

THE BIRTH OF CEPHALOMETRY (PART I)

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It is common practice in plastic and maxillofacial surgery to analyze the morphology of the face according to various measurements of the craniofacial skeleton, used as guidelines to correct deformities or disproportions. Today, one could not conceive orthodontic treatments or jaw surgery without the use of cephalometry.

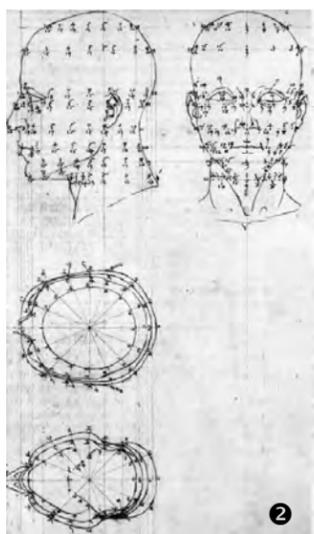
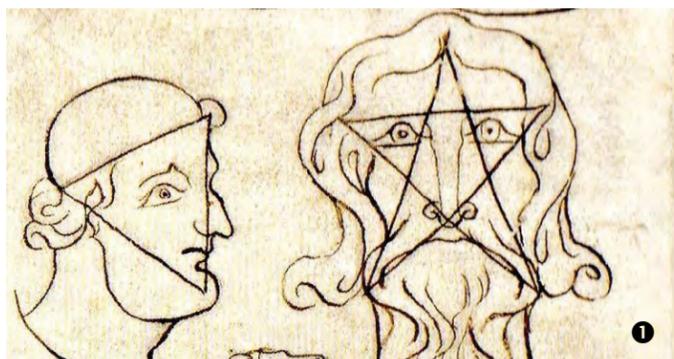
Before being used in medical practice, skull and facial analysis have a long history related to philosophy and art. Used initially to determine the beauty and the character related to particular facial features of a person, the analysis of the craniofacial skeleton progressively became a method for anatomists and physical anthropologists to describe human diversity.

Physiognomy

The analysis of human facial features in relation to beauty, intelligence and diseases has been a subject of debate since Antiquity, sometimes in the quest for ideal facial proportions leading to canons of beauty, the most famous being the Greek sculptor's Polycleitus (c. 450 BC). One century later, Aristotle (384-322 BC) described in his *Physiognomica* the art of reading one's character from one's bodily features. He compared male and female bodies and faces to those of various animals: males look like brave lions because of their larger mouth, squarer face, large eyebrows, while women are more like shy panthers. Since these early writings considering the face as a reflection of the qualities of the soul of its owner, numerous treatises have attempted to define and measure the various features of the human face, giving rise to the famous *Gold Numbers* or the *Divine Proportions* published in 1509 by Fra Luca Pacioli.

These studies had two applications that were sometimes combined: an initiation for painters or sculptors and recognition of an individual's character and personality. Painters like Villard de Honnecourt (13th century) (Fig. 1), Pietro della Francesca (1412-1492) (Fig. 2), Leon Battista Alberti (*De la pintura*, 1435), Leonardo da Vinci (Fig. 3), (a good friend of Fra Luca Pacioli), Albrecht Dürer (Fig. 4), (Vier Bücher von menschlicher Porportion, 1528), Pierre-Paul Rubens (*Théorie de la figure humaine*), (Fig. 5), have superimposed drawings of human faces with geometrical figures: circles,

squares, rectangles and triangles, adding sometimes a mensuration of the different parts. Following the physiognomic trend initiated by Aristotle, other philosophers and artists like Jean d'Indagine (*Chiromantia*, 1522), Giambattista Della Porta (*De humana physiognomia*, 1586), Charles Le Brun (*Traité de géométrie physiognomonique*, 1671) (Fig. 6) have emphasized the links between animal and human fea-



