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ASTRONOMY AND MATHEMATICAL SCIENCES IN BYZANTIUM

By

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I. Introduction

Byzantium occupied in terms of time a period of eleven centuries (330–1453 AD) and in terms of space a big area between three continents. Politically it was placed at a period of great turmoil owing to barbaric invasions and social reforms. All these facts hinder the research, which is required in order that a full picture of the development of Sciences, especially of Astronomy, during that period, may be constructed. The attempt to do so is also thought to be hampered by the simultaneous appearance and growth of Christianity which is still being considered as 'a sign of contradiction' not only for its metaphysical aspect but also for its cultural value. This is particularly the case with those who saw Byzantium as belonging to 'the dark ages', i.e. to the period marked by the prevalence of mysticism, magic and astrology, when the development of sciences, especially the natural ones, was opposed.

However, more recent studies made by distinguished researchers* have dispersed the slanders, overthrown the accusations and restored justice and truth, so as to make the spiritual radiance of Byzantium and its contribution to civilization even more apparent. Ch. Diehl writes that "Byzantium created a brilliant civilization, the most brilliant perhaps of all that had ever seen the light in Christian Europe up to AD 1100. It was through this civilization that Byzantium exercised a wide influence on all peoples of Eastern Europe"¹. Also Sir W.C. Dampier observes that "the Byzantine Empire maintained a background of civilization throughout the worst times of barbarism in the west of Europe"².

(*)Reference is here made only to some of them: Krumbacher, Diehl, Runciman, Vasiliev, Dölger, Bréhier, Gelzer, Moss, Dvornik, Cohen, Hussey, Hunger, Tannery, Heiberg, Dalabre Amantos, Koukoules, Kougeas, Orlandos, Sotiriou, Zakythinos, Tomadakis, Tatakis, Karagiannopoulos, Drandakis, L. Benakis, Maltezos, Stephanides etc.

1. Diehl, 1943, p. 173–174.

2. Dampier, 1946, p. 47.

Prof. Vogel's article about Mathematics and Astronomy in Byzantium (1967) is very interesting, and A. Tihon is right, when she writes (1981, p. 605) that byzantine Astronomy is a sector almost unknown as yet.

Let us now have a brief look into education in Byzantium and then into the cultivation of natural sciences, especially Astronomy, mainly carried out by various sages and researchers of that time.

II. Education and Learning

Elementary "Paideusis". Elementary education began at the age of six or seven continuing probably for three years and not being under a uniform State programme. Education was considered by the Byzantines to be "the art of arts and the science of sciences". As St. Gregory Nazianzen writes: "all those who have sense will acknowledge that education is the first of the goods we possess"³. From the IXth century, if not before, the State looked after education and determined the relevant obligations of the parents. A good education was the ideal of every Byzantine. "Apaideusia", lack of mental training, was considered a misfortune and disadvantage and almost a crime.⁴ A full educational system was developed. Teachers were paid by the pupils' parents. Education was also given to young girls who attended school with the boys or went to separate schools in women's monasteries or received education at home.⁵ Buckler is right in accepting J.B. Bury's view that "in the Eastern Empire every boy and girl whose parents could afford was educated"⁶.

"Encyclios paideusis". This kind of education began at the age of eleven and ended at an age between sixteen and eighteen or even twenty. It comprised a curriculum of non-Christian subjects which was often characterized as "profane learning" (θύραθεν

3. (MPG, 35, 425 and 36, 508).

4. Runciman, 1966, p. 223.

5. Koukoules, 1948, p. 35 fol.

6. Buckler 1949, p. 200.

παιδεία, ἐξῶθεν παιδευσίς) or as "wisdom from without" (ἐξω σοφία). It was given in seven stages: Grammar, Rhetoric, Philosophy, Arithmetic, Music, Geometry and Astronomy. The Fathers of the Church were as a rule its main supporters. St. Basil and St. Gregory Nazianzen studied in Athens and loved Greek science. St. Gregory Nazianzen reproaches the Christians who abhorred "wisdom from without" (ἐξῶθεν σοφία) for not judging correctly⁷. St. Gregory of Nyssa recommends the study of Geometry and Astronomy, for by them "the intellect is provoked to virtue".⁸

Universities and Schools of Higher Education. At the dawn of the Byzantine era Alexandria had already been the highest centre of science since the third century B.C. It had a very rich library, out of which Julius Caesar would have sent 700,000 books to Rome had it not been burned during the siege in 47 B.C. There was a Museum, scientific collections, a zoological garden and an Observatory. Natural Sciences, and Medicine were thriving until the city was burned by the Arabs in 641 A.D.

