

Committee 1
Symmetry in Its Various Aspects:
Search for Order in the Universe

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Various Forms of Symmetry and Beauty

Robert M. Ricketts
Professor
American Institute for Bioprogressive Education
Scottsdale, Arizona

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VARIOUS FORMS OF SYMMETRY AND BEAUTY

The human mind easily comprehends the phenomenon of symmetry. Consequently the subject crosses many branches of science.

Symmetry, psychologically may start with truth and fairness between the two sides of a successful relationship. In governments symmetry comes out of deals in politics and is manifested in reciprocal trade arrangements.

The wheel is a manifestation of radial symmetry. In weights and measures, symmetry is achieved when the scales are balanced. In mathematical equations, it occurs when one value is equal to another.

Beauty of form and proportion is noted around an axis of symmetry. In animal morphology symmetry is displayed when parts fit together and work in harmony and in equilibrium. Bones are hardened systems of stress and joints are strategic breaks in a stress system. In order to permit locomotion, muscles balance on each side of joints. Muscles can be stretched nearly 1.6 times their resting length because of the Divine Proportion in the bands of the sarcomeres.

In the atom the rotations of electrons around a positively charged nucleus maintain the atom in a steady state. Symmetry is present at the most fundamental level in the molecule with repeated identical patterns. Electricity seeks to become symmetrical as witnessed in lightning which equalizes charges from the earth up to the clouds. Even rare earth or glacial trace minerals have a symmetry as seen with Kirlian photography of the "corona discharge" of electrolytes in three planes of space like the vision of the sun during an eclipse (Fig. 1).

Homeostasis = Equilibrium

Certain symmetry within the body is identified as a specific acid-base or pH which also represents a relationship that is commonly referred to as 'balance'. The word 'homeostasis' applies to the body's attempt to maintain an equilibrium from conception to death. When "heterostasis" steps in, it triggers the body system's response to go into action.

Nutrition to the individual cell is delivered by way of the "interstitial fluid" as the medium. This fluid is found in connective tissue and constitutes a reservoir for the physiochemical provisions for normal homeostasis. This means that the interstitial fluid becomes a control mechanism as a "balancing agent" between the blood vessel and the cell membrane. Sodium, calcium and chlorine concentrations in the outside of the cell membrane are countered by potassium, magnesium and phosphate concentrations within the cell in order to produce the proper electrical potentials. Electrolytes together with acid-base are regulated in the interstitial fluid together with the supply of oxygen, hydrogen, nutrients and minerals. The arteriole and the venule form a loop as dilation and constriction is innervated by the autonomic nervous system. The end organ of the lymph vessel serves as the drain lines. This is a remarkable dynamic system and another form of symmetry.

Dynamic Symmetry – The Golden Cut – The Divine Proportion

An enigmatic form of symmetry has been recognized, theoretically, as long as man has had a memory because it is so abundant in nature. It is a singular most unique relationship seen in geometry and paralleled in mathematics. It is rhythm in the proportion of 1.0 to 1.618. It is basic to the "golden cut". A golden cut can be produced with the ruler and compass (Fig. 2).

Forms using these proportions are used in most kinds of art. Variations of the “golden proportion” characterize the natural world in plants, in flowers and sea animals even 500 million years ago as seen in the trilobite.

The Divine Proportion can be identified in all types of human design. It is basic to the Divine rectangle (see Fig. 2), the triangle, the pentagon and the logarithmic spiral (**Fig. 3**).

It flourishes in art and architecture. It is evident even in the Athens Parthenon but before that, implicit in the gateway in Babylon (**Fig. 4**).

It is manifested in most anything that is pleasing to the psyche and senses. It is experienced in the harmony in music in a set of physical vibrations of strings on a piano.

Symmetry in Motion

Nature’s designs display an organization for the conservation of energy. Normal physical performance occurs with a maximum efficiency in order to conserve tissue. The anatomy of animals’ bodies are arranged on an infinite design, otherwise survival in a hostile environment could lead to extinction rapidly.

Thus a concept of symmetry occurs with movement. The senses delight in the prance of a beautiful horse. The mind is intrigued with the grace of the leaping gazelle or the movements of the ballet dancer.

Beauty itself

The sense of beauty, as something that excites or pleases the senses, resides in the reticular formation in the center of the brain which is also referred to as the “reptilian complex” or the “limbic system”.

Pacioli, a teacher of Leonardo de Vinci referred to this beauty and called it the 'Divine Proportion'. In honor of a greek sculptor, Phidias, who employed it in his work, it has been given the symbol 'phi' (ϕ). Multiples of that relation have been called ϕ^2 , ϕ^3 and ϕ^4 . Progressively smaller proportions are phi prime (ϕ'), ϕ'^2 .

Fibonacci Numbers

Further, a wedding of the 1.618 number exists between mathematics and geometry. This relationship was discovered by Filius Binacchio who brought arabic numbers to the western world in 1202. The label was shortened to Fibonacci. It is a graduation made by adding the last two integers in a series. After a few additions each new total will increase by 1.61803..... and will not change thereafter (Fig. 5).

Mathematics did not exist in the old Roman world. The older geometry plus mathematics of the thirteenth century were the tools that changed philosophy to science because the basis of science is measurement which was difficult without numbers.

Symmetry in Morphology

Absolute symmetry is static while dynamic symmetry implies action or life. This will become more obvious with the recognition of the proportions in golden rectangles, triangles, the polygon and logarithmic spirals.

In Watson and Crick's description of the DNA molecule, the twisted rope ladder represents a sort of divine proportion. A series of steps in golden rectangles (1.0 on one side with 1.618 on the other) made up the ladder. This format at

least fitted the conception of the linkage of protein molecules as the very makeup of our genetic material.

Symmetry is present as equal division takes place in the process of mitosis. Perhaps electromagnetic frequencies are involved in the split. Polarization takes place, the chromosomes divide with one of each pair attracted to each pole for the formation of daughter cells (**Fig. 6**). When symmetry and perfection are not forthcoming, the body scavengers, looking for strange things or something out of order, will identify them and remove them. This is nature's 'culling system' (the rotten apples are thrown out). This indicates that maintenance of symmetry is a truly basic process of nature.

Embryonics

With a continued mitotic division, each cell must be provided with oxygen and nutrients. A "control" of growth and development takes place. The organism, for survival and replication, must follow a finite pattern. By the process of differential growth, cells on the outside of a glob of cells grow faster than those on the inside. A cup shape ultimately closes over to become a tube. On the dorsal side a notocord develops which symmetrically separates the sides (see Fig. 6). Increased differential growth and drift on the cephalic end starts to form a bilateral brain. The complete embryo forms a spiral with a tail (**Fig. 7**).

The spiral is logarithmic and is characteristic of many aspects of nature. It represents the dynamic symmetry in morphology (**Fig. 8**). The human lower jaw develops on a spiral principle which permits **mandibular growth to be predicted**.

The Triangle and Spiral

In order to appreciate the spiral, the triangle is basic. The golden triangle, isosceles in kind, makes a 72° , 72° and 36° form where the base is 1.0 and the sides are 1.618) (see Fig. 3). If one base angle is bisected, the opposite side is sectioned into a golden cut! Further bisections of base angles produce triangles within triangles. As the points of the triangles are connected a logarithmic spiral is produced (see Fig. 3). Further, the pentagon displays this triangle within itself and is the base for the five pointed star in the core of some fruits (see Fig. 3).

This spiral is characterized by the beautiful nautilus shell but these same type of spirals are also seen in flowers and the cochlea of the ear as a basic aspect of biology (Fig. 8).

Human Body Proportions

In the body, a multitude of Divine Proportions exist in the minutest detail. The study of various normal body proportions represent a remarkable repetition of this phenomenon. One explanation for a general right and left symmetry of the body is that the body has two divisions of blood and nerve supply. The brain is bilateral and is connected through the corpus colosum. Yet the body is seldom absolutely symmetrical as is characterized by right handedness or left handedness.

Functional proportions, of the 'Divine' type, prove the concept of 'dynamic' symmetry posed by the artist and theoretician, Jay Hambridge in 1919. In the finger, each phalanx, beginning with the terminal phalanx, can be considered a value of 1.0. The next phalanx is a ϕ and the third phalanx is ϕ^2 . This shows that the third phalanx is equal in length to the sum of the first two (or symmetrical). The next phalanx in the hand is ϕ^3 which means that it is equal

to the length of the first three, again symmetrical (**Fig. 9**). The same proportions are seen in the toes.

This relation may explain the efficiency of the human hand and the arm. The hand in turn is golden to the forearm which is golden to the joint at the scapula. The foot is golden to the foreleg and the foreleg is golden to the hip (see Fig. 9).

In body height, the distance from the heel to the apex of the pelvis is ϕ relative to the pelvis to the top of the head as 1.0 (as a functional unit of the upper body). The lower body will total the length from the heel to the knee the length to the rim of the pelvis. This point on the apex of the pelvis also is on a parallel with the umbilicus, the site of the body's first neurotrophic supply.

Human Skull and Facial Proportions

The beautiful human face is a masterpiece (**Fig. 10**). **It is a medley of divine proportions** with one relation often entering into other proportions. The human face is also usually reasonably symmetrical side to side from the midsagittal plane. But it had to grow in a manner to acquire that beauty.

Research on facial growth with the computer led to the revelation of the "Divine Proportion" or "Golden Relations". *First* a significant sample of children composited from data revealed a central site for **polar growth phenomenon**. It was located at the base of the sphenoid bone, essentially at the exit of the second division (the Trigeminal or Fifth cranial nerve (**Fig. 11**)). The *second* finding was the vertex of **gnomonic figures** located at the entrance of the first and third divisions of the Fifth nerve. The *third* finding was in the frontal perspective; a **bipolar growth behavior** was observed. Fourth, an **orderly 1, 2, 3, progression** was noted in the increase of the nasal cavity, the maxilla and the mandible which suggested Fibonacci numbers (see Fig. 11).

The *fifth* finding was that the human mandible grew on an arc which was thought to be the function of a logarithmic spiral which is a function of recurring Divine Proportions (Fig. 12).

The Human Facial Features

Vertical Dimensions

Functionally the face begins at the scalp at a point referred to as trichion (Tri) (little triangle) and ends with the lower border of the chin, menton (M) (Fig. 13). Between these two extremes are located the eye (Lc) (lateral canthus), the nose (Al) (alar curve) and the mouth (St) (at stomion).

In beautiful faces are found three dynamic symmetries to be considered as units. These are the upper face (Tri-Lc), the mid face (Lc-St) and the lower face (Al-M). These differ from the traditional 1/3 reference of artists. Analysis can be made easily with Golden Dividers (see Fig. 13).

To the forehead, Tri to Lc level, used as 1.0 the lower face to menton will be ϕ . The larger lower part tends to serve as an anchor for comfort in the psyche. When the divider is inverted without changing the spread, the distance of menton (M) to the alar rim of the nose (Al) will be 1.0 and the dimension up to trichion (scalp) will be ϕ .

Equal distances are revealed for the upper face (or forehead), and the lower face. These are "Divine Units" of equal height. But a third measurement, equal to each of the first two is the mid face Divine Unit from the eye (Lc) to the mouth (St).

It will be noted that this analysis displays an overlapping or reciprocity of two key parts contributing to Divine beauty; One is the nose height and the second is the

upper lip length (which contains the filtrum). In addition, the eye (Lc) to the nose (Al) serving as 1.0 will demonstrate ϕ to the chin. The nose (Al) to stomion (St) employed as 1.0 will show ϕ to the chin also. By inverting the divider, the upper lip height employed as 1.0 will show nose height to be ϕ . Finally the upper lip thickness to the cupid's bow used as 1.0 will display ϕ for the lower lip (See Fig. 13).

Transverse Dimensions

Starting with 1.0 as the widest part of the nares (Ln) the angle of the mouth at chilion (Ch) will be ϕ . A divine proportion ϕ will be seen at the lateral canthus of the eye (Lc). Further, a ϕ^3 dimension will be seen at the width of the head just above the ear but it is most often covered by hair (see Fig. 13).

Skeletal Framework

Beautiful external features are difficult if not impossible to obtain if the underlying facial skeleton is dysplastic. The human face is technically called the 'splachnocranium'. The internal brain portion of the skull is called the 'neurocranium'. The division between the face and the neurocranium has been called the "hafting zone" which is an axis of symmetry (Fig. 14).

