

A PHYSICAL ANTHROPOLOGIST ON THE CRANIOFACIAL TEAM

John C. Kolar, PhD
Medical City Children's Hospital
Dallas, Texas

Wait a minute! I thought anthropologists

Study “primitive” cultures

Dig up prehistoric cultures

Study old bones and fossils

All of this is true, but

Physical anthropologists also study living people:

1. They study physical differences among living populations
2. They study human growth and development
3. They study human engineering

How do we study these subjects?

ANTHROPOMETRY

What is anthropometry?

The measurement of the human body and its individual parts.

Where did anthropometry come from?

A BRIEF HISTORY OF ANTHROPOMETRY

Until the late Renaissance, the only way to measure the body (or pretty much anything else) was through the use of

CANONS

Rules of simple proportionality

CANONS

Canons were based on the idea of using one thing to measure another, especially body parts.

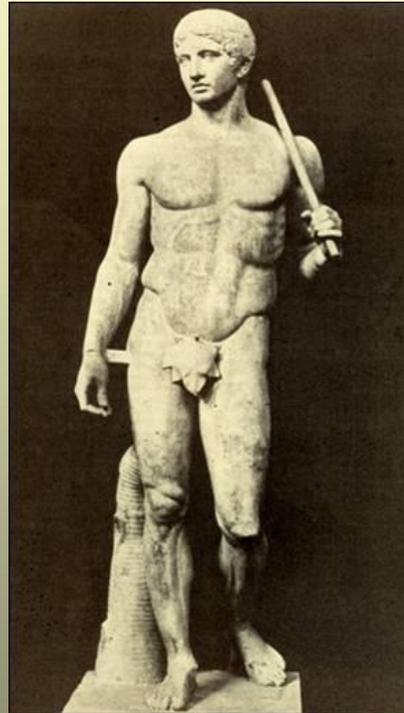
For example:

Cubit – the distance from the tip of the flexed elbow to the tip of the middle finger (@ 18 inches)

Hand – the width of the palm of the hand (@4 inches)

Classical Greece and Rome

The early Greeks and Romans continued to develop these proportions for the human body:



The Lancebearer (“The Canon”)
Polycleitus (5th century, B.C.)

Neoclassical Canons of the Renaissance

During the Renaissance, artists such as Leonardo DaVinci, Albrecht Dürer, Cennino Cennini, and mathematicians Piero della Francesca and Luca Pacioli, re-discovered the Greco-Roman canons and started to experiment with proportions of the head, face and body, including:

3-Part Facial Canon – the face is divided into three equal vertical parts:

forehead height = nose height = lower face height

Orbital Canon – the distance between the eyes is equal to the lengths of the eye fissures

ANTHROPOMETRY

How did we get from these artists and their canons to the use of measurements for studying the human form?

We can thank one person:

Johann Sigismund Elsholtz



Anatomist, botanist, hygienist, early experimenter with distillation and intravenous infusion

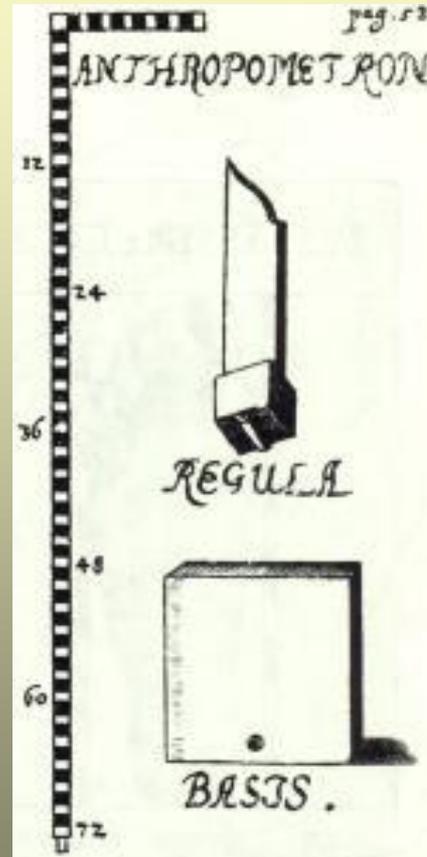
WHO?

Johann Sigismund Elsholtz (1623-1688)

Elsholtz received his PhD from the University of Padua in 1653. He published his PhD thesis, "*Anthropometria*" in 1654.

Elsholtz studied the symmetry of the human body. His problem was that there was no instrument to measure the body and no standard system of measurement, so he invented both:

The Anthropometron (1654)



The Anthropometron

Elsholtz's instrument was a vertical rod, which he divided into 6 equal segments he called "pedis" (feet). Each pedis was subdivided into 12 equal segments, which Elsholtz called "uncias" (inches) – the first standard ruler.

