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Anatomical Society of Southern Africa

Selected abstracts of papers presented at the 18th Annual Congress of the Society held at the Morula Sun, Mabopane, 12–15 April 1988

Anatomiese Vereniging van Suider-Afrika

Uitgekose uittreksels van referate wat opgelewer is gedurende die 18de Jaarlikse Kongres van die Vereniging wat van 12–15 April 1988 by die Morula Sun, Mabopane gehou is

“Pear-shaped” cells in the gut of the tigerfish

Hydrocynus forskahlii

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The presence of “pear-shaped” or “rodlet” cells amongst the epithelial cells of the alimentary tract has been reported in a number of exotic teleost fishes.¹ The aim of the present study was to establish the presence and describe the morphology of this “cell type” in the gut of the tigerfish, *Hydrocynus forskahlii*.

Small pieces of tissue from the gut of *H. forskahlii* were fixed in 4,5% glutaraldehyde in Sørensen's phosphate buffer for 24 hours at 4°C. Samples were post-fixed in 1% osmium tetroxide for 4 hours at 4°C and processed for transmission electron microscopy using standard techniques.

“Pear-shaped” cells were present in the mucosa of the distal part of the gut. These cells are characterized by a thickened membrane which encloses the cytoplasmic organelles. The nucleus is situated basally in the cell. Electron-dense, membrane-bounded rod-like structures, which arise from the supranuclear region, converge apically. Vesicles of different sizes are present in the cell. The “pear-shaped” cells open to the lumen of the digestive tract through narrow intercellular pores. The adjacent cells are covered with microvilli on their free surfaces.

The appearance and the structural organization of the “pear-shaped” cells differs from that of other epithelial cells lining the digestive tract of the tigerfish and indeed from most cells lining the digestive tract of other vertebrates. Whether these cells are developmental stages of goblet cells or possibly protozoan parasites is not clear. The exact status of the “pear-shaped” cells remains to be determined.

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Endothelial junctional healing of end-to-end anastomoses in normal and compromised small arteries

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Recent advances in stroke therapy have been highlighted by direct intracranial microsurgical approaches to ameliorate focal occlusive lesions, and thus improve the blood supply to the ischaemic brain. However, in-

different results have emphasized the importance of performing a perfect anastomosis, and our aim in this study was to investigate the healing process of the endothelial lining at the anastomotic junction. We were also interested in factors which may compromise the luminal size of the vessel and evaluation of their influence on the healing process.

The common carotid artery of the rat was chosen as an experimental model due to its approximation in size to the luminal diameter of the middle cerebral artery of the adult human brain. Microsurgical techniques were used to expose, sever, and do an end-to-end anastomosis. In addition to this, the blood flow was compromised to achieve either a complete closure or partial stenosis proximal or distal to the anastomosis. The vessels were sampled at different times (7 to 30 days post-operative) and prepared for microscopy.

A definite increase in platelet aggregation and fibrin formation was noted where endothelium was deficient (entry points of needles; anastomotic junction; endothelial/media separation due to vascular clip injury). There was a predisposition towards fibrosis and necrosis where the anastomosis was noted to be under tension during surgery, and where the adventitia was resected from the vessel stumps. Torsion often led to malpositioning of the stumps and interfered with healing. Handling of the vessel, as well as incorrect suturing technique, caused anastomotic stenosis. All the above was exacerbated where the vessel lumen was compromised. Re-endothelialisation was rapid and completed by the fourth week.

We conclude that damage to the endothelium must be limited by using closer needle/suture ratios, lighter vascular clips, and avoiding tension and torsion. Also, a perfect anastomotic technique is essential and adventitial stripping should be avoided as this adversely affects collateral circulation.

The origin of deuterosomes—a preliminary study

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Only a few of the basal bodies of a ciliated epithelial cell form around the diplosome whereas the majority originate around deuterosomes.^{1,2} The origin of these deuterosomes is still a matter of conjecture. Deuterosomes are thought to form as a result of consolidating fibrous granules,¹ although deuterosomes originating alongside the parent centrioles have also been described.³ This study was undertaken to determine the true origin of deuterosomes.