The Skull Base

Traditionally two parameters have been used for a base for the determination of cranial floor characteristics. The division from Sella Tursica to Basion and Nasion is one reference. The oldest, and best for current use, is the plane from the anterior border of foramen magnum to the junction of the nasal bone with the frontal bone - from Basion to Nasion (called the basicranial axis). A line dropped from the foramen rotundum (Pt point) establishes a point labelled Cc. (the cranial center) which was proven in 1969 (see Fig. 11). On the Basicranial Axis, where

it crosses the posterior border of the condyloid process of the mandible (articulare), the divine proportion is realized as found in normal samples (**Fig. 14**).

The Mandible

While the skull base is the first consideration in morphology, the second element for the face is the mandible which contains the chin. A "Xi Point" measured at the ramus centroid, represents the mandibular foramen at the entrance of the third branch of the trigeminal nerve into the mandible. With Xi to condylion (Co) taken as 1.0, the divine proportion ϕ is present with the distance of Xi to mental protuberance (Pm). Furthermore as the mandible is situated in the face for the greatest harmony, the distance from Cc to the Gonion at gonial angle, is golden to the distance from Cc to Gnathion (see Fig. 4).

The Maxilla

The Frankfort Horizontal Plane is used in anthropology and in clinical orthodontics. It is formed from the superior border of the external auditory canal (Porion) to the lower border of the orbit (orbitale) (see Fig. 14). A perpendicular dropped from the posterior margin of the pterygopalatine fossa forms a coordinate grid. Horizontally, the distance of the maxilla (Point A) is 1.618 the dimension from the Vertical plane to Porion.

Vertical Criteria for Maxilla and Teeth

If the vertical dimension from the Frankfort plane to Point Pm is related to Point A (at the base of the alveolar process) a golden section is formed. From A point to the incisal edge of the lower incisor as 1.0 the distance of the lower incisal edge to Pm is 1.618. **These two very important measurements are critical to lower facial dynamic symmetry (see Fig. 14).** Another vertical reference for

ideal symmetry is the height of the lower molar at a golden point from the palatal to the lower mandibular border.

Frontal View Proportions

Intuitively in conversation, a person will speak to another person's eyes. Beautiful eyes serve as an advantage socially and vocationally. The orbits in width are golden to the bony space between them (Fig. 15).

The mouth is often the second component of the face receiving attention in conversation, as it also manifests facial expression. The width of the maxilla to corresponding points on the mandible are in ϕ relations from the midline (see Fig. 15). In the smile, the teeth are displayed and further demonstrate the Divine Proportion from the lower central incisor to the upper to the lateral incisor gingival embrasure and thence to the premolar area. Thus, irregular teeth subliminally effect the facial attraction.

THE THEORY OF NEUROTROPHISM

The divine proportions do not just happen. They must develop from a basic order. The gnomonic figures of growth of facial cavities have a vertex at the entrance of sensory nerves (see Fig. 11). Neurotrophism is considered to be the combined blood and nerve supply. If a blood vessel is cut, a new collateral circulation will develop. The part fed by the blood vessel can be preserved. However, if the nerve is cut, to include the neurosensory, the neuromotor and the neurovascular branches, the anatomical portion served by the nerve will die.

If a disease condition altering the sensory innervation exists for a period of time, enough to bring the neurotrophic influences into play, then distortion, asymmetry or dysplasia will prevail. Thus the facial form is produced by the influence of the sensory side of the nerve (Fig. 16). This leads to a consideration of electro

magnetic stimulation phenomenon of a frequency of some nature. Its like more current going to one side than the other.

Application of The Divine Proportion in Maxillo-facial Orthopedics

The question often asked is “What if a person does not have these proportions in the face?” The answer is “They are not very handsome or pretty”. In fact ugliness is of the most severe human afflictions as exemplified in the play “Phantom of the Opera”.

The task of the diagnostician is to first determine the parts most out of order and then devise corrective measures. When faces are planned with and reconstructed following the “Divine” principle, they can hardly miss being beautiful.

The first patient was selected to show how their proportions can be applied to a growing child (age 7.2 years) with an open bite malocclusion and a dysplastic maxilla. The tracings before and after extra oral traction are noted (**Fig. 17**).

The second is an adult female patient with multiple functional problems and severely long face with unsuccessful orthodontics (**Fig. 18**). The steps are shown in the application for the planning of orthodontics, maxillary surgery and genioplasty.

SUMMARY

Symmetry has many connotations in many branches of science. But one of the most unique is the dynamic symmetry represented by the Divine Proportion which is 1.0 to 1.618. This wedded to mathematics with Fibonacci numbers. This phenomenon is an integral part of nature.

It is possible that the divine proportion has served as a strong point in natural selection down through the ages as nature tends to cast off the ugly and cull out the weak. There could have been an operative factor in that the most efficient arrangement was the most pleasing and most beautiful for the one doing the choosing. For propagation of the offspring the selection is usually made by the female of an animal species, including man.

The most beautiful applies to that which gives the highest degree of pleasure to the senses and suggests that the object of delight approximates or tends toward one's conception of "ideal". Thus, esthetics, beauty and art may fall into science as things can be measured and tend to lie on a statistical curve, with the peak of the curve approximating the most ideal.

The human head is the same as Cro-magnon man and is but only 35,000 years old. Australopithicus is 2 million to 14 million years before present. In theory humankind could be yet evolving but the face is already a marvel of perfection. A beautiful human face is an architectural masterpiece. It is a medley of Divine Proportions with one part often entering into two or more other proportions.

The beautiful face is quickly analyzed by a three part symmetry vertically referred to as the "Divine Units". People look into the eyes for expression, the mouth for speaking and register the nose subliminally. The proportions are critical whether the face be long or short in type. However, when these proportions do not exist due to disease states, accidents or malformations, the face is unattractive. It is fortunate that by conceiving the underlying unity and symmetry via the Divine Proportions, that sophisticated planning of correction is made available. Furthermore with the application of these "Divine Principles" the face can be sensibly predicted from childhood to maturity.

While the body as a whole is designed for efficiency in performance, man's face is his window to the world. It is in most cultures exposed to society for

communication and social exchange. It is for this reason that it receives so much attention and adoration.

It is evident that the human head and face is a part of a Divine Order. Maybe it is the perfect end product of a long line of evolutionary forces as each face contains its own rhythm. The whole subject awaits the forces of the future.

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LEGENDS FOR ILLUSTRATIONS

Fig. 1

Kirlian photography of Fulvic powder showing a symmetrical energy corona discharge from minerals (courtesy Morganics, Inc. 6/15/98).

Fig. 2

- A. The method of obtaining the "Golden Cut" with a compass and a ruler.
- B. The graduations of phi (1.618) from 1.0.
- C. Method of constructing a "Golden Rectangle" from a square and the formula for ϕ .

Fig. 3

- A. The "Golden Triangle".
- B. Series of bisections of a base 72° angle.
- C. Connections of base angles in a curve produces the logarithmic spiral.
- D. The Golden triangle is basic to the pentagon; note the reciprocal golden cuts.

Fig. 4

The gateway to the gods that guarded the city of Babylon. Mesopotamia existed for 3,000 years starting at 4000 B.C. Note the repetition of Divine Proportions in the architecture.

Fig. 5

When any number in a sequence is the sum of the two previous numbers, a progression is formed. When divided already at $8/5$ the relation is 1.6 ultimately to 1.618 and stable thereafter.

Fig. 6

Left

- A. Mitosis, showing the pulling apart of chromosomes toward the centrioles.
- B. The clefting.
- C. The symmetrical daughter cells (after Ham and Cormack 8th Ed.)

Right

- A. The folding of the neural plate in the embryo.
- B. The joining to form a neural crest.
- C. The symmetrical migration of the crest cells (after Ricketts).

Fig. 7

- A. The general form of the embryo at five weeks displays a spiral.
- B. The spiral characterizes the growth of the human mandible (like the ram's horn).

Fig. 8

The beautiful repeated curves in the Nautilus shell are untiring.

Fig. 9

- A. The human hand has a series of relations in each phalange.
- B. The body has a ϕ progression from the head to the toe as shown.

Fig. 10

The beautiful face of Lana Turner has almost perfect proportions to be compared with analysis in Fig. 13.

Fig. 11

Growth research led to the appreciation of the Divine Proportion phenomenon.

- A. The Polar expression from the base of the sphenoid (note circle). The behavior is progressive and orderly likened to the volume of a sphere $\frac{4}{3} \pi r^3$.

- B. Gnomonic behavior, additions without a change in shape at the three divisions of the fifth nerve.
- C. Bipolar behavior in the frontal due to bilateral neutrophism.
- D. A Fibonacci expression in the nasal cavity, maxilla and mandible at registration points.

Fig. 12

The findings leading to the discovery of the arc of mandibular growth.

- A. Bending of central core and orderliness of occlusal plane.
- B. Location of Eva point and Pm point for establishing the true radius point (Tr).
- C. Growth displayed on the arc from composites of the same children at 5, 8, 13 years and a group of males at age 18. Note the upward and forward movement of the teeth.

Fig. 13

- A. Points on the facial soft tissue employed for analysis (see text).
- B. The lateral face oriented on the Frankfort Plane. Note the proportion from the nose to Lateral Canthus is ϕ to the ear tragus.
- C. The Ricketts Golden Divider.
- D. See text for description of the proportions. Note that dimensions at 1, 2 and 3 are symmetrical.

Fig. 14

Analysis of a composite of 30 adult normal Peruvian Males age 22 years.

- A. The line from Basion to Nasion is the Basi-Cranial Axis. On it, from articulare at the mandibular neck to Cc forms ϕ to Nasion.
- B. Horizontal proportion; glenoid fossa to pterygoid vertical to orbitale; Porion to PTV to point A. Molar from Xi to length of corpus. Vertical Fh to A to Pm.
- C. Condylar axis (Co Xi) to corpus axis (Xi-Pm). Facial axis (Cc to Gn) and Ramus Axis (Cc to Go).

D. Height, point A to lower incisor to Pm, Palatal plane to molar to mandibular plane. FH to Xi to mandibular border.

Fig. 15

Divine proportions in the Frontal View.

- A. Note the orbits are \varnothing to the nasal bridge; maxillary width (J) to the midline is \varnothing to the lateral border of the ramus (Ra).
- B. Mandibular width growth is gnomonic in character.

Fig. 16

Patient K.X. with ideopathic mandibular hypertrophy displaying severe facial asymmetry.

- A. The frontal tracing of oriented P.A. cephalometric x-rays showing 22 mm. greater height on the right side.
- B. The view in the lateral tracing showing the occlusal plane in alignment with the Xi points.
- C. & D. The left and right mandible.
- E. The view in the submental vertex showing differences in location of the teeth and skewing of mandibular form.
- F. Comparison of two sides superimposed on the mandibular border.

Fig. 17

Patient M.C. Female, age 7.2 years. Note convexity and upward position of Point A originally. The dotted line indicates the Divine height and the dashed line shows the amount of dysplasia present.

M.C. age 9.1 after orthodontic treatment with cervical traction shows height for the jaws and the lower balanced incisor.

Fig. 18A

Patient M.Mc ♀ age 27.36 years.

Long face open-bite. 6 years of orthodontics - TMJ problems of posterior displacement. Note lip strain and the recessive chin.

Fig. 18B

Divine Analysis

Skeletal – FH to Point A as 1.0 and the A to Pm is 2.032

= 16 mm. excessive to maxillary height.