In Constantinople a high educational establishment known as "The Auditorium" was set up by the Emperor Constantine (330); but there were also various other Schools. A set of subjects known as the "quadrivium" (namely, Arithmetic, Geometry, Astronomy and Music) was taught at the "Auditorium". This institution was reorganized by Theodosius II in 425 A.D. and renamed "Pandidacterion". From that time it became renowned. It had a staff of thirty one professors. The "Pandidacterion", except for some short interruptions, reorganizations and completions went on until 1453, when Constantinople was captured by the Turks. It was at its peak during the periods when famous masters such as Leo the Mathematician (836 A.D.), Constantine Porphyrogenitos (845 A.D.) and Michael Psellos (1018–1078), taught there. It is worth noting that the programme of studies drawn up by Olympiodoros (5th century) who had taught first in Alexandria and later in Constantinople, was found to be nearly the same during the ninth, eleventh and twelfth centuries.⁹ Astronomy and Mathematics were considered indispensable subjects and were taught to the students during the last years of their attendance.¹⁰ In the capital there were also "the Patriarchal School", the "Ecumenical Didascaleion", the Maurolycos School etc. Universities or schools of high education were also at Berytos, Antioch, Gaza, Caesaria, Damascus, Ephesus, Edessa, Thessaloniki and other places. The University which was established at Nicaea during John Vatatzes' reign (1225–1254) gave a new drive to education generally, in the Empire of Nicaea.

7. MPG, 36, 508.

8. MPC 46, 181.

9. Bréhier, 1950, p. 444.

10. Koukoules, 1948, p. 131–32.

The University of Athens took up a new splendour after Hypatia's death (415) with the flight from Alexandria of many professors, such as Proclus (410–485). Many gentiles and Christians went there to study philosophy, physics and mathematics. Among them were St. Basil, St. Gregory, Julian the Apostate and Theodore, who in 662 became Archbishop of Canterbury and worked in England for twenty years with excellent results. We must also mention the "High School of Natural Sciences" in Trebizond of Pontos, which was marked by unusual vivacity during the reign of Megalocomnenoi (1204–1461). In this school, astronomy was specially cultivated and very probably there was an Observatory in the town.¹¹

III. Astronomy and Mathematical Sciences

Ist Period. Historians fully agree that in Byzantium Astronomy and Mathematics made the most of the progress. The Byzantines wrote commentaries where they collected, systematized and commented on the works of ancient Greeks and Alexandrians. The followers of the neo-Platonic school, Porphyrus, Iamblichos and Proclus revived the spirit of Plato, preserved mathematical science and gave it a new drive to further development.

Alexandria remained for a long time the "scientific metropolis of the empire", where various researchers published interesting works on Mathematics and Astronomy. *Theo of Alexandria* (330–395 AD) wrote a commentary on the *Almagest* of Ptolemy giving astronomical information concerning Hipparchos and recorded two eclipses of the sun in 365 and 372. He also dealt with Geometry and Arithmetic and published "Euclid's Elements" with commentary. *Synesios Bishop of Cyrene* (370–414) – a pupil and admirer of Hypatia – also dealt with Astronomy and Physics, condemned the astrologers and made an astrolabe by himself¹². We should also mention: *Marinos* (end of the fifth century) and *Simplicios* (beginning of the sixth century) who wrote commentaries on Euclid and Aristotle, and also *Cosmas Indico-pleustes* who, around 547, published his "Christian Topography" which contains many, very ingenious, notions of cosmography. In Athens, *Proclus* was distinguished as a geometrician and astronomer. He published: 1) *On the Ist of Euclid's Elements*; 2) *A sketch of Astronomical theories*, 3) *A Selection from the works of Hipparchos, Aristarchos and Ptolemy* 4) *Remarks on Ptolemy's Tetrabiblos*, 5) *On the Sphere, viz. celestial cycles*, and 6) *Elements of Physics, or on Movement*.