The respiratory epithelium of the nasal cavities of 18–23-day-old rabbit

embryos were removed, fixed in glutaraldehyde, post-fixed in osmium tetroxide and routinely prepared for electron microscopy.

Groups of deuterosomes, as well as a few fibrous granules, appear more or less simultaneously at the beginning of ciliogenesis in the cell. Single deuterosomes, however, appear alongside parent centrioles, in a similar way to new centrioles that form alongside mature centrioles. These deuterosomes may occur on their own, but in most cases are already surrounded by the procentrioles developing radially around them. In some instances these complexes of parent centriole, deuterosomes and procentrioles are linked to form chains consisting of procentrioles and deuterosomes.² The detachment of the deuterosomes from the parent centrioles has not been observed in the current study. Whether all the deuterosomes in a cell are formed as described above, could not be ascertained in this study and warrants further investigation.

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A comparative study of the structure of left ventricular bands

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Left ventricular bands (LVBs) have recently been associated with a number of clinical phenomena. This study of the structure of LVBs sought morphological evidence to indicate whether or not the implication of LVBs in the genesis of premature ventricular contractions or atypical chest pain is justified.

LVBs from twenty ovine, twenty bovine, twenty human and ten canine hearts were fixed in neutral buffered formalin as soon after death as possible. The bands were then embedded in paraffin wax and serially sectioned. Sections were mounted on glass slides and stained with haematoxylin and eosin.

Light microscopic examination of sections from all samples showed that the LVBs contained cardiac conduction fibres of the Purkinje type. The bundles of Purkinje fibres were surrounded by a sheath of connective tissue which in turn was surrounded by a layer of endocardium. In some cases nerve fibres were observed to pass into the LVBs. Of the animal LVBs, those of the dog were found to have the greatest number of features in common with those of the human.

The histological findings confirm that LVBs are a normal structural component of the heart. The presence of conduction tissue in the LVBs suggests that they form part of the cardiac conduction system and therefore could be implicated in conduction disturbances such as premature ventricular contractions. The occurrence of nerves within LVBs lends support to the proposal that stretching of LVBs during the cardiac cycle may, in certain instances, cause activation of myocardial pain fibres.¹ At least on morphological grounds the canine LVB appears to be a suitable animal model for clinical studies.

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An *in vitro* model for Still's murmur

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Despite the high prevalence of Still's murmur, its exact cause has not been determined. Recent studies have shown a statistically significant association between the presence of left ventricular bands (LVBs) and Still's murmur. By means of an experimental model and fluid dynamic theory, this study investigated the possibility that Still's murmur is related to the Aeolian tone, whereby regular vortex shedding around cylindrical structures transversely positioned in a flowing fluid results in vibrations at a predictable frequency.

LVBs were isolated from bovine and equine hearts and each end attached to a nylon thread. A band was suspended across a cylindrical flow chamber and a sound transducer attached to the wall of the chamber to record vibrations as water flowed through the chamber. When the flow

exceeded a specific rate a vibration of the LVB was observed. These results were repeatable with LVBs of varying thickness.

Fluid dynamic theory concerning the von Karmen phenomenon was applied to a hypothetical model of an LVB situated in the left ventricular outflow tract and the behaviour of the anticipated vibration was predicted. The characteristics of the oscillation were remarkably similar to those reported by numerous investigators of Still's murmur.

The results obtained from the experimental model together with fluid dynamic theory suggest that the vibrations of Still's murmur are the result of an Aeolian tone.

The effect of intestinal mesenchyme on the differentiation of endocrine cells from gizzard endoderm of chick embryos

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At hatching (21 days of incubation) the gizzard (muscular stomach) of the chicken contains hardly any endocrine cells. Nevertheless we have previously demonstrated the potential of gizzard endoderm to differentiate into proventricular types of endocrine cell by associating it with mesenchyme from the proventriculus (glandular stomach).

To determine whether gizzard endoderm can respond to non-gastric mesenchyme, we have combined intestinal mesenchyme from 4-day quail embryos with gizzard endoderm from 4-5-day chick embryos. The layers were separated with collagenase and the combinations cultured briefly *in vitro* and then as chorio-allantoic grafts until their total incubation age was 21 days. Control grafts comprised re-associated endoderm and mesenchyme of quail intestine and of chick gizzard.