Elsholtz completed his instrument by attaching a horizontal slide and a detachable base, so the anthropometron would be portable.

Other scientists adopted Elsholtz's instrument and we have been measuring ever since.

Except Elsholtz

Once he got his PhD, Elsholtz, like many other PhDs abandoned his research for other interests.

He became court botanist, alchemist, and physician to the Elector (Duke) of Brandenburg in Germany and studied:

Botany

Distillation

Intravenous Injections

Nutrition & Hygiene

The Beginnings of Anthropometry

During the eighteenth century, anatomists started to measure height and weight of children to study their growth. Many of them still used variations of the canon system to describe body proportions, but the use of measurements was about to take its second scientific leap, courtesy of

Karl von Linné (Linnaeus) (1707-1778)

Linnaeus was a Swedish botanist and physician who developed a system for classifying all living organisms

He published *Systema Naturae* in 1735, which established the modern system of biological classification.

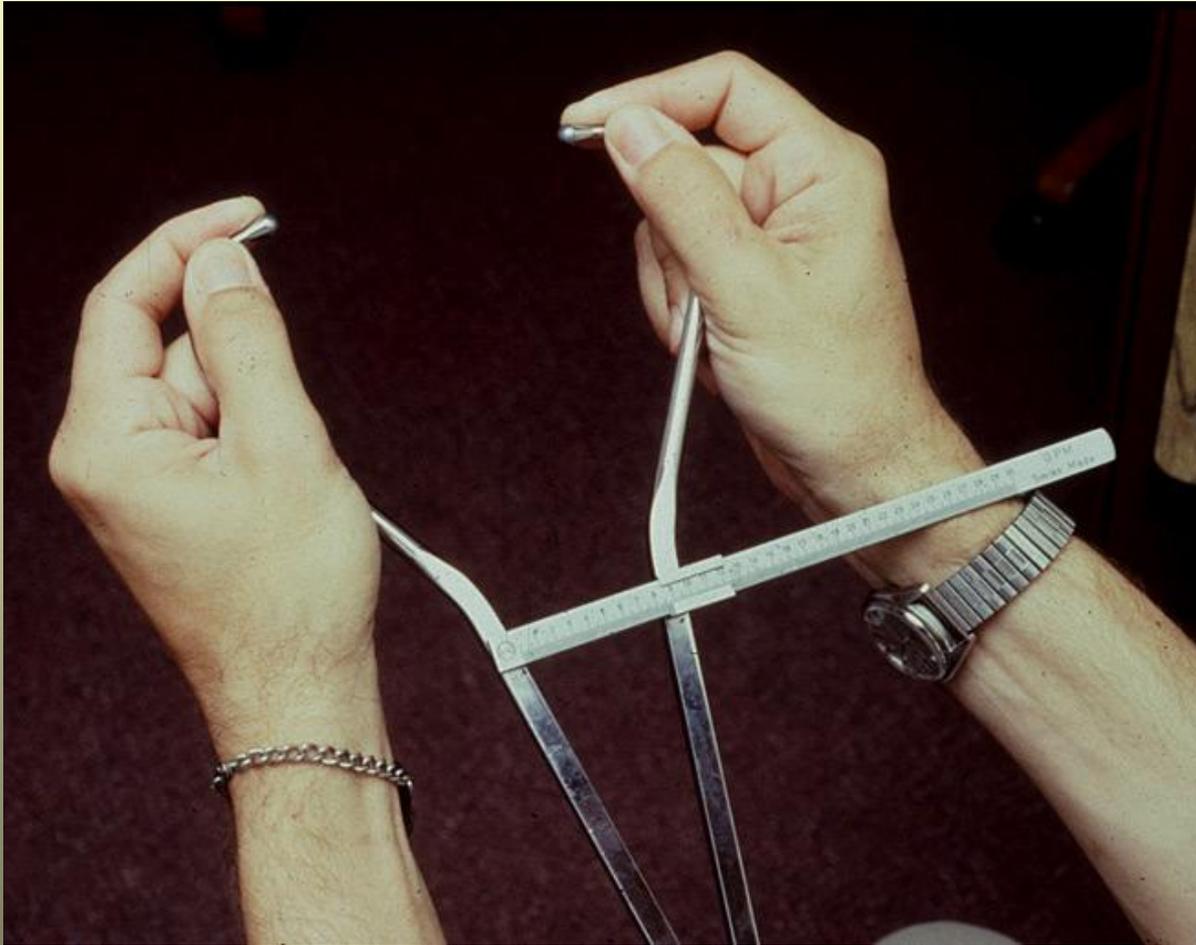
Among the many things scientists classified were living human populations. Some of their work was based on visual observation, but others measured people to compare the size and shape of the human body, including the head and face, in different populations.

