The genesis of the term "cataract" in respect of cataract by Piotr Nogal

Theses of the author that contradict the existing knowledge of the history of medicine/ophthalmology:

- 1. Babylonians performing cataract surgery over 4000 years ago perfectly knew the anatomy of the eye.
- 2. The term "cataract" is not derived from the beliefs in the flow of the mysterious substance like a waterfall from the brain to the eye, which contradicts the thesis about irrational treatment of the etiopathogenesis of cataract by ancient Mesopotamians and Egyptians.

"Cataract" is an ophthalmological disorder whose essence is lens opacities, blurred vision up to and including practical blindness. Up until just a few decades ago, the term "cataract" was unknown for the majority of the population, but due to improved awareness and a significant increase in the percentage of people in the population suffering from this disease, it has become a well-known term.

It is worth, though, focusing for a moment on the genesis of the name "cataract" for lens opacities and giving due respect to the ancient pioneers of ophthalmology. The author of this paper found it highly satisfactory to investigate history, including the history of medicine in this area, and to establish the most likely explanation for having the disease named "cataract" by an ancient civilization that invented the first way how to treat this disease surgically.

While the first records of eye surgery in the history of mankind come from India before 4500 BC, naming the disease "cataract" appears in the history in the area of Mesopotamia and Egypt along with the descriptions of the methods of treatment several thousand years BC. It is in the ancient Babylon that the first records of the disease itself and its surgical methods appear; first they were performed using a bamboo knife, and then with a bronze spike. The beginning of the surgical treatment of cataract documented in the history of medicine is considered to be the date of publication of the Code of Hammurabi (Babylon); the 18th century BC, which, among 13 columns of cuneiform script concerning doctors, provides paragraphs about ophthalmologic surgical treatment (*Orłowski J., "Contemporary Ophthalmology", Volume 3; Introduction*). The author justifiably points out that the history of cataract surgery in Mesopotamia is certainly older than the Code of Hammurabi itself, which refers to the already existing method of treatment.

Up to the publication of this paper it was assumed in the history of medicine that the term "cataract" originated from the beliefs of the ancient in Mesopotamia and Egypt that cataract is the result of the flow of inflammatory fluid, causing lens opacities, from the brain into the eye, like water from the river cataract (waterfall). Such prevailing knowledge is also referred to by Polish ophthalmological authorities, including the late Prof. B. Iwaszkiewicz-Bilikiewicz:

"It was once believed that inflammatory fluid flows from the brain into the eye, like a waterfall, causing blindness - hence it was called cataract. The Polish term - cataract - illustrates the lens opacities observed within the clouding of the pupil." (Prof. B. Iwaszkiewicz - Bilikiewicz, GERIATRIA 2008; 2: 252-254)

or Prof. E. Wylęgała in an interview for Gazeta Wyborcza of 14.05.2014 entitled "We owe cataract surgery to pilots and a dentist" ("...In ancient times it was believed to be caused

by the liquid dashing down from the brain into the eye. Hence it is called cataract - derived from the thresholds of the Nile. In Babylon the clouded lens was pushed inside the eye with a spike or a stick. [...] The Babylonians "performed operations" not knowing the structure of the eye.").

Would it be appropriate that we agree with the interpretation of the term "cataract" that prevails in the history of ophthalmology? And with the fact that the Babylonians used to perform operations not knowing the structure of the eye? Do we have the right to discredit the civilisations of Mesopotamia and Egypt, the largest and most developing ones in the history of mankind, in this way to recognize them as "superstitious savages, poking in the eye with a stick" without the knowledge of its anatomy? Did such great civilisations, which developed medicine from scratch, described anatomy and performed successful skull trepanations in a hot climate in the age of no antibiotics, really believe that something resembling the cataracts on the Nile flows from the brain into the eye? Certainly NOT!!! The analysis and evidence on these theses are presented by the author below.

Let the reference to the next paragraph be an amazing fact invoked by Prof. J. Orłowski; the Babylonian method of surgical treatment of cataract of more than 4000 years ago ("depressio seu reclinatio lentis"; pushing the lens into the vitreous humour) did not change until the 18th century of our era! (Orłowski J., "Contemporary Ophthalmology", Volume 3; Introduction)

In order to contradict the prevailing to date theses of superstitious and, nomen omen, blind "faith" of the ancient in the bizarre, in terms of anatomy and physiology, cause of the lens opacities due to some "cataract from the brain into the eye", and theses that ancient Babylonians performed eye surgery without the knowledge of its structure, it is worth focusing briefly on the achievements of these two civilizations, especially the Mesopotamian one, because it is where the earliest records of surgical treatment of cataract come from.