Restriction of quail cells to non-epithelial components in experimental grafts confirmed clean separation of the layers. Endocrine cells were revealed in sections by immunocytochemistry. They were very rare in gizzard controls but fair numbers were detected in intestinal controls and experimental grafts. Hence gizzard endoderm can indeed respond to intestinal mesenchyme by differentiating into endocrine cells.

Of the seven different types of intestinal endocrine cells present in intestinal controls, five (serotonin-, neurotensin-, somatostatin-, glucagon- and pancreatic polypeptide-immunoreactive cells) were present in almost all experimental grafts. These are types found also in normal proventriculus. Two non-proventricular, specifically intestinal, types (secretin- and motilin-immunoreactive cells) differentiated in over half of the experimental grafts. That they did not appear in all may indicate that the ability of gizzard endoderm to differentiate into specifically intestinal endocrine cell types is not always as great as its capacity to form gastric types: whether it declines during the period of development studied is being investigated.

The influence of a low frequency electrical field on the growth rate, death rate and incidence of congenital malformations in two generations of mice (*Mus musculus*)

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In view of the controversy surrounding the possible adverse effect on man and animals of the electrical field generated by overhead power lines, a pilot study was undertaken to investigate the effects of an electrical field on the growth and development of mice.

Two generations of mice were exposed to a constant a.c. electrical field of 10 kV/m (the standard electrical field generated under power lines) in specially designed cages. The first generation was placed in the electrical field as adults after being paired and the second generation was born in the electrical field. Data concerning incidence of external congenital malformations and deaths as well as growth rate (measured as mean mass of pups at birth and at weaning age) were recorded and compared with data from a control group exposed to the same conditions, except for the electrical field.

No external congenital malformations were recorded in either group. A statistically significant increase ($P < 0,05$; chi-square test) in the number of deaths of pups of the first generation of the experimental group was

found before the age of weaning; the second generation showed a statistically significant increase in the number of stillborn pups ($P < 0,05$) as well as in the number of deaths of pups before weaning ($P < 0,05$). No statistically significant difference between the experimental and control groups was found for the mean mass of the pups of either generation at birth. The pups of the first generation experimental group showed a statistically significant lower mean mass at the age of weaning than the controls; this difference was not found in pups of the second generation experimental group.

The results of this pilot study indicate that an a.c. electrical field of 10 kV/m has a biological effect which is possibly attributable to a stress effect on the mother.

Effects of a constant low level electrical field on mice (*Mus musculus*): a study of fertility and the histology of the testis

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The need for electricity is rapidly increasing, resulting in higher voltages being carried in overhead power lines. The question whether the energy field under these lines has an adverse effect on the fertility of mammals has been raised by many.¹

To test the effect of a constant electrical field on the fertility of two generations of mice, they were exposed to an electrical field of ~10 kV/m. Each generation consisted of 10 pairs of mice each of which were allowed 5 litters before being sacrificed. The fertility of each generation was compared with a control group (exposed to identical surroundings with the omission of the electrical field) and statistically analysed. Histological sections of the testis of the male mice of both the experimental and control groups were studied for the presence of abnormal spermatogenic cells, such as multi-nucleated giant spermatids.

The fertility of both generations of the experimental group was compared with that of the control group and no significant difference was observed. The testes of experimental animals showed no increase in the presence of abnormal spermatogenic cells when compared with that of the controls.

Spermatogenesis (a continuing process of rapid cell division) is sensitive to noxious factors, such as high-frequency radiation. This results in a higher incidence of abnormal spermatogenic cells and eventually results in a decrease in the number of normal spermatozoa and thus lowering of the fertility of the individual. As no difference in the fertility between experimental and control groups was found and no increase in the number of abnormal spermatogenic cells, the conclusion drawn from this study is that a low-frequency electrical field does not alter the fertility of mice over two generations.

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The development of the ethmoid region of *Gallus*

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A study of the normal stages of the early development of the chondrocranium of *Gallus* was undertaken to provide a model with which to compare cranial abnormalities resulting from the application of teratogenic agents. Previous researchers have demonstrated the usefulness of chick embryos in experimental teratology.