Frontal – Chin is 4 mm. to the left

Step 1 shows dental decompensation required (blackened)

Step 2 shows coupling of the teeth prior to planning jaw surgery

Fig. 18C

Step 3 shows rotation of the mandible and impaction of maxilla

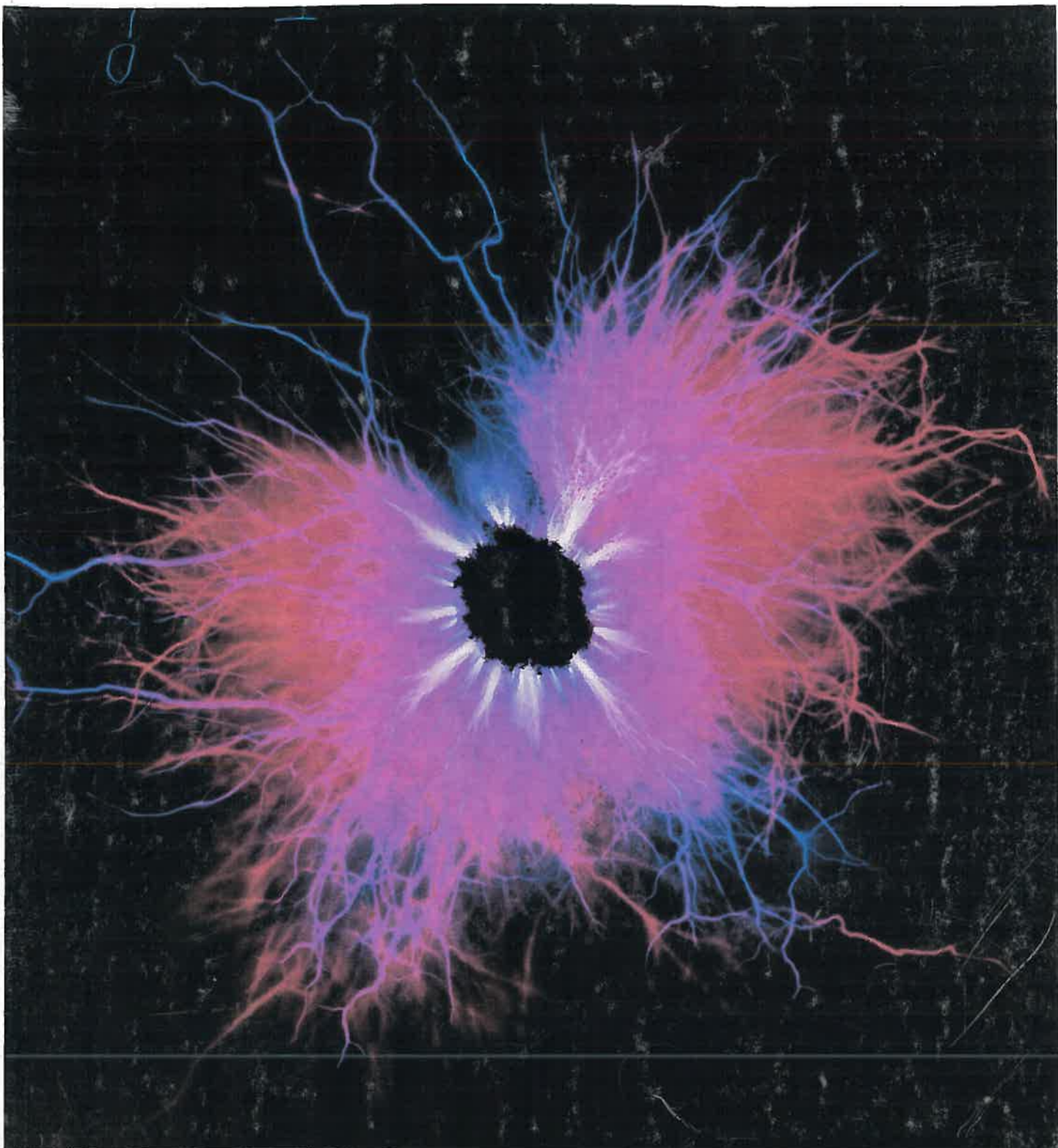
Step 4 shows establishing face proportions

Step 5 shows sectioning for genioplasty

Step 6 shows surgical chin position and soft tissue resultant

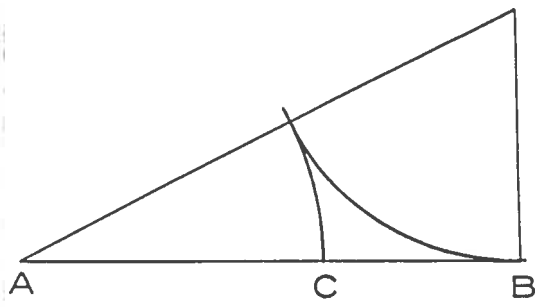
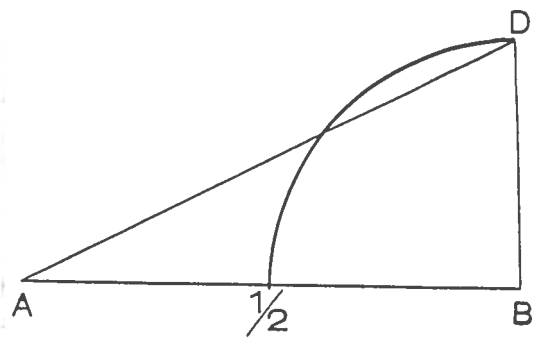
Fig. 18D

- A. The final plan for the patient called for a 6 mm. wedge to be removed and a 6 mm. chin advancement to be made, accompanied by a 6 degree rotation, in order to achieve the Divine Proportions.
- B. The plan worked out almost exactly as designed. Tracing of the lateral headplate made after correction, almost precisely superimposed on the plan.
- C. The proportions of the face follow the underlying skeletal and dental modification.

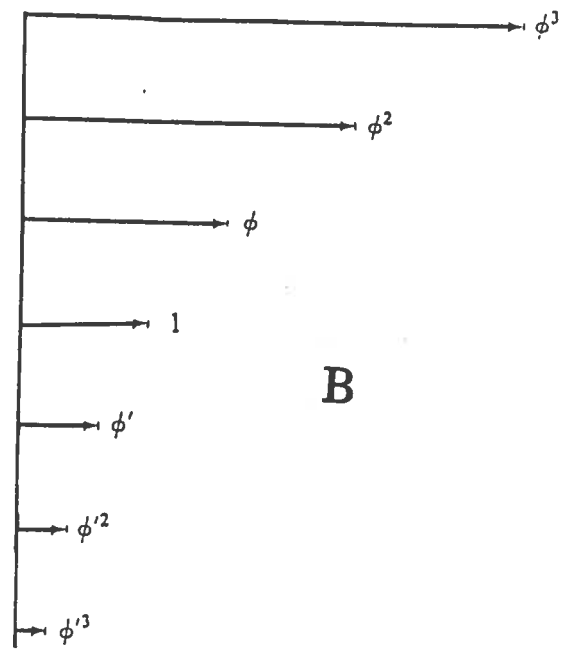
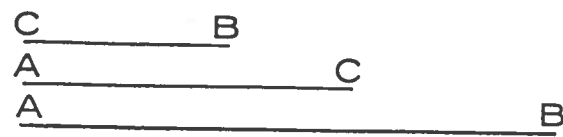


Fulvic Powder
Morganics Inc. ©1998
pwdr

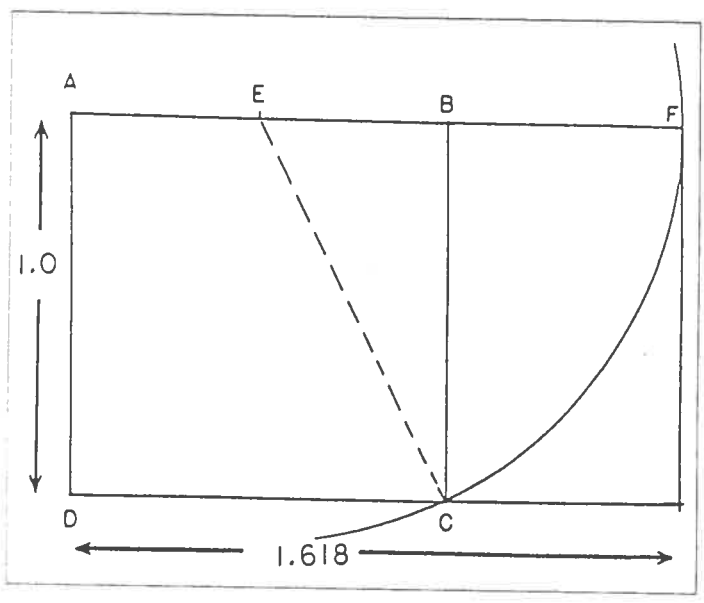
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A

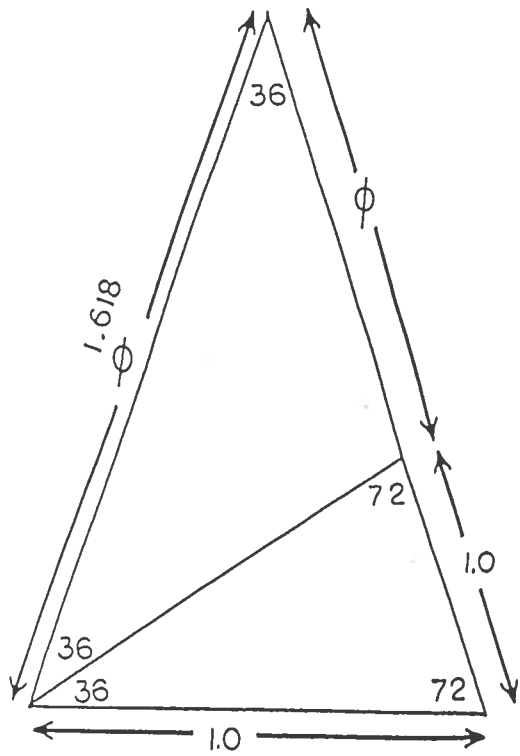


B



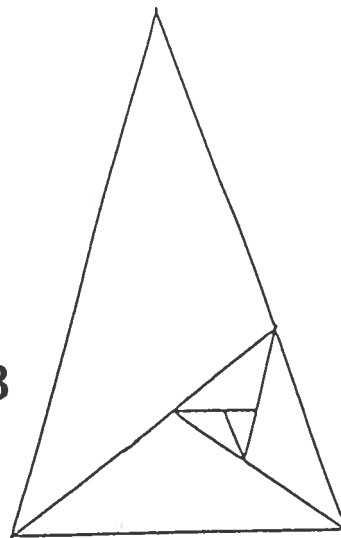
$$\Phi = \frac{\sqrt{5} + 1}{2} = 1.61803$$

C

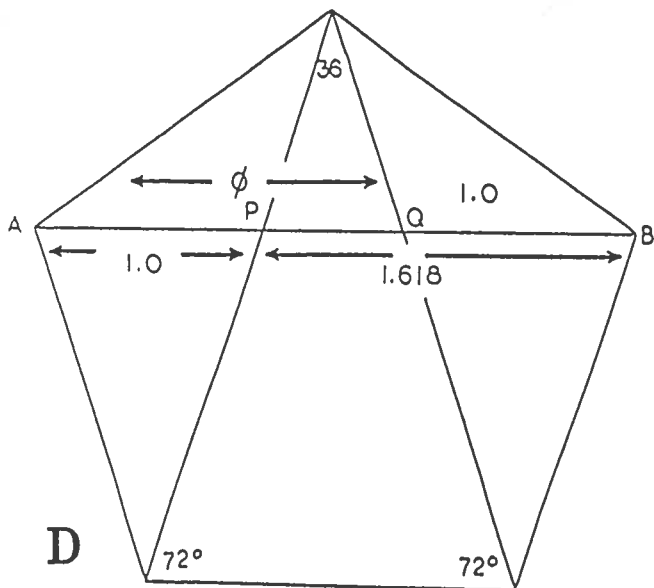
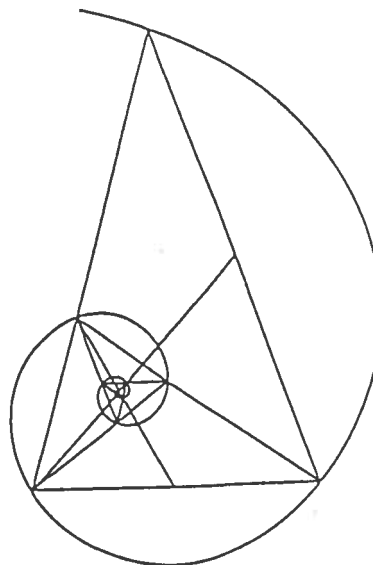