The Emperor Julian the Apostate (336–363) occupied himself with the study of Astronomy and was a supporter of the heliocentric system. In his work "To the king sun" he writes that the planets revolve round the sun "as if they were dancing round a king".

11. Plakidis, 1943 p. 78–87.

12. MPG, 66, 1577–1588.

Constantinople acquired many professors of science who came from Alexandria after it had been captured by the Arabs (seventh century), and some of them were actually invited there. Such were: *John Philoponos* (sixth century) a pupil of Hammonios, and *Stephen of Alexandria*. Philoponos was an excellent philosophical and scientific intellectual. Beginning as a serious student and critic of Plato and Aristotle, Philoponos developed his own original ideas which are considered today as being far higher than those of Copernicus and Galileo. We especially note his ideas of the movements of bodies and his critical observations about *impetus* and *inertia*. Bodies, he says, move because of the impetus they have in themselves, having no need of God's intervention. Movements of heavenly bodies are natural and as such may be investigated by science. He wrote monographs on Astronomy and Mathematics, and strove against apocryphal sciences.

In the sixth century there was built the architectural masterpiece of Constantinople, a combination of theoretical study and applied sciences. The architect *Isidore of Miletos* was systematically occupied with mathematics and published a treatise on the construction of concave mirrors. He invented an instrument for drawing a hyperbola and set up a School for Engineers. In cooperation with *Anthemios of Tralles* he built St. Sophia – the wonder of the ages. Anthemios dealt with geometry and optics – parabolic mirrors, the properties of the parabola etc. Also to the same period belongs *Domnios the Philosopher* who, in his works on Arithmetic revealed a critical and creative ability, and *Eutocios of Askalona* who published a commentary on the works of Archimedes, a treatise on Apollonios' "Conics" and gave a good deal of authentic information on mathematical subjects such as the Delian problem. We note also Emperor *Heraclios* (610–641) who published a commentary on Ptolemy and a work on the construction of "Aratus' Sphere".

2nd Period. "The ninth century saw a revival of learning in philosophy and science"¹³ which was warmly supported by the Emperors. Emperor Bardas (850) refounded the old University of Constantinople, and professors of geometry, astronomy and philology were appointed. Thus the ninth century marked the beginning of a new era of Greek-Christian revival in the natural Sciences, which is normally divided into two stages; the *early revival* (IX–XI century) and the *main revival* (XIII–XV century). The twelfth century is mainly characterized as a period of literary revival.

The only interruption to spiritual progress in Byzantium occurred during the period AD 650–850, which is often spoken of by certain historians as dark ages. During that period there were certain

disturbances due to the Iconoclastic disputes on the one hand and to barbaric raids on the other. However, the spiritual decay observed during this period was by no means universal nor was it applicable to all subjects. A real decay was observed *only* in classical studies, while on the contrary there was progress in legislative, administrative and strategic works. It was then that beautiful buildings were built, and the ecclesiastical poetry and hymnography were at their peak. It was exactly then that *John of Damascus* and *Romanos the hymn-writer* lived. John of Damascus (first half of the eighth century) also dealt with Astronomy and generally with nature and strongly attacked Astrology and the art of divination¹⁴. Also Akhmim's papyrus of Arithmetic has given us very important information concerning the practice of numbers by the Byzantines during the seventh or eighth centuries¹⁵.

Classical studies completely disappeared during that period owing to the destruction by the Arabs (641) of the spiritual centers of Alexandria, Gaza and of all Egypt. Alexandria had for a thousand years been the treasury of Greek letters. On the other hand, from the ninth century the Greek East ceased to be concerned with dogmatic matters. From then on the Emperors were no more called Roman¹⁶ but Greek as it is stated in the official chronicles of the Western Church.