Four embryos from a closed White Leghorn stock were removed at 24-hourly intervals from 3 days incubation up to 21 days, fixed in Allen's fluid, and serial sections prepared from the majority of specimens. Heidenhain's iron haematoxylin, Bismarck brown and eosin were the main dyes used; graphic reconstructions were made from camera lucida drawings of the sections.

In the literature, confusion still exists about the development of the ethmoid region of birds, especially regarding the presence or otherwise of an intertrabecula in the region from which the interorbital and nasal septa develop. Experimental work on cold-blooded animals (salamanders)¹ has shown that this region is severely affected by substances such as lithium.

The interorbital septum appears for the first time in 5-day embryos of *Gallus* as the procartilaginous, azygous anterior part of the trabeculo-

polar bars. Anterior to the level of the attachment of the inferior oblique eye muscle it is continuous with the future nasal septum, which at this stage is only a wedge-shaped mesenchymatous ridge on the ventral surface of the ethmoid plate.

There is no indication that this anterior part of the trabeculo-polar bars, the trabecula communis, is ever paired, either as a procartilaginous or as a cartilaginous element and there is no trace of an intervening element.

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The effects of relative speed, using stature and lower limb length, on submaximal oxygen consumption during walking

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Relative speed expressed as statures. sec^{-1} (St.s^{-1}), or as a Froude number,^{1,2} has been used extensively to 'normalise' gait patterns in populations of differing linear dimensions. The relationships between stride time and walking speed, and between relative stride and relative speed,³ have been shown to be less variable when walking at relative speeds than at absolute speeds (m.s^{-1}). The effects of different gait patterns on submaximal oxygen consumption ($\dot{V}\text{O}_2$) have been well documented.³ The aim of this study was to examine the effects of different relative speed methods, using stature and lower limb length, on $\dot{V}\text{O}_2$ during walking.

Stature ($\bar{X} = 180,3 \pm 7,47$ cm; c.v. 4,14%), body mass ($\bar{X} = 71,7 \pm 6,49$ kg; c.v. 9,05%) and lower limb length ($\bar{X} = 86,7 \pm 6,29$ cm; c.v. 7,25%) were measured in 11 caucasian males (mean age $21,6 \pm 3,7$ years). After a period of habituation, each subject completed 31 randomly assigned 4-minute walking sessions on a Quinton model 643 motorized treadmill; [8 between 1,11 and 2,35 m.s^{-1} , 8 between 0,6 and 1,3 St.s^{-1} , 8 between Froude numbers 0,27 and 0,55, 7 between 1,24 and 2,68 lower limb lengths. sec^{-1} (Ll.s^{-1})]. Expired gas was analysed by means of a computer-assisted on-line data collection system.

The characteristic curvilinear relationship between $\dot{V}\text{O}_2$ and increasing walking speed was not significantly altered by any of the relative speed methods used. This relationship was best described by a least-squares exponential fit in all cases. Furthermore, inter-subject variations in $\dot{V}\text{O}_2$ ($\text{ml.kg}^{-1}.\text{min}^{-1}$) were not significantly reduced ($P < 0,05$) by any of the relative speed methods when compared with the variability in $\dot{V}\text{O}_2$ ($\text{ml.kg}^{-1}.\text{min}^{-1}$) at absolute speeds (m.s^{-1}). It was concluded that relative speed, in the forms used in this study, cannot be used to reduce inter-subject variation in $\dot{V}\text{O}_2$ while walking, neither do these techniques have a significant effect on the relationship between $\dot{V}\text{O}_2$ and increasing absolute walking speeds.

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Single year height and weight velocities for South African rural black children

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Growth rates of children are sensitive indicators of their health and well being. In America and Europe longitudinal growth studies have allowed the development of growth rate or growth "velocity" charts which can be used to monitor the normality or otherwise of a child's growth. Longitudinal studies have been rare in developing countries and have not been undertaken previously on the African continent. In 1985 and 1986 two longitudinal studies were initiated in South Africa; at Vaalwater, in the northern Transvaal, and Ubombo, in northern KwaZulu. These studies involve subjects aged from five to 18 years attending rural schools.