A

B



C



D



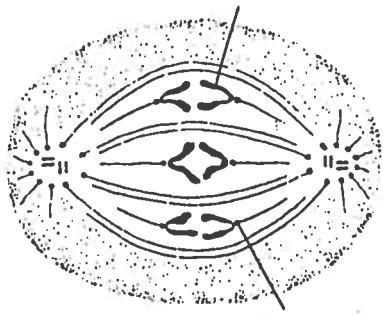
FIBONACCI SERIES

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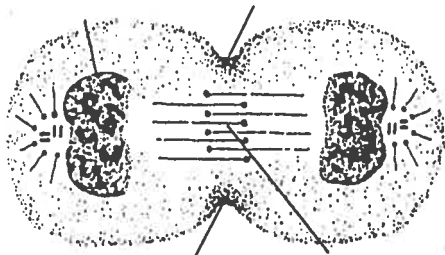
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|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|------------|-------------|
| 0 | 1 | 1 | 2 | 3 | 5 | 8 | 13 | 21 | 34 | 55 | 89 | 144 | 233 | 377 | 610 |
| 1 | 1 | 2 | 3 | 5 | 8 | 13 | 21 | 34 | 55 | 89 | 144 | 233 | 377 | 610 | 987 |
| <u>1</u> | <u>2</u> | <u>3</u> | <u>5</u> | <u>8</u> | <u>13</u> | <u>21</u> | <u>34</u> | <u>55</u> | <u>89</u> | <u>144</u> | <u>233</u> | <u>377</u> | <u>610</u> | <u>987</u> | <u>1597</u> |

Divide:

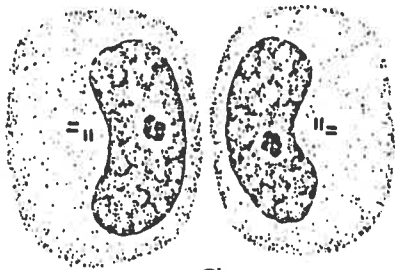
| | |
|-----------------|----------------------|
| 0 / 1 = 0 | 34 / 21 = 1.61904 |
| 1 / 1 = 1 | 55 / 34 = 1.6176 |
| 2 / 1 = 2 | 89 / 55 = 1.61818 |
| 3 / 2 = 1.5 | 144 / 89 = 1.61797 |
| 5 / 3 = 1.666 | 233 / 144 = 1.61805 |
| 8 / 5 = 1.6 | 377 / 233 = 1.61802 |
| 13 / 8 = 1.625 | 610 / 377 = 1.61803 |
| 21 / 13 = 1.615 | 937 / 610 = 1.61803 |
| | 1597 / 987 = 1.61803 |



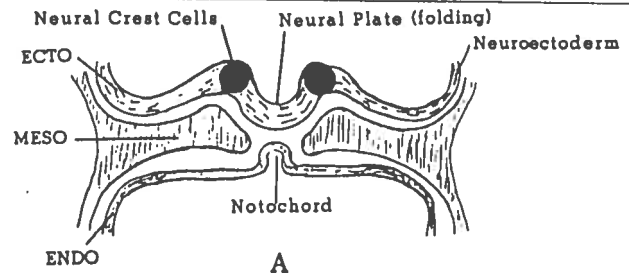
A



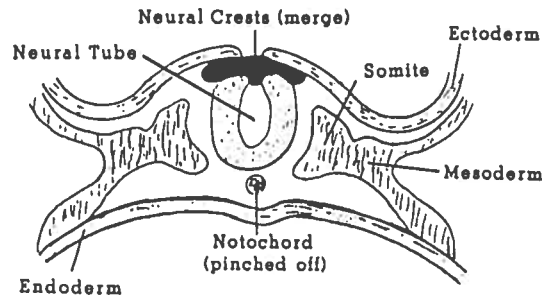
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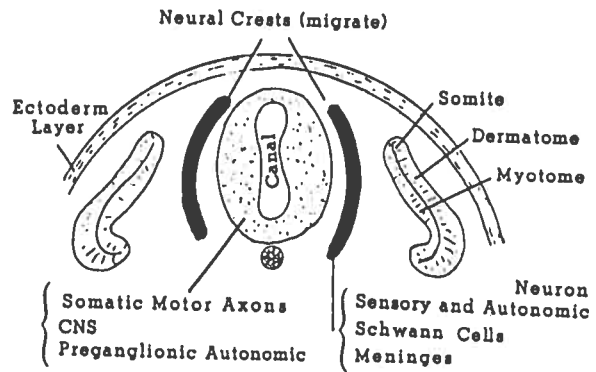
C



A

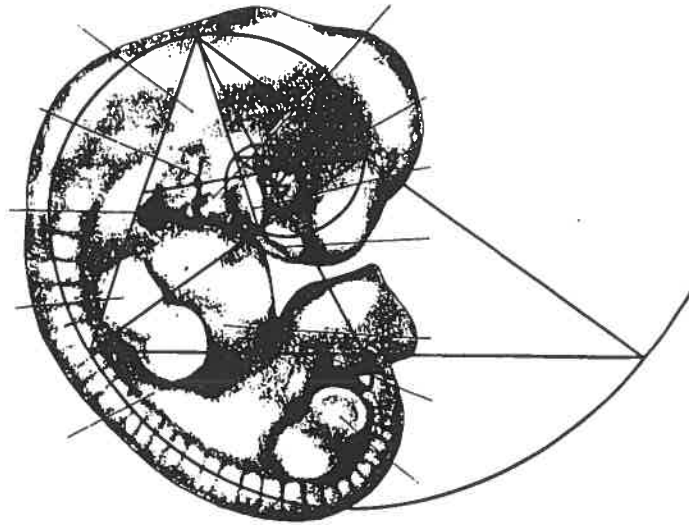


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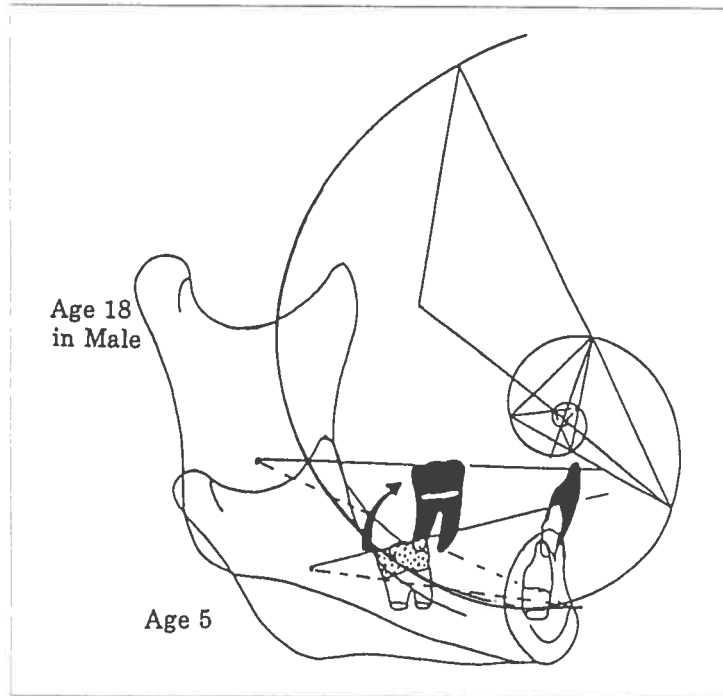