Patriarch Photios (820–891) was distinguished for his philosophical and mathematical knowledge and became famous for his "Myriobiblos". During the reign of Theophilos (829–842) the University opened again and *Leo the Mathematician* was distinguished as its head teacher. Besides philosophy, he taught the "Quadrivium"—that is, Arithmetic, Geometry, Astronomy and Music. Other regular professors were *Theodegios* of Astronomy and *Theodore* of Geometry. Mathematical sciences constituted the completion of the whole circle of education. According to Fuchs (1926, p. 18–19), it was then that a revival of mathematical studies was established. Leo, who received world renown, had worked for the collection and publication of Archimedes' works, and it was from these manuscripts that they were handed down to us. Also, it was then that the astronomical works of Ptolemy were published. A chronicler of that time wrote that "Leo had cultivated science to the utmost, going through all the branches of philosophy and its sister sciences i.e. Arithmetic, Geometry and Astronomy".

14. MPG, 94, 896; 93, 894; 93, 1701.

15. Theodorides, 1957, p. 493.

16. Although during the first centuries of Byzantium the Emperors were eager to call themselves «*Romaioi*» and to claim for their own a Roman tradition their training was purely Greek. Theodosius II in A.D. 425 appointed to the University of Constantinople both Latin and Greek teachers. Later, Latin became almost unknown in Byzantium (Buckler, 1949, p. 201).

13. N.H. Baynes, 1952, p. 161–62.

IV. Latest centuries of Byzantium.

During the eleventh and twelfth centuries a new endeavour was made for the cultivation of mathematical sciences. Here we should mention *Michael Psellos* (1018–1096) who was considered to be the “supreme of the philosophers” and “the soul of the University”. He studied in Athens and occupied himself with every kind of knowledge. He taught in the order followed by Plato and mentioned in his “Republic”. Grammar, Rhetorics and Dialectics were followed by the “Quadrivium” which was followed by Philosophy and Metaphysics. Physics and Mathematics were taught with special care according to the precepts of Nicomachos, Euclid, Diophantos and Theo. He used Plato’s method of interrogation. He was also distinguished as a writer of astronomical, mathematical and physical treatises. Krumbacher considers him as equal to R. Bacon. His fame was spread outside the Byzantine Empire, in the Latin West, Persia, Babylonia, and Egypt.

Theodore Prodromos (twelfth century) dealt with Mathematics and Astronomy. *John Tzetzes* (1110–1180) wrote astronomical works and the Emperor *Manuel Comnenos* (1141–1180), though in favour of astronomical studies, consciously served astrology. This is proved by the fact that John Kamateros composed a long astrological poem addressed to the Emperor¹⁷.

Historians have observed an exceptional flowering of physical and mathematical sciences, especially of Astronomy during the last three centuries of Byzantium mainly during the times of the Palaeologi (1258–1453). Speaking about these times *Tannery* writes: “Si ils n’ont pas eu un grand genie, ils n’en sont pas moins, comme sciences et comme connaissances philosophiques, tout à fait à la hauteur, sinon audessus de la plupart des auteurs occidentaux” de la même époque¹⁸. We are now before a period of intense revival of letters and sciences. We shall refer to the chief representatives of that period. They are:

Nicephoros Blemmydes (1197–1272), who according to Bréhier was “the most prominent sage of his time”. His “Epitome of Physics” (MPG, 142 1032–1302) is notable for its clarity, exactitude, and systematic presentation. In thirty-one chapters he expounds subjects of general physics, mathematics, astronomy and meteorology. He left an unpublished work on “Heaven and Earth, the Sun, the Moon Time and Days”. He also wrote an astronomical poem addressed to the King John Vatatzes (1241). He cherished a special esteem for Plato.

George Pachymeres (1242–1310). According to Krumbacher he was “the notable representative of

the multiformity of writing” during the thirteenth century. In his two-volume history he gives much information on natural knowledge. More notable and interesting is his “quadrivium” (*Quadrivium de Georges Pachymeres*, Roma 1940, p. ci 457) a pioneering work for his time. Pachymeres dealt with Diophantos and solved the problem of indefinite equations of second-degree.