This paper reports on the yearly growth velocities in height and weight of children from Ubombo, KwaZulu. The children were seen on three occasions at yearly intervals and at the times of measurement each subject was free of any overt signs of illness or disease. Anthropometric measurements of height, weight, sitting height, bi-acromial and bi-iliac diameters, head and upper-arm circumferences and skinfolds from the triceps, biceps, subscapular and supra-iliac sites were taken on each

occasion. Mean velocities have been calculated and compared with similar data from Britain and America. The magnitudes of the height and weight velocities were consistent with those of European and American children. The rural South African children, however, exhibited an extended growth spurt with higher growth velocities at older ages. Significant growth rates were maintained in the late teenage years, resulting in adult heights and weights that were not too dissimilar from those of European and American children. It is suggested that this pattern of growth is the result of these children being subjected to a nutritional and socio-economic environment that hampers their genetic potential and produces an adaptive response in the form of an extended growth period.

Morphological characteristics of professional circus artists

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Extensive literature surveys have indicated that no anthropometric investigations have been conducted on circus artists, with the result that virtually nothing is known about the morphological characteristics of this elite group of performers who develop highly specialized motor skills. The objectives of this study were to obtain biographical information and body size, shape, proportional and compositional data from a total of 19 (13 male and 6 female) professional circus artists who specialised in acrobatic, flying trapeze, juggling, oriental and contortionist acts. The subjects were members of international troupes who were touring with the Boswell-Wilkie circus in South Africa.

Basic anthropometric data were obtained using the techniques and equipment recommended by the International Working Group on Kinanthropometry (IWGK). These data were used to calculate body surface area (BSA), proportionality profiles, anthropometric somatotype ratings, skinfold sums and total body fat.

The means and standard deviations for the circus males were: age (yr) 23.0 ± 3.9 ; circus experience (yr) 9.3 ± 8.2 ; training time (min/day) 81 ± 48 ; stature (cm) 172.6 ± 8.4 ; mass (kg) 65.2 ± 10.1 ; BSA (m^2) 1.8 ± 0.2 ; somatotype $1.6-4.9-3.1 \pm 0.5-1.2-1.2$; Σ 6 skinfolds (mm) 37.0 ± 9.2 and relative body fat (%) 6.5 ± 1.0 . The following data were obtained for the circus females: age (yr) 24.4 ± 6.5 ; circus experience (yr) 19.2 ± 8.0 ; training time (min/day) 147 ± 58 ; stature (cm) 159.5 ± 9.5 ; mass (kg) 54.1 ± 4.7 ; BSA (m^2) 1.6 ± 0.1 ; somatotype $2.0-4.3-2.3 \pm 0.6-0.8-1.0$; Σ 6 skinfolds (mm) 50.4 ± 15.2 and relative body fat (%) 11.4 ± 2.4 .

Within the framework of this study the findings indicated that the average male artist had practised his profession for almost a decade and was in his early twenties. He was relatively small and light, had very little body fat and an ecto-mesomorphic somatotype rating. The average female artist on the other hand had almost two decades' experience and was in her mid twenties. She was of average height and weight and, like her male counterpart, also had little body fat and an ecto-mesomorphic somatotype rating. Proportionally the male and female artists were very similar.

Are Americans bigger? Morphofunctional characteristics of higher socio-economic status 'coloured' children from Cape Town

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This study provides a preliminary assessment of body size, proportions and fitness of a selected group of children. Data were collected in 1987 from 710 pupils aged 6–19 years attending schools for better-off 'coloured' communities. Seventy-five per cent of parents were from the first, second and third socio-economic categories (5 category standard). Weights and heights of prepubertal Cape Town (CT) children are on a par with nationally representative American (NCHS) standards,¹ whereas adolescents are slightly shorter and lighter. The weight for height plot of CT subjects, however, is above the NCHS standards in the entire age range. While triceps skinfolds of the CT children are similar to those of Americans, their subscapular skinfolds are thicker.² Upper and lower extremity lengths, chest circumference and bi-iliocrural diameter of CT subjects do not differ from those of white children of Philadelphia,¹ but the trunk is slightly shorter (anterior length from suprasternal to symphysis). Initially (6–10 yr) arm circumferences are comparable with

NCHS values, but later (11–19 yr) they are lower. Cape Town children are physically not as fit (as measured by grip strength, pulse rates and neuromuscular reaction time) as their American counterparts.¹

In conclusion, 'coloured' children from Cape Town whose parents are well educated and economically affluent are not smaller than their American counterparts. Differences in physical performance require further investigation.