C

A



B



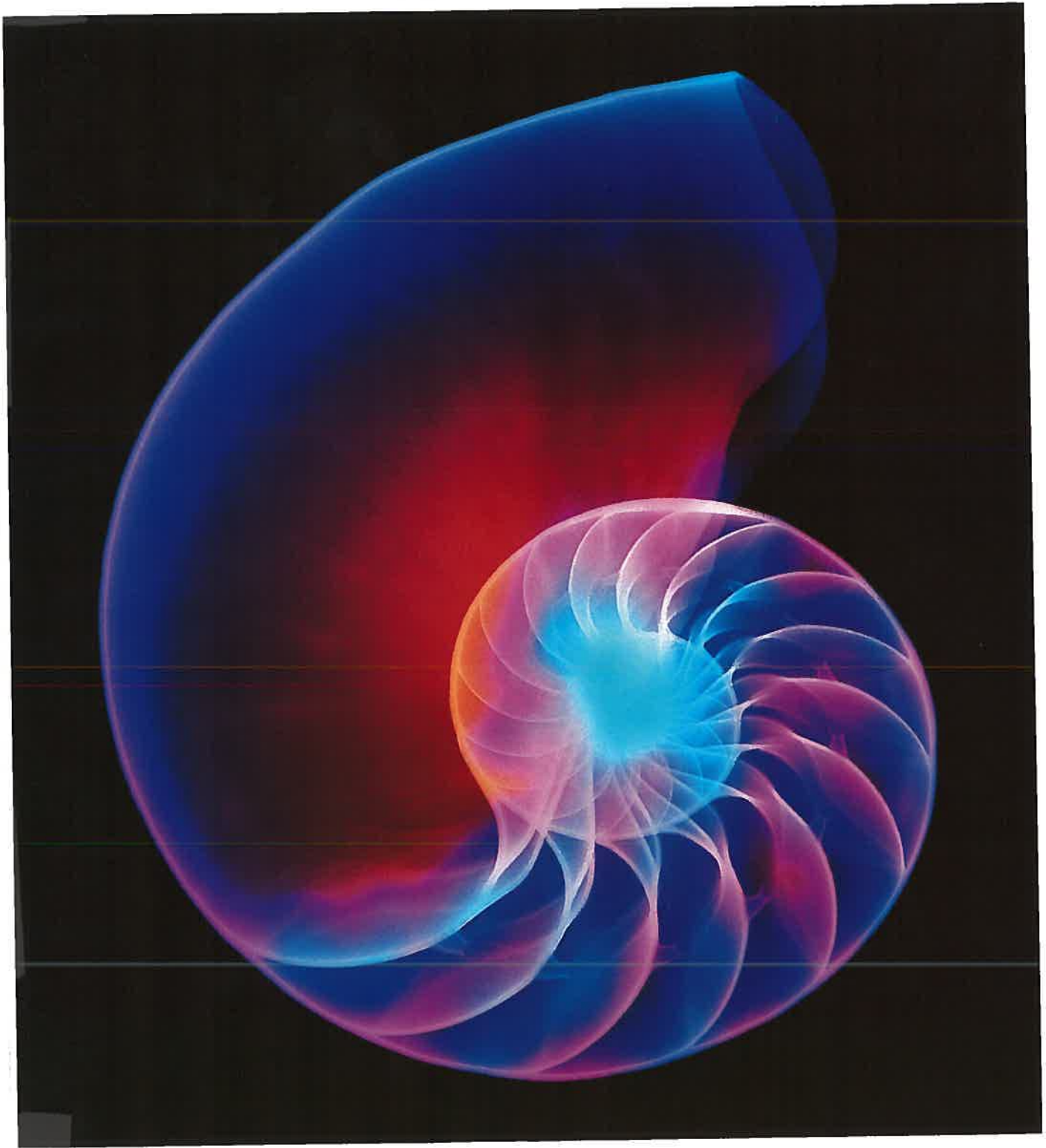
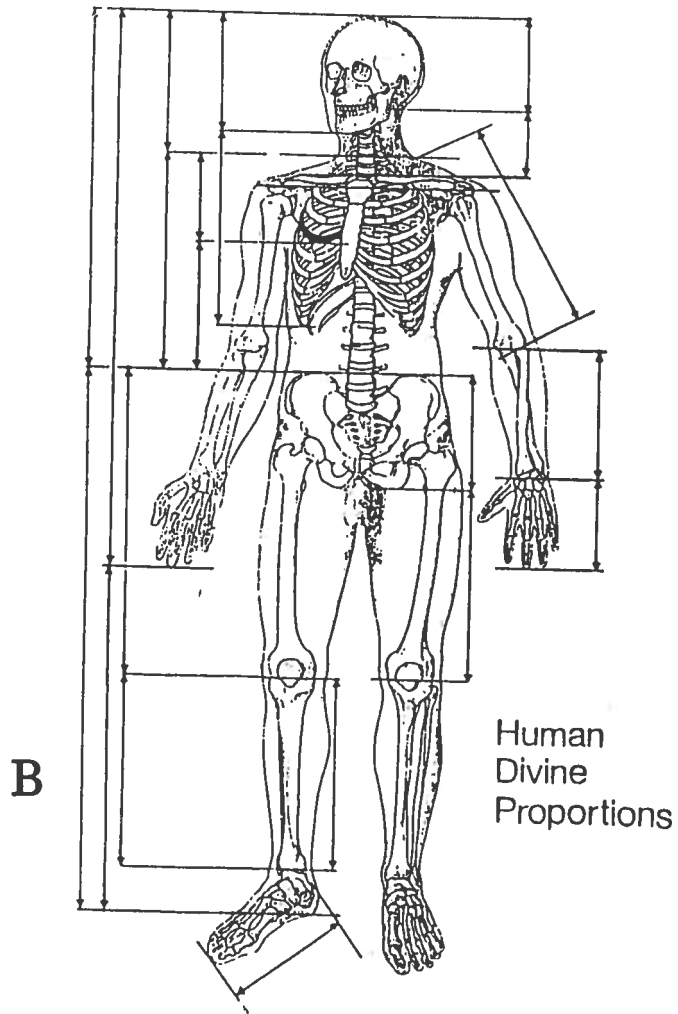
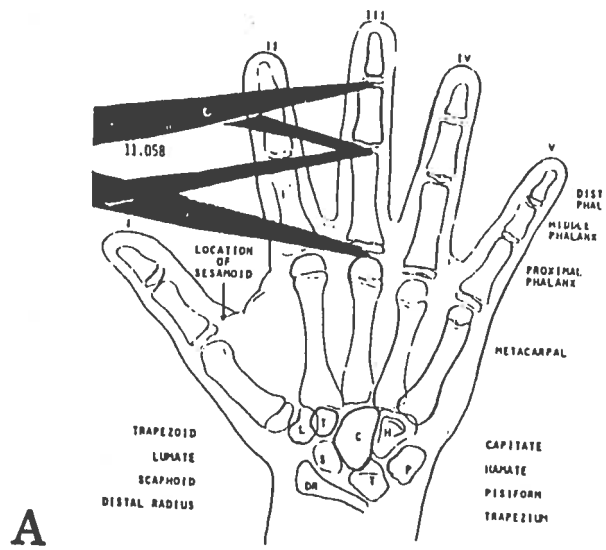
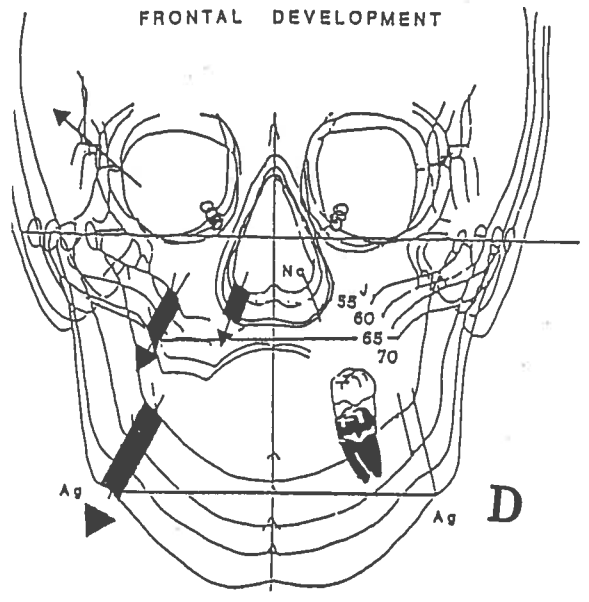
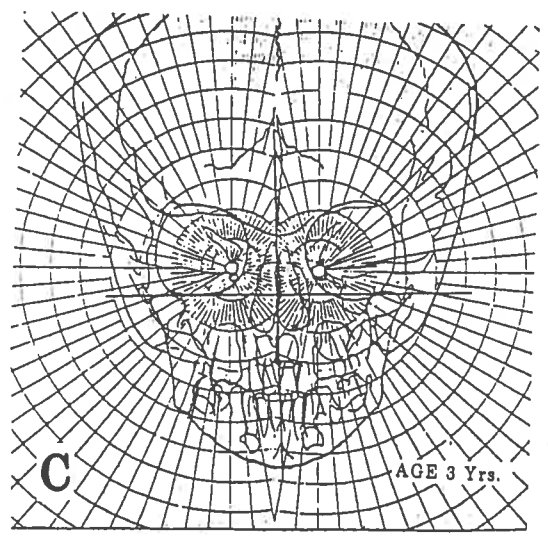
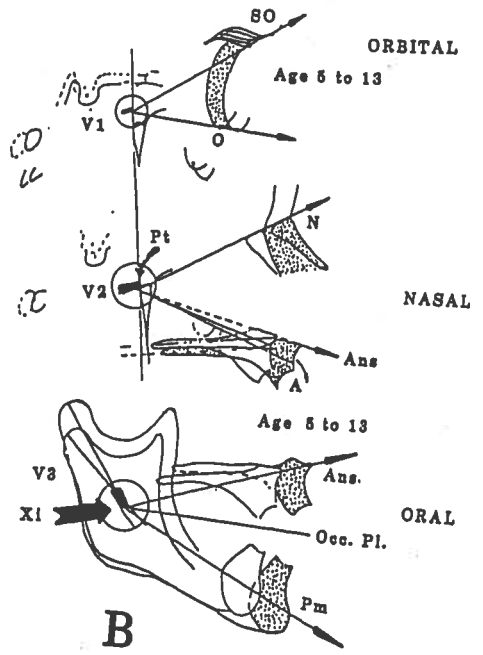
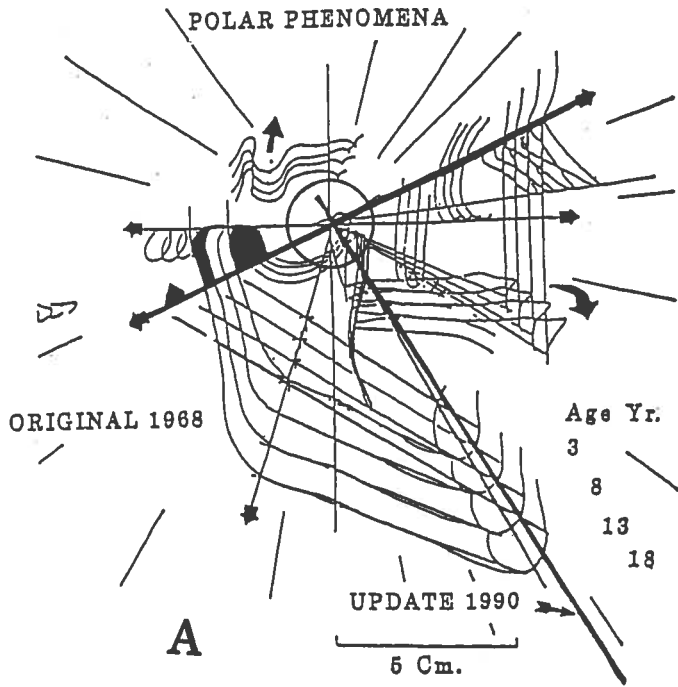
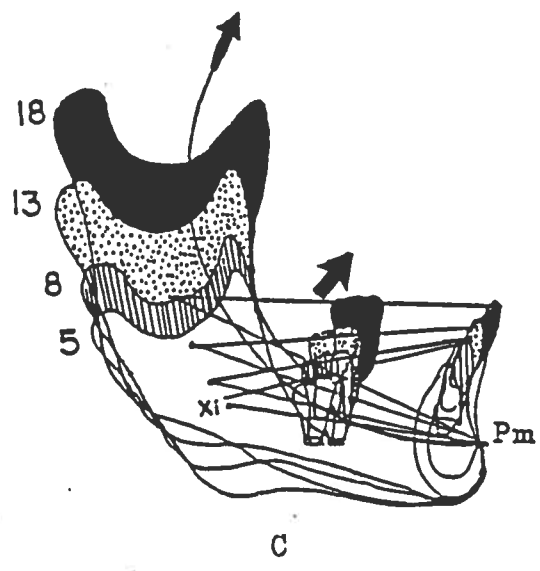
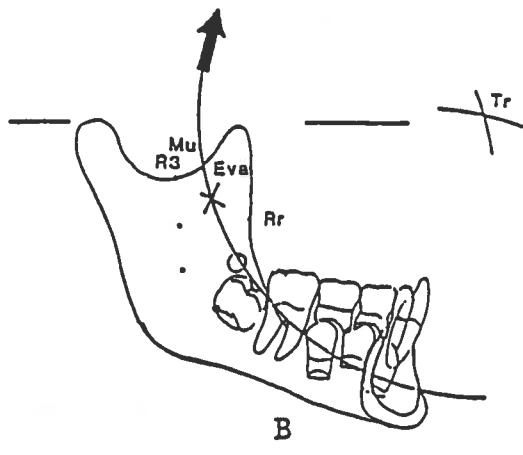
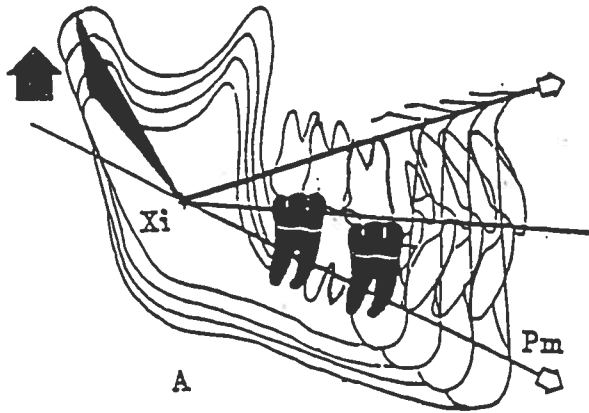


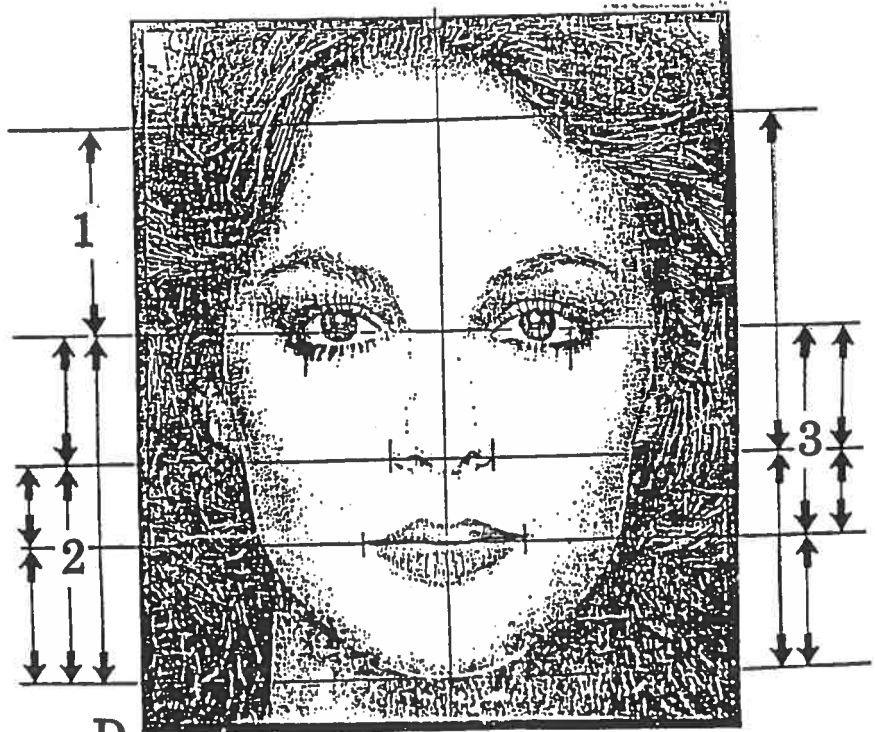
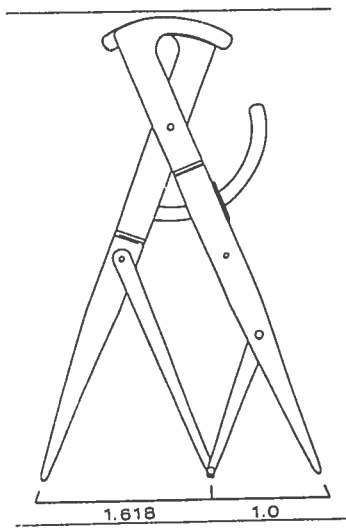
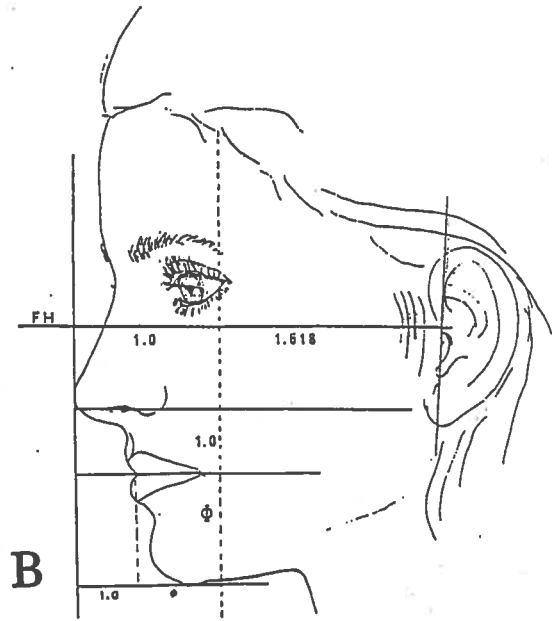
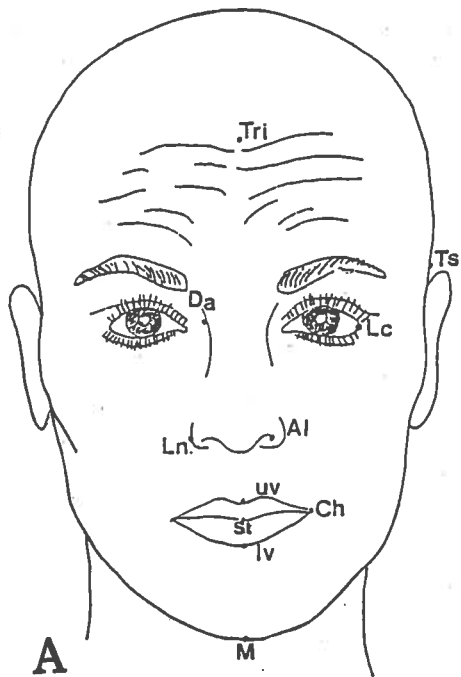
Figure 8