1. Villard de Honnecourt
2. Pietro della Francesca
3. Leonardo Da Vinci: *Grotesque heads*

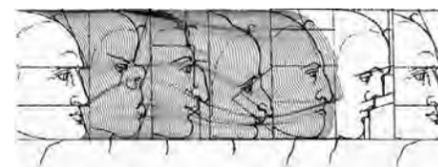


Figure 4: Albrecht Dürer: *Human proportions*



Figure 5: Pierre-Paul Rubens: *Theory of the human face*



Figure 6: Charles Le Brun: *Geometric physiognomy*



Figure 7: Johann-Gaspar Lavater: *From frogs to beautiful men*

During the 18th Century, the Swiss clergyman Jean-Gaspard Lavater (1741-1801) devoted a great part of his life and most of his writings to what he called *The Physiognomy* or the art to know the human beings according to their facial features. Like della Porta, he draws similitudes between the face of individuals and animals, establishing a gradation starting from the most perfect profile, represented by the classical Greek statues, to the ugliest frog-like faces. (Fig. 7) His objective was to create a true science of facial interpretation where beauty and ugliness are in exact relationship with moral beauty and depravity of men and women. As a man of faith, however, he refuted all links between animals and humans. Although criticized during his life for practicing a pseudoscience, he was also very admired by known philosophers and writers. Goethe, who was eight years younger, was particularly interested by this possibility to create a practical psychology and offered him several portraits with commentaries of his own. He also wrote the chapter on

skulls in one of Lavater's books. The friendship between the two men did not last because of their opposed religious beliefs.

The school of angles

Since the middle of the 17th century, scientists, anatomists and physicians also became interested in measuring the body and the cranio-facial structures, one of the first being the German Johann Sigmund Elsholtz, who proposed a system whose purpose was to correlate bodily proportions and diseases. He invented a special ruler the *Anthropometron* for his calibrations. *Anthropometria, sive de mutua membrorum corporis humani proportione et navorum harmonia libellus*, was published in 1663. During the 18th century, the physician Louis Jean-Marie Daubenton (1716-1800), a collaborator of the French naturalist Buffon, studied the point of junction between the vertebral column and the cranium, which he called the occipital foramen, and noticed that it varies between the animal species, being more anterior or posterior, according to the tilting of the head and its relationship with bipedia or quadripedia.

The real starting point of what has been called the "school of angles," precursor of our modern cephalometry, should be attributed to the Dutch surgeon and anatomist Petrus Camper, following his lectures on this subject in 1770 to the Amsterdam Drawing Academy. According to his new portraiture technique, an angle is formed by two lines, from the advancing part of the maxilla to the most prominent part of the forehead. Camper claimed that antique Greco-Roman statues presented an angle of 100°- 95°, Europeans of 80°, Orientals of 70°,