This work was supported by grants from the University of Cape Town and the Medical Research Council.

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An anthropometric comparison of two groups of South African rural black children

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The physical status of two groups of black schoolchildren from rural areas of South Africa was investigated as part of continuing longitudinal studies of human growth and development. About 350 Pedi/Northern Sotho children from Vaalwater, northern Transvaal (VW), aged 5 to 18 years, have been seen every six months from January 1986, at which times standard anthropometric measurements of body length, diameter, circumference and skinfolds were taken. The second study involves about 450 Zulu children from Ubombo, KwaZulu (UB), of similar ages to the Vaalwater subjects. Annual visits were made to the area at which time the standard anthropometric measurements described above were taken. This paper reports a comparison of height, weight and skinfolds between these subjects and compares them to American (NCHS) growth charts.

Both groups and both sexes demonstrated height and weight curves that started at the 50th centile of NCHS growth charts at 5 years of age and gradually fell away during subsequent years. By adolescence, means for height and weight were close to the 5th centile but during adolescence catch-up growth occurred so that young adult means were between the 5th and 50th centiles. The UB children were heavier at all ages than the VW children. Weight for height showed the UB children to be on the 50th centile whereas the VW children were near to the 10th centile. In an attempt to determine whether these differences in weight were due to fat or lean body tissues, skinfold measurements were analysed and compared to Swedish norms. Both groups were similar for biceps, subscapular and supra-iliac skinfolds but triceps skinfold was greater in the UB samples of both sexes. It is suggested that these differences are most likely to be due to nutritional factors relating to the staple diet but this remains to be confirmed.

Sexual dimorphism, ontogenetic trends and phylogenetic regression of the *massa intermedia* in the primate thalamus

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Qualitative and quantitative studies of the *massa intermedia* (MI), or inter-thalamic adhesion, were carried out on seven different primate species, including man, in order to determine ontogenetic and phylogenetic trends of this thalamic structure. Quantitative analyses of 65 human brains of both sexes and varying ages was also carried out to decide whether sexual dimorphism exists in MI or not. Rosales *et al.*² recorded an increase in area of MI in females but did not reveal whether this was due to an increase in vertical and/or horizontal diameter. Therefore, measurements of both vertical and horizontal diameters of MI were made with a Helios-Vernier caliper to the nearest 0.001 mm, and the data analysed by the Kruskal-Wallis test.

There are indications from the findings of this study that the vertical diameter of MI is significantly larger in females than in males. This difference may be related to variation in the degree of thalamic laterality between the sexes, but no significant difference was found either in the occurrence or size of MI with increasing age of the human samples.

Volumetric analysis and microscopic observations on the major nuclei

of MI (nuclei *centralis medialis*, *rhomboidalis* and *reuniens*) were performed using stained serial sections of the whole thalamus. These comparative investigations confirmed published qualitative reports of regression in these nuclei.^{1,3} It is suggested that during primate evolution these nuclei underwent regression with concomitant regressive development of the rhinencephalon to which MI retains strong connections. Furthermore, this regression may also be due to an increase in *direct* fibre projections from the phylogenetically newer thalamic structures to the primary sensory areas in the cerebral cortex.

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A morphometric study of remodelling of the lumbar spine under the stress of lateralization

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Remodelling of bone in adults occurs as a response to stress and is therefore a measure of ecosensitivity. Degenerative changes in the human lumbar spine may be interpreted as evidence of failure of a bone to adapt to stress. It was thus decided to investigate remodelling characteristics of the lumbar spine, initially in individuals without apparent degenerative changes.

Femora, humeri and lumbar spines of 146 males from the Raymond Dart Skeletal Collection were measured. The orientation of spinous and transverse processes was determined about a plane of symmetry through the centre of the vertebral body and spinal canal.