Maximos Planudes (1260–1332) was distinguished as a mathematician. He wrote a work entitled: “A system of figures, called the great, according to the Indians” (1303) introducing the arabic numerical symbols for the first time into Byzantium. M. Cantor writes¹⁹ that the arabic figures were made known in Byzantium during the fourteenth century, but Tannery having made a more detailed investigation into the matter maintains that this system was already in use in the twelfth century.²⁰

Theodore Metochites (1260–1332) has been an exceptionally remarkable scientific personality, the greatest forerunner of the humanist renaissance of the fifteenth century, the precursor of the revival of astronomical studies in Byzantium and, according to H. Beck, the main representative figure of the world-view (Weltbild) of the fourteenth century. As is known, Aristotle was prominent in the West, while in Byzantium the study of Plato had already begun since the eleventh century. Metochites maintained that Plato should be seen as equal to, if not more esteemed, than Aristotle. He wrote several astronomical works, and contributed significantly to the cleansing of Astronomy from the impure elements and prejudice of astrology. We quote Fuchs’ very characteristic remark: “In the programme of the fifteenth century education, astronomy played an important part, the relevant preparation being made through the research of Manuel Bryennios and Theodore Metochites²¹.”

Theodore Meliteniotes (1361) was, according to Bréhier, “the greatest – next to Gregoras – astronomer of Byzantium”. He served as Rector of the Patriarchal School between 1360–1388. His work: “Astronomical Tribiblos” (1361) is a classic. In the first two volumes he uses the original works mainly of Ptolemy, but also of Pappos, Theo, and Philoponos, and in the third he highly praises Astronomy as a science and attacks astrology and sorcery. This work has been characterized as “the most erudite astronomical writing” (Krumbacher) and “the most voluminous and most scientific astronomical work of the entire Byzantine era.”²²

Another most remarkable figure of Byzantium was *Nicephoros Gregoras* (1295–1359/60) who through his entire scientific and many-sided activity, became

17. This was published by L. Weigl under the title: Johannes Kamateros Εισαγωγή Ἀστρονομίας (An Introduction to Astronomy) Leipzig and Berlin 1908, p. 142.

18. P. Tannery–J. Heiberg Vol. IV 1920, p. 427.

19. 1907, p. 511.

20. 1920, p. 205.

21. 1926, p. 64.

22. Tatakis, 1949, p. 244.

the pioneer astronomer of his time. He calculated all the eclipses of the sun for the preceding one thousand-year period, and foresaw many such eclipses of the sun and the moon for the future. He constructed an original astrolabe (having in mind the works of Ptolemy, Synesios of Cyrene, Hammonios and Philoponos), and closely studied the question of the calendar and of the determination of Easter Day (paschalion). He ascertained the error that had been made in the calculation of the first full moon after vernal equinox, and on the basis of his whole study he drew up a draft for the correction of both the calendar and the determination of Easter Day Paschalion. This draft he submitted for discussion before a group of learned men known as "The Logical Assembly" (λογικὴ πανήγυρις) and subsequently to Emperor Andronicos II in 1234. After a long discussion the Emperor was convinced that the correction was right and was willing to put it immediately into operation. But as Gregoras writes in his History, he did not do so "in order not to raise confusion among the ignorant, and cause a division in the Church for which he had so much toiled". (Ἄλλ' ἵνα μὴ τοῦτου σύγχυσις μᾶλλον τοῖς ἀμαθέσι φανῆ καὶ μερισμὸν ἐπαγάγῃ τῇ Ἐκκλησίᾳ "ἦν αὐτὸς πολλοῖς τε ἴθρωσι τε καὶ πόνοις συνεστήσατο" σεσιγήμενον ἄφηκε τὸ πρᾶγμα καὶ ὄλωσ ἀνεπίρητον).