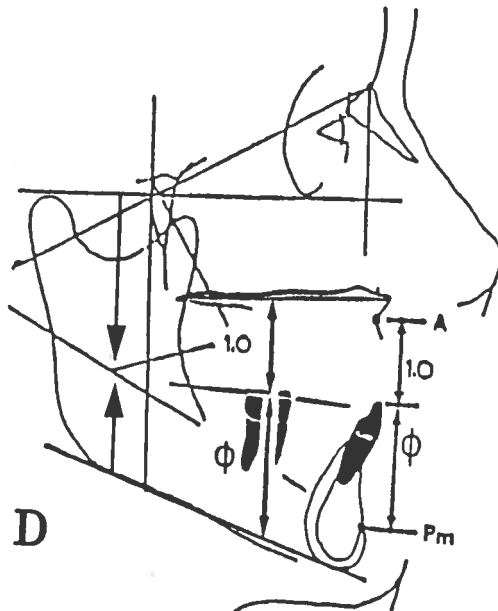
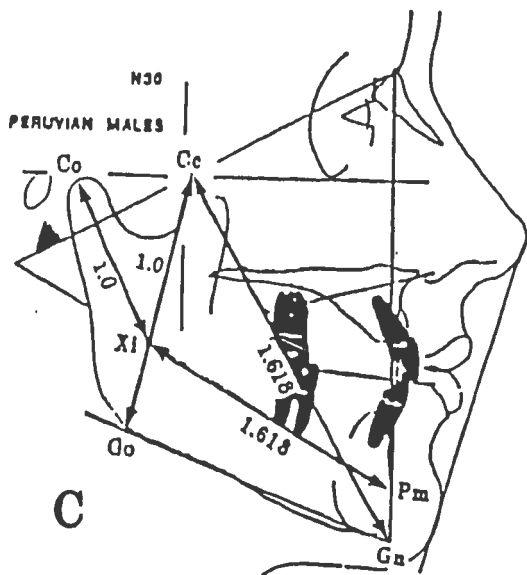
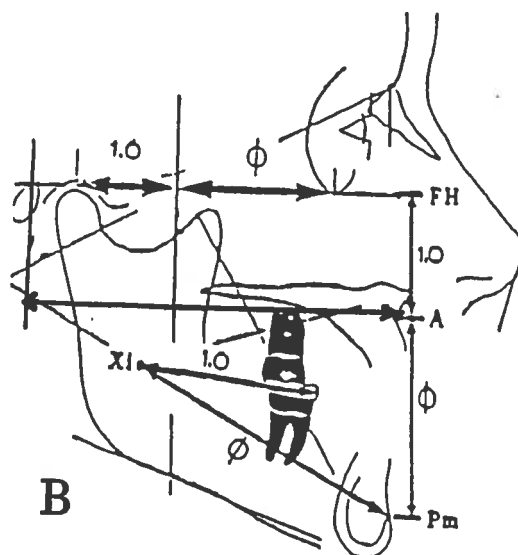
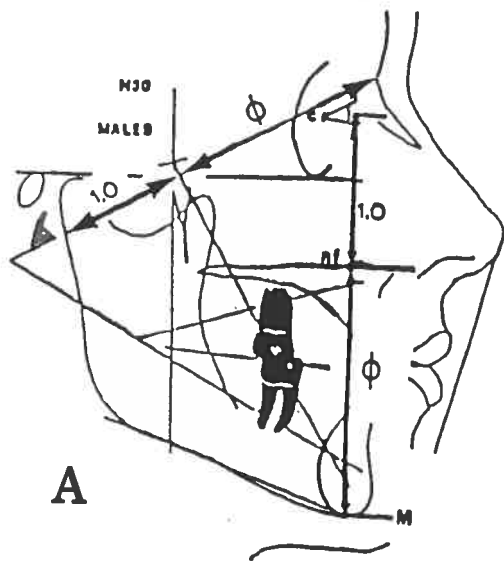


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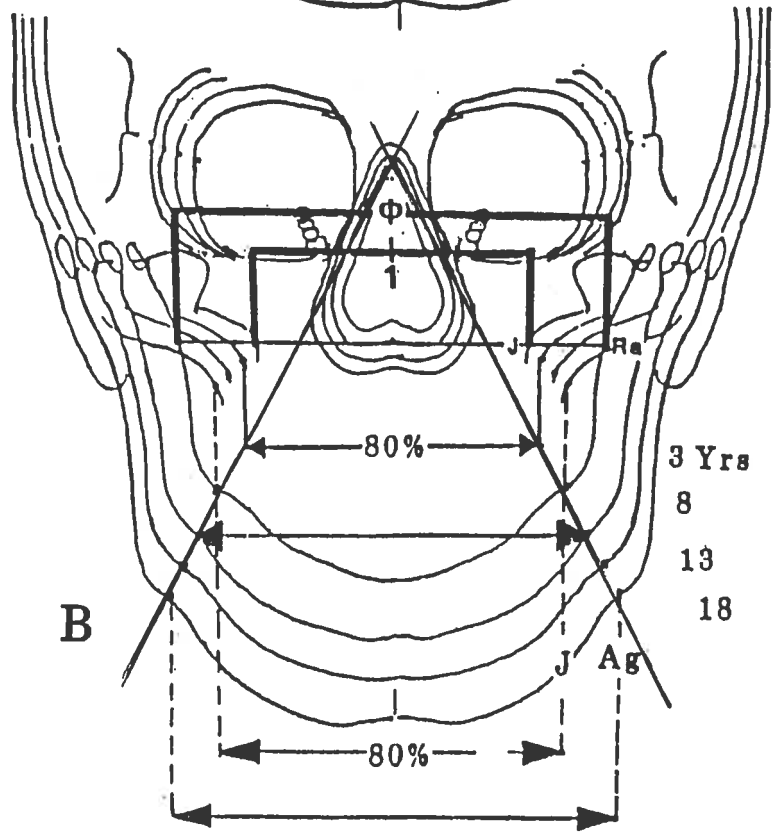
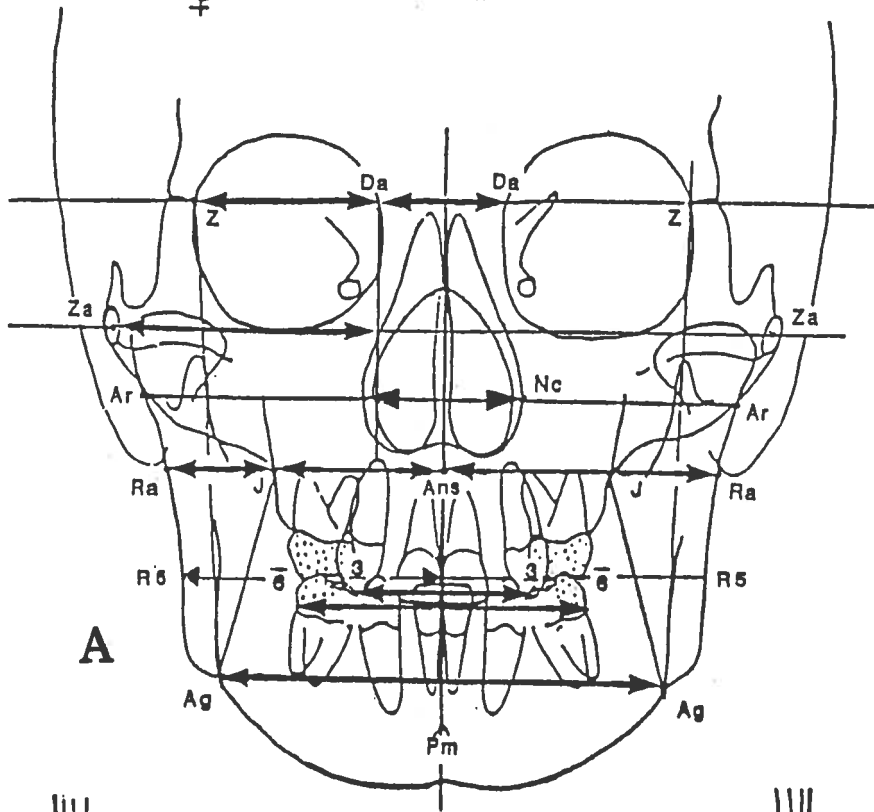
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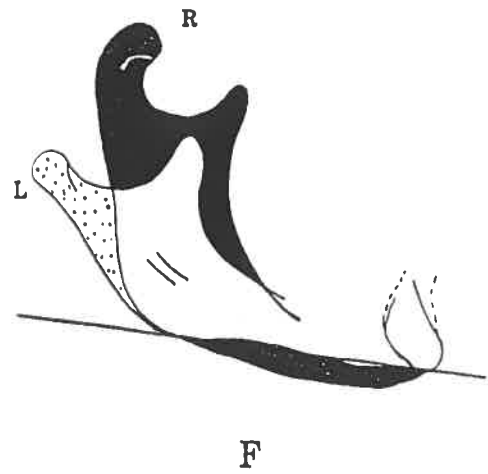
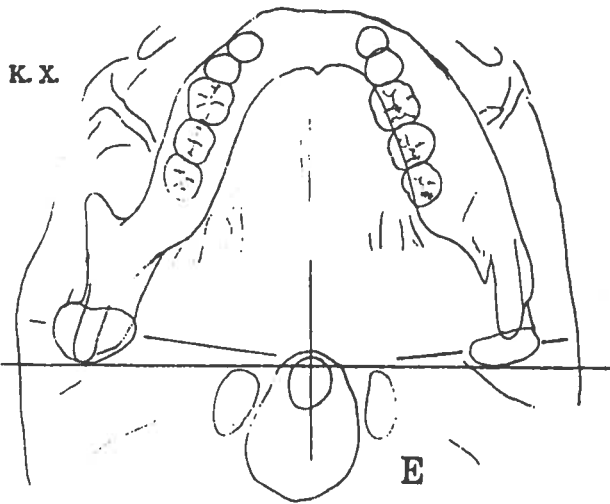
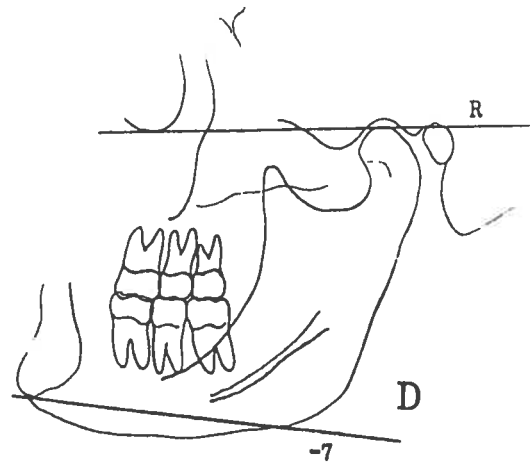
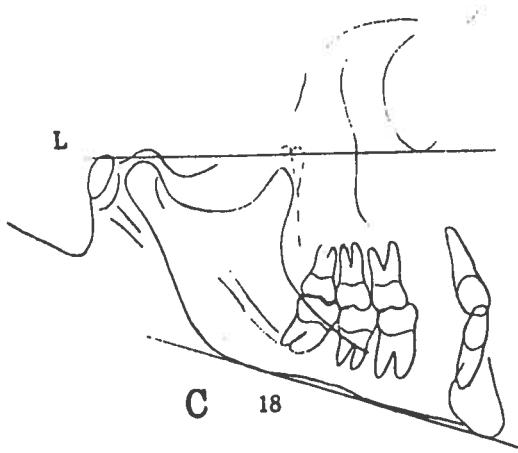
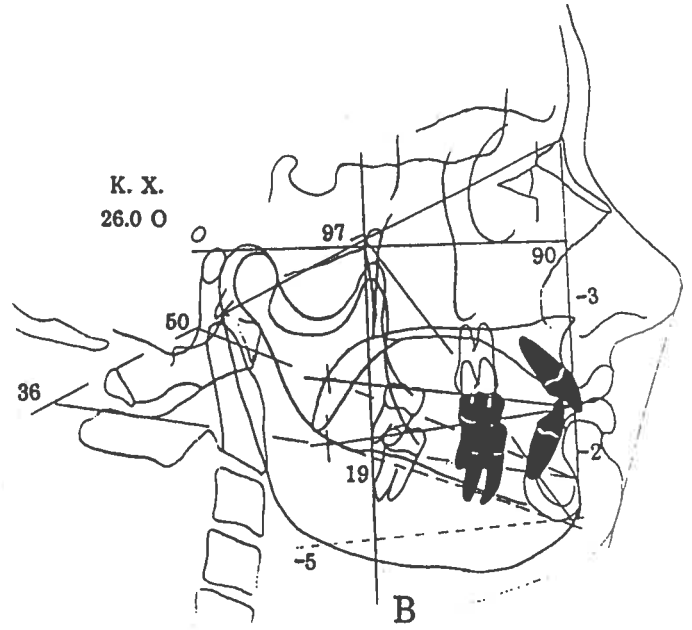
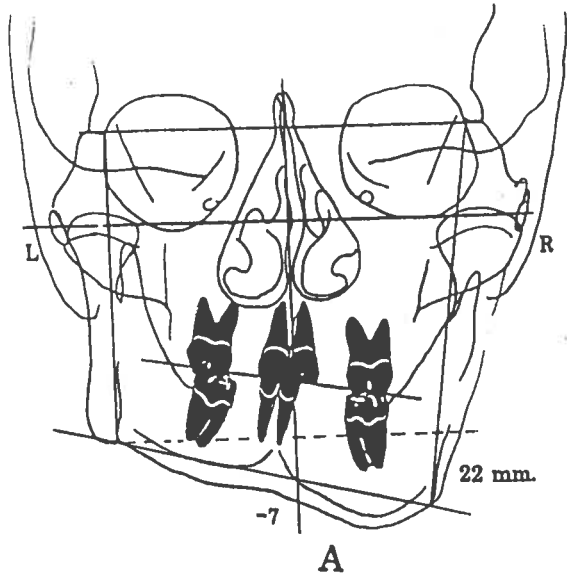
C