CRANIOFACIAL ANTHROPOMETRY

Measurement of the head and face of living subjects.

Traditional anthropometry uses simple instruments to take these measurements, most of which were invented in the late eighteenth and early nineteenth centuries.

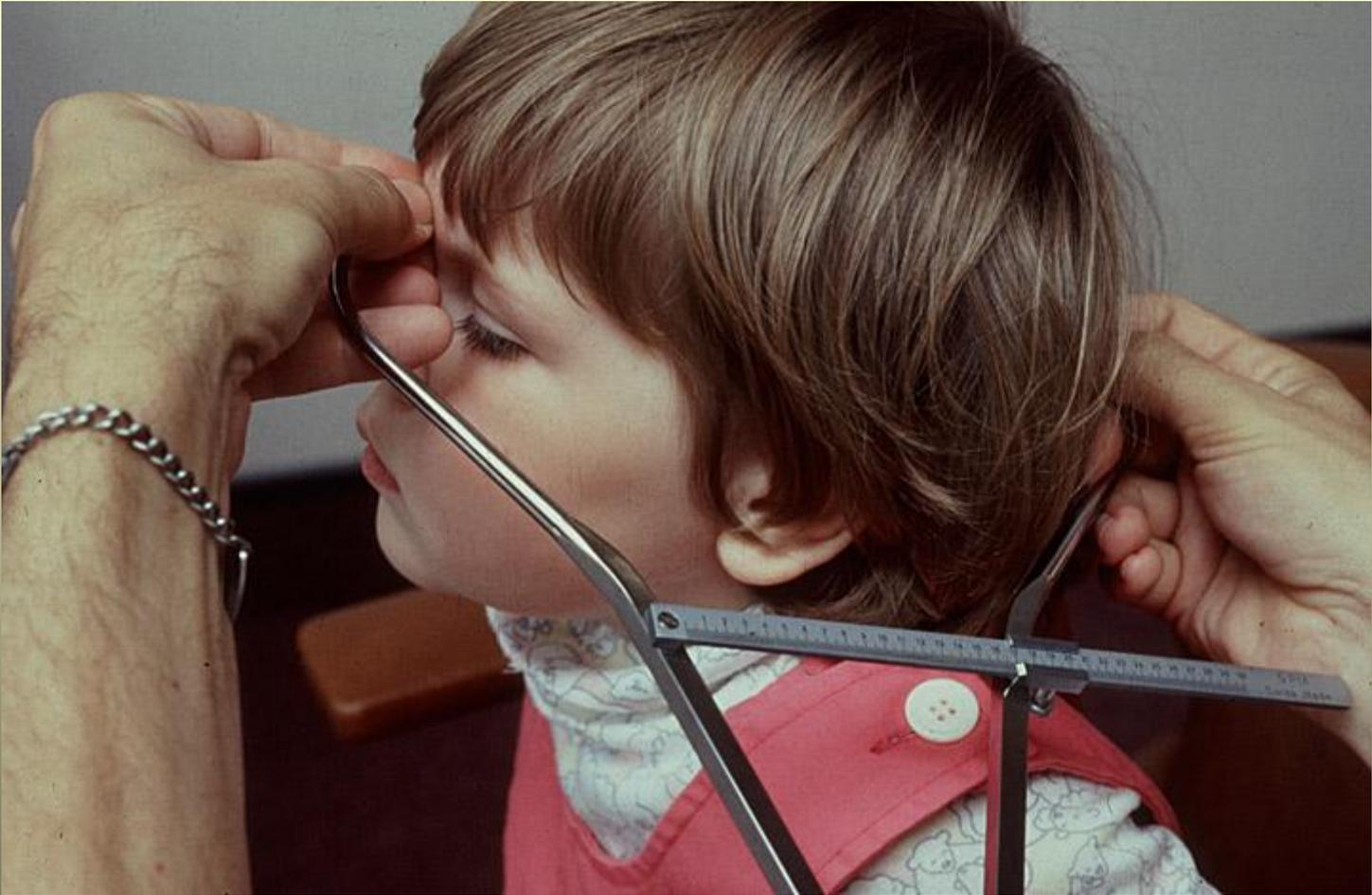
SPREADING CALIPER



HEAD WIDTH



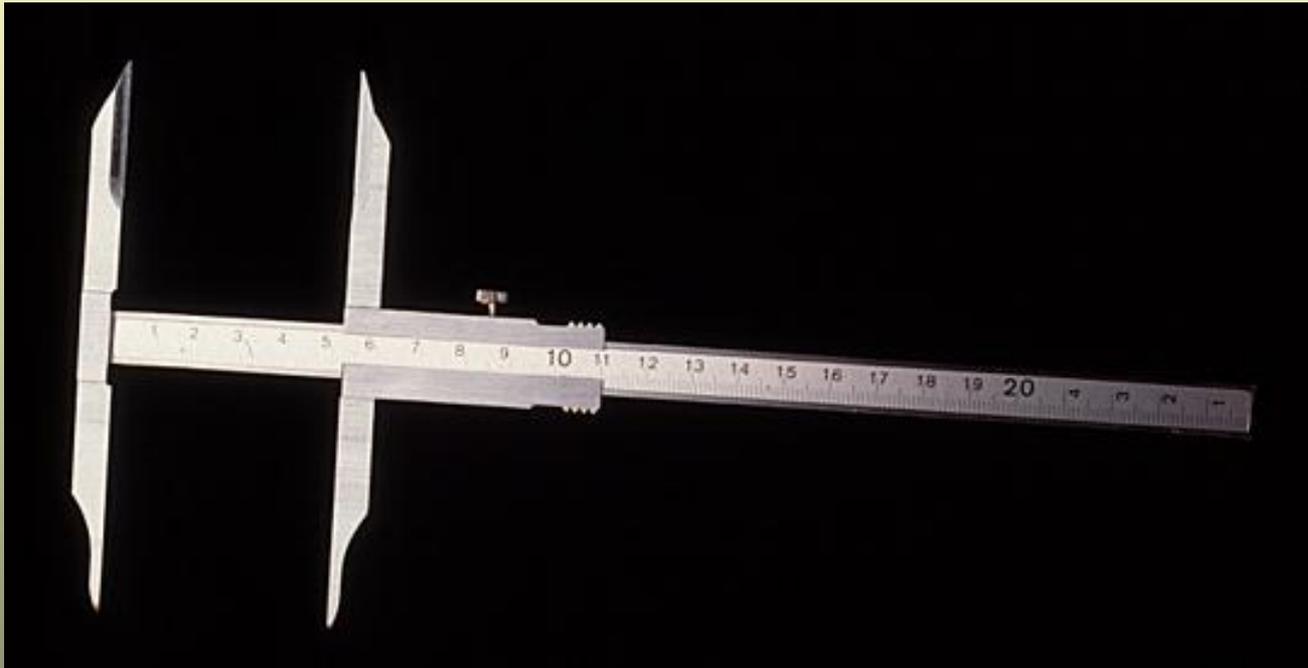
HEAD LENGTH



Cephalic Index (Anders Retzius – 1843)