Gregoras' disciple, *Isaak Argyros*, a mathematician, astronomer and theologian, who continued his teacher's struggle for the correction of the Paschalion, informs us further that the draft of the calendar reform had been submitted to a committee of Church representatives who praised it and expressed the opinion that it should be put into effect. Unfortunately the reform was not made in 1324 but in 1578 by Pope Gregory XIII. Had it been made at that time the calendar would perhaps have still been called Gregorian in honour of Nicephoros Gregoras. L. Bréhier writes that of all the works of Gregoras those that are marked by a "véritable progrès" are the "forecast of the eclipses" and the "draft correction of the calendar" (1950–p. 448), while R. Guilland regards more notable the works on "the astrolabe and the Paschalion". These assertions are significant pointers to the value of Gregoras' astronomical work. Gregoras fought, decisively against the astrologists who were by no means negligible in number. There were many of them in Byzantium as well as in the West and in Arabia where even distinguished astronomers were not quite free from this kind of superstition.²³

In Trebizond, *Greg. Chioniates*, *Manuel, K. Lukites* and *G. Chrysokokkis* became known as celebrated astronomers (circa 1335–1336). In Byzantium there were *G. Acropolites* (1220–1282), *M. Moschopoulos* and *Nic. Rabdas* who, in about 1341, wrote two mathematical treatises one of which, according

to M. Cantor, "constitutes the first Civil Arithmetic known to us".²⁴ In the steps of Gregoras, *N. Cabasilas* wrote a commentary on Ptolemy's *Almagest*, and as Cantor notes²⁵, through him begins a new generation "which prepares the revival of classical science in Europe". To this revival great contribution was made by humanists such as *G. Scholarios* (mid-fifteenth century) and *G. Gemistos* or *Plethon* (1355–1452). Gemistos wrote a treatise on the calendar where he suggested the introduction of a special Lunar-Solar Calendar. He believed in the sphericity of the earth, and contributed much to the publicity of Strabo's works in the West where they were quite unknown before the fifteenth century. Moreover, he inspired Cosmas the governor with the idea of establishing a Platonic Academy in Florence, Italy.²⁶

V. General Conclusions

The following conclusions may be drawn:

1) The Byzantine period is a continuation of the classical and Alexandrian era. During the Byzantine period the scientific and hellenic texts were further cultivated.²⁷ Bréhier writes: "Without any interruption the public schools of the late classical antiquity continued their activities within the Eastern Empire and similar schools were set up in Constantinople. The basic lines of operation and outlook of these establishments remained the same".²⁸ "Despite any inevitable opposition or misunderstanding, the ancient and the Christian worlds were harmoniously united in Byzantium so that the assiduous study of Greek texts went on especially from the fourth century onwards", writes M. Stephanides (p. 212), a specialist in the history of physical Sciences. "Christianity was from the very beginning favourably disposed to the tradition of learning"... "The close link between the Greek and the Christian culture means remained firm", observes (p. 451) the historian S. Kougeas.²⁹

26. After the occupation of Greece by the Turks (1453) the scientific movement was naturally interrupted. Later on, however, the cultivation of natural sciences especially of Astronomy started again under the conqueror's rule. (See *D. Kotsakis: Die Astronomie in Griechenland am 18. Jahrhundert., Med. Lunds. Astr. Observatory, 1939. Also, same writer: L'étude de l'astronomie chez les Grecs au XVIII siècle, Lund 1940.*

27. Kotsakis, 1982, 1983, p. 87.

28. 1950, p. 456.

29. E. Gibbon wrongs early Christianity in making it responsible for the downfall of the Roman Empire «let his love for the Rome lead him into sarcasm in dealing with the early Christianity which he makes responsible for her downfall». S. Runciman admitting this great injustice writes that, although a great historian, Gibbon was not such for medieval Greece and that he could have easily been called a Roman. Although he admired classical Greece he never understood the Greek spirit. He despised the Byzantines and considered them as Greeks who were the usurpers of the heritage of Rome (Runciman, S.: *English Historians of Medieval and Modern Greece, Anglo-Greek Review, Athens 1946, p. 106–107* (in Greek).