The first traces of human presence within Mesopotamia come from the Paleolithic Age of more than 100 000 years ago. The Sumerians, who lived in this area, had probably arrived there from Asia (presumably from areas of Vietnam and India) in the 4th millennium BC. They built irrigation systems, which helped them develop the agriculture of Mesopotamia, invented the wheel and then the pottery wheel. They used metal tools which were produced using copper. They invented a technology of bronze production. One of the most important achievements was the invention of writing by the Sumerians (the end of the 4th millennium BC). They developed a fixed system of weights and measures. The unit of length was cubit and the units of weight were mina (approx. 1/2 kg) and talent (approx 30 kg). They also used the decimal and sexagesimal numeral system and created the calendar based on the Moon phases. They developed the bases of mathematics, geometry, astronomy. The Hittites (one of the peoples of Mesopotamia) were the first to produce iron. In the 3rd millennium BC the Sumerians were conquered by the Akkadians, who did not destroy the culture of the defeated, but developed it. Another migration wave of Semitic Amorites led to the ultimate collapse of the Sumerians and formation (in the 19th century BC) of the new power in Mesopotamia, a state called Babylon. The creator of the greatest power of Babylon was the most known ruler of the so-called Old Babylonian state, king Hammurabi (ruling from c. 1728 BC to c. 1686 BC). He went down in history primarily as the codifier of law. The Code of Hammurabi is of great importance for historians, including for us in the present case. It allows us to find out about the standards of social life and everyday life of the then inhabitants of Mesopotamia of that time. In the code the famous principle of equivalent punishment for the criminal, "eye for an eye, tooth for a tooth", was introduced.

Hammurabi's Code also describes the principles of medical liability for harm done to a patient by failed treatment of cataract or lacrimal sac abscess! Does that not constitute a very strong indication (even proof) that anyone who undertook surgical treatment of cataract and lacrimal bag abscess had to fully understand the anatomy of the eye in order not to have their hand cut off as compensation for the harm (implicitly, for complications after surgery)?! None of the current trainee specialist doctors in ophthalmology, who after all already know the anatomy of the eye, would not pursue at any price for a place at the operating table not knowing yet precisely dependencies governing the eye physiology during cataract surgery and yet without surgical technique at the appropriate level if so radical punishments were involved in terms of possible liability for complications during the surgery. Everyone would care about training their hand and getting to know the anatomy and physiology of the eye best before they touched it with a surgical tool. After all, we have only two hands and losing either of them means the end of the surgical career for a physician.

Thus, having analysed the Code of Hammurabi, we can be almost sure of excellent knowledge of eye anatomy among Babylonian surgeons and suspect that like nowadays, when young eye care practitioners go to India and Africa to do "surgical training courses" under the guidance of great teachers on the eyes of poor volunteers affected with cataract, those young surgical trainees in Babylon probably learnt the surgical technique on the eyes of volunteering slaves who could also not afford to pay for their treatment. Hammurabi's Code actually assumed only a financial penalty for eye damage in the case of a failed treatment of a slave, and not loss of hand by the doctor as in the case of a failed surgery performed on a full citizen of Babylon.

We do not know exactly where the word "cataract" was used for the first time in relation to cataract. All the more so because during the period of Middle Kingdom of Egypt (approx. 2133 - approx. 1786 BC), and therefore in the age of thriving Hammurabi's Babylon, the two states very beneficially intensified their mutual trade relations, and thus probably exchanged information and technologies, including terms for human diseases and their treatment methods. And so the achievements of the Egyptian civilisation should be briefly described.

In Egypt mathematics was developing - volumes and surface areas of prisms, cones, cylinders and cuboids were calculated. Stone processing and articles of glass were successfully dealt with as well. Hieroglyphic, hieratic and demotic scripts were created. The Egyptians developed and utilized the water clock and the calendar which became the basis for the invention of the Roman and the Gregorian calendars. Astronomy was being expanded and phenomena on Earth were being anticipated, which were conditioned by dependencies observed in space. Finally, the Egyptians created incredibly technologically advanced structures (until now the methods of implementation of the pyramids or temples are not known, in which rock blocks weighing between ten and twenty tonnes and having irregularly interlocking shapes formed a structure lasting for thousands of years without any binders). Medicine was at a high level - scull trepanations were performed, the structure of the human heart was known. Corpses were mummified, which were preserved in a great condition for thousands of years! The awareness of the human body construction, including the skull, was therefore much higher than a few thousand years later in medieval Europe.

Thus we can be confident that both of these civilisations described above were too highly developed to, firstly, "poke in the eye with a stick without the knowledge of anatomy", and secondly, to give a name "cataract" to lens opacity due to almost superstitious "beliefs" in "irrational flow of the clouding into the eye from the brain".

The author posed himself the question: where did the term "cataract" in the ancient ophthalmology really derive from? The answer seems to be interesting and simple at the same time. It constitutes another discovery of the author in medicine, which the Reader of this paper will become easily convinced of after referring to the following evidence.