D

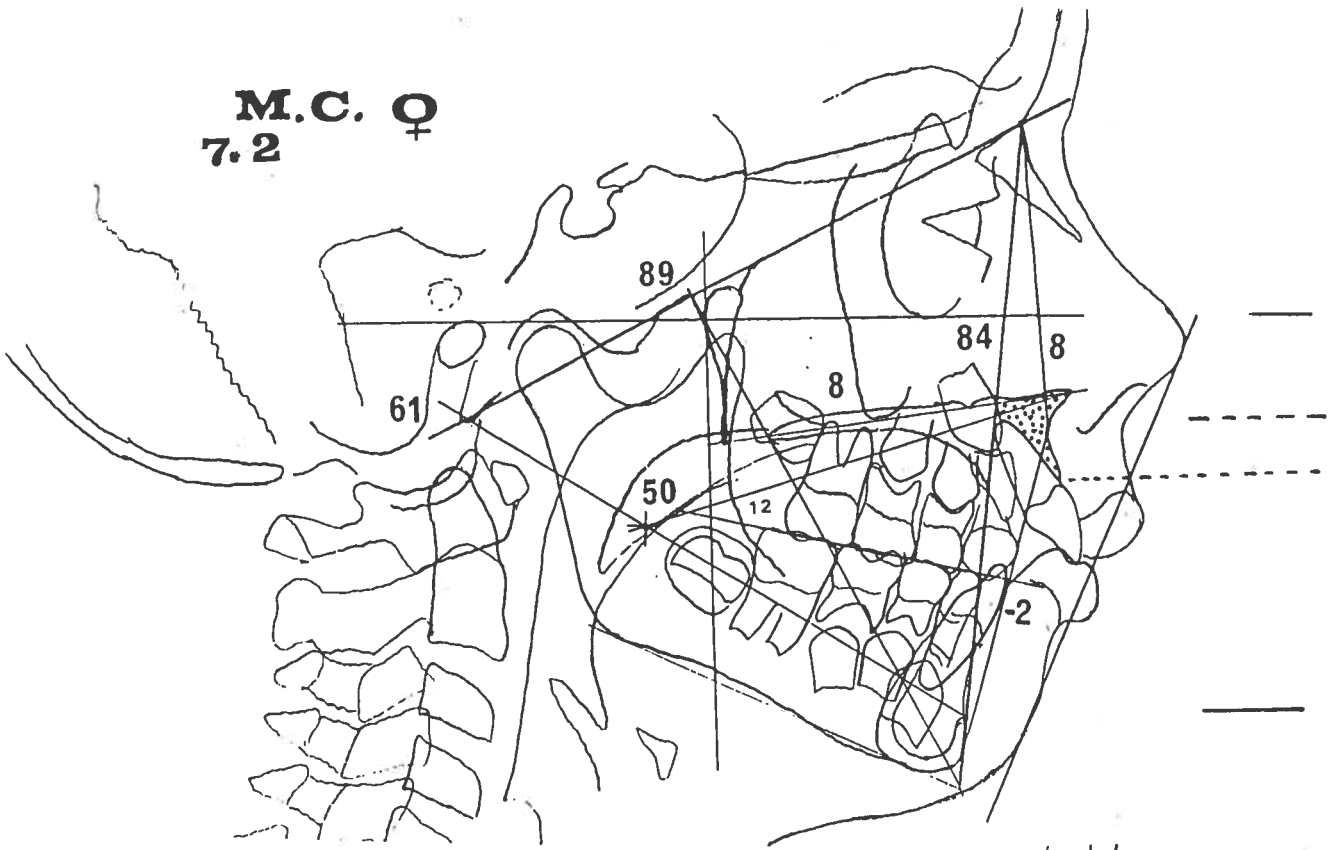


♀ ADULT COMPOSITE N82

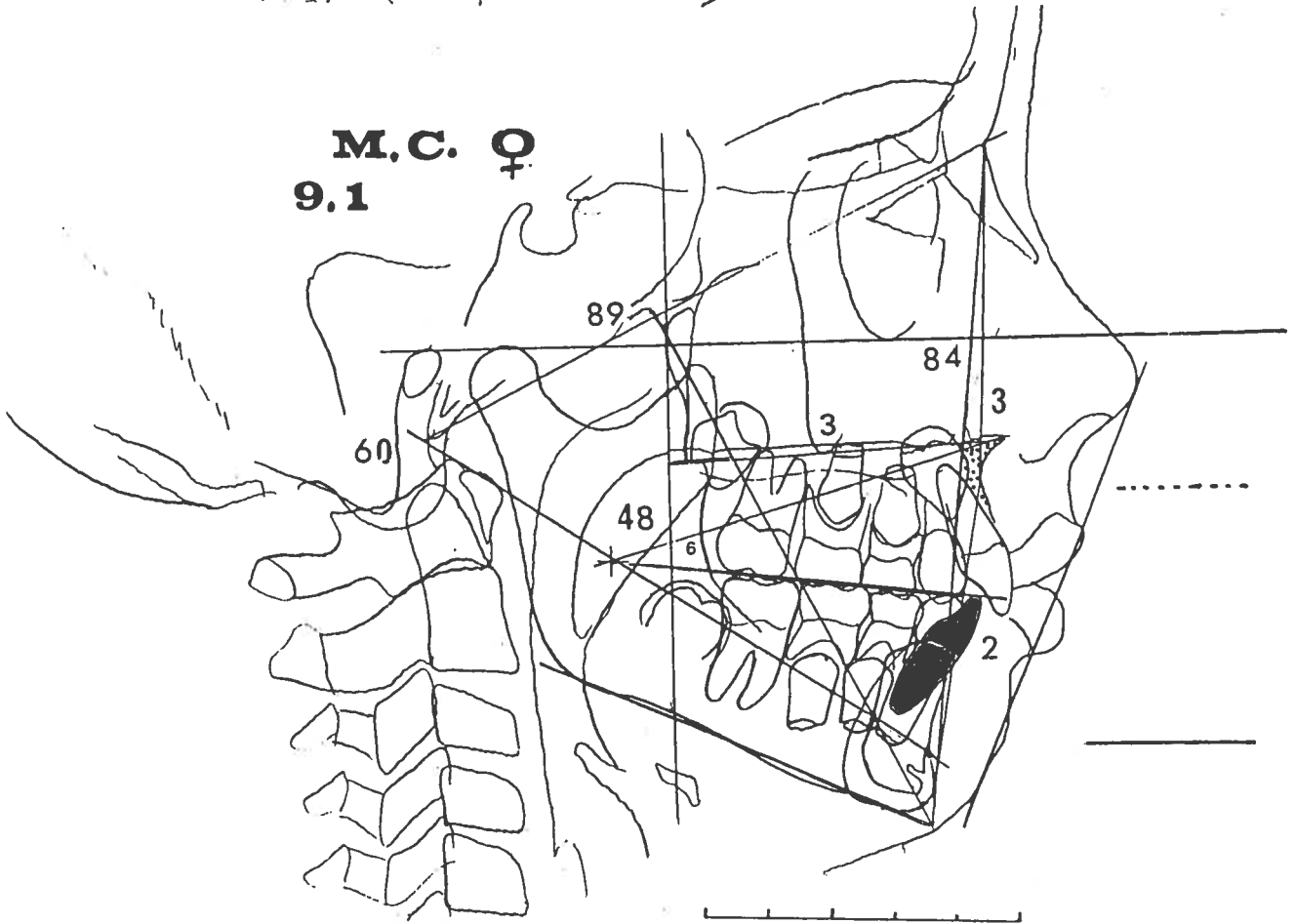


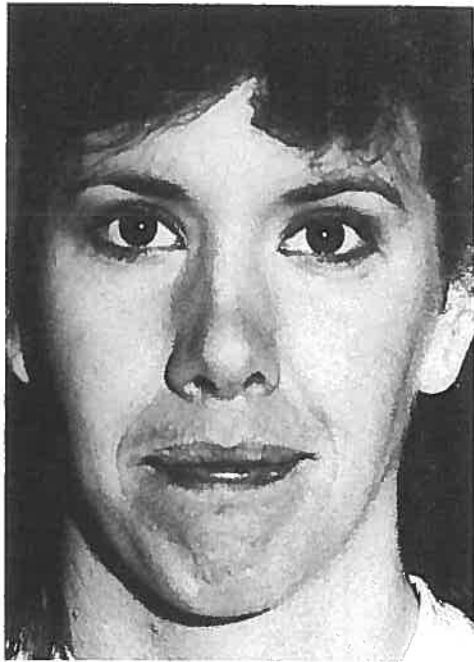


M.C. ♀
7.2



M.C. ♀
9.1

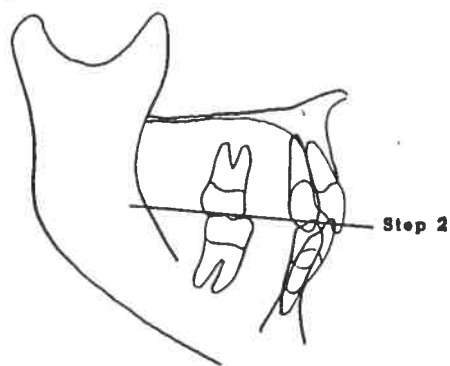
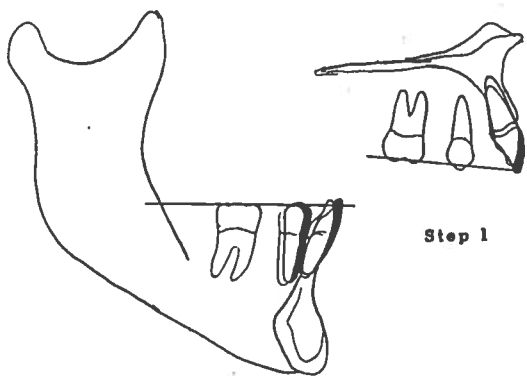
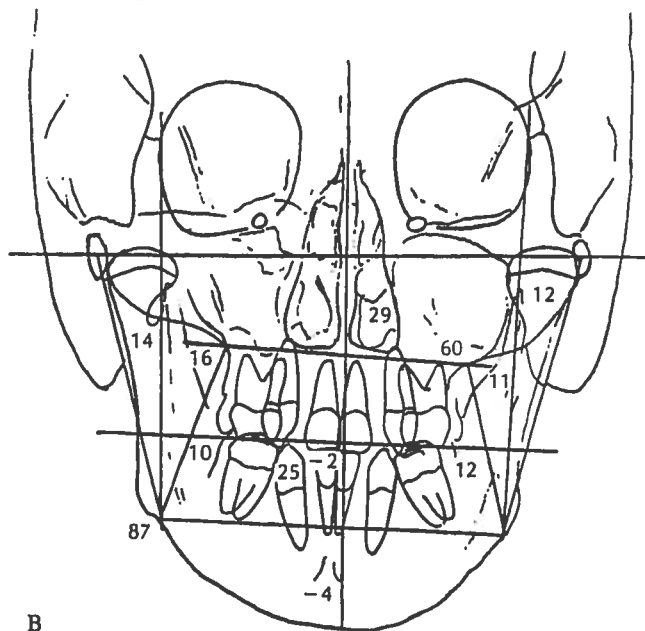
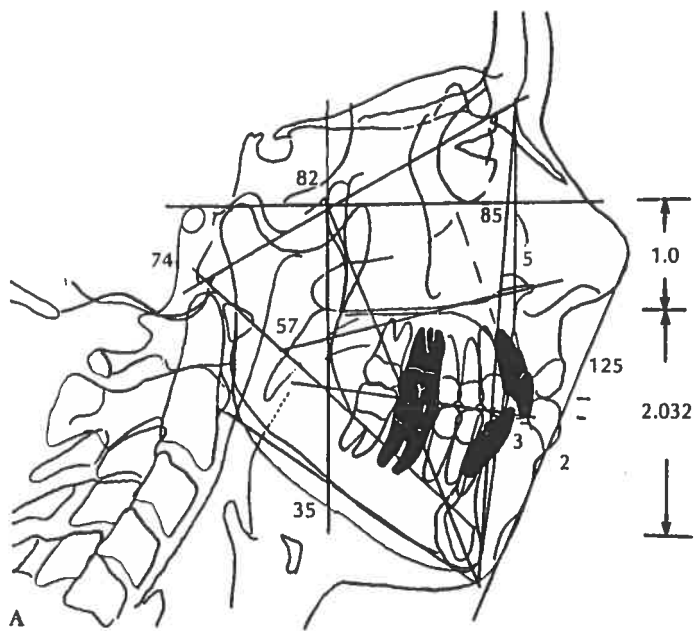


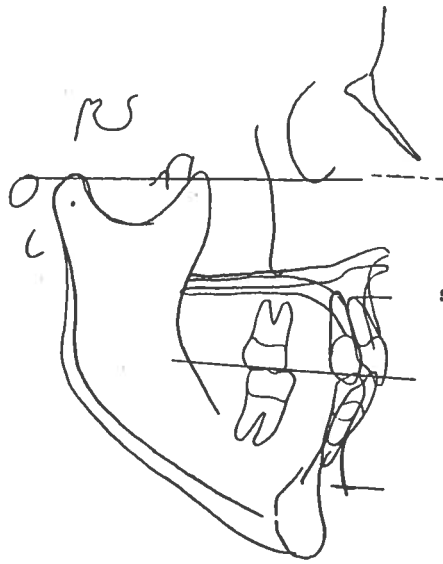


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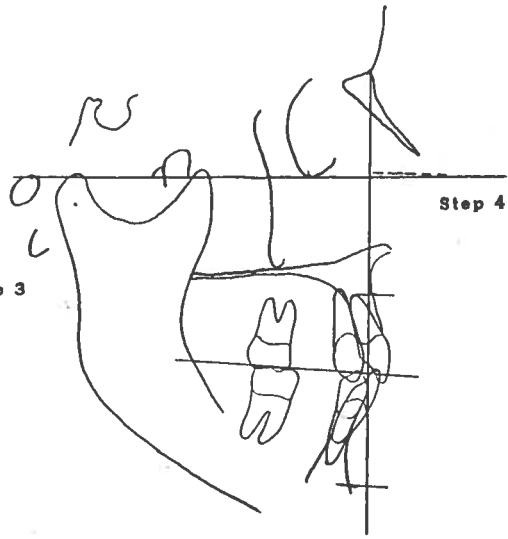


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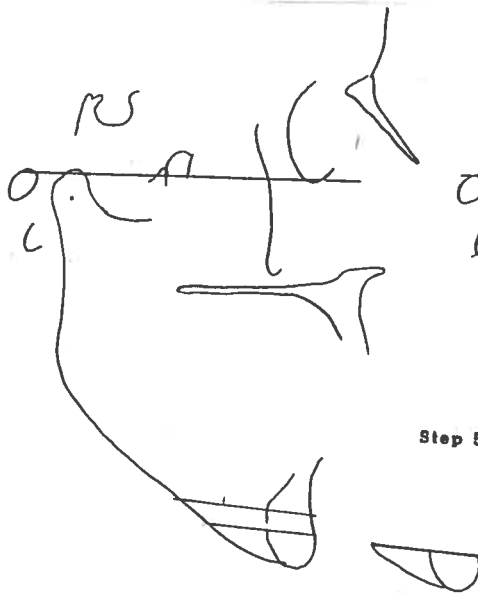




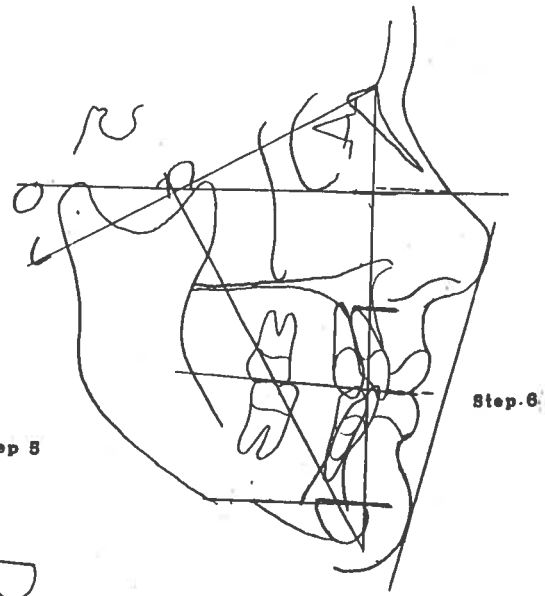
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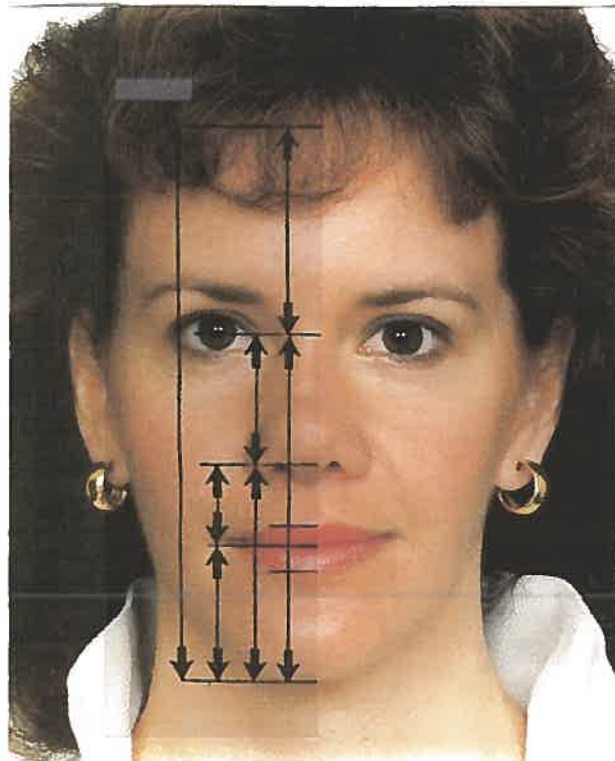
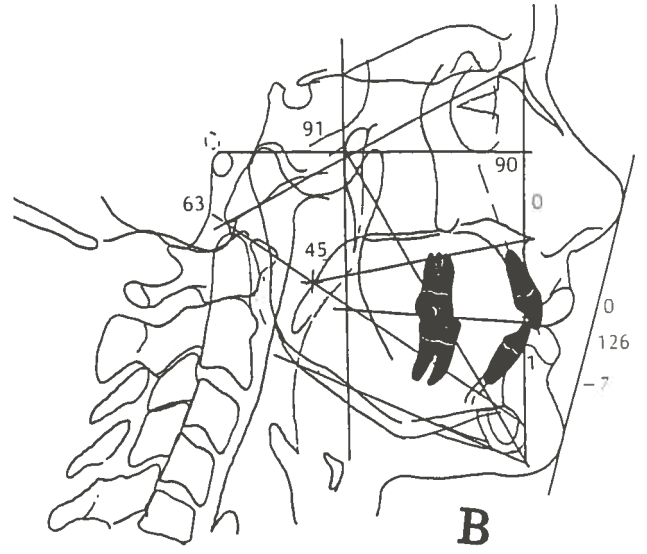
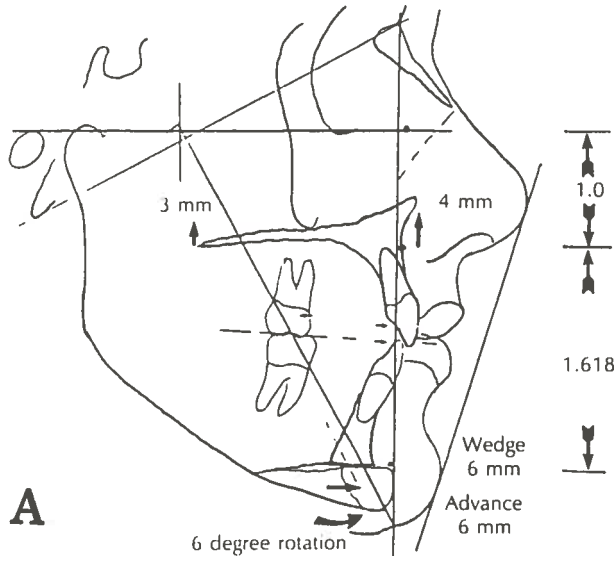
Step 4



Step 5



Step 6



C