It is rightly observed that «worst of all, the calm judgement is sometimes obscured where Gibbon's prejudices and prefe-

23. Kotsakis, 1954, p. 228 and Heller, 1882, p. 202.

24. 1907, p. 517.

25. *ibid.* p. 509.

2) Astronomical and mathematical sciences were not cultivated in Byzantium as in ancient Greece. After the first scientific period (sixth to third century B.C.) a turn began to appear in the sciences from the second century B.C. In Byzantium, Architecture, Engineering, Shipbuilding, Metallurgy, Art, Painting, Sculpture and the art of Decorating were intensely cultivated. In the field of Art the sense of *beauty* of the classical antiquity and the sense of *highness* of medieval times were harmoniously and successfully united. The cultural contribution of Byzantium was vast. Its beneficial influence was felt in Asia – as far as India and China – in Egypt and Africa, in Russia, Western Europe and the British Isles.

3) To a certain extent the astronomical and the mathematical sciences were also cultivated. The other peoples (in the near and far East) did no *more* than collect observation material, while in ancient Greece *pure science* was first cultivated through the introduction of 'the theory of proof' especially in Geometry, (an achievement peculiar to the Greeks). The Byzantines by publishing and commenting on ancient, scientific texts contributed to the progress of science, the more so as they often expressed original ideas. The spiritual potential flowering of science in Byzantium was the result of internal causes. The Greeks felt again the power of their own superiority and their long tradition. The contribution of the Arabs to the revival of sciences in Byzantium was very poor. Their science soon collapsed and the Byzantines came back to their original sources.³⁰

4) The fact that persistent attack against astrology and apocryphal sciences was carried out at that time, constitutes a proof of the right scientific approach to various problems and of the critical ability of the Byzantines. Fathers of the Church, Church Councils and Byzantine Sages condemned astrology and recommended pure science.³¹

5) There is a general consensus among scholars that Astronomy and Mathematics were particularly cultivated during the period of the Paleologi. Krumbacher characteristically writes: "N. Blemmydes, G. Pachymeres, Th. Metochites and N. Gregoras did no less for empirical and natural research in the limited circle of Byzantium than R. Bacon did in the West."³²

As regards Gregoras, it can be said that he stands at an even higher level, if one bears in mind what A. Crombie and E. Dijksterhuis say about Bacon.

6) The Greek historian, Professor J. Karagiannopoulos writes: "Byzantium is a State of Orthodox Christian dogma and religion, which, however, did

rences are involved» (*Everyman's Encyclopaedia*, Vol. VI, 4th ed. London 1958, p. 749).

30. Krumbacher 1897, p. 437, Heller 1882, p. 162–165, Dijksterhuis 1956, p. 326.

31. Kotsakis 1983 p. 69.

32. 1897, p. 437. As we have already shown elsewhere (1956A, p. 21–23) Krumbacher's statement is absolutely right.

not use clergymen in administration and, by law, prevented them from interfering in the affairs of the State. Consequently, it is a secular State. Its society draws upon the cultural traditions of Greek antiquity, at the same time, however, it is inspired by the Christian spirit and is led by the Christian moral law". Further on, the same researcher writes: "The Byzantine Church, in spite of its weakness and faults, in spite of its dark periods – which are unavoidable in every earthly institution – raised figures of distinguished virtue and piety; it was spiritually united with the people and after the fall of the State, during the dark centuries of servitude (1453–1821), it succeeded in keeping the nation united and capable to regain its lost freedom".³³

7) The spiritual and scientific flowering of Byzantium would have been accelerated if it did not succumb to the Mohamedan force. In any case the flowering of sciences was carried to the West long before the fall of Constantinople (1453). After this Fall, however, the Byzantines who came to the West helped to create the Italian Renaissance of the fourteenth and fifteenth centuries and the whole scientific movement that followed in Western Europe.

8) In conclusion we may repeat the confirmation of L. Bréhier and P. Valéry: In Byzantium we find united the three basic elements of the European Civilization: Hellenic Thought, Roman Law and Christian faith.

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