It is a highly probable thesis of the author that in the history of giving lens opacities the term "cataract" a mundane life event played a role, which was associated with a contact with a river cataract (waterfall) in the childhood, youth or older age by a man who due to lens opacities later suffered deterioration of vision and not knowing how to describe the vision deteriorated by cataract compared it by reminiscences of seeing "through waters of a cataract". So let us imagine an Egyptian who is swimming in the Nile near a waterfall or walking to the other side under a waterfall (cataract) and looking through the stream of water regularly flowing down. Many years later, brought as an old man on a donkey in a merchant caravan to Mesopotamia for his cataract surgical treatment and asked by a Babylonian ophthalmologist how he can see he replies that as if through a river cataract... giving at the same time to this disorder the term "cataract", which has been prevailing in ophthalmology for all time.

Fig. 1, 2 : pictures of a swimming pool "cataract" (waterfall) through which the author took the experimental photos; image is seen differently through water flowing down than through the air near the waterfall.





Fig. 3 : picture of objects in near and distance vision taken with a camera "through the air"; image without "cataract" (in the photos there is the swimming pool and my daughter's book in LED lighting; such lighting in modern cars causes the greatest problems in road traffic to patients with even only initial subcapsular lens opacities)



Fig. 4 : picture of the same objects taken through the swimming pool waterfall ("cataract") just after its start; the waterfall stream thickness is initially low, the image is relatively clear.



Fig. 5 and 6 : pictures taken one after the other, after picture no. 4 (above) and in the same lighting conditions as the pictures above. All 3 pictures through the "cataract" were taken every 0.5 seconds from the waterfall start, through water increasingly flowing down (the optical medium is increasingly less stable and increasingly more non-transparent). This situation may correspond to increasingly stronger lens clouding in the process of lens opacities in the human eye and aptly illustrates the deterioration of vision in a patient with intensifying cataract.



On the above photos all the visual symptoms typical for "cataract" in the human eye can be seen, which have been reported by cataract patients coming to us (deterioration in visual acuity impossible to correct by wearing glasses, blurry vision, reduced contrast and colour vision, scattering of light; glaring and the "halo" effect around light points, especially LED ones, the impression of excessive light brightness, etc.)

And here is the proof for solving by the author another medical puzzle, this time being the origin of a genius in its simplicity term "cataract" given by people who thousands of years ago in Mesopotamia and Egypt built the foundation for our civilisation, and who should be given apologies for doubts expressed by generations of modern doctors in rationalism and knowledge when giving the term "cataract" to cataract. They should be respected primarily for the fact that not being armed with advanced diagnostic, medical tools and antibiotics they created such methods of treatment as pushing cataract into the vitreous humour or successful skull trepanations, as evidenced by the traces of correct postoperative healing of cranial bones in post-mortem preparations of mummified corpses. Not only do we have no right to diminish our predecessors' achievements, but also it is worth focusing more on their achievements that allow us for the current development in medicine. And then we could also avoid overlooking a relatively simple, low-loading for patients and effective treatment method that was already invented several thousand years ago and which we (the "omniscient" circle of contemporary doctors) happened to make fun and even

mockery of, due to our misunderstanding of the message from before thousands of years... And yet always when something appears incomprehensible or "idiopathic", it is worth again humbly asking yourself the question: "Why?", and maybe even referring to the manuals of medicine written on papyrus, scrolls of parchment, clay steles or tablets...

At the end of this paper, being aware, to our excitement, that the website www.nogalmedicine.pl is visited by Guests from over 100 countries around the world, the author would like to draw attention to the achievements of Polish people in the history of cataract treatment and research, since they are pioneering in the world ophthalmology and it is worth reminding it to the Colleagues all around the world. These include Prof. W. Kapuściński, Senior and Prof. J. Sobański, who invented special tweezers in 1950 to remove cataract without removing the lens bag, or Prof. T Krwawicz, who developed in 1960 in Poland a special cataract cryo-extractor, introducing cataract surgical treatment to lots of smaller hospitals throughout the world that did not have expensive equipment to extract the disorder. The author, a physician seeking the mechanisms of diseases rather than operational methods, finds the pioneering research on lens biochemistry (soluble and insoluble protein in the lens) and lens changes in cataract by Prof. Helena Żygulska-Mach extremely valuable. She was one of the few who dealt with the search for the cause of cataract, which is most able to help the patient in preventive cataract treatment, that is avoiding it. In this way we can surely also avoid potential complications related to surgery.

A few weeks ago on the Internet information appeared about the creation of a robot in China who was treating teeth, which might replace dentists in the near future... A "robot" for surgical treatment of cataract (Femtosecond Laser) does already exist, so it is probably time to move again, like already mentioned Prof. H. Żygulska-Mach, in the direction of conservative medicine and find the causes of cataract and methods of its non-operative treatment, which was also mentioned in the article by Prof. E. Wylęgała cited above. Even and just not to be a few thousand years later accused of "poking" in the eye with an "archaic" phacoemulsificator or laser... when the causes of cataract seemed to be almost obvious and at our fingertips... well, actually within our intellect, which as yet no robot in medicine can replace...