History, continued from page 50

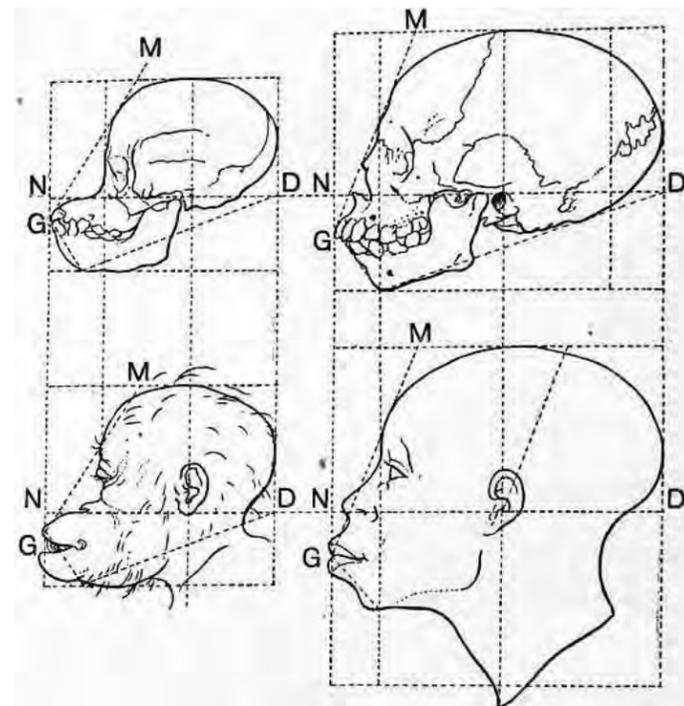


Figure 8: Petrus Camper: *The facial angles*

Black people of 70° and the Orangutan of 42-58°. Without judgment on the intelligence of their owners, Camper claimed that, out of all human races, Africans were the most removed from the classical sense of ideal beauty. (Fig. 8)

My main purpose is to consider the beauty of the parts of the human body, particularly the head. Nobody can deny that the heads of Apollo of the Belvedere, of the Venus of Medici and of the Laocoon are beautiful and would prefer them to our most beautiful individuals.

The facial angle allows not only to establish a distinction between skulls of various animal species, but also to trace a gradual line that results, in our view, from the reconciliation of the human varieties.

Since this first description by Camper, numerous scientists and physicians have referred themselves to this and other angles, to classify mankind according to the shape of their skull and facial structures with obvious prejudice. For example, Julien-Joseph Virey a French physician, naturalist and anthropologist wrote in 1801 a book called: *Histoire naturelle du genre humain ou recherche sur ses principes fondamentaux physiques et moraux*. Based on the facial angle, he distinguishes the different human types according to their cranio-facial shape.

The Celtic races have noble and proud figures, which can be measured by the facial angle. The more acute the angle, the face lengthens in a muzzle and shows an ignoble figure close to the beast; when the angle straightens, it takes a look of magnitude, nobility and sublimity. Ugliness indicates all the physical and moral dissoluteness.

The norma verticalis

In 1795, Johann Friedrich Blumenbach, a German Professor of Medicine, often considered as the father of physical anthropology, came up with a new classification scheme. In his book, *On the Natural Variety of Mankind*, he divided humanity into five varieties. He associated each with a particular geographic area—Negro (African), Mongolian (Asian), Malay (Southeast Asia), American Indian (American), and Caucasian (European). Blumenbach introduced the word Caucasian to describe the variety of mankind—the Georgian—that had originated on the southern slopes of Mount Caucasus. This was for him the most beautiful race. The other races represented degeneration from the original type, up to the further apart, the heads of Mongols and Negroes.

In his book *Decas Collectionis Sivae Craniorum Diversarum Gentium*, he illustrated 40 skulls from various origins. By the end of his life, Blumenbach owned the greatest contemporary collection of human skulls (what he terms his “Golgotha”): 245 whole skulls and fragments and two mummies. Unlike Camper, Blumenbach measured skulls along several lines. Placing scores of skulls of individuals from around the world in a line and measuring the height of the foreheads, the size and angle of the maxillaries, the angle of the teeth, the eye sockets, the nasal bones, and also Camper’s facial angle in profile, Blumenbach produced what he called the norma verticalis, that is the view of the skulls from above. A line is drawn at the maxillary level, allowing comparing the protrusion of the face in relation to the forehead in different skulls. (Fig. 9)

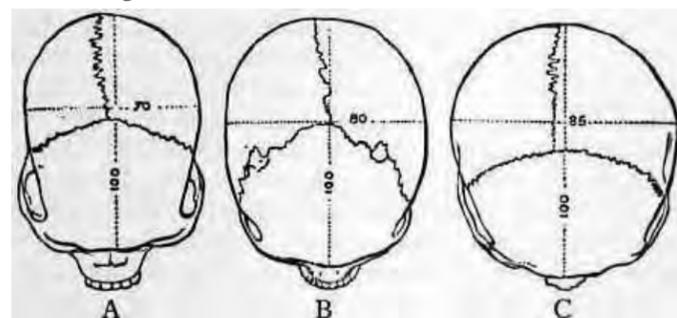


Figure 9: Johann Friedrich Blumenbach: *Norma verticalis*

Phrenology and craniology

The relationship between the osseous cranium and its content, the brain, lead a few anatomists to deduct that a small cranial capacity signifies automatically a small brain and small intelligence. Franz Joseph Gall (1758-1828), a renowned Viennese physician and anatomist has gone further in building a new theory according to which, intellectual, moral and emotional faculties are located in the brain in particular sites. The exterior aspect of the cranium will therefore reflect the development of this or that capacity.