Using length of long bones as a criterion, a prevalence of right-handed individuals in the sample was found (R > L = 71%, $\chi^2 = 20,8$; 1 d.f.). The asymmetry in the femora was reversed (L > R = 72%, $\chi^2 = 39,1$). This cross asymmetry occurs significantly more often than one-sided dominance (63% $\chi^2 = 6,8$). No systematic asymmetry in orientation of the tip of the spinous process in the upper lumbar spine was found. In the lower spine however, there was a trend of left deviation, significant at the L5 level (63%, $\chi^2 = 9,7$).

Right-handedness was related to left deviation of the spinous process at L5 (69%, $\chi^2 = 7,1$), which related also to left leg dominance (cross asymmetry).

Since lateralization produces differences in the amount of mechanical stress between antimeres, regular asymmetry of the spine indicates that its remodelling occurs in response to mechanical stress.

I wish to thank Professor P.V. Tobias for access to the Raymond Dart Skeletal Collection.

Variations of maxillary stress trajectories among modern humans

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The phylogenetic interpretations of evolutionary changes in hominid maxillary buttressing systems presuppose an intraspecific uniformity of bio-mechanical adaptations.¹ The range of variability of maxillary stress trajectories among modern humans was assessed in order to challenge such notions.

Fifty human crania were randomly selected from the Raymond Dart Skeletal Collection. Superficial striations of cortical bone were traced from the juga, over the maxillary tooth roots, to the buttressing pathways leading superiorly. A split-line technique² was employed on a sample skull to ensure the correspondence of these striations with the stress trajectories.

The most common trajectories found were from the I1 to the nasal aperture; the I2, canine, P3 and mesial half of the P4 alongside the lateral nasal margin; the distal half of the P4 to the infraorbital region; the M1 and mesial root of the M2 to the maxillary root of the zygomatic process; the distal M2 root and M3 roots to the posterior maxillary alveolar process. This modal pattern occurred in just 14% of the right maxillae, and 10% of the left maxillae. Only the canine, distal M1 and the M2 root trajectories did not vary in general orientation. Asymmetric patterns were found in 84% of the individuals, but no trend in directionality could be ascertained.

It can be concluded that human maxillae are not uniform structures in the distribution of the stress forces applied to the teeth. It is unlikely that early hominid maxillary structures can be adequately interpreted without due consideration of potential intraspecific variations.

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Morphological variations of the juxtamastoid eminence

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The juxtamastoid eminence is a bony ridge which bounds the medial aspect of the mastoid notch. Olson¹ has stated that the juxtamastoid eminence and associated features of the human mastoid region are evolutionary consequences of the adaptive resculpturing of the basicranium required for orthograde posture. He then used the juxtamastoid eminence to propose a phylogenetic scheme. Much confusion, however, has arisen in the literature as to the anatomy and function of the juxtamastoid eminence.

The following investigations were conducted in an attempt to clarify the basicranial morphology and to assess the validity of phylogenetic relationships based on the juxtamastoid eminence. A random selection of 229 skulls from the Raymond Dart Skeletal Collection was investigated for morphological variations in the mastoid region.

The juxtamastoid eminence was found in 91% of cases, and was highly variable in size, shape and relative position. Variability was noted between and within population groups, and even within single individuals. Thirty dissections of human material revealed the attachment of the posterior belly of the digastric muscle, usually by a fleshy belly to the mastoid notch and a deep, flat tendon to the juxtamastoid eminence in 40% of the cases. The muscle attachments of the remaining 60% were highly variable.

The mastoid regions of *Gorilla* (4), *Pan* (3), *Papio* (10), and *Cercopithecus* (15) revealed no juxtamastoid eminence. Hominid fossils, including *Australopithecus africanus* (2), *A. robustus* (2), *A. boisei* (1), *Homo habilis* (1) and *H. erectus* (1), showed the presence of the juxtamastoid eminence.

The great deal of variability found in the mastoid region, with particular reference to the juxtamastoid eminence, leads one to question the validity of phylogenetic relationships based entirely on this region.

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Brain size/body weight variability in modern humans: consequences for interpretations of hominid evolution

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The aim of this work is to establish a two-dimensional range of variation of cranial capacity (CC) and body weight (BW) against which their sensitivity as indicators of hominization can be evaluated.

Variances within 5 male and 5 female samples of individual CC values were combined with variance of 122 population means¹; BW variances within 65 samples of one sex individuals and among 52 populations¹ were used to estimate species totals.

	CC, mean = 1350 cm ³				BW, mean = 55 kg			
	Var.	%	s	c.v.	Var.	%	s	c.v.
Intragroup (one sex)	12 250	50	111	8,2	55	55	7,4	13,5
Intergroup (one sex)	6 700	27	82	6,1	30	29	5,5	10,0
Between sexes	5 600	23	75	5,6	18	17	3,9	7,1
Total	24 550	100	157*	11,6*	103	99	10,1*	18,5*

* - from the total variance.

Coefficients of variation (c.v.) of human CC fall within the range of one-sex c.v.'s for 12 species of New World and Old World monkeys² (6,1 - 16,6), and are on par with those for great apes (8,7 - 10,7 one-sex-pooled data, 11,3 - 13,1 combined sexes).³ Coefficients of variation of

BW tend to lie below values for 12 monkey species.² A two-dimensional elliptic normal range allows for CC-BW correlation. Scatter of CC and BW estimates for australopithecines and habilines, as published by Tobias, McHenry and Blumenberg, lies below the range including 99% of humans but covers a smaller area. CC/BW range determines the range of the number of extra neurons. Its width for 98% of modern humans (4.1×10^9) exceeds the difference (3.1×10^9) between *H. habilis* (OH 7) and an average for *H. sapiens*.³ Thus brain size alone, or CC/BW combinations, should be used only very cautiously as indicators of hominization.

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Dental pathologies and anomalies in the inhabitants of an ancient Greek colony, Metaponto, in Italy

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The aim of this work is to describe dental health and certain dental anomalies of a rural population related to the ancient Greek (6th–3rd century BC) colony on the Gulf of Tarent. Of the skeletons excavated, 155 adult remains had dentitions sufficiently well preserved to warrant examination.

Frequency of hypoplastic rings on front teeth was 78%. This is one of the highest ever reported and indicates widespread poor health and/or malnutrition during childhood.

Caries was present in 57% of individuals. Carious lesions were rare on front teeth (less than 10% of incisors and canines were affected), but frequent on molars (above 30%). The occurrence of severe lesions was high—45% of them resulted in *ante-mortem* tooth loss, *caries prima* constituted only 15% of all lesions. Altogether, 28% of individuals showed *ante-mortem* tooth loss, predominantly of molars, which had apparently followed extensive carious changes. There are several cases of fistulating periapical abscesses indicating the degree to which disease progressed before tooth loss. Tartar deposits were common (24 cases), some of them

of unusual thickness. Dental wear was moderate, with the exception of a few cases in which teeth were used in a tool-like fashion.

Among dental anomalies, most notable were two cases of crowding of incisors coupled with rotation of canines giving the mandibular dental arcade a trapezoid shape. Variations in the size and direction of eruption of third molars were also observed.

An uncommonly high frequency of hypoplasia, together with widespread and severe caries, indicate poor health and lack of dental hygiene of the population, whose living conditions, as has been concluded earlier,¹ were typical of European preindustrial rural people.

We thank Professor J.C. Carter (Institute of Classical Archaeology, University of Texas) for his invitation to examine the material.

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An area of intimal creases associated with aortic dissection in the region of the ligamentum arteriosum

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The causes and mechanisms of dissecting aneurysms of the aorta are controversial. Traumatic rupture occurs commonly in the vicinity of the ligamentum arteriosum. In this preliminary investigation, autopsy findings were supplemented by gross inspection and scanning electron microscopy of the descending part of the aortic arch obtained from autopsies and dissection room cadavers ($n = 40$).

A slightly depressed area of varying size showing transverse creases of the intima is present in the lumen of the aorta close to the insertion of the ligamentum arteriosum. This area was noticeable in 12% of aortas investigated. Intimal tears and intramural cleavage when present were confined to this area. Study by light microscopy of wax sections stained with hematoxylin and eosin did not show any specific histological changes in this area.

It is concluded that structural weakening of the media of the aorta allows the intima and the inner parts of the media to slide longitudinally, while the outer parts of the media and adventitia are held static by the ligamentum arteriosum. An area of intimal creases with greater resistance is thus created which ultimately ruptures due to the tractive effect of blood flow.

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