$$\frac{\text{Head Width} \times 100}{\text{Head Length}}$$

SLIDING CALIPER



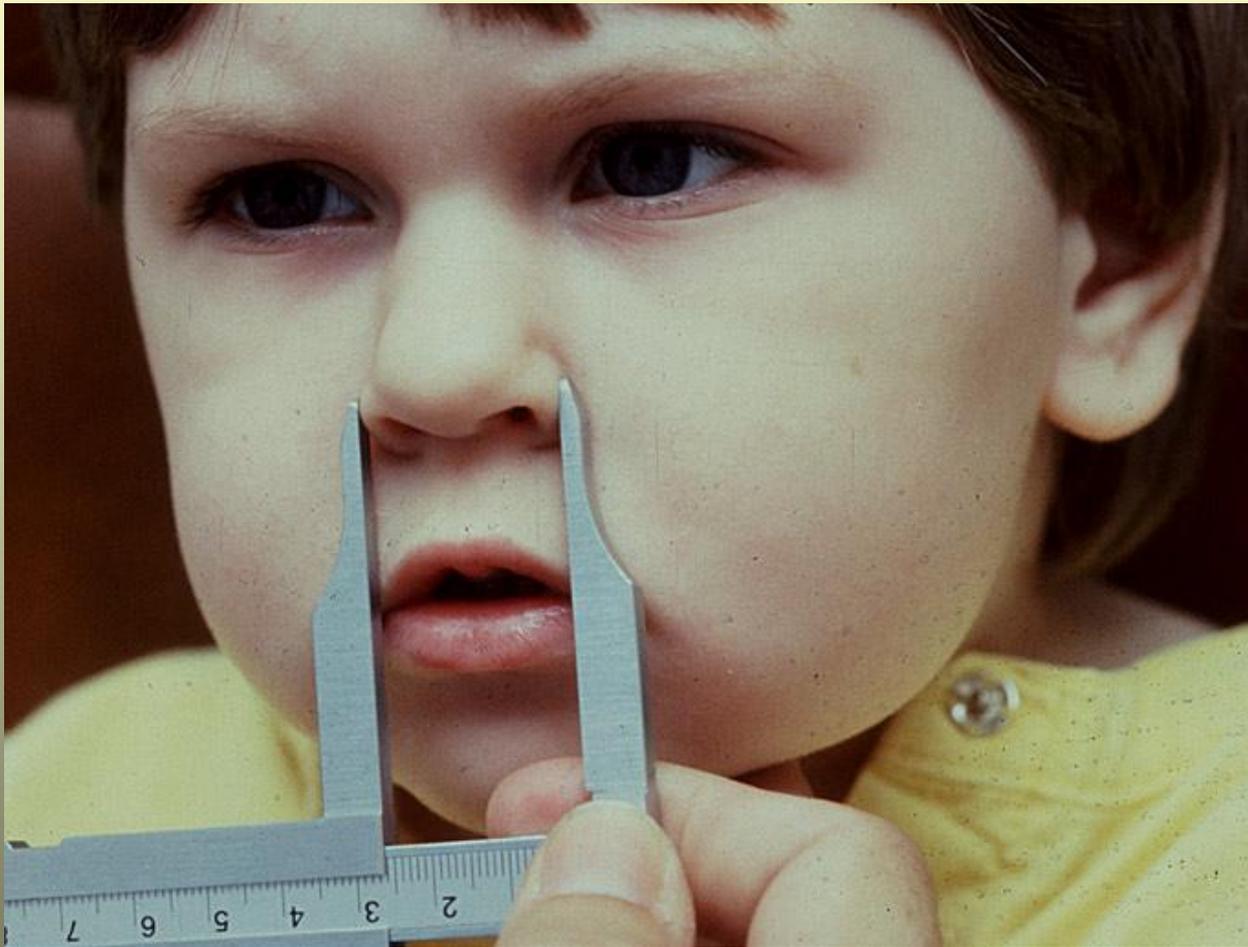
INTERCANTHAL WIDTH



NOSE HEIGHT



NOSE WIDTH



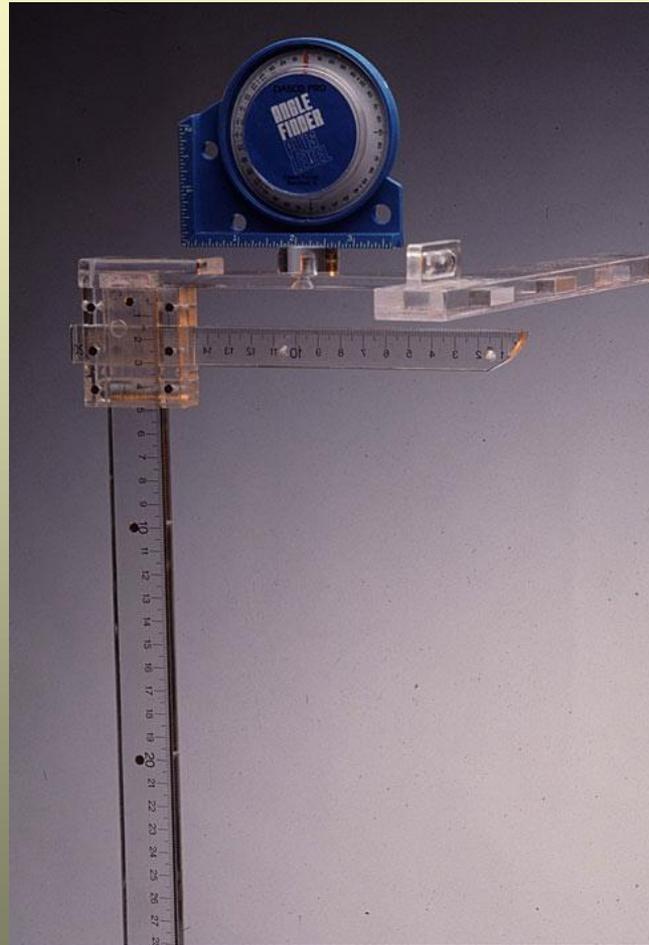
NASAL INDEX

$$\frac{\text{Nose width} \times 100}{\text{Nose Height}}$$

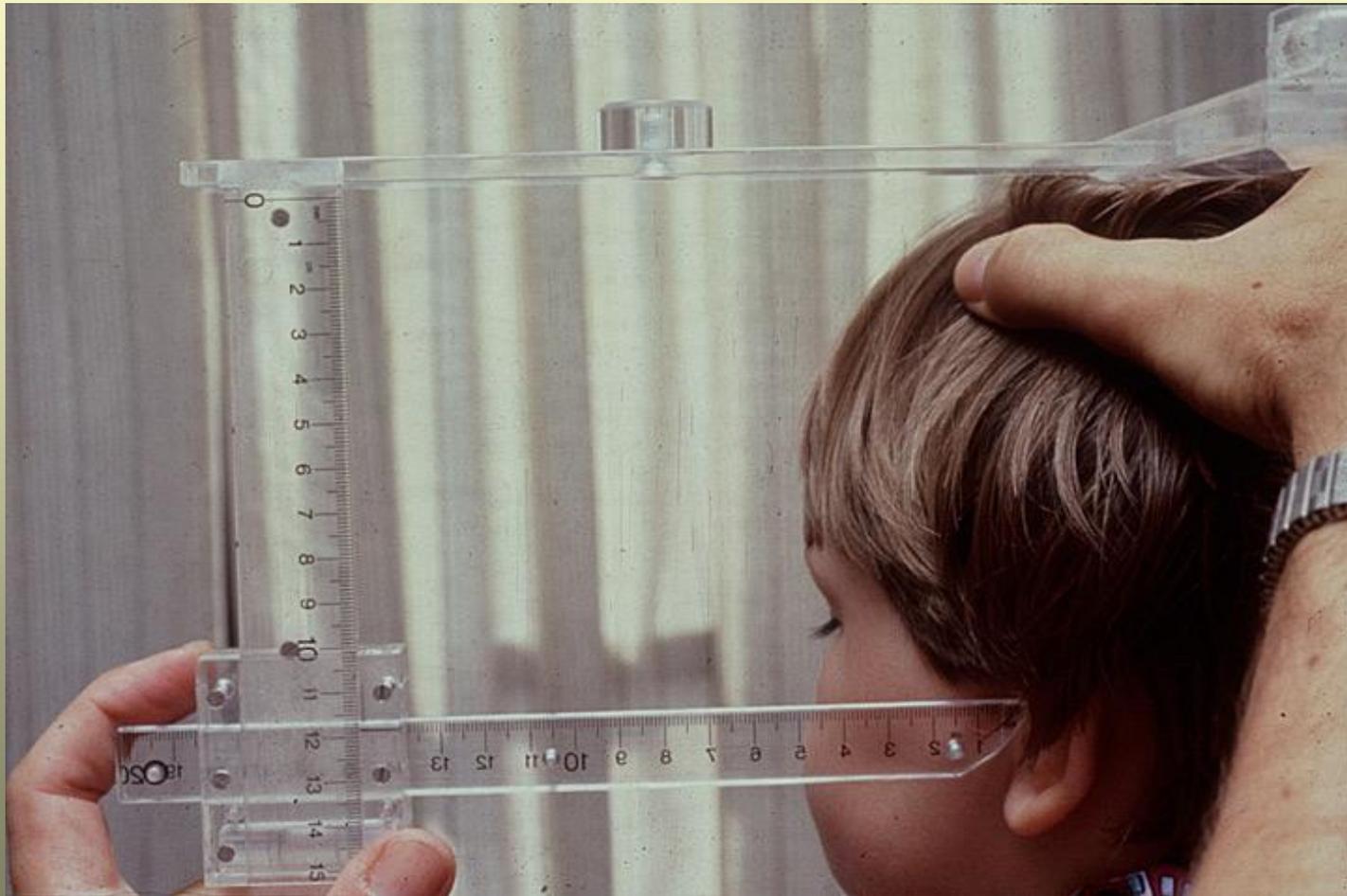
HEAD CIRCUMFERENCE



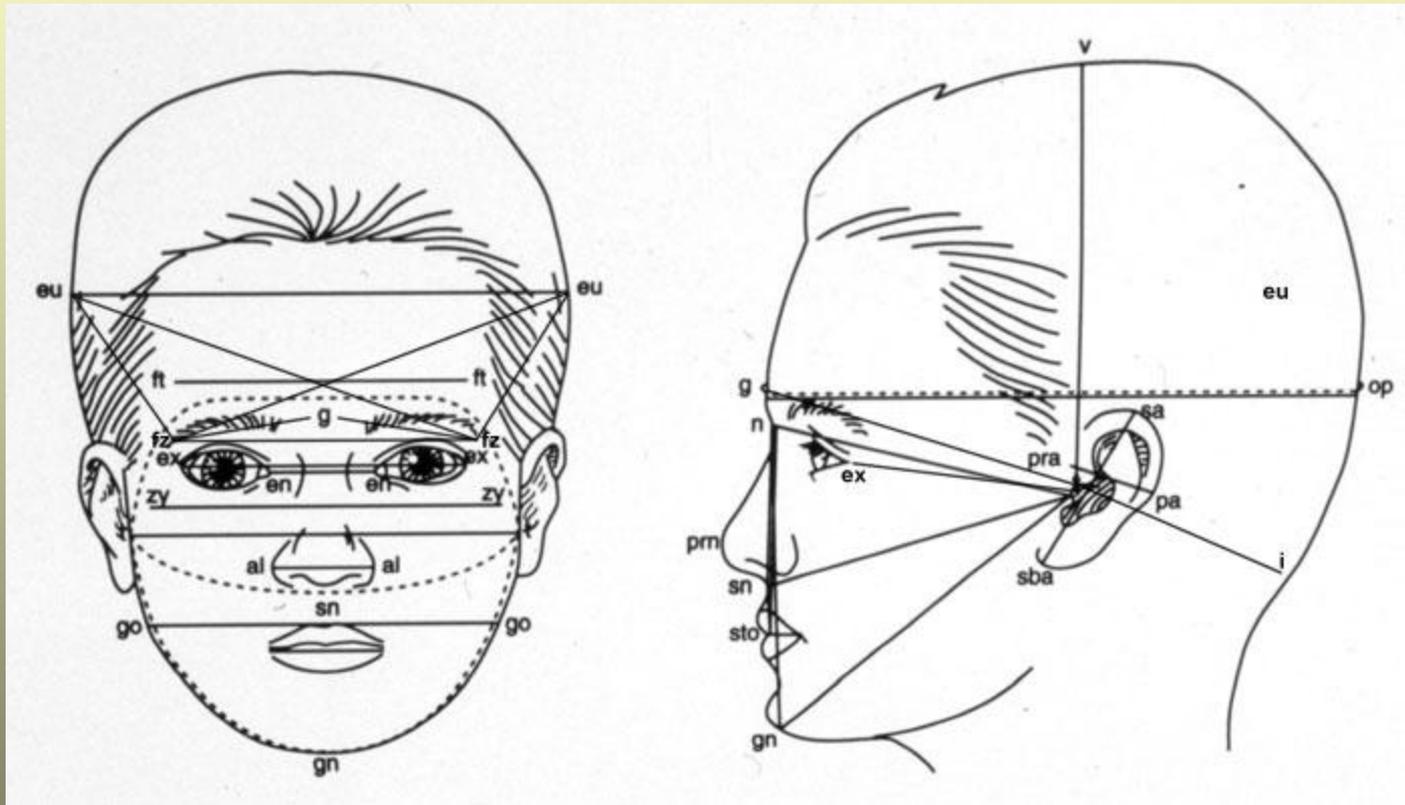
DOUBLE SLIDING CALIPER



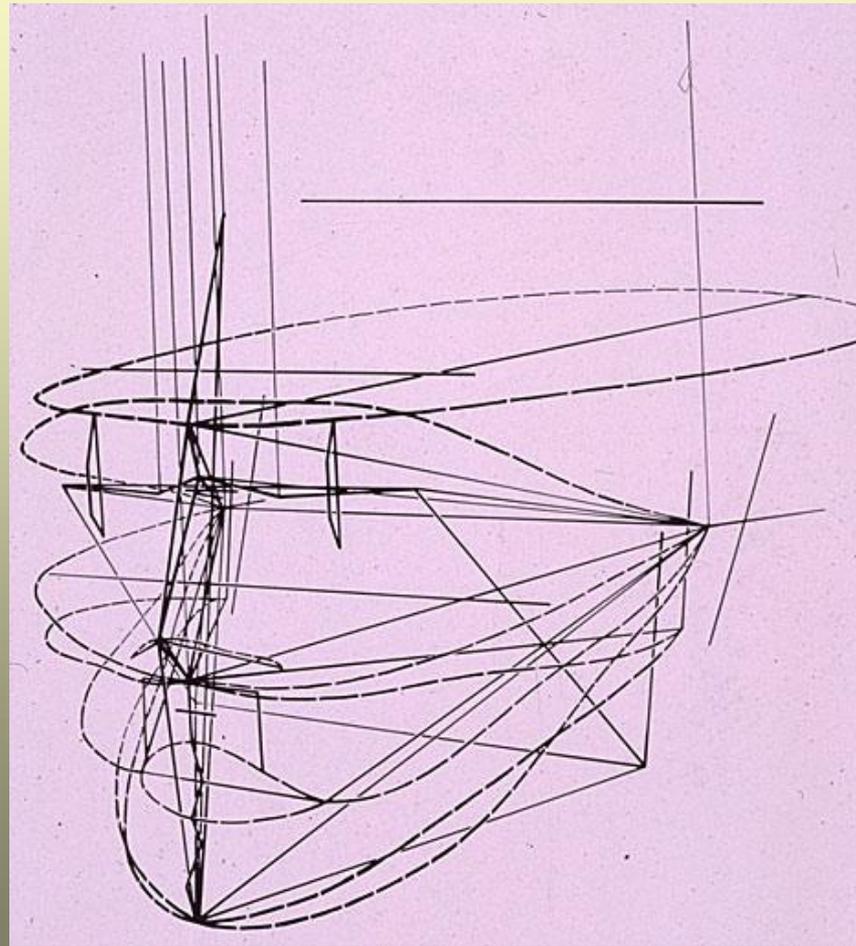
HEAD HEIGHT



MEASUREMENTS IN YOUNG CHILDREN



MEASUREMENTS IN OLDER CHILDREN



MEASUREMENTS AND PROPORTIONS

Morphology and dysmorphology are factors of shape, not of linear dimensions;

However, the relationships between linear dimensions, calculated as proportions, do describe form;

So, you need to consider both to understand morphology, as well as growth and development

Craniofacial Anthropometry

Source and origin of other measurement techniques,
including

X-ray cephalometry

Photogrammetry

Two- and three-dimensional CT measurements

Three-dimensional camera measurements

APPLICATIONS OF ANTHROPOMETRY

1. STUDIES OF HUMAN GROWTH

Individual Growth

Population Statistics

Secular Trend (Population changes over time)

2. MORPHOLOGICAL STUDIES

Description of Population Characteristics

Racial & Ethnic Comparisons

3. CRIMINOLOGY

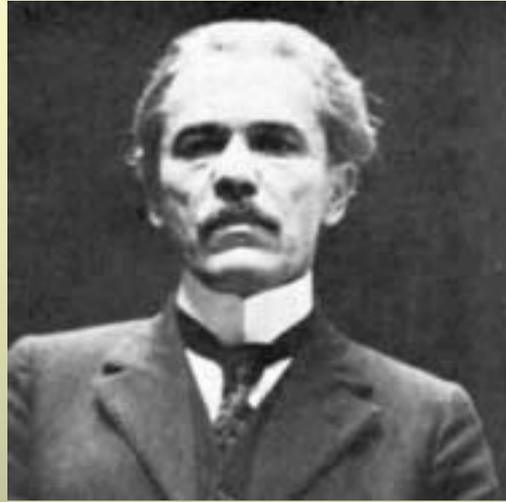
Cesare Lombroso

CLINICAL ANTHROPOMETRY

How did anthropometry become a technique for studying craniofacial anomalies?

The first suggestion came from Dr. Aleš Hrdlička, Czech-American physician and physical anthropologist, in his 1920 book, *Anthropometry*.

Aleš Hrdlička (1869-1943)



Founder, Physical Anthropology Department, Smithsonian Institution

Founder, American Association of Physical Anthropologists

Founder & Editor, *American Journal of Physical Anthropology*

Charles University, Prague (1964)

The first clinical anthropometry program was begun by the Department of Plastic Surgery, Charles University, as a way of studying the growth of the head and face of children with cleft lip & palate.

Dr. František Burian, department chair, initiated the idea.

Dr. Karel Hajniš, Department of Anthropology, designed the measurement system

Dr. Laszlo Farkaš, plastic surgeon, assisted Dr. Hajniš in designing the system

The Hospital for Sick Children, Toronto (1970)

Craniofacial anthropometry began at Sick Kids Hospital as a collaboration between craniofacial surgeon, Dr. Ian R. Munro, and Dr. Leslie Farkas, now a researcher at the hospital, as a means of monitoring the growth of the head and face in children undergoing reconstructive surgery of the head and face for congenital anomalies.

1981 – *Anthropometry of the Head and Face in Medicine*, the largest study of normal craniofacial growth ever published.

1987 – *Anthropometric Facial Proportions in Medicine*, based on the 1981 data.

Medical City Dallas Hospital (1986)

Establishment of the craniofacial program at Medical City Dallas Hospital (Medical City Children's Hospital), founding directors Drs. Ian R. Munro, Kenneth E. Salyer & Derek A. Bruce

Clinical anthropometry program established as part of the craniofacial program by Dr. John C. Kolar, anthropologist

1997 – publication of *Craniofacial Anthropometry*. First English-language textbook on craniofacial measurement techniques since Hrdlička (1920).

CLINICAL ANTHROPOMETRY

At the individual level:

Identifies craniofacial anomalies quantitatively, rather than subjectively, by comparison to sex- and age-matched normal standards

Describes postoperative outcomes by comparing preoperative and postoperative measurements and proportions

Monitors long-term craniofacial growth by comparing normal and patient growth patterns

Using proportions to adjust abnormal dimensions, can be used to plan surgical procedures

CLINICAL ANTHROPOMETRY

At the syndrome level:

Identifies patterns of dysmorphology characteristic for specific syndromes through accumulation of quantitative findings from clinical patient samples

Describes syndrome-specific long-term craniofacial growth patterns, whether postoperative or non-operative