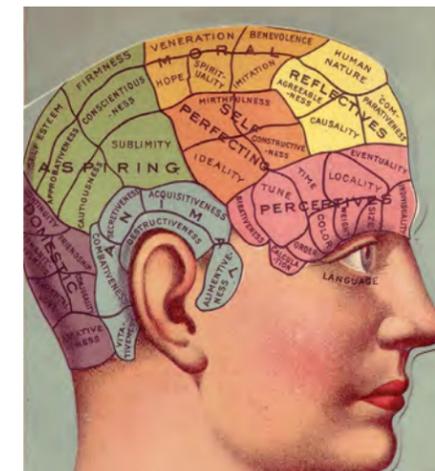


Figure 10: Franz Joseph Gall: *Phrenology*

He believed that the bumps and uneven geography of the human skull were caused by pressure exerted underneath from the brain. The brain was divided into sections that corresponded to certain behaviors and traits that he called fundamental faculties. (Fig. 10) There were 27 fundamental faculties, among them were: recollection of people, mechanical ability, talent for poetry, love of property, and even a murder instinct. Based on the surface of a person’s skull, Gall could make assumptions about the person’s fundamental faculties and therefore their character. Although mocked by many of his contemporaries, Gall’s methods, that he called craniology, had an enormous success particularly among writers and teachers trying to find out the positive or the negative bumps of their pupils.

The cephalic index

Another type of skull measurement was determined by Anders Retzius, a Swedish professor of anatomy, initially to classify ancient human remains found in Europe. He classed skulls in three main categories; “dolichocephalic” (from the Greek dolikhos, long and thin), “brachycephalic” (short and

broad) and “mesocephalic” (intermediate length and width). The cephalic or cranial index is the ratio of the maximum breadth to the maximum length of the skull, multiplied by 100. In his book *Om Formen af Nordboernes Cranier* (1843), Retzius supposed that it was possible to establish the mental and moral capacities of a man thanks to these measurements. For him, the dolichocephalic people that are the Nordic Whites were superior to the brachycephalic Blacks. Today, the cephalic index remains an important parameter for ultrasound biometry of the fetal head.

Facial forms

Sir Charles Bell (1774-1842), best known for having described the so-called Bell’s palsy, has written several essays on the anatomy and philosophy of facial forms and expressions where he criticized Lavater, Camper and Blumenbach, proposing a new method of analyzing the facial features for expressing beauty, underlying the importance of the relationship between the forms of the skull and the face as expressed by the various functions, such as the organs of mastication, speech and expression.

By this more accurate method of measuring the skull having been brought to observe distinctions not only in the cranium and bones of the face, but in the face itself, and in the cranium independently of the face, I wished in the next place to consider more at large the varieties in the form of the face, and the reason of the secret influence of certain forms on our judgment of beauty. From the examination of the heads both of men and brutes, and of the skulls of a variety of animals, I think there is reason to say, that the external character both of man and brutes consists more in the relative proportions of the parts of the face to each other, than has been admitted.

Initially, cephalometric analyzes were mainly concerned with the concept of beauty and ugliness comparing the facial features of mankind and animals. These measurements and angles served as tools of education for painters and sculptors, and also often for writers to describe the character of their heroes. Since the 19th century, doctors became more and more interested in these methods of craniofacial recognition to acknowledge the indices of mental disease, depravation and crime of an individual. We shall see in a next article a few incredible theories and misjudgments by some notorious scientists using these theories. ISAPS