The origins of violence by cultural evolution

Piero Giorgi

second edition

This book is dedicated to nonviolent cultures

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Piero P. Giorgi
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Contents

Preface

This work is aimed at students and academics of political science and sociology in general, and Peace Studies in particular.

While thinkers such as Plato, Aristotle, Machiavelli, Hobbes, Locke, and Rousseau laid the foundations of political science within the domain of the humanities, more recent contributions by Spencer, Freud, Lorenz and Wilson have challenged political sociologists with biological themes.

The elimination of barriers between the humanities and science is a topical issue and we do not apologise for crossing academic boundaries, in order to provide readers with interdisciplinary factual information and concepts necessary to discuss the origins of violence.

After thirty years of university teaching and research in developmental neurobiology and ten years in Peace Studies, with this work we would like to engage political scientists and sociologists in a discussion on violence and nonviolence. This implies addressing concepts of neurobiology and anthropology for an audience mainly educated in the arts and humanities. For this purpose, one needs to define basic concepts and terminology (Section 1.1) and set the terms of the discussion (Section 1.2) within an interdisciplinary context (Section 1.3).

Peace Studies is a young discipline introduced by Johan Galtung in the 1960s, but occasionally explored by several thinkers in the past. Theoretical aspects of peace research have much to do with the issue of human nature, which implies the study of the origins of behaviour (Part 2) and the nature of *Homo sapiens* (Part 3). If one finds evidence of congenital violence, the aim of peace research would be limited to the development of remedial policies. If a nonviolent human nature turns out to be a feasible alternative, an explanation for thousands of years of violence is needed (Part 4).

Research on the origins of violence cannot be conducted in a neutral, objective, dispassionate context, as if one was calculating

the molecular weight of sodium chloride. Prejudice, political agenda, simple ignorance, all contribute to shift the perception of evidence in different directions (Section 5.1). This suggests that the origins of violence must become a topic of careful multidisciplinary research (Section 5.2). For this one needs to formulate hypotheses and expose them to the test of research (Section 5.2.9). The aim of this work is only to stimulate research, without seeking final answers or solutions.

Trying to change society is a useless, romantic idea, we are told. But even a cursory analysis of archaeology and history proves this suggestion myopic, to say the least; all human societies have changed dynamically in time and space, by introducing new ways, combination of ideas, and sometimes returning to old ways. The question is whether in the future these changes will mainly be guided by the interests of a minority, as in the past, or be the result of an explicit, intellectual consensus (Section 5.3).

I am very grateful to many friends, colleagues and students from whom I have gained much either through conversation or correspondence. But I must record special gratitude to a number of scholars working and/or studying in the field of Peace Studies. Ralph Summy introduced me to Peace Studies and provided sound concepts. Johan Galtung pointed to high peaks. Glenn Page showed me the power of humanity and courage. My colleagues Kevin Warburton and David Hyndman offered useful discussions. Students with their cheeky questions made me reflect again. .

As in most of my work in the last few years, I have been greatly assisted by my wife, Pargash — with research, editing, affection, and many a *caffelatte e phulka.* David Giorgi made himself available whenever I needed his expertise in multimedia. Marisa Giorgi told me about other cultures.

Introduction to issues

1.1. Terminology and definitions

1.1.1 Introduction

Vague terminology and ill-defined concepts impinge upon discussions on the origins of human behaviour in general, and violence in particular.

A distinction exists between *basic concepts* and their terminology on the one hand, and *complex concepts* and their terminology on the other. Consensus is necessary on the terminology of basic concepts; with these tools one can embark into agreement or disagreement on complex concepts, well knowing that a possible disagreement is not simply due to semantics. Hence the inclusion of this initial section on terminology and definitions.

Throughout the work we make use of terms as defined here, not as inconsistently or vaguely used in both the academic and popular literature. References to the literature about concepts and terminology are provided in subsequent sections, when these terms are used

1.1.2 Basic concepts need consensus

Pertinent basic concepts are defined below with reference to human beings. Discussion about the origins of human behaviour and violence may just be a waist of time if a consensus is not reached about basic concepts beforehand.

Human beings - All adult individuals belonging to modern *Homo sapiens* that have existed on earth since about 100,000-50,000 BP (before the present). This definition avoids both inappropriate generalisations that would include earlier 'species' of *Australopithecus* and *Homo*, and parochial exclusions that would

ignore cultural diversity in time and space.

Food collectors - Those cultures that gather plant food, capture small animals (foraging) and chase and kill large animals (hunting), hence the term hunter-gatherers. The most basic cultural diversity of human beings concerns the strategy used to obtain food.

Food producers - Those cultures that have domesticated plants and animals (farmers and horticulturalists) or only animals (nomadic partoralists). These cultures produce just enough food for day-to-day needs (subsistence economy) or produce food in excess for bartering (commercial economy). Popular but ambiguous adjectives such as 'primitive', 'tribal', 'uncivilised', 'native', etc. and their antonyms have contributed to conceptual confusion in anthropological discussions.

Genetic information - Specific sequences of nucleotides of the genetic material, deoxynucleic acid (DNA), that in turn define the sequences of amino acids of specific protein(s). Genetic information directly defines proteins — and indirectly other molecules through the enzymatic function of some proteins — but alone it cannot define structures, functions and the sequence of events occurring in time and space.

Epigenetic information - Epigenetics, or epigenetic control, is the sum of the genetic and non-genetic factors acting upon cells to selectively control the gene expression that produce increasing phenotypic complexity during development (Hall, 1992). In recent times the usage and meaning of this term has become ambiguous, and the term stereo information was used instead in the present work.

Stereo information - The three-dimensional organisation of cells and molecules in the embryo that selectively induces the expression of genetic information in the correct temporal and spatial sequence. Genetic information is activated and guided by stereo information and the two together provide the necessary information for the stereo blueprint of development (Section 2.2.4). In developing

humans, stereo information begins to act at conception and continues well after birth. In the case of the nervous system, it continues to influence cell structure and function throughout life in the form of learning and memory.

*Congenital characteristic*s - Characteristics that are present at birth, as a consequence of stereo and genetic information guiding development during fetal life.

Functional potentiality - A function characteristic of the human species (e.g., speech) which is potentially present in the human fetus, but does not eventuate in the absence of appropriate post-natal stereo information necessary for its final development and definition (e.g., language).

Behaviour - An action performed by a human being. One could even equate behaviour to changes in the state of contraction of both skeletal and visceral muscles.

Instinct - A specific behaviour which is congenital and cannot be modified after birth. Human beings are born with a very limited set of instincts.

Behavioural predisposition - The congenital tendency of an individual to adopt a type of behaviour (e.g., competition) as opposed to another (e.g., cooperation). A predisposition does not constitute a behaviour and can be easily overridden by effective post-natal stereo information.

Aggression - A behaviour that damages the body and/or the mind of other human beings. Aggression normally is motivated by egoistic gains for oneself or for one's kin group.

Aggressiveness - The behavioural predisposition to select aggressive or competitive behaviours, as opposed to alternative ones (submission, fleeing, talking, etc.). Aggressiveness is not behaviour or a behavioural trait.

1.1.3 Complex concepts need debating

Pertinent complex concepts are defined below.

Violence - All institutions, cultural traits and behaviours that limit the development of people's potential and deny people's aspiration of being in control of their body, their behaviour and their social environment. This definition goes beyond the common usage, which is limited to verbal and physical abuse, by including structural (indirect) violence, cultural violence and personal (direct) violence. These concepts have been introduced by Johan Galtung. In this context physical abuse (restraining, wounding, torturing and killing) represents direct violence against one's aspiration to be in control of one's own body. As defined here, violence only applies to human beings. For animals the term aggression (homologous to direct violence) is sufficient. Moreover, the term direct violence is synonymous with aggression and applies to individuals, while structural and cultural violence apply to communities, institutions and societies.

Nonviolence - All institutions, cultural traits and behaviours that promote the development of people's potential and satisfy people's aspiration of being in control of their body, their behaviour and their social environment. It should be noticed that the absence of structural violence (nonviolence) is by itself conducive to positive peace. The same is not true of direct violence, as its absence is not sufficient for peace.

Cooperation - Behaviour aiming at sharing resources and advantages with other individuals. Cooperation is not necessarily submissive or generous.

Altruism - Behaviour that aims at providing advantages to other individuals, who normally belong to one's kin group, at the expense of the subject's well-being and/or life.

Origins - A term used in the context of information theory in general and causation in particular. All factors responsible for the definition of a structure or a concept represent the origins of that particular subject of discussion. In particular the term 'origins' will be used here in two main types of discussion: phylogenetic origins (evolutionary mechanisms leading to the establishment of a particular trait in humans) and ontogenetic origins (the developmental mechanisms leading to the definition of a particular trait in a person).

1.2 Setting the question

1.2.1 Introduction

As structural and direct violence (Galtung, 1969) has been a continuous cause of human suffering ever since history was recorded, one may ponder the origins of these social traits which are widely practiced in most contemporary human cultures (Spatz-Widom, 1989). However, a small but significant number of cultures are characterised by a virtual absence of structural violence and a very low level of direct violence (Bonta, 1993; Sponsel & Gregor, 1994). This raises the important question of whether violence is a natural and unavoidable human characteristic, the fundamental issue addressed by this work.

Discourse on human nature and violence is as old as philosophical thinking itself.[1] In the past the scope of the discussion was limited by the lack of relevant information in anthropology and neuroscience (Stevenson, 1987). Today it is probably the interdisciplinary character of this topic that prevents progress in an environment of exaggerated academic specialisation. Advances in this field of speculation are also hampered by the obvious political implications of defining the origins of violence. [2]

1.2.2 The topics

Unlike previous discussions on the origins of human violence,[3] which predominantly focused on war, the present work is based on a more fundamental approach (Section 1.3.4).

The discussion follows the sequence of topics listed below:

- The historical origins of the idea of congenital human violence: the vast majority of academics and lay persons are more or less convinced that we are natural killer apes (Section 1.2.3).
- The information system that defines the human brain and behaviour: the brain develops in a manner quite different from any other organ in our body (Sections 2.2 & 2.3).

- The evolutionary forces that made *Homo sapiens* very different from other Hominids and other Primates: an extreme case of biocultural evolution (Section 2.4).
- The importance of the social behaviour of modern food collecting cultures: hunter-gatherers and nonviolence (Sections 3.2).
- The idea of congenital human violence is not supported by modern science: one needs an explanation for the origins of violence practiced during historical times (Sections 3.3 & 4.1).
- A hypothesis on the origins of structural violence in early food producing cultures: from food surplus to social stratification (Section 4.3).
- A hypothesis on the origins of direct violence: from charisma to enforced obedience (Section 4.3.6).
- A hypothesis on the origins of wars of defence: from killing animals to killing humans (Sections 4.4).
- A hypothesis on the origins of wars of conquest: from selling defence to taxation (Section 4.5).
- The mechanisms of cultural transfer that perpetuates structural violence: small minorities controlling large-size, hierarchically structured societies have a vested interest in keeping their subjects ignorant, greedy and violent (Section 5.2).
- The need for long-term academic speculation about the future: from theoretical utopias to practical neotopias (Section 5.3).

1.2.3 The pessimistic view of human nature is widely accepted

Arguably, the idea of congenital violence in humans is currently well established in the social psyche of most cultures and it represents the underlying assumption of their institutions. Briefly, this pessimistic view of human nature is supported by five influential sources:
- The Christian view of Saint Paul ("God ... condemned sin in human nature...", *Romans* 8 : 3) set the dualistic scene for an unfortunate alienation of spirituality, which has since been perceived as operating outside and against a dark natural heritage of human beings.

- The cynical view of 'every man against every man' subscribed by Thomas Hobbes (1958, p. 106) implied the necessity of absolute monarchs (now the State) in control of violent humans who are not capable of social self-management.[4]
- The strong biological determinism of Herbert Spencer and Thomas Huxley, contemporaries of Charles Darwin, portrayed human violence as a product of evolution[5]
- The instinctivism of Sigmund Freud, who suggested that our social malaise is caused by repressed instincts of eroticism and aggression (Freud, 1961), delayed the understanding of the social causes of psychopathology.
- The simplistic biological view of Konrad Lorenz (1966) led to the idea that violent humans just obey evolutionary rules. He started the semantic confusion between aggressiveness, aggression and violence.
- The genetic view of Edward Wilson, who believes that "we are strongly predisposed to slide into deep, irrational hostility" (1978, p. 106), encourages repressive methods to deal with criminals and international conflicts.

With these founders of political science, psychoanalysis, ethology and sociobiology stating so clearly that humans are naturally violent, it is hardly surprising that this idea is currently permeating the social psyche of most cultures and thus their political institutions, legal systems, education and media. Popular science writers, such as Ardry (1970), Hart (1991) and Wrangham & Peterson, 1996), have further reinforced the same idea in the lay person.

As a result, the average person in the street is convinced that human beings have a brutal ancestry, a genetic inclination toward violence (Midgley, 1978). This of course hinders any attempt at understanding the real origins of human violence, it removes our responsibility to even try and reduce the obvious cultural transfer of violence, and ineffectual repressive methods continue to be pursued.

1.2.4 The optimistic view of human nature is unpopular

The notion of congenital nonviolence in humans is being dismissed as naive, romantic, and generally eccentric by most educated persons. It should be stressed that congenital nonviolence does **not** mean congenital goodness (see Section 3.3.4); it is only a negation of violence in our genes, as positive evidence of congenital characteristics cannot be tested experimentally in humans (see Section 4.1, note 1).

- At the end of the 19th century, a Russian nobleman, Prince Petr Kropotkin, carried out extensive anthropological research in eastern Europe and published a book entitled *Mutual aid* which documented the extensive degree of cooperation and nonviolent solutions of conflict existing among the different cultures he studied (Kropotkin, 1914). How can a killer ape engage in such a systematic day-to-day pursuit of cooperation with others?
- A psychologist working in the USA, Eric Fromm, suggested that palaeolithic humans adopted nonviolent social strategies in association with appropriate neurological imperatives (Fromm, 1973 pp. 153-208).
- An anthropologist working in UK, Ashley Montagu, carried out extensive research on human nature and aggression and came to the conclusion that palaeolithic humans were not violent, and that living human beings have the same degree of congenital predisposition to aggression as their ancestors did (Montagu, 1968).
- An animal psychologist working at the University of Washington, David P. Barash, shifted his ideas about the origins of human behaviour from sociobiological positions (Barash, 1978) to a critical view of congenital violence in humans, and published the first textbook for Peace Studies (Barash, 1991).
- A librarian working at Penn State Library, Bruce D. Bonta, provided a rich bibliography of 438 references about 45 different cultures that are nonviolent (Bonta, 1993). Are these people not human beings?
- An anthropologist working in USA, Leslie Sponsel, has pointed to the relevance of anthropology for Peace Studies and the need to define human nature (Sponsel, 1994).

Unlike Hobbes, Freud and Lorenz (Section 1.2.3), most of the above authors who have an optimistic view of human nature are modern scientists trained in cutting-edge research (see also Section 4.1.2). It is most interesting to observe that both the educational establishment and the media favour the input from the opposite camp of this scientific divide.

1.2.5 The current debate on the origins of violence

Semantic confusion still impinges upon the academic debate on the origins of violence, and current trends are dominated by the concern for biological 'objectivity' (Eibl-Eibesfeldt, 1989; Haas,1990 pp. 1-25) as opposed to the 'soft' approach of social sciences.[6] This explains the success of sociobiology, as discussed by Lopreato (1984), Ruse (1985), Van der Dennen & Falgar (1990) and Melotti (1984, 1985, and 1990). A more recent discussion on the anthropology of nonviolence was offered by Sponsel and Gregor (1994).

A multidisciplinary analysis of the evidence available from neurobiology, evolutionary biology and anthropology suggests, in our view, that violence is not an inescapable trait of human nature and that, if anything, our brain may have a predisposition toward nonviolence. The basic philosophical outlook of the present work was inspired by the works of Ashley Montagu, Erich Fromm and Johan Galtung. In light of my interest in history, I could not avoid taking a historical approach to the idea of peace (Summy & Saunders, 1995), although I might have exaggerated and found myself in the palaeolithic.

The optimistic view of human nature is often branded as neo-Rousseaunian and romantic by radical sociobiologists (Section 5.2.5). It was indeed romantic and uninformed when inappropriately stated by Jean Jacques Rousseau 200 years ago,[7] but the present work has nothing to do with Rousseau's ideas about 'man in nature' and 'negros and savages'. Even more distant from modern neurobiology and anthropology was Thomas Hobbes (1588-1679), whose forcibly uninformed idea of human nature continues to represent the theoretical foundation of modern

political science.

If the present alternative idea is correct (Section 5.2.8), the possibility exists of identifying — then reducing and eventually eliminating — the cultural traits that generate violence and perpetuate it through subsequent generations.

Outside this theoretical framework, the traditional approaches used so far to reduce violence are violent punishment and religious ethics, both of which have, so far, had very limited success. About the role of religion on the present topic, see Section 4.4.3, note 4.

NOTES

[1] Debates have already taken place among the first followers of Confucius. Meng Tzu (Mencius, 371-289 BC) believed in the nonviolence of human nature and defined four 'beginnings' (predispositions) of goodness, while Hsun Tzu (Hsun Ch'ing, ca 298-ca 238 BC) took a diametrically opposed view: "The nature of man is evil; his goodness is only acquired by training" (Fung, 1952, vol. 1, pp. 119-127, 284-288). More than two thousand years later discussions on this important issue are still affected by semantic confusion, emotional distortion and political polarisation.

[2] For example, in 1993 a panel of experts appointed by the National Institute of Health of the U.S.A. debated whether to pursue the $60 million a year research program on the biological basis of aggression or to channel funds toward the study of social and family influences (Kiernan, 1993). The controversy was still lively at the 1994 annual meeting of the American Association for the Advancement of Science, with two opposing panels, one debating on 'biological factors playing some role in violent behaviour' and the other condemning the use of 'neurogenic determinism' to dismiss environmental influences (reported by Charles Mann in *Science* , 11 March 1994, and followed up by two letters on August 26). A preliminary definition of aggression, aggressiveness and violence, as proposed here, would have probably made those debates more constructive. In the late 1990s

such discussions are rare, but not because scientists have become more rational; 'targeting' research by governments means that academic freedom is rapidly decreasing and little space is left for healthy, 'irrational' discussions.

[3] Cf. Barash (1991) for bibliography.

[4] Bobbio (1993, pp. 93-99) discusses the possible abuses of the State as the least evil, when compared to anarchy and violence.

[5] Petr Kropotkin wrote the first book on nonviolent cultures to contradict an 1888 article of Thomas Huxley "The struggle for existence in human society" (Kropotkin, 1914, pp. 329-341). About Spencer, cf. Kropotkin (1914, p. xv) and Desmond, A. & Moore, J. (1991) *Darwin*. Michael Joseph, London.

[6] The current concern for a scientific approach to those social topics which are value-charged is eloquently described by Gould (1991 p. 331): " ..... one of those soft and woolly thinkers who let hope and sentimentality get in the way of analytic toughness and willingness to accept nature as she is, warts and all..... one could only see personal hope rather than scientific accuracy in his accounts".

[7] The popular association of Rousseau (1952) with the concept of the 'noble savage' seems to me quite inappropriate. A few words have been quoted out of context by generations of writers who obviously never read Rousseau's original works. When referring to 'man in nature' or 'negros and savages' or 'Caribbeans' he describes them as "Solitary, indolent ..." ('On the origin of inequality', p. 337), "... destitute of every species of intelligence ..." (p. 338) and having no morality ('The social contract', p. 393). The nonviolent nature of pre-historical humans is then described by him in a rather negative way: "... he would have spent his days insensibly in peace and innocence ..." ('On the origin of inequality', p. 338), "... fortunate enough to be ignorant of those excellences, which whet the appetite ... consequently fall into fewer and less violent disputes." (p. 346), "... without speech and

without home, an equal stranger to war and to all ties ..." (p. 346). It is difficult to detect any degree of nobility in this idiot of the woods who helped Rousseau to show "... that man is naturally good." (p. 362). This is a far cry from modern anthropological thinking. The position of the present work is therefore not neo-Rousseaunian. Evidence from modern neuroscience, anthropology and peace research warrants a very different optimistic view of human nature (Parts 2 & 3).

1.3 Methodology and original approaches

1.3.1 Introduction

The aim of this work is to provide social and political scientists with a basic interdisciplinary discussion on human nature, and with the conceptual tools necessary to address the important question of the origins of violence. This very aim implies the need to adopt special methods of presentation and original conceptual approaches.

1.3.2 Special aspects of interdisciplinary work

Interdisciplinary work does not provide the same depth and detail as a monodisciplinary discussion would. Specialist reviews are normally presented as "... from the perspective of ...", an approach which enjoys the advantages of addressing fellow specialists and the self-granted right of ignoring other perspectives.

Thus, only concepts will be mentioned here and specialist literature will be cited at the level of reviews only. If this approach seems acceptable for introductory university courses, it should also be acceptable for an interdisciplinary study directed at monodisciplinary academics who are not familiar with the discipline in question.

As in the case of behaviour in general, the origins of violence can refer to congenital and post-natal factors that define aggressive behaviour in an individual (the ontogenetic aspect) or to evolutionary processes that lead to the onset of violence in most cultures (the phylogenetic aspect).[1] A discussion on the first aspect involves concepts in developmental biology and neuroscience. A discussion on the second aspect involves concepts in evolutionary biology, anthropology, archaeology and history. Concepts from all these disciplines will be used, as no single discipline is in a position to offer a holistic discussion on human beings.

To invite advanced monodisciplinary academics — social and

political scientists in this case — to lean over the windows of their safe ivory towers is seeