. Similar to them in terms of being a forerunner was Farkas Bolyai (1775-1856).[74] The members of the above-mentioned group were mostly focused on trying to show that the 11th axiom was a logical consequence of the previous axioms. The thinkers of the 19th century had already sensed that another kind of geometry existed other than the Euclidean kind. It was Ferdinand K. Schweikart (1780-1859) and in 1818 Franz A. Taurinus (1794-1874) in 1826 who pulled strongly in this direction.[75] Carl F. Gauss (1777-1855) took only a plausible

[74] In his principal work entitled Tentamen, Farkas Bolyai gives an account of the experiments which he undertook to prove the 5th postulate and he lists the different reformulations of this postulate.

[75] The historical data were taken from Zoltán Gábos' comprehensive work. Cf. Gábos Zoltán: Mit adott a fizikának Bolyai János? *(What was János Bolyai's*

stance in this issue and thus cannot be credited with being the discoverer of hyperbolic geometry.[76] The credit for this is indisputably due to János Bolyai (1802-1860) and to Nikolai Ivanovich Lobachevsky (1792-1856), who both came to the same conclusion but entirely independently of each other. Bolyai was first to make the discovery, Lobachevski was the first to publish it. What is the essence of this discovery? To discover this, we shall focus principally on Bolyai's line of thought, but before that let us become acquainted with his life and fate.

János Bolyai was born on 15th of December 1802 in Kolozsvár, Hungary. His mother was Zsuzsanna Árkosi Benkő, his father was Farkas Bolyai who, in 1804, was appointed to be professor of mathematics, physics and chemistry at the Reformed Church College of Marosvásárhely. The son János' talents in music and mathematics had already surfaced early in his life. He progressed quickly in his studies at the Reformed Church College of Marosvásárhely and at the age of sixteen was able to enroll at the Emperor's and King's Academy of Military Engineering in Vienna. He completed his studies here by the age of twenty. He was then

contribution to physics?) In: Bolyai emlékkönyv *(Bolyai Memorial Volume)*. Vincze Kiadó, 2004. 268-269.

[76] Barna Szenássy had examined thoroughly Gauss' works regarding the non-Eucledean geometry. He could not find any evidences which proved his achievements in this field. Cf. Szénássy Barna: Megjegyzések Gauss nemeuklidészi geomeriai eredményeihez. (*Remarks to Gauss' achievements in the non-Eucledean geometry.*) In: Bolyai emlékkönyv. Vincze Kiadó, 2004. 111-120. Gauss was also ranked by András Prékopa in this group. V.ö. Prékopa András: Bolyai János felfedezésének előzményei és utóhatása. (*The preliminaries to János Bolyai's discovery and its post-discovery influence*). In: Bolyai emlékkönyv. Vincze Kiadó, 2004. 98.

posted to the city of Temesvár, to a military fortress. He played the violon with great skill and he was a good fencer. He began to investigate the question of the 11th axiom already during his years at the academy. His interest in parallelism stems from his father's interest in the same. He was able to solve the question of the axiom of parallelism while he was serving as a military officer at Temesvár. Upon finding the solution, he wrote the following to his father in a letter dated on 23 November 1823: „out of nothing I have created a new and different world." He wrote this all down in Latin in 1825. His father also authored a two-volume work of mathematics entitled Tentamen, which served as a textbook in Marosvásárhely. In this, attached to the first volume in appendix form, were János Bolyai's results in non-Euclidean geometry published in 1832. It had already appeared earlier in a separate publication and in 1831 they sent it to Gauss. Originally it bore the title, *Scientia Spatii,* that is, the Science of Space.[77] János Bolyai's life was laden with obstacles. Already at age thirty he suffered from illness and he hardly had any unperturbed time for practicing his art. There were no Hungarian mathematicians who could have been his intellectual peer, and thus none recognized the significance of his discovery. Not even in the rest of Europe had the time come for this while he lived. It was only well after his death that his work was slowly recognized for its

[77] The longer Latin title appeared on the cover of the appendix: *Appendix, Scientiam Spatii absolute veram exhibens; a veritate aut falsitate Axiomatis XI. Euclidei (a priori haud unquam decidenda) independentem; adjecta ad casum falsitatis, quadratura circuli geometrica*. In English: *Appendix, the absolute true science of space; independent negotiation of the (a priori never to be decided) correct or incorrect state of the Euclidean-type XI-th axiom; the geometrical rectangularization of the circle in case of its incorrect state.* Cf. Prékopa András: Bolyai János forradalma *(János Bolyai's Revolution)*. Természet világa. 2003. I. Special Edition. 13.

worth, much as it was in the case of Riemann. From his marriage two children were born, Dénes and Amália. János Bolyai died in Marosvásárhely in 1860 as a forgotten man. Three persons and a military guard of honor attended his funeral. In the local Reformed Church's Registry of Deaths the pastor entered the following words: „He was a renown mathematician with a great mind, first among the best. It is a pity that his talents have been buried unused."[78] Even today we could not express better than these two sentences do the lessons to be learned and the message addressed to our Hungarian nation.

The 11th axiom in its essence states that a parallel line can be drawn in the plane determined by a straight line through which is drawn another straight line leading to and through a point not on the former line. János Bolyai noticed the fundamental fact that this axiom's role in Euclidean geometry is to prevent one from stepping out of it.[79] It essentially closes and seals this system. Stated otherwise, it is not possible to prove that the 11th axiom is the logical consequence of the preceding ten axioms. If this in fact is true, then one simply has to leave it for what it is worth and replace

[78] Puskás Ferenc: Előhang a Bolyai-emlékkönyvhöz. *(Forward note to the Bolyai Memorial Volume)* In: Bolyai emlékkönyv *(Bolyai Memorial Volume)*. Erdélyi Magyar Műszaki Tudományos Társaság, Kolozsvár, 2003. 11-12.

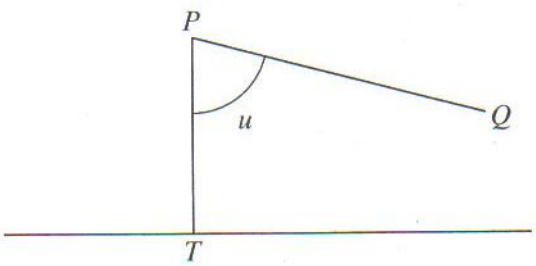
[79] Cf. Gábos Zoltán: Mit adott a fizikának Bolyai János? *(What was János Bolyai's contribution to physics?)* In: Bolyai emlékkönyv *(Bolyai Memorial Volume*. Vince Kiadó, Budapest, 2002. 269. „The axioms have a singular and separate role within the Euclidean framework for the assertion inherent in it emphasizes and fixes its Euclidean character. It represented such an inflexible element that it prevents the stepping out of the Euclidean system. The removal of the obstacle has opened the way to a new, logically possible geometry and also towards a new spatial model."

it was another assertion. As a replacement Bolyai offered no less than stating that many parallel lines can be drawn in the plane through the point not on the straight line. This was as equally astonishing a claim as Einstein's claim that the speed of light was perpetually constant. János Bolyai's eye-opening assertion resulted in him being able to finally step out of the Euclidean system and thus launched a process of mathematical evolution which, in essence, continues today. He had opened the closed world!

We are not in the position to delve into the concrete mathematical details of this find and all we shall mention is that a hyperbolical algebraic expression finally has a role in the new geometry and this is why it was given the name of hyperbolic geometry.[80] In

[80] Beneath is the resume of a description of hypebolic geometry in a mathematical light on the basis of Kiss Elemér: Matematikai kincsek Bolyai János kéziratos hagyatékából, (*Mathematical treasures in the manuscript-bequest of János Bolyai*). Typotex, Budapest, 2005. 21. Refering to the paragraph 29 of the Appendix:

$$\operatorname{ctg}\frac{u}{2} = e^{\frac{x}{k}}$$



where PT=*x*, *m*(TPQ parallel-angle)=*u* belonging to the distance *x*, *e* is the Euler-number (*e*=2,718...), *k* is a real number characteristic of space.

borderline cases this geometry dips into Euclidean geometry. With respect to its significance and academic courage, the new perception of geometry established by Bolyai and Lobachevsky led to further results. The path branched into two directions.

One of the more significant movements in several areas of mathematics proposed the introduction of axiomatization. The interesting aspect of this is that the Bolyai mode of thinking basically put an end to the seemingly universal applicability and eternal validity of *more geometrico* reasoning while also pointing to the correct use of axiomatization. There was no longer reason to fear the consequence of the axioms providing nothing more than an inflexible framework for academic reflection. Instead they now have a role whereby they create order in the different fields of endeavour. If one would like to move on from an area which is axiomatically ordered because the system appears to be closed, then the „inflexible" element needs to be found and then replaced in a way that the former truths not suffer damage, all the while being able to move on to a more open world. This is what happened in numerous fields of mathematics, for instance in the fields of algebra and the theory of numbers, but positive forward steps were taken in the field of geometry also.[81] This was resolved by David Hilbert (1862-1943) in 1899.

The thinkers of the other significant branch of the launched process remained within the confines of geometry and is associated with the name of Riemann. Bernhard Riemann (1826-1866) was able to

[81] Cf. Prékopa András: Bolyai János felfedezésének előzményei és utóhatása *(The preliminaries to János Bolyai's discovery and its post-discovery influence)*. In: Bolyai emlékkönyv *(Bolyai Memorial Volume)*. Vincze Kiadó, 2004. 106.

submit to Gauss two years before Gauss' death the so-called habilitation thesis needed to acquire the right to teach at the university. Of the three topics he was supposed to present, Riemann had only worked on two, and Gauss asked him to present the third. He thus worked this out also and with it he gave a contribution to mathematics which later served as the basis for Einstein's theory of relativity. The third topic dealt with the basics of geometry.[82] Riemann successfully passed his examination in 1854 and Gauss passed away the following year. It is most likely that the academic world did not grasp the significance of this work either because it was only in 1866, two years after Riemann's death that it was published.[83] Riemann had basically generalized Gauss's theories concerning surface geometry. He most likely was not familiar with hyperbolic geometry as worked out by János Bolyai and Lobachevsky, but neither was it familiar to nor acknowledged by the academic world. The essence of it all was that Riemann worked with positve curved surfaces while hyperbolic geometry deals with negative curved surfaces. It would appear that in both cases Gauss took a diplomatic stance, demonstrating no avid support for either the Bolyai-Lebachevsky geometry or for the Riemann type of geometry. One can always wonder how much he saw or understood these forces that would form the future.

[82] Cf. Szente János: A hiperbolikus geometria és a Riemann-geometria kapcsolata *(The relation between hyperbolic and Riemann geometry)*. In: Bolyai emlékkönyv *(Bolyai Memorial Volume)*. Vincze Kiadó, 2004. 308-309. Riemann's thesis: *Über die Hypothesen welche der Geometrie zu Grunde liegen.*

[83] Cf. Szente János: A hiperbolikus geometria és a Riemann-geometria kapcsolata *(The relation between hyperbolic and Riemann geometry)*. In: Bolyai emlékkönyv *(Bolyai Memorial Volume)*. Vincze Kiadó, 2004. 308.

In recapitulating all of this, there is something reassuring that I would like to say. We saw the revolutionary character of the Bolyai-Lobachevsky geometry[84] and while progressing on this revolutionary road Riemann's even more generalized perception geometry appeared. Neither achieved overwhelming success because their significance was not recognized. At that time no one had the idea „that geometry and reality could be different and that geometry could be understood as a class of abstract theories without abandoning recourse to application, for even its arbitrarily interpretable structures are examinable by the same methods as, for example, functions or other mathematical entities," observes the mathematician András Prékopa.[85]

Average everyday perception suggests that the world about us is Euclidean, meaning that it can be described with the help of points, straight lines and planes. Kant taught the same and his authority steered even the academics' attention in this direction.[86] Bolyai, however, was sharply critical of Kant's speculations concerning space: „The otherwise highly worthy and profound-minded Kant happened to assert, incorrectly and twistedly, the meaningless tenet that space ... is not an independent entity but only an illusion

[84] In 1894 the international bibliographic congress of mathematical sciences in Paris gave the name of *Bolyai-Lobachevsky geometry* to the new geometry which we also often called hyperbolic geometry. Cf. Kálmán Attila: Bevezető Bolyai János új, más világába *(Introduction to János Bolyai's new and different world)*. In: Természet világa. Bolyai memorial edition. 2003. I. Special edition. 43.

[85] Prékopa András: Bolyai János forradalma *(János Bolyai's revolution)*. Természet világa. 2003. I. Special edition. 12-13.

[86] Many have noted that Gauss most likely did not want to take a stance against the Kantian world.

or object in our visions.(!)"[87] Today we truly see the reality of space differently. In referring to the general theory of relativity we can state that space is the reality which shows these or those types of characteristics. Thus it exists not only in our imagination but is present as a real element of nature.[88] With his courageous step, Bolyai showed that non-Euclidean geometry also is logically possible, in fact, several kinds of it are possible, and, irregardless of how abstract these geometries are, they can be correlated to the real physical world. Thus it is accurate for the Bolyai-Lobachevsky perception to be referred to as the Copernican turning-point of geometry. When Professor George Bruce Halsted, in 1891, translated Bolyai's new theory of space into English, he wrote the following in the foreward: „These twenty-four pages are the most

[87] Quoting Gábos Zoltán: Mit adott a fizikának Bolyai János? *(What was János Bolyai's contribution to physics?)*, op.cit. 274.

[88] We have taken the term *nature-element* from the mathematician Kálmán Kérdő. We mention here that the author of this book, who is a theologian, mathematician and physicist, does not interpret space in the same way as the mathematician Kálmán Kérdő. According to the understanding of Kálmán Kérdő, space is real but it needs to be imagined in a manner whereby space exists as such by itself and within this there are „non-space elements". These he calls nature-elements. These nature-elements have their own particular architecture, yet space does not possess such particular architecture. Mathematics describes the architecture of the nature-elements within it. In such a mathematical description numerical correlations constantly come to the forefront as a result of the discrete phenomena of the microworld. According to the understanding of the author of this book, purely geometric space cannot be separated from the nature-element within it. The various fields of force are to be interpreted as nature-elements and the structure and architecture of these is identical to space. Space, thus, is not an independently existing entity but the condition of the material, field of force and field which exhibits either this or that type of structural framework.

exceptional two dozen pages in the history of thinking"[89] In opening up Euclid's closed world, János Bolyai and Nikolai Lobachevsky launched a process in the domain of the exact sciences which provided a program for the 20th century. In reference to the realization of this program Einstein said that, „For physical reasons it appeared certain that metrical space is one and the same as gravitational space. Given that gravitational space is determined by the configuration of bodies, it follows that the geometrical structure of space is dependent on physical factors. Space then, according to this theory ... is no longer absolute and its structure is dependent on physical effects."[90] This is an asssessment which would have greatly pleased Bolyai.

[89] Prékopa András: Bolyai János forradalma *(János Bolyai's revolution)*. Természet világa. 2003. I. Special edition. 13.

[90] Albert Einstein: Válogatott tanulmányok *(Selected studies)*. Gondolat, Budapest, 1971. 257.

The seventh major change

AXIOMATIZATION AND THE UPWARD OPENING INFINITE WORLD

By the end of the 19th century life began to bustle in ever-larger an area of mathematics. Newer and newer information in greater amounts was being accummulated in the already existing mathematical disciplines and hitherto non-existing disciplines came into being. A good example of the former kind could be the information increase within the theory of numbers, and examples of the latter kind could be the appearance or rapid development of topology, set theory and probabilty. We would like to focus on two essential things from the midst of this bustling. The one is the giving of due attention to axiomatization and the other is the future-oriented changes which have already taken place in set theory.

We had previously mentioned the question raised by many in the wake of the establishment of non-Euclidean geometry: would not the correctly interpreted axiomatization help create order in certain fields of mathematics? Another formulation of the question was: could not a more perfect axiom system be found which would not require corrections such as the Euclidean system did? For we did see a case where a veritable axiom –which, as it turned out, could not be proven with the help of the preceding ones– could be changed and in this way a contradiction-free geometry could be constructed. This obviously raised the question of the thorough examination of the axiom systems. This desire and intention was most particularly voiced by those in the fields of geometry, algebra and numbers theory. A type of axiom system training was in fact

begun in these fields. Giuseppe Peano (1858-1932) was the one who, using the lessons gleaned from the axiomatic building up of geometry, prepared, in 1889, a system of axioms for arithmetic. Initially this was met with scepticism but later it was accepted. A much more comprehensive and profound examination of the axiom systems was undertaken by David Hilbert (1862-1943) whose pertinent and exceptionally thorough work appeared in 1899 with the title *Grundlagen der Geometrie.* He was the first to theoretically clarify the meaning of the axiom systems. According to him, it is not necessary to define the point, the straight line and the plane but to perceive them as basic concepts. He introduced five relations: incidency, order, congruency, continuity and parallelism. Accordingly, he established twenty-one axioms: eight axioms of incidence, four axioms of order, five axioms of congruency, three axioms of contunuity and one axiom of parallels. He did not differentiate between axioms and postulates. He declared that an axiom system is successful from a theoretical viewpoint if it satisfies the following three criteria: *contradiction-free, independent and complete.* That is, let it not arise that something is asserted and at the same time denied, that an axiom cannot be generated from a previous one, and that any theorem of any field of the discipline not be generated from the system. This system of requirements brought great reassurance to the mathematicians, for it clarified the basis of axiomatization. Both the Euclidean and the non-Euclidean geometry were true and were in accepted even in their generality. Hilbert also was of the opinion that every field of mathematics could be axiomatized and with such a system in hand it would be possible to decide on the verity or fallacy of any claim. Bertrand Russell (1872-1970) and Alfred Whitehead (1861-1947) also embarked on this task. They were of the conviction that the entirety of

mathematics rests upon a few basic principles. Leaning on the Peano axioms, in the period 1910-13 they co-authored a three-volume work entitled *Principia Mathematica.* Practically speaking, in this they rewrote every precept of pure mathematics into a single, logically consequential, formal system. They themselves were under the impression that they had found such a comprehensive thesis. Not much later, Godfrey H. Hardy (1877-1947*)* commented the following: „There, of course, is no such thesis, which is fortunate because if there were, then this collection of rules would serve as the solution to every possible mathematical problem, and with this our mathematical activity would come to an end."[91] As it turned out, Russell and Whitehead's efforts were none other than to lead mathematics back into an axiomatized, closed world. They had somehow overlooked that this is not the conclusion that should have been drawn from Bolyai and Lobachevsky's work, but much more the opposite. The Euclidean system was not a faulty system nor was it because of this that the axiom of parallelism needed to be replaced. It was replaced because there was need to become acquainted with a much broader world. Euclidean geometry was valid in its time, much as it is in the present and will be in the future. But it is only valid for a limited part of reality. Bolyai and Lobachevsky created another system of axioms, a more general one, but not one which purported to claim the ultimate truth and that couched within itself. It is to this that Hardy said: no such thing. Here already it can be seen that human thinking is open and refuses to be shut in. Nature also is like this. It was only years later, after Hardy, in 1931, that Kurt Gödel (1906-1978) made public his renown thesis of non-completeness. This

[91] John D. Barrow: A fizika világképe *(The worldview of physics)*. Budapest, Akadémiai Kiadó, 1994. 333.

proved that in every formalized axiom system there exist arguments which –even within the system– can be neither disproved nor proved. Gödel's thesis, in simpler language, says that if an axiom system which satisifies certain general conditions is contradiction-free, then it cannot be complete. Hungarian mathematician László Kalmár (1905-1976) commented on the ultimate meaing of this in the following way: „The Gödel thesis is valid for every so-called 'intelligent' axiom system where certain very general conditions have been met."[92] Gödel, however, went beyond this and showed that an expanded axiom system can always be supplied within which the validity of the argument can surely be decided. It was with astonishment that the world of mathematics registered this assertion. For what mathematics can ultimately achieve is none other than an unending series of situations which cannot be decided by logic. Then Alonzo Church (1903-1995) of Princeton stepped forward with a method according to which the true or false condition of certain mathematical arguments cannot be decided in a finite number of steps. Alan M. Turing (1912-1954) came to the same conclusion in Cambridge, even though his reasoning had taken a different path. He had, in his imagination, invoked the use of computer which would do the calculations needed for the claim inverse to Church's claim. But it turned out that this computer could not do the calculations. Because there are an uncountable number of sets and within this there also are incalculable numbers which are not infinite in the sense that it would take an infinite amount of time

[92] Kalmár László: A matematika alapjai, II. kötet, 2. füzet. Egyetemi jegyzet *(The basis of mathematics, vol.II. notebook 2, University notes)*. Tankönyvkiadó, Budapest, 1976. 451.

to count them but are immanently infinite..[93] These numbers also have a larger cardinality than that of the natural numbers, thus in the question of deciding whether arguments are true or false, the possibility of deciding is all the more pushed to infinity. The more we would expect help to make the decision, the more the Turing computer says that it is increasingly less possible. In this sense it is truly worth dwelling more on Márton Sain's observation concerning this whole question: „... this assertion decidedly steps out of the world of mathematics and connects mathematics to a reality beyond mathematics."[94] John D. Barrow in 1988 offered the following overview of the situation and its hidden key: „If the universe is mathematical in some deep sense, then the mysterious undecidabilities demonstrated by Gödel and Turing are part of the fabric of the universe rather than merely products of our minds. They show that even a mathematical universe is more than axioms, more than computation, more than logic — and more than mathematicians can know."[95] It is almost this identical thought which surfaces form the theologian Thomas F. Torrance's opinion which is a rather precise formulation about the essence of

[93] Cf. John D. Barrow, op.cit 333-336. Such uncountable numbers are, for example, the irrational numbers, or within these the so-called transcendant numbers. Using another expression, these are called uncountable cardinality of sets. Church and Turing were able to recognize what Cantor did not: the set of so-called *incalculable* numbers are found within the set of uncountable numbers. For these cases there is no method which can be used to calculate certain numbers to a desired accuracy. Cf. Paul Davies: Isten gondolatai. Kultúrtrade, Budapest, 1995. 96-98. E.g. In the case of π there is an algorythm.

[94] Sain Márton: Nincs királyi út! *(No royal road!)*, op. cit. 806.

[95] John D. Barrow: The Mathematical Universe, Natural Science, May 1989, 311. Quotes Thomas F. Torrance: Creation, Contingent World-Order and Time, op. cit. 12.

mathematics but we can hardly be sure that all mathematicians would be willing to accept this assessment. „In mathematics, of course, we elaborate symbolic systems as refined instruments by which we may extend the range of our thought beyond what we are capable of without them. The significance of mathematical symbolism, however, is to be found not in the mathematical equations themselves but in their bearing upon non-mathematical reality. As far as I can see, mathematics is effective in the physical sciences because it belongs to the actual contingent world, and reflects and expresses the patterned intelligibilities embodded in it, even though they cannot be captured in abstract mathematical form."[96]

If we now think back to that very long voyage which mathematics has travelled from ancient times to the 20th century, and especially if we take note of the changes of perception during this time, then we must agree with Euclid when he responded to King Ptolemy I.'s enquiries: „There is no royal road leading to geometry!"[97] From a closed, axiomatically thinking world in which neither by inductive nor deductive thinking could it relate to a physical world, we have arrived to an openly structured mathematical perception which we can, to the best of our knowledge, declare to be the instrument needed to intellectually grasp the contingent universe, and as such their nature is congruent with one another. János Bolyai had already had forebodings of this.[98] It is a fact, nonetheless, that

[96] Thomas F. Torrance: Creation, Contingent World-Order and Time. Handwritten notes, 9.

[97] Sain Márton: Nincs királyi út! *(No royal road!)*, op. cit. 147. The king asked how, by what means, could one master geometry with the least amount of effort?

[98] Cf. Toró Tíbor: A fizika geometrizálása (Physica More Geometrico) *(The geometrization of physics)*: Bolyai János es Albert Einstein 'befejezetlen

there are physical phenomena which cannot be described with mathematical concepts and, at the same time, mathematics has a wealth of concepts, proceedings and equations which physics has not yet tapped. Not all of physics has yet been invested with „mathematical truth" and not all of mathematics has yet been paired with „physical truth". We can, though, with full conviction state that both mathematics and the world of nature are of an open framework. This is why we can always proceed forward in the acquisition of knowledge.

szimfóniája' *('Unfinished symphony' of Janos Bolyai and Albert Einstein)*. In: Bolyai memorial volume. Akadémiai Kiadó, Budapest, 2003. 283-304.; Gábos Zoltán: Mit adott a fizikának Bolyai János? *(What was János Bolyai's contribution to physics?)*, op. cit. 272.

The eighth major change

A MATHEMATICIAN OFFERS RELIGIONS A CHANGE OF PERCEPTION

By the second half of the 19th century mathematics was evolving in so many different directions that no one mind could have reined it in as a whole. The divergence between the different disciplines appeared so marked that the good mathematicians spontaneously sought common ground and principles. Georg Cantor (1845-1918) was among these. Working with infinite sets, he happened upon correlations. Some he was able to prove while the rest remained at the level of conjecture. It was only many years later that he was shown to be correct in his claims when these were also proved. It appears that axiomatization was not a central issue for him and he searched for the possibility of integration elsewhere. He developed a newer field of mathematics which became known as *set theory*. On the surface, the two distinct directions taken by axiomatization and set theory do not seem to have anything in common. Much like Bolyai, Cantor was soon struggling with finding solutions to the same problems, without which he could not advance in his work. He succeeded in resolving the relations pertaining to the cardinality of sets, which in simple language means that, much as in the case of natural numbers, he was able to interpret the relationship of „smaller-larger" as it pertained to the cardinality of sets. An exception to this was the renown rule of *trichotomy.* This states that among the three of $a=b$, $a<b$ and $a>b$, in the case of natural numbers, one and only of these possibilities will always be fulfilled. Cantor considered this to be a type of ordering principle in the case of infinite sets. Others were of the belief that this could be proved. It turned out that, in the case of infinite sets, neither the precept

formulated in the rule of trichotomy nor its opposite could be proved. It behaved exactly like the axiom of parallelism. Given the nature of the problem, an unexpectedly vigorous evolution began in this domain. Mathematical historian Márton Sain captures very accurately Cantor's role in this: „In the world of mathematics, Cantor was perhaps the greatest prophet. ... the biggest triumph of his teachings was the confirmation by more modern and precise methods of his arguments, many of which he could only foggily define but which were evident from his clearly observed concepts. There is no longer any domain of mathematics which the results of set theory have not advanced to a greater or lesser degree."[99]

The mathematical problems raised by Cantor ushered in many more new questions and tasks, many of which reached beyond the borders of mathematics and inspired other disciplines. It touched theology and philosophy even more. How? This will be the question we shall have to answer. We shall even raise the question as to whether theology was able to recognize the possibilities which this offered.

It was Descartes who caused a bit of an uproar in modern philosophy when he identified the idea of „infinity" with that of perfection and the idea of God. In his view, man by himself is not able to bring the idea of infinity into existence and therefore God must have placed this idea in man.[100] With this an old problem once

[99] Sain Márton: Nincs királyi út! Matematikatörténet *(No royal road! The history of mathematics)*. Gondolat, Budapest, 1986. 776.
[100] Cf. Emmanuel Levinas: Transzcendencia és megértés *(Transcendence and interpretation)*. In: *A modern tudományok emberképe (The human face of modern knowledge)*, Gondolat, Budapest, 1988. Edited by Krzysztof Michalski, 227.

again raised its head, that being the question whether the finite is capable of grasping the concept of the infinite, or whether the infinite can be accommodated within the finite. Spinoza's and Leibniz' philosophical arguments gave cause for much debate in this. The major players among German, French and English philosophers of even the later centuries were not able to make any breakthroughs in this but Cantor's results in set theory in the last third of the 19th century finally did. By the first part of the 20th century the new discipline of set theory had become an indispensable means of bringing together the diverging branches of mathematics. Imbedding this theory into mainstream mathematics was done at the price of heated debate. Cantor was attacked countless times and it soon became apparent that the heat of this debate soon sparked a larger fire which then left singe marks both on philosophy and theology. The debate instigated the re-thinking of many questions in both disciplines. Cantor did nothing more than prod others to think through what God meant as an Absolute and how far the human mind is capable of going in grasping the correlation between the finite and the infinite.[101] At this time Kant still commanded a great deal of respect in the field of philosophy and this was particularly felt in theology.[102] In comparison, Cantor's

[101] Cf. Georg Cantor: Végtelenség a matematikában és a filozófiában *(Infinity in mathematics and philosophy)* (Gesammelte Abhandlungen mathematischen und philosophischen Inhalts, Szerk. Zermelo, Berlin, 1932, new edition: Hildesheim, 1962.) Filozófia Figyelő, ELTE, Budapest, 1988/4. 56-87. The translation was done by Zoltán Szabó, the notes were written, the articles were selected and the editing was done by Imre Ruzsa.

[102] Cf. ELTE, Filozófia Figyelő, op. cit. 80. The mathematician Ernst Zermelo wrote a comparative comment about Kant's perception about the „finite and infinite"and Cantor's interpretation. This is also given by Imre Ruzsa, op.cit 83. Zermelo defends Kant in that he uses these two concepts pertaining to *the world*

thoughts were entirely novel. „The two forms of *actual* infinity, the transfinite and the absolute infinite, are often confused despite the strict differences between them. The first one, although infinite, can still be increased. The latter is to be considered as being *non-increasable* which in mathematical circles means *indefinable.* We encounter this type of error in connection with replacements, for example in Pantheism, and this is the Achilles heel of Spinozan ethics, ... Equally remarkable is that, since Kant's time, the faulty belief that the *absolute* is the ideal limit of the finite has spread among philosophers. In truth, this limit is to be perceived only as a *transfinitum, or as the minimum of all tranfinitums* (that is, as the smallest number beyond the finite, marked by me with an omega)."[103] Cantor's simple interpretation here following is evidence of great intellectual depth: This thinker drew conclusions from his theory which surfaced only much later in 20th century theology. Again, we here quote him: „The *transfinit,* with its countless forms and configurations, refers, by necessity, to an *absolute*, to a „veritable infinite", whose magnitude is not affected by any type of addition or subtraction and which, because of this, must be viewed as a quantitative *absolute* maximum. This latter concept surpasses by a certain number of degrees the human ability to grasp this in as much as he excludes himself from the sphere of mathematical determination. On the other hand, the *transfinit* not only fills the wide field of possibility in learning about God but also offers fertile and constantly increasing dimensions for ideal research. Furthermore, I am convinced that in the world of the living also, to a certain degree and in different respects, the

intellect: „the human mind, because of its innate nature, is forced to perceive the world as bordered and boderless, finite and infinite.

[103] ELTE, Filozófia Figyelő, op. cit. 79-80.

transfinit attains reality and existence, so that the glory of the Creator, arising from His absolute free will, can more resolutely gain expression than it would be possible in the case of a simple 'finite world'. This, however, has still to wait a long time for general recognition, even though this recognition could be of great value for *theologians* as support material in undergirding the cause (religion) which they represent."[104] To Cantor's mind, mathematics functions according to the rationalization which God has invested in the human mind and in the world. In „the glory of the Creator" he saw the harmony of what was graspable of the unity of the created universe. As a consequence of this there exists the possibility of using the mathematical deductions originating from the rationality of the created world to blaze new paths towards newer discoveries, all the while never forgetting that this rational activity of man and the world's rational nature ultimately point beyond themselves in a transfinitive way. With this, Cantor, in all practical terms, introduced an exceptionally plastic example of the universe's own inherent rationality and, at the same time, allowed to suggest that this mode of thinking would have exceptional significance in making further discoveries in nature. In debating this with contemporary philosophers, he further clarified this in the following latin formulation: *„Omnia seu finita seu infinita* ***definita*** *sunt et excepto Deo ab intellectu determinari possunt!"* That is: everything, with the exception of God, is either finite or *determined* infinite and intellectually definable.[105] It is thus obvious even in mathematical thinking that the intellect, in its own ontological state, is not capable of grasping the meaning of God but, in pointing beyond itself in a transfinitive way, it can allude to his existence. Expressed

[104] ELTE, Filozófiai Figyelő, op. cit. 82-83.
[105] ELTE, Filozófiai Figyelő, op.cit. 71. Imre Ruzsa's translation.

once again in other words: there exists no academic interpretation which can necessarily deduce the existence of God from nature. At most it can only allude to it. This is the teaching of the Old Testament as well as that of the New Testament.[106]

Within Cantor's ideas there is a very important perception factor which Christian theology has so far ignored. When he speaks of infinite set theories and then within this he distinguishes between transfinite and absolute finite, he is providing a veritably usable tool for theologians in interpreting the concept of God. Cantor not only points to this but also envisions grand possibilites. Transfinite is a infinite which can be changed. We can, for example, increase its cardinality. The natural numbers are a good example of this. An absolute infinite set, however, has the property of retaining the same character even if we remove any infinite fraction of the set or if we add any infinite set to it, be that transfinite or absolute. The set of real numbers is like this, it remains unchanged. Furthermore, in what concerns the cardinality of these infinite sets —which Cantor called continuous cardinality—, there can always be found sets which have greater cardinality. These things are still grasped easily enough by the intellect. God, however, cannot be defined by the intellect, insists Cantor. We can hardly appreciate how much this new perception of the infinite which Cantor introduced into mathematics can help in interpreting the trinity. For it is known how great a difficulty it was for Christian theology to interpret and to make understood that in essence the one God is three persons. What is more, that which the apostle Paul writes in his letter to the

[106] Psalm 8 and Romans 1-2.

Colossians —that in Christ dwellt the fullness of God— [107] comes up as a question. This caused true difficulties and even sharp debate already for the fathers of the Reformation, but not finding any better solution, they also accepted the previously mentioned old interpretations. The so-called *perichoresis* approach tries interpreting the trinity by describing the inter-permeability of the three persons on and through one another. The *aequalitas* approach very simply states that there are three persons but these are „mutually equivalent". One gets the impression of an intellectual exertion trying to weld these three persons together and the interpretation that will be accepted is the one which can solve this cohesivity most attractively, with the most intellectual finesse or most capturing narrative presentation. But if we are pushing for a shift in perception and remove the ground-upwards method of thinking we can attain a higher-level of interpretation. We cannot know if Cantor had this in mind or relied exclusively on God's Absolute character as a starting point but we —now as his late followers— can bravely raise the question in light of his proposal concerning the interpretation of God.

We had earlier explored how important a monotheistic interpretation of God was for the Jewish people of the Old Testament period. The basis and indispensable condition of every teaching of this period was the premise of one God. Christianity also preserved this but in a trinitarian fashion and consequently the question arose of how to unchangeably invest the character of the one God in the three persons. What did it mean that in Christ dwellt the fullness of the Deity? This statement can only issue from a

[107] Colossians 1:19 and 2:9. The formulation in Colossians 2:9 is stronger because it notes that Christ in bodily form was invested with the fullness of God.

changed perception. It is not by starting out from the three different persons individually, that is from the Father, from the Son and from the Holy Spirit, and by then trying to unite them in one form or other that the interpretation should begin but by the inverse, that is, by starting from the fullness of God and then interpreting the fullness of God as it pertains to each person. We must perhaps take as our starting point, before anything, the existence of the One- who is pre-eminently Triune-God in his fullness and from here it is He who reveals Himself as the fullness of God in the Father, as the fullness of God in the Son and as the fullness of God in the Holy Spirit. If we are expecting a metaphorical perception then Cantor's concept pertaining to infinite sets is exceptionally suitable for this. The fullness of the one God can be found in the Son such that the Son is invested with the fullness of God as much as are the other two persons, all the while none of this diminishing the fullness of the one God in his Trinitarian existence. This is a higher-level interpretation of monotheism inheret to Christian thinking, it being based on the many traces in the Bible leading to this, but it had never acquired an interpretation which could so plastically clarify this divine secret. Thus, using Cantor's argument for set theory, a much more understandable picture can be etched of the secret of the Trinity. All that transpired in this case also was that a world which had been closed by the human mind was newly opened. The earlier interpretations provide explanations of the secret, and even though they are to be recognized as worthy intellectual achievements, they ultimately do not extend beyond the human exertion of establishing –by a representation assembled from its component elements– that God is one essence. This is closed thinking. If, however, it is not by human intellectual exertion that we try to find an interpretation of the Trinity, then we shall

have gained access to an open world, something which is in accord with the Biblical perception.

The ninth major change

THEOLOGY AND A NEW *MORE GEOMETRICO* PERCEPTION

Physicists were actively insterested in discovering whether there was any relationship between the geometrical space espoused by mathematicians and gravitational force. Einstein also worked a great deal on this if only to judge by the spatial equations resulting from his theory of general relativity. On the one side there are physical parameters while on the other side there are only geometrical ones. It is this general situation which the Transylvanian-Hungarian physicist Tibor Toró characterizes when he speaks of the *geometrization of physics*.[108] Tibor Toró speaks about the application of geometry in physics in the sense of a geometry which has already been reformed by Bolyai and Lobachevsky. Thus, geometry had already achieved its own academic revolution and had created its open world. Already Bolyai was cogitating on how this new type of geometry related to reality. It was as if he had asked whether gravitational force was not of this nature. Bolyai was the first to reflect on this: „... the law of weightiness seems to be in close relation or continuation to the size, nature and character of space."[109] Bolyai and Lobachevsky thus opened a closed world, created a new geometry and asked how this was related to nature. In other words: how can reality be described

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[108] Cf. Toró, Tíbor: A fizika geometrizálása *(The geometrization of physics)* (Physica More Geometrico): Bolyai János es Albert Einstein 'befejezetlen szimfóniája' *('unfinished symphony' of Janos Bolyai and Albert Einstein)*. In: Bolyai memorial volume. Akadémiai Kiadó, Budapest, 2003. 284.

[109] From slide number 491 of the Bolyai archival papers of the Teleki-Bolyai Library in Marosvásárhely. Quotes: Tibor Toró: A fizika geometrizálása *(The geometrization of physics)* (Physica More Geometrico): János Bolyai and Albert Einstein 'befejezetlen szimfóniája' *('unfinished symphony')*., op.cit. 286.

by the new geometry? When, in relation to this, Tibor Toró uses the *more geometrico* expression, he is emphasizing its use in the strict sense as it had been newly interpreted and extended by Bolyai and Lobachevsky. This meant that the direction to take in physics was the one that had been taken in geometry, that of opening the closed world; that is, we can once again say: in the mode of geometry. In this way, the expression *more geometrico* acquires a somewhat more positive sense.

Unfortunately, Christian theology was not able to keep step with this positive change in meaning. Admittedly, the perception in the natural sciences did not change immediately either. More time was needed for this. For a certain time everything stayed much the same. While on the one hand Bolyai and Lobachevsky had liberated academic thinking from the omnipotence and inflexibility of the *more geometrico* principle, it was due to the influence of the Protestant theologian Immanuel Kant (1724-1804) that the negative aspect of the *more geometrico* method was unremittingly used throughout the 19th century. Kant, with his own authority, basically deepened the crisis arising from the newer age's dualist perception. He viewed both time and space as belonging to the *a priori* categories because he could logically conceive of no other solution. Kant was of the opinion that the physical world could only be understood to the extent that the *a priori* filter of the human mind makes it possible. This would mean that the true and original nature of things could never be known and all that could be known about them was how they appear to us. From this position followed Kant's sweeping onslaught against all forms of natural theology which is evidenced by the unsparing logical refutations of the different proofs of God's existence. A further consequence,

according to this interpretation of things, was that God remains entirely unknown and cannot be made the object of any perception. And if this is the case, then what will become of the question of knowing God, a question which Christianity ties to the Biblical facts of the revelation? Kant also recognized this difficulty and, still adhering to the principle of *more geometrico,* he determinedly searched for a method whereby he could lay the foundations of faith with the help of reason. In this way, with the precision of mathematical deduction, he came to the conviction that the starting point of all things was ethics. „The starry sky above me, the moral law within me," he would say.[110] He had found the fixed point for which he had been searching, that being man's self-interpretation. While Newton had placed the whereabouts of the point of absolute rest in a world of distant gigantic heavenly bodies, Kant purported to find this same point of absolute rest in man himself.[111] His Copernican turning-point had led here. In its stricter sense this caused some confusion within theology because, when thought through consistently, it meant that God does not exist independently of man's intellect and as a consequence, with the moral sense of his practical mind, man can postulate a „deity" acceptable for his purposes. Taking the lead from this, Friedrich Schleiermacher (1768-1834) found the essence of religion to be in the „feeling of unconditional dependence" and in his wake, respected theologians, equally under the influence of the spirit of Kantian axiomatic philosophy, regularly published their works of

[110] Immanuel Kant: Kritik der praktischen Vernuft: Tamás Nyíri quotes here from his own translation of this work of Kant. Nyíri Tamás: A filozófiai gondolkodás fejlődése *(The evolution of philosophical thinking)*. Szent István Társulat, Budapest, 1977. 303.

[111] Cf. Thomas F. Torrance: Space, Time and Incarnation. Oxford University Press, London, 1969. 44.

systematic theology. The highly respected Albrecht Ritschl (1822-1889) and his followers re-introduced Kant's idea of the moral imperative and built up every detail of their system on this. A member of this same school was the renown historian Adolf von Harnack (1851-1930) who, in his book entitled *The essence of Christianity* and written in the spirit of Kantian apriorism, argued that the teachings themselves of the historical Jesus are not the same as their Gospel accounts. Ernst Tröltsch (1865-1925) pushed the imagination of theological liberalism even further and came to the conclusion that not only did moral *a priori* exist but that *religious a priori* did also, it serving as assistance to the human intellect in its capability of developing religion by itself. From the given examples it can be seen how great the influence of philosophy on Protestant theology had become. Everyone in these disciplines was looking for a basic truth or theory to serve as a starting point and on this they built up their entire logic system in the spirit of *more geometrico* principles. This became the basis of the so-called Kultur-Protestantism. Theology not only followed philosophy in lockstep but imitated its reasoning. It was of this predicament that Sören Kierkegaard (1813-1855) gave a fittingly and deservedly harsh and sarcastic opinion when he wrote that, „Theology, all primped up, is sitting at the window, courting philosophy for its favours and offering it its charms."[112] Kierkegaard subsequently zeroed in on the essence of it all by using as his starting point the fact that the *Logos* is not identical with the *physis*, something which Christianity had let fade into oblivion. God fully differs from this world, He is entirely different. We are incapable of proving His existence for surely the human intellect cannot surpass itself. „The greatest

[112] Nyíri Tamás: A filozófiai gondolkodás fejlődése *(The evolution of philosophical thinking)*. Szent István Társulat, Budapest, 1977. 440.

paradox of the intellect is that it has discovered something which it is incapable of conceptualizing."[113] Kierkegaard's question was not, „what is the essence of Christianity" but, „how can man become a credible Christian?" Protestant theology, unfortunately, did not take this warning seriously.

It was well into the 20th century when Karl Barth (1886-1968) seriously reviewed the situation of Christian theology and concluded that theology had drifted away from its living roots. His formulation of this was that theology had separated itself from the base found in God's word and had built on anthropo-focused ideas. Barth similarly avowed that the *Logos* was not identical to the *physis,* that is, to the world. His expression, *Gott ist der ganz Andere*, that is, *God is entirely different* became very well known. His purpose with this was not to formulate a new basic argument which could be pinned to theology's flag as some motto or slogan and then have things built onto this. This method was that of *theologia naturalis* and one of its more dominant forms was the *more geometrico* type of thinking. Barth built up his theology on the premise that there exists a unity and a genuine relationship between God and His revelation. This relationship was not one created by the human intellect as some theologians seemed to think. Barth then was able to free theology from a closedness which it had created for itself and place it on the Biblical revelation's plane of infinite freedom. In other words, he had found the stiffening brace which had prevented any exit from the system. The physicist Carl-Friedrich von Weizsäcker describes the theologian Barth's situation in the following way: „This is a verification of the

[113] Nyíri Tamás: A filozófiai gondolkodás fejlődése *(The evolution of philosophical thinking)*, op. cit. 439.

contribution of so-called Kultur-Protestanism and Christianity to the level of culture achieved wherein are embodied exceptional historical realizations and, at the same time, originating from isolated observation, a trivialization which closes its eyes in front of the ravine on whose edge leads the path of enlightened theology. If Christianity is verified by its cultural contribution then every critique of culture, every world-changing causality, be that social-Darwinist, technocrat or Marxist, will sink the Christian faith into forgotten history. Barth very clearly knew that if he rightly took the risk of basing his life on Christ, then Christ had to be more than these world-changing causalities and even more than the world which is so easily changed."[114]

This Barthian „theory of knowledge revolution" occurred at the same time that Einstein pieced together his theory of relativity and the quantum theory's beginnings appeared on the horizion. Barth published his renown *Römerbrief* in 1918, which was a commentary and interpretation of the apostle Paul's letter to the Romans. It also included all the newer insights which he later expounded upon in detail, primarily in his thirteen-volumed life work entitled *Kirchliche Dogmatik*. Entirely independently, Barth in the field of theology and Einstein in the field of physics, they both emphasized that the goal is always the objective interpretation of reality. Einstein was of the opinion that if the essence of nature was not what we, as observers, could apprehend from various phenomena, then there is no sense in

[114] Carl F. von Weizsäcker: Zwischen Religion und Moral, Überlegungen zum Gedenken an Dietrich Bonhoeffer, Evangelische Kommentare, 1976/7. 398. Ervin Vályi Nagy quotes him in: Nyugati teológiai irányzatok századunkban *(Tendencies in Western theology of this century)*, Református Zsinati Iroda, Budapest, 1984. 27-28.

pursuing research, because this would, at most, be the gathering of data which we could order or view as having symbolic meaning but from this we would never grasp the inner essence of nature. Much the same is true in theology. The essence of Barth's new perception is entirely similar to Einstein's reasoning. Thomas F. Torrance says the following about the two great revolutionaries in epistemology: „Karl Barth and Albert Einstein stood up for the claim that the empirical and theoretical components of recognition are inherent within it. This follows from the recognition of the fact that the theoretical and empirical elements are already within one another, all hidden within reality. Both men refuted, within their own particular fields of endeavour, the basic tenets of dualistic reasoning which, otherwise, could be found in the thinking of the antique world and in the worldview of the middle ages as much as in modern thinking from Galileo to Newton."[115]

We must then examine what effect the theology of the Reformed-faith Karl Barth had on theology itself, given that it had elicited serious attention from every denomination of the 20th century. Barth had basically laid aside the axiomatic approach and designated the Biblical revelation as the basis of his theology. He very determinedly emphasized that God is entirely different from the world. From this it follows that the human intellect is different from the divine word. Thus the perfect and ultimate knowing of God is unimaginable, yet continuous progress is possible in this process of knowing God, just as the Bible, at several turns, speaks of this (Ephesians 3:17-18). Theology can thus continue to seek and

[115] Thomas F. Torrance: Transformation in the Frame of Knowledge, (It is not known by the author to which work the published article belongs. Separate reprint without any data.) 397-404.

study the acts and the will of God as they have been given in the Revelation, or, in other words, the infinite love of God, as shown through Christ, towards the created universe and to man within it. In theology this signified the opening. If theologians choose a basic tenet for themselves and then build up their entire theology on this, it will amount to nothing more than a theoretical system interwoven with bits of religious wisdom. All such systems have proven to be closed systems which, sooner or later, have ended up in the museum of religious practice.

A very delicate question needs to be raised as a consequence of this topic. Can theology be axiomatized? Can basic tenets be selected and then an entire theological system be built on these? Our answer is a definitive *no.* It is not possible to assemble such a system of axioms in the case of theology. Yet even today such efforts are undertaken. Either certain basic tenets of theology or Bible verses are selected and then designated as axioms. The unavoidable difficulty with this is that the original interpretation of an axiom qualified it as a truth recognized by the human intellect, something from which there is no backtracking in the continuous search for truth. Axioms, therefore, are always basic truths as determined by the intellect. If we thus create a theological system of axioms we must equally extend to it the threefold requirement of *independence, contradiction-free* and *completeness* but in such a way that the Gödel-type road towards a world of open logic always be accessible. If this could be done, then some very interesting things would surface in theology. Fortunately, such systems of axioms cannot be created not even for the intermediary fields of truth because they would all prove wanting in the requirement of independence. For no system of tenets based on Biblical truths can

be assembled whose claims are not related to the love of God as shown in Jesus Christ. Were one, who is standing on Christian ground, still try to create such a system of axioms, and were one to think these axioms through very logically, one would ultimately come to the conclusion that the Christian system of tenets can possibly only have one single tenet. That tenet is Jesus Christ Himself. Yet it cannot be said of Christ, that He is a principle or claim which has been engendered and accepted by the reasoning power of the human intellect. For Christianity Jesus is not some intellectual or conceptual truth but the second person of the Trinity, that is, a living divine person. As a consequence, the open world of Christian theology is to be created otherwise. It is only the infinitely open world of the Revelation which can provide this to a continuously searching mankind.

The tenth major change

THE CONTINUOUS AND DISCRETE WORLD

Unavoidably affected by Newtonian mechanics, classical physics also lived its glorious moments already throughout the 19th century.[116] As we saw, the introduction of absolute time and space proved advantageous to Euclidean-type axiomatic thinking. This was due, to a large extent, to Kant who, with his authority, dominated this century also. The sheer weight of this reasoning and the lack of anything better was such that its momentum carried philosophy throughout the entire 19th century. And as we saw, many towed this line, even theologians. But we also saw, through their open criticism of Kant, that neither Bolyai nor Cantor were willing to follow as many other physicists also did. Several well-respected physicists felt physics to be functioning so well, to be almost so perfect, that they did not bother to reflect on the possible inner development of their own discipline.[117] Lord Kelvin described it this way: „only a few smaller clouds cast a shadow on the clear, blue sky of physics".[118] Even Planck's professors had tried to dissuade him from becoming a physicist.[119] In general it could be

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[116] Cf. Nagy Károly: A huszadik század fizikájáról és világképformáló szerepéről *(20th century physics and its role in forming world concept)*. Természet Világa. I. Special edition. 2006. 4. Especially noteworthy is the physicist Loránd Eötvös' appraisal.

[117] Cf. Simonyi Károly: A fizika kultúrtörténete *(The cultural history of physics)*, op. cit. 385.

[118] This was taken word for word from Károly Nagy. Nagy Károly: A huszadik század fizikájáról és világképformáló szerepéről *(20th century physics and its role in forming world concept)*. Természet Világa. I. Special edition. 2006. 4.

[119] When Max Planck applied to enter the university, Professor Philipp von Jolly adviced him to attend other faculty for there is very little to research in physics.

said that, aside from a few exceptions, every important phenomenon in physics had been described with the help of mathematics. The mathematics of already that period was being done at fantastically advanced levels. Well worked out theorems and proofs in every domain were evidence of the advanced stage of development. At the forefront was analysis and within that functions and infinitesimal calculation. Differential and integral calculation provided increasingly more assistance in the description of the world of physics. It is important to note that the majority of the physicists were also outstanding mathematicians. Thus these individuals laid down a solid foundation for physics. Perhaps the best example of this could be James Clerk Maxwell (1831-1879) who, with his astonishing mathematical acumen, put into mathematical form that which Michael Faraday (1791-1867) was able to describe in words only. Such a description of natural phenomenon was grounded into a continuity-based type of mathematical thinking: whatever was experienced in nature conjured up images of the continuous world. It is not surprising then that within academic circles a type of happy contentment was the general mood in the second half of the 19th century. The mathematical continuity perception verified the behaviour of nature and with the help of laws, principles and theorems it was possible to explain what had happened in the past and also what would happen in the future and when it would happen. The time, however, came in 1900 when nature unexpectedly „divulged" something different than what the mathematics of continuity „knew" about it. Max Planck (1858-1947) was the first to encounter the facts, that, in the case of heat

Cf. Nagy Károly: A huszadik század fizikájáról és világképformáló szerepéről *(20th century physics and its role in forming world concept)*. Természet Világa. I. Special edition. 2006. 4.

radiation, energy shows discrete values, which he named quantums of energy. Shortly after, in 1913, Niels Bohr (1885-1962) showed that energy is discrete even at atomic level. This, of course, was a bold divergence from the continuity perception. The discrete series of the so-called Planck-constant had to be introduced first if anything was to be understood of the heat radiation and sub-atomic phenomena. Later, Einstein confirmed the new perception with his „discovery" of photons of light. After him Erwin Schrödinger (1887-1961) described the movement of particles with his wave theory equation but which meant that he had to introduce the so-called *eigenvalues* which relate to the energy and to the description of the discrete condition of the existing particles found within the atomic-scaled world. This advance already began to point in the direction of the traditionally accepted continuity perception no longer providing an adequate basis to realistically describe the phenomena of nature. — The best mathematicians had a presentiment of this fact. John von Neumann (1903-1957), a renown Hungarian mathematician, played a preeminent role in the development of twentieth century mathematics. In describing the mathematical bases of quantum physics[120] he came to the conclusion that there were no hidden parameters in nature. In principle, there is no limit to cognition, something which mathematicians explain to theologians in the following way: God did not resort to using hidden parameters when he created the world. In discovering all of the above, man could come to admire the openness of the intellect

[120] His famous work is entitled "Mathematische Grundlagen der Quantenmechanik. Cf. Simonyi Károly: A fizika kultúrtörténete a kezdetektől 1990-ig. *(The cultural history of physics from the beginnings to 1990)*, op. cit. 461-467.

and of the natural world. It was this which gave renewed hope to man in the late twentieth century and it now serves up new tasks for scientists of the twenty-first century. More and more closed fields have been opened up and worlds unimaginable earlier have been made accessible for scientific research.

Another larger field, the macro world, also began to present phenomena which could not be explained with the Newtonian principles of classical physics. Such was, for example, the movement of Merkur perihelium or the bending of light within the gravitational fields of large heavenly bodies. Einstein asked himself the question whether it was Newton's or Maxwell's equations that should be considered exact in terms of describing nature. Einstein decided upon the latter's equations and it was based on this that he came forward with his general and special theories of relativity. By this time the meaning of so-called axiomatization had also changed. In physics, all the Newton and Maxwell type equations were called and are still called axioms. Similar is the situation in quantum mechanics where the initial and basic tenets are called axioms. These axioms of physics differ from the axioms of Euclidean geometry because the former have their origins in the actual perceiving of nature. Newton himself called the there basic laws of motion axioms.[121] It could thus be said that Einstein sided with Maxwell's axiom system. As to what this meant mathetically, we shall forego delving into the details. Instead, we shall simply refer to its end result by saying that both the theory of relativity and the quantum theory are to be considered part of a general theory in the description of natural phenomena which ultimately, in special cases,

[121] The word „axiomata" can be found in the title on the pages discussing the laws of motion.

yields the results of classical physics. If we use the Bolyai-type extended interpretation of *more geometrico*, then we are thinking correctly because here physicists notice a type of closedness to the axiom system and they step forward by opening up the old system, in this way establishing new basic tenets. In Einstein's case this meant abandoning the Newtonian approach to absolute time and absolute space, it having prevented him from stepping out of the sytem. He chose as his basis the tenet that light travels at a constant speed, irregardless of the system it is in and independent of everything. In appearance this is about as absurd a claim as that of Bolyai when he claimed that infinite number of parallel lines can be drawn through a point relative to a given straight line. On the basis of Bolyai and Einstein`s proposals, however, a theory was introduced by which the world's large scale phenomena could be fittingly described. Furthermore, it provided explanations for phenomena for which classical physics could not. Classical physics, as Newton wrote it in his renown *Principia,* continues to be valid as a borderline case of the theory of relativity. This means that in smaller measure, in a world of gentler velocity, the equations of classical mechanics very precisely describe the motion of bodies. The mathematics of the general theory of relativity, as a newer and more general theory of gravitational time and space, is reasonably well clarified even though time still has the character of a geometric parameter here. It is hoped that with the use of even more general and newer mathematics more attention can be given to time and with this another step will be taken into an even more expansive world.

There remains a rather difficult mathematical problem in the world of quantum entities. The problem is that the discrete world of

quantum physics, in its basic form, has thus far only been described or touched upon by the continuous mathematical approach. This unusual situation, in a certain way, tends to direct our attention towards the world of discrete entities. In ancient times, great significance was attributed to natural numbers and there was a great fear of continuity.[122] We observed this in the comparing of sections or lengths. In the world of numbers, sticking to discrete values was what won out and, with the help of this, explanations were sought for various phenomena and for other things also which had very little to do with numbers. This might even be termed a type of naïve mathematical world. The so-called theory of numbers of this time could be termed „brain racking"[123] much rather than well-established mathematical thinking. More than two thousand years have passed since then and over this time, based on the perception of continuity, man has built up an amazingly invaluable method of mathematical thinking. He has discovered the existence of real numbers; he has established the complex number system, the real and complex functions, and the higher level operations; he has worked out the algorithms and set theory and he has made noticeable progress in practically every field of mathematics. The Wolf prize recipient, Hungarian mathematician László Lovász, describes the achievements of the closing chapters of mathematics with the following words: „One of the greatest achievments of mathematics is the grasping the concepts of infinity and continuity. Set theory and analysis are fields of central importance in

[122] Tradition has it that Hippasos, Pythagoras' student, was killed by his colleagues because he had proved that certain geometric measures could not be expressed with whole numbers.

[123] Cf. Lovász László: Egységes tudomány-e a matematika? *(Is mathematics a unified discipline?)* Természet világa. 1998/III. Special edition. 47.

mathematics."[124] It is to be emphasized that mathematics was able to do all of this because of its continuity approach. And then this continuity approach lost its applicability in the world of quantum entities, not allowing the needed forward step. The lessons learned from the history of mathematics indicated that, in this case also, it was necessary to dispose of the fixing or inflexible elements and instead, on the basis of the old *kata physin* principle, that is, according to the nature of the entity in question, search for the solution in the world of discrete mathematics. Thus the numbers and the world of discrete mathematics found itself once again in the foreground. New activity was launched in a domain which is based on and built on the discrete world of numbers. It is sufficient here to mention one of the pioneer mathematicians of this field, Mandelbrot. In the wake of graph theory came the world of *fractals*, then *fractal-dimensions* and then the definition of *self-congruent forms* was established and their study begun. In physics, in the micro world, a new interpretation gave birth to the string approach and shortly after to the M-theory which describes both strings and brans. These are all good examples of how mathematics comes to the aid of physicists in describing nature. Naturally, this is equally true in reverse for as much as physics and physicists readily reach for this help they also motivate mathematicians to work out solutions to new domains of knowledge. Nowadays the new field of mathematics is discrete mathematics. László Lovász is of the opinion that continuous mathematics and discrete mathematics are complementary to one another[125] and these should be viewed as

[124] Lovász László: Egységes tudomány-e a matematika? *(Is mathematics a unified discipline?)* Op.cit. 47.
[125] Cf. Lovász László: Egységes tudomány-e a matematika? *(Is mathematics a unified discipline?)* Op.cit. 47.

such when describing natural phenomena. Numerous mathematicians have indicated that a new world with much to offer is opening up with the advent of discrete mathematics. It is to be suspected that the continuous and discrete worlds together will establish a mathematics which will be able to ascertain from its higher level the content of validity of the lower levels. This phase has not yet arrived but is to be expected later. „The application of the methods of discrete mathematics to continuous mathematics has not at all reached the level which could be attainable."[126] The question, however, quite simply is, with all the fault lines on the horizon why do we still place hope in this? The answer is that, together with László Lovász, we believe that mathematics will remain a unified discipline and the presently dissonant parts will once find one another.

The long road travelled by mathematics from the time of the Greeks to the present is vividly portrayed by Hungarian mathematician Gábor Domokos in his inaugural address at the academy of sciences, in which a modern-day mathematician has a „conversation" with Aristotle on the subject of the discrete and continuous world.[127] Already there are signs which clearly indicate in the direction of applying the worthy results of discrete mathematics. As for how a discrete world behaves, or what interesting correlations this new field of mathematics brings forth and how this can be brought into relation with describing the

[126] Lovász László: Egységes tudomány-e a matematika? *(Is mathematics a homogenous discipline?)* Op. cit. 47.
[127] Domokos Gábor: Dialógus a kontinuumról. Modellek a diszkrét és a folytonos között. *(Dialogue abaout continuity. Models between the discrete and the continuous)* Természet világa, Year 136., no. 12. December 2005, 538-542.

elements of nature is presented by the mathematician Kálmán Kérdő in the appendix attached to this book.

The eleventh change as a possibility

AT WHICH POINTS CAN CLOSED WORLDS BE OPENED?

We have taken ten examples from humanity's cultural history, which demonstrated well how closed systems of thought have come to exist, and the manner their unlocking has taken place. We have taken as our basis the brilliant mathematical discovery of János Bolyai and Nikolai Lobachevsky, when they both realized that although the Euclidean axiom-system is of unimaginable importance for the practice and development of mathematics, still, given the fixed nature of the axioms, it may aide in our understanding of only parts of geography. Therefore, the axiom-system's sphere of validity is limited. In this sense we labeled the whole system closed. We have seen that it was exactly the famous parallel-axiom that prevented escaping the closed system. Therefore it has become feasible to leave it behind and, in the interest of progress replace it with a different, more appropriate axiom. Utilizing this mathematical case as a metaphor, an analogy or even as a comparison, the existence of the same element became apparent in other types of thought-systems, which prevents stepping out of them, i.e. it renders them rigidly closed. This technique could often be used in the present, moreover it facilitates foresight.

Experience demonstrates that a system need not be axiom-structured in the mathematical sense, it still may become closed. In such situations it is worthwhile to return to the basics, and examine the basic principles which are the driving force of, and exert their effect deep within the system, and the principle responsible of being so rigid that prevents secession from this closed system must

be identified. Leaving the field of mathematics and observing the systems functioning all around us, we may encounter many closed systems. Probably because these are working, "live" systems, yet these also may become closed. The following cases will demonstrate the usefulness of our approach, albeit borrowed from the field of geometry, it points to the way closed worlds may be opened. We will only present a few, and the possibilities of their practical adaptations will be left to people who yearn for freedom of thought, creation and belief.

Systems of Church doctrine

Treading in the third millenium it can be established that the most unsettling concern in Christian circles is the splintering of the community. The question cannot be dismissed by saying we acknowledge plurality or the pluriform-type of existence and rounding it out, in reassuring ourselves, by suggesting that the strength of Christianity is in its multiplicity of forms. This would be true had we not allowed the lines of separation become to fault lines, or more, the fault lines to deepen into ravines. If we study the situation carefully, there is not little choice left other than to at least build bridges across these ravines, and crossing these bridges we can at least examine these fault lines from the perspective of the other denomination. And as much as it is possible, while getting to know one another, let us expend effort in trying to tame the fault lines into becoming borders which are crossable.

One of the most colourful and most valuable components of 20th century church history has been the ecumenical movement. It is

still alive today, perhaps now seeking new forms of activity or other possibilities. Two of this movement's essential benefits and use are to be mentioned. One is that the ecumenical movement, in many respects, translated into activity akin to diplomacy which veritably laboured for rapproachment. This is perhaps best evidenced by the establishment in 1948 of the World Council of Churches (WCC) and also its many-faceted activities. This organizational work, however, depends mostly on the given church leaders and can be interpreted as an event which the given historical situation dictated, which, before anything, else directed its activities towards the creation of mutual friendship and confidence. The General Assembly of the WCC could be cited as a good example of this. In the last two decades of the last century, alongside the WCC General Assemblies, large ecumenical world meetings which were seeking answers to the world's important academic and cultural questions would be organized. An example of this was the World Convocation gathering in Korea in 1990 under the title Justice, Peace and Integrity of Creation. Church diplomacy took a backseat here and in-profession issues came to the forefront. In our age, it may well be that these latter large assemblies, gatherings and meetings have more weight than the gatherings concerned with church politics. In any event, these wide-ranging ecumenical activities naturally had the effect of establishing academic theological dialogue among certain denominations. By the 1970's and throughout the 1980's, countless events featuring interdenominational dialogue took place and by the 1990's the summaries and conclusions of this dialogue were published. The novelty of these meetings was that they were academic discussions and therefore it was almost exclusively theologians who participated. This theological in-trade dialogue for the present is in a stage of either expectation or repose, but does

exist. One visible manifestation of this none too visible academic work was the publication in 1999 of the Augsburg Declaration which charted the first step on the road to the accord concerning doctrine between the Roman Catholic and Lutheran Churches. Initially it was deemed a great success, but later the signers of the Declaration became more cautious. For here important questions, both academic and of principle, had been on the negotiating table and it turned out that the two parties have since interpreted the text of the Declaration differently. Noting well our topic, we can here, with our opinion, participate in ecumenism's efforts of this academic nature.

At first glance it may appear as if, in the wake of ecumenical dialogue and its relative inactivity, the churches have simply taken note of their doctrinal differences and on the basis of this have determined where the lines separating them are to be found. There, however, was something promising in this, and that was the academic nature of the dialogue undertaken. Previous to this there had not been anything like this for a long time. And it is most unsettling, perhaps even upsetting, that the open thinking space of Christianity has also given rise to inflexible systems of doctrine. It is natural that each denomination developed its own system of doctrines. Ultimately, with the assistance of their intellect they must give account of their beliefs. Many such articles were published. Such a recapitulation was, for example, the Second Helvetian Confession of Faith in the 16th century, whose introduction states the following: „we are prepared, with the expression of our thanks to yield and align ourselves with them in the Lord who would, from the Scriptures, teach us more uprightness." This can be seen to be a good example of openness.

I am taking as my starting point and directing attention to the reference made in the quoted sentence whereby certain theological questions need to be both examined academically and evaluated. If I restrict myself to the Protestant Churches —for I myself belong to this group and as a matter of etiquette I would also like to make my first critical comment about us— then my decided opinion is that the Protestant churches did not follow in the spirit of the fathers of the Reformation and today's scatteredness and inflexible separate positions are a result of this. The fathers of the Reformation moved forward but we always wanted to return to them for answers to our questions. This already is a sign of a certain closedness. Overstating things somewhat, it is not to them we should return but, like they did, we should move forward. For what we see before us in each denomination is its seemingly static and fixed theological system or tradition whose perhaps most obvious example is the teaching concerning the sacraments. The interpretation of the Lord's Supper is precisely something about which there should be a common agreement between denominations. It is on this seemingly unmovable teaching and hardened-into-dogma spirit that our entire separatedness is built. Were I to formulate a more direct opinion, I could say that the doctrinal tenets have „stiffened into ideology" and thus reflect the system of doctrines which they have become, and this is the biggest obstacle in the rapproachment of the denominations. But let us think this through and try to find a solution. Every intellectual system has basic tenets on which the system rests. With respect to their function, these basic tenets are like the axioms in mathematics and the natural sciences. Mathematics, especially the case of János Bolyai, is a good example of how closed systems can be opened and how marked

development can ensue. It is generally true that it is good if a field of discipline has a system of axioms because this system can then serve as a basis on which the given field can be built up. Which means, that the field of knowledge at hand can be pursued in a disciplined manner. This was seen to be the case with the Euclidean system of axioms also. In the same way, theology also has basic tenets or teachings which serve well for denominational, academic thinking. We know, however, that a body or system of knowledge built up on a fixed system of axioms or pre-conditions leads to a closed world, allowing us to become familiar with only a certain area of knowledge. We can only take a step forward to a higher level of knowledge if we are able to open the closed world. To do this we have to identify or find the „axiom" which closes the system. János Bolyai's genius lay in this very ability of his of seeking and finding the tenet of Euclidean geometry which made it closed, which would not permit any exit from that closed world. Earlier we had indicated that it was the axiom of parallelism which was the tenet in question. Bolyai replaced this tenet in such a way that it was not invalidated yet the result was the one could thereafter move to a higher level of knowledge. This is when he wrote to his father, on 3 November 1823 that, „from nothing I have created a new and different world!" We can also use this as an analogy. Our true ecumenical task —I could say our most worthy task— would be to seek out together those points of our denominations' theological teachings which close these up as systems of thought and, on a Biblical basis, with a new approach, replace the old with that which would lead the theologies of all the Protestant denominations towards the infinite freedom won in Jesus Christ. It is this perception which, as a lesson learned, theology, as the body of knowledge of the Christian churches, could emulate.

Church organization

The organization of the church is an exceptionally complicated structure, hardly fathomable for the outsider, or rather one whose tangled network limits its transparency. It also wears the spirit which was formed by history, in both the positive and negative sense. The ones who fill different positions in the church hierarchy do not always dispose of all which needs to be known. It is very difficult to understand and to navigate the inner logic, illogicality, structure and principled background of a church organization which comes with a history of two thousand years. It is no wonder that we waver when we wish to say something about it. Where does one begin? This question is all the more valid because countless differently structured church bodies have come into being and it would not be possible to take all of them into account. We might thus begin with a generalized approach, namely with the simple hypothesis that the church organization reflects in good approximation the system of doctrines which it represents. This follows from its very nature as its members, sooner or later, will force it to shift direction if it is not in accord with its own doctrines. From this it follows that a church organization will always change in a manner that will best fulfill or satisfy its doctrines. Furthermore, if acceptable, it would follow that the organizational structure with all its hierarchical trappings will direct the organization in the spirit that its doctrines prescribe and represent, be that closed or open. It is according to this that the whole organization must function and it is in this spiritual environment that reason and knowledge must also be practiced. The individuals who practice this trade of academic reasoning are, in principle, independent and they either bow to the

will of their organization or operate in a climate of conflict. At times they are even asked to resign from their university chair. What is that might engender conflict for such a scholar? First of all, if the tenets of the organization and the activities of the officials of the organization as specified by its tenets are not in accord with the scholar's convictions, then this scholar appears as a „foreign body" within the said organization. In view of his intellectual positions, he does not fit into either the doctrines or the organization and in this way thwarts the operation of the organization. But the question that arises here is how the leadership of the organization perceives the scholar. If the leadership respects the scholar's *sui generis* independence then the scholar is in the position to improve the organization. He can inject new ideas, improve its operation and life and can raise it to higher levels of respect and recognition. If, however, the scholar is perceived as a simple employee who must also accommodate himself to the closed „order" as specified by the designated limits, then already there are difficulties. For one of the biggest problems is the limiting of the intellect or spirit, which in itself is the sign of a closed system. If a scholar or thinker must constantly ask whether he can, in the course of his reasoning, arrive at this or that kind of result, then everything around him is already closed. Wherever the superior levels mandate what „necessities" are to be adhered to by an independently thinking individual, there the gates have closed. Organizations of this nature, sooner or later, slip into dictatorial mode. There exist church organizations like this also. So how is it that these church formations continue to survive? Only because, for shorter or longer periods, their members are willing to accept these limitations. The members generally do not accept the limitations for an endless period of time so they either elicit change with a so-called „revolutionary" event or else the

organization itself, through slow reformation, changes. In such cases the new thinking often co-habits with the earlier thinking, now perceived as the more conservative perspective, and in the meantime, as a result of a quiet, inner evolution, the organization changes in a natural way.

Having arrived to this point, it is necessary to raise an onerous question: can every kind of independent thought blaze a path for itself? Should every new thought engender an inner re-organization? Absolutely not. But ultimately a set of regulations is needed which can assure good order within the community. In this case, from what new thoughts will there arise a positive result? From those thoughts and ideas which are able to modify the system so that its closedness ceases and at the same time can provide an openness to accommodate further development. There are innumerable paths and methods to this but whichever is chosen, it must always be examined. It must be determined if an idea, thought or perception which considers itself to be new will not cause or result in a newer closedness on the same spiritual level. Should it also lead to a closed system, albeit a different one, the result will be anarchy. Therefore, the leaders are to possess sufficient knowledge, informativeness and wisdom to be able to make good decisions after having listened to the opinion of others. It remains to be said that never is there a perfect decision and every decision points only approximately in the right direction. On the other hand, should an organization, be it church or other, make decisions in an already dictatorial mode, then the odds of the decision being unsound are much greater. Organizations like this do not survive for long. But if attention is given within a community to the independence of the individual and the individual's

intellectual spirit is not tied in knots with obligatory requests for the granting of permission, then evolution can be expected. This is all the more true of any church organization which strives to live according to God's revelation and takes the apostle Paul's warning to heart: „the Word of God cannot be put in chains" (2 Timothy 2:9). The result of such a perception can be none other than the opening of a closed world.

The openness and closedness of political systems

Let us take as our starting point the view that the essential purpose of politics is providing service for the benefit of the *polis*[128], thus politics should be working on improving the situation of its given society, its community. The question is how? Let us take as examples two extreme cases. If a government or political system puts forward some particular priniciple, religion or philosophy and it obligates the citizenry to adhere to this, then it has locked them into an ideological world. It was this situation which took root in Central and Eastern Europe during the many decades following the Second World War. We certainly had the opportunity to become acquainted with different forms of this method. In this situation people soon submit to the perception that it is no longer necessary to think, that man's creative abilities are no longer important and that man's freedom has no place in the responsible directing of his fate. The people in positions of authority do everything in his stead and all he has to do is live his life as an obedient citizen with degraded rank. The problem with this is that it is counter to man's

[128] The word *polis* means the inhabitants of the city or state. It is in this Greek word that is concentrated everything which refers to politics.

nature. In this, man found himself within a closed system in which there was, in most instances, little chance of gaining freedom. There is no forum here, and thus his opinion will never be heard. More exaclty, his opinion will be heard but only to those who originally established the closed system and maintain it as such. The circle has closed, there is no escape. If a certain majority has accepted this ideological situtation, then the thinking and creative person finds himself in a veritably hopeless situation. In this situation democracy as such is only realized beneath even a minimum level and is thus not sufficient to promulgate change. The system in this way has taken on a dictatorial status and has closed itself in. It hardly has any contact with the outside world, it has minimal freedom of movement and if it has any, it is controlled. Here there is no evolution, or only in a hardly discernable measure.

The other question concerns the degree of openness that should be allowed in a society. If too much freedom is permitted by a government and the freedom starts wittling away at order and swings over into licentiousness, then community life will rapidly end in anarchy. Licentiousness or uninhibitedness can appear in the ethical behaviour of individuals as well as in the merciless trampling, cheating and unjust humiliation of others and in the boundless exploitation of nature and its resources. This is no doubt why Calvin said that an autocratic system is better than anarchy. What do we have in mind then if we do not find excessive freedom to be desirable? The fact that man is weak and a sinner cannot be overlooked. If through sin man closes himself into a licentious world, ethically and intellectually he will sink to the lowest level. The apostle Paul speaks of the situation of such men as being the slave of sin (Romans 7-8). It is from such chaotic circumstances that

dictators come to the rescue of societies, saying that they have made order. But this is only a physical type of order. A society can only count on having a happy future if its members practice tolerance, love and justice towards one another. This can only be realized if all of these three become internalized in spiritual order in the members of society and they truly understand its necessity. Thus Christianity proclaims for man a new spirituality and a new form of life as a realistic possibility.

We have thus arrived to the conclusion that a political system serves the welfare of society best if it does not implement the extremes of dictatorship and licentiousness and, instead, propogates, encourages and establishes an intellectual and spiritual environment which endeavours to practice common tolerance, respect and love, and in ensuring human dignity, it frees man to be able to create.

The openness originating from man's freedom

We can imagine a normal human life as having two ordering factors which work simultaneously. The Christian avows that he can live his freedom according to a certain personal *autonomy*. At the same time he avows that this autonomy is not unlimited because he has to be aware that *heteronomy* also exists. *Autonomy* means accepting laws which are applicable to ourselves while *heteronomy* means accepting laws which exist and are applicable independent of us.[129] Man thus lives his life between these two limits. We would

[129] The word autonomy is composed of the Greek words *autos* (self) and *nomos* (law). The word heteronomy is composed of *heteros* (other, different) and *nomos* (law).

like to examine this from a Christian viewpoint. Autonomy exists so that, in exercising his Christian freedom, man exercise his creativity and also recognize the danger of chaotic license in his personal life. Heteronomy exists so that in his life and behaviour he not be lead by arbitrariness, neither with respect to himself nor with respect to others, so that he have something to guide him in his freedom. It is in this autonomy that man can live his situation as it is limited by and made dependent on heteronomy. It is „within this framework" that he is to realize the so-called Christian values which the Bible lists in several places. „But the fruit of the Spirit is love, joy, peace, patience, kindness, goodness, faithfulness, gentleness and self-control" (Galatians 5:22). It is not the law which decrees this for the Christian but are concomitant to the freedom of Christian life. These are the natural consequences of his faith. The healthy and sober understanding of the complimentariness of autonomy and heteronomy keeps man on the right track. The question is, why does the Christian take this on? Because of his faith in God, this is what he believes to be right and this is what is good for his fellow man also. The Christian, as we can see, does not live his life in a closed world of his own creation according to his self-made morals but exercises his freedom in faith according to the rules of his new life in Jesus Christ for the benefit of his fellow men. It is in this way that he wishes to be useful to society and to the community to which he belongs. It is in this situation as granted to him by God does he feel free. The extremes of political autocracy and license are foreign to human nature.

Man was furthermore created for freedom in that his thinking is open in an upwards direction. It is man's academic and intellectual freedom that we are here speaking of. Kurt Gödel also pointed to

this in his renown tenet of *undecidableness*, but Mihály Polányi (1891-1976) also recognized this in his commitment to academics.[130] The human intellect always strives to reach a higher level of knowledge, and when it reaches it, it is startled to learn that the higher-level knowledge did not arise as a logical consequence of deductions at the lower level but simply as a result of man's intuitive abilities. Polányi also pointed out that this higher-level knowledge does not invalidate the lower-level knowledge but only limits its applicability. This observation can only come from a higher-level. For if the human spirit is so free in its natural self, then it must be left —even given the opportunity— to exercise its freedom. This one of the basic rules of academic freedom.

The openness of universities

Universities were always considered as the most sacred of places in what concerns the academic freedom of conscience. The professor became a professor because he could „avow" with a clear conscience the academic truth according to his conviction. In this sense, universities were considered as places of safe haven. Wherever and whenever this freedom was curtailed, there the university's original mandate suffered a setback. The question begs itself: in what way can it happen that a university's freedom is curtailed? Two ways are to be mentioned in answer to this. The first way is when scholars are limited by instructions or privations from above which impede them in doing free research or in fully developing their ideas. The second way is when scholars are forced

[130] Cf. Polanyi, Michael: Personal Knowledge. Routledge and Kegan Paul, London, 1983. 69-202.

to present interpretations, philosophy-inspired perceptions or imposed results which run contrary to their own academic convictions. In both cases outsiders become involved. With their own methods, in a directed fashion, the outsiders force the university's scholars to abandon their freedom. This can also be said to be a closed system. Many scholars have fallen victim to this. A university is open if, with every material and intellectual resource and all available equipment and instrumentation, it serves the cause of developing knowledge without any ideological interest.

Given that the university is the depository of academic freedom of conscience, we can in all good conscience state that the university has a definitive role in the life of the society and nation it serves in the present and for the future. If the universities of a nation or society are spiritually closed, the future there is endangered. If they are open, the whole nation will flourish in hope and in knowledge. If the two restraining elements which we mentioned in the life and functioning of the university are identified as factors causing inflexibility and are consequently removed, the closed system will be opened. A sure consequence of this will be the free evolution of knowledge and with this will increase the prosperity of society, the nation and its citizens.

BIBLIOGRAPHY

Albright, William Foxwell: Yahweh and the Gods of Canaan. The Athlone Press, London, 1968.

Barbour, Ian G.: When Science meets Religion. Enemies, Strangers or Partners? Harper, San Francisco, 2000.

Barrow, John D.**:** A fizika világképe. (*Worldview of Physics*) Budapest, Akadémiai Kiadó, 1994

Barth, Karl: Church Dogmatics. Editors: G.W. Bromiley and T. F. Torrance. T and T Clark International, London, New York. First paperback edition, 2004.

Bavinck, Herman: Reformed Dogmatics. Vol. 2: God and Craetion. Baker Academic, Grand Rapids, MI., 2004.

Biblikus Teológiai Szótár. (*Theological Dictionary of the Bible*) Második Kiadás, Róma, 1976.

Boer, Harry R.: A short History of the early Church. Eerdmans, Grand Rapids, MI., 1976.

Bolyai-Emlékkönyv. (*Memorial Book on Bolyai in Hungary*) Bolyai János születésének 200. évfordulójára. Vince Kiadó, 2004.

Bolyai-Emlékkönyv. (*Memorial Book on Bolyai in Transylvania*) Bolyai János születésének 200 éves évfordulójára. Erdélyi Magyar Műszaki Tudományos Társaság, Kolozsvár, 2003.

Bright, John: Izrael története. (*History of Israel*) MORE Zsinati Iroda, Budapest, 1977.

Boman, Thorleif: A héber és a görög gondolkodásmód egybevetése. Kálvin János Kiadó, Budapest, 1998.

Cantor, Georg: Végtelenség a matematikában és a filozófiában (*Infinity in Mathematics and Philosophy*) (Gesammelte Abhandlungen mathematischen und philosophischen Inhalts, Szerk. Zermelo, Berlin, 1932, új kiadás: Hildesheim, 1962.) Filozófia

Figyelő, ELTE, Budapest, 1988/4. 56-87. A fordítást Szabó Zoltán készítette, a jegyzeteket írta, a szemelvényeket válogatta és szerkesztette Ruzsa Imre.

Clayton, Philip and **Peacocke**, Arthur (editors): In Whom We Live and Move and Have Our Being. Eerdmans, Grand Rapids, MI., Cambridge, U.K., 2004.

Clayton, Philip and **Schloss** Jeffrey (editors): Evolution and Ethics. Human Morality in Biological and Religious Perspective. Eerdmans, Grand Rapids, MI., Cambridge, U.K., 2004.

Clemens, Ronald E.: Old Testament Theology. Marshall, Morgan and Scott, London, 1978.

Copernicus, Nicolaus: De revolutionibus orbium coelestium. Libri VI. Norimbergae apud Ioh. Petreium, Anno M.D.XLIII. (Book number is O1218tt in the Great Library of the Reformed College of Debrecen.)

Csikszentmihályi, Mihály and **Damon**, William and **Gardner,** Howard: Good Work, When Excellence and Ethics Meet. Basic Books, 2001.

Davies, Paul: The 5th Miracle. The Search for the Origin and Meaning of Life. Simon and Schuster Paperbacks, New York, 1999.

Dearman, J. Andrew: Religion and Culture in Ancient Israel. Hendricson Publisher, Peabody, Massachusetts, 1992.

Domokos, Gábor: Dialógus a kontinuumról. (*A Dialogue on the Discrete and Continuity*) Modellek a diszkrét és a folytonos között. Természet világa, 136. évf. 12. sz. 2005. december, 538-542.

Dowe, Phil: Galileo, Darwin and Hawking. The Interplay of Science, Reason and Religion. Eerdmans, Grand Rapids, MI., Cambridge, U.K., 2005.

Einstein, Albert: Válogatott tanulmányok. (*Selected Studies*) Gondolat, Budapest, 1971.

Ellis, George F. R.: The Far-Future Universe. Eschatology from a Cosmic Perspective. Pontifical Academy of Sciences and the Vatican Observatory, Vatican City and Templeton Foundation Press, Philadelphia and London, 2002.
Euklides: Az elemek első hat könyve. (*First Six Chapters of Elements*) Fordította Baumgartner Alajos. Franklin Társulat, Budapest, 1905.
Euklides elemei. (*Euclid's Elements*) Ford.: Brassai Sámuel. Nyomt: Emich Gusztáv. Pest, 1866.
Euklidész: Elemek. (*Elements*) Gondolat, 1983. Ford.: Mayer Gyula.
Euclidis: Opera Omnia. Ediderunt: I.L. Heiberg et H. Menge. Lipsiae, MDCCCLXXXIII.
Euclidis: Elementa. Edidit etlatine interpretatus est I.L. Heimerg. Vol. I. Lipsiae, MDCCCLXXXIII.
Forde, Gerhard O.: The Captivation of the Will. Luther vs. Erasmus on Freedom and Bondage. Eerdmans, Grand Rapids, MI., 2005.
Gaál, Botond: Az ész igazsága és a világ valósága. (*The Truth of Reason and the Reality of the World*) Az egzakt tudományok történelmi fejlődése keresztyén nézőpontból. Hatvani István Teológiai Kutatóközpont, DRHE, Debrecen, 2003.
Gaál, Botond: The Faith of a Scientist – James Clerk Maxwell. The István Hatvani Theological Research Centre, Debrecen University of Reformed Theology, Debrecen, 2003.
Gábos, Zoltán: Mit adott a fizikának Bolyai János? (*What is the Contribution of Bolyai to the Physics?*) Bolyai emlékkönyv. Vincze Kiadó, 2004. 267-281.
Gingerich, Owen: The Book Nobody Read — Chasing the Revolutions of Nicolaus Copernicus. Walker and Company, New York, 2004.
Gregersen, Niels Henrik (editor): From Complexity to Life. On the Emergence of Life and Meaning. Oxford, University Press, 2003.

Hall, Stuart G.: Doctrine and Practice in the Early Church. Eeredmans, Grand Rapids, MI., 2003.
Halasy-Nagy, József: Az antik filozófia. (*Philosophy of the Ancient World*) Danubia kiadás, Budapest, 1934.
Hegel: Előadások a világtörténet filozófiájáról. (*Lectures on the Philosophy of World-History*) Akadémiai Kiadó, Budapest, 1966. 39-40.
Hilbert, David: Lectures on the Foundations of Geometry 1891-1902. (Editors: Michael Hellett and Ulrich Majer) Springer, 2004.
Jammer, Max: Einstein and Religion. Physics and Theology. Princeton University Press. Princeton, NJ., 1999.
Kálmán, Attila: Bevezető Bolyai János új, más világába. (*Introduction to Bolyai's New and Different World*) In: Természet világa. Bolyai emlékszám. 2003. I. Különszám. 38-43.
Kalmár, László: A matematika alapjai, II. kötet, 2. füzet. (*Basis of Mathematics*) Egyetemi jegyzet. Tankönyvkiadó, Budapest, 1976.
Kant, Immanuel: Kritik der praktischen Vernuft.
Kiss, Elemér: Matematikai kincsek Bolyai János kéziratos hagyatékából. (*Mathematical treasures in the manuscript-bequest of János Bolyai*) Typotex, Budapest, 2005.
Kecskés, Pál: A bölcselet története. (*History of Wisdom*) Szent István Társulat, Budapest, 1981.
Kolb, Robert: Bound Choice, Election, and Wittenberg Theological Method. From Martin Luther to the Formula of Concord. Eerdmans, Grand Rapids, MI., 2005.
Komoróczy, Géza: Bezárkózás a nemzeti hagyományba. (*Locked into National Tradition*) Osiris, Budapest, 1995.
Kvasz, Ladislav: The Mathematisation of Nature and Cartesian Physics. In: Philosophia naturalis. Vittorio Klostermann, Frankfurt am Main, Band 40, Heft 2, 2003. 157-182.

Kvasz, Ladislav: Galilean physics in light of Husserlian phenomenology. In: Philosophia naturalis. Vittorio Klostermann, Frankfurt am Main, Band 39, Heft 2, 2002. 209-233.

Kvasz, Ladislav: Changes of Language in the Develpoment of Mathematics. In: Philosophia Mathematica. The Philosophical Journal of the Canadian Society for History and Philosophy of mathematics. Series III. Vol., Canada, 8. 2000. 47-83.

Levinas, Emmanuel: Transzcendencia és megértés. (*Trancendence and Perception*) In: *A modern tudományok emberképe*, Gondolat, Budapest, 1988. Szerkesztette Krzysztof Michalski.

Lovász, László: Egységes tudomány-e a matematika? (*Is Mathematics a Unified Science?*) Természet világa, 1998/III. különszám. 44-49.

Maxwell, James Clerk — *A Dynamical Theory of the Electromagnetic Field*. Edited by T. F. Torrance, Scottish Academic Press, Edinburgh, 1982.

Miller, Keith B. (editor): Perspectives on an Evolving Creation. Eerdmans, Grand Rapids, MI., Cambridge, U.K., 2003.

Miller, Patrick D.: The Religion of Ancient Israel. SPCK, London, Westminster John Knox Press, Luisville, Kentucky, 2000.

Miller, J. Maxwell – **Hayes**, John H.: Az ókori Izrael és Juda története. (*History of the Ancient Israel and Juda*) Studia Orientalia, Pázmány Péter Katolikus Egyetem, Piliscsaba, 2003.

Myers, David G. and **Jeeves,** Malcolm A.: Psychology. Through the Eyes of Faith. Harper, San Francisco, 2003.

Nagy, Károly: A huszadik század fizikájáról és világképformáló szerepéről. Természet Világa. I. Különszám. 2006.

Newton, Isaac: Philosophiae Naturalis Principia Mathematica. London, 1687.

Nyíri, Tamás: A filozófiai gondolkodás fejlődése. Szent István Társulat, Budapest, 1977.
Osterhaven, M. Eugene: The Faith of the Church. Eerdmans, Grand Rapids, MI., 1982.
Peters, Ted and **Benett**, Gaymon (editors): Bridging Science and Religion. Fortsress Press, Mineapolis, 2003.
Peters, Ted and **Hewlett,** Martinez: Evolution from Creation to New Creation. Conflict, Conversation, and Convergence. Abingdon Press, Nashville, 2003.
Polanyi, Michael: Personal Knowledge. Routledge and Kegan Paul, London, 1983.
Polkinghorne, John: Science and the Trinity. The Christian Encounter with Reality. Yale University Press, New haven and London. 2004.
Polkinghorne, John and **Welker,** Michael (editors): Faith in the Living God. A Dialogue. Fortress Press, Minneapolis, 2001.
Polkinghorne, John and **Welker,** Michael (editors): The End of the World and the Ends of God. Science and Theology on Eschatology. Trinity Press International, Harrisburg, PA., 2000.
Prékopa, András: Bolyai János forradalma. Természet világa. 2003. I. Különszám. 3-21.
Richardson, W. Mark – **Russel**, Robert John – **Clayton**, Philip – **Wegter-McNelly**, Kirk (editors): Science and the Spiritual Quest. New Essays by leading Scientists. Routledge, London and New York, 2002.
Sain, Márton: Nincs királyi út! (*No Royal Road! — History of Mathematics*) Matematikatörténet. Gondolat, Budapest, 1986.
Schwarz, Hans: Creation. Eerdmans, Grand Rapids, MI., Cambridge, U.K., 2002.

Schwarz, Hans: Theology in a Global Context. The Last Two Hundred Years. Eerdmans, Grand Rapids, MI., Cambridge, U.K., 2005.

Simonyi, Károly: A fizika kultúrtörténete a kezdetektől 1990-ig. *(The cultural history of physics from the beginnings to 1990)* Akadémiai Kiadó, Negyedik Kiadás, Budapest, 1998.

Sirat, Colette: A zsidó filozófia a középkorban. *(La Philosophie juive au Moyen Age)* Logos Kiadó, Budapest, 1999.

Stannard, Russel: The God Experiment. Can Science Prove the Existence of God? Hiddenspring, NJ., 1999-2000.

Stewart, Ian: 2050 matematikája. In: A következő ötven év — A tudomány a huszonegyedik század első felében. Vince Kiadó, 2003. 42-51.

Szabó, Árpád: Hogyan lett a matematika deduktív tudománnyá? II. *(How did mathematics become a deductive field of knowledge?* II.*)* Matematikai Lapok, Bolyai János Matematikai Társulat, Budapest, 1957. 3-4. szám.

Szénássy, Barna: Megjegyzések Gauss nemeuklidészi geomeriai eredményeihez. (*Remarks to Gauss' achievements in the non-Eucledean geometry.*) In: Bolyai emlékkönyv. Vincze Kiadó, 2004. 111., 120.

Szente, János: A hiperbolikus geometria és a Riemann-geometria kapcsolata. *(The relation between hyperbolic and Riemann geometry)*. In: Bolyai emlékkönyv. Vincze Kiadó, 2004. 305-324.

Takács, Előd: „... Az Úr vezette egymaga ..." *Izrael letelepedése és Józsué honfoglalás-tradíciójának teológiai értelmezése („... The Lord alone led...." Interpretation of the tradition of Israel's settling and Joshua's conquest of the land)..* Dissertationes Theologicae 5. Debrecen, 2002.

Teres, Ágoston: Biblia és asztronómia. (*Bible and astronomy*) Springer, Budapest, Róma, Parizs, 1999.

Toró, Tíbor: A fizika geometrizálása (Physica More Geometrico): Bolyai János és Albert Einstein 'befejezetlen szimfóniája'. *(The geometrization of physics…: 'unfinished symphony' of Janos Bolyai and Albert Einstein)* In: Bolyai emlékkönyv. Akadémiai Kiadó, Budapest, 2003. 283-304.

Torrance, Thomas F.: Space, Time and Incarnation. Oxford University Press, London, 1969.

Tóth, Kálmán: Ószövetségi kortörténet. *(Old Testament Period History)* In: Bibliai atlasz, Református Sajtóosztály, Budapest, évszám nélkül.

Vallástörténeti kislexikon, Második bővített kiadás, Kossuth Könyvkiadó, 1973.

Van Huyssteen, J. Wentzel: The Shaping of Rationality. Toward Interdisciplinarity in Theology and Science. Eerdmans, Grand Rapids, MI., Cambridge, U.K., 1999.

Weizsäcker, Carl F. von: Zwischen Religion und Moral, Überlegungen zum Gedenken an Dietrich Bonhoeffer, Evangelische Kommentare, 1976/7.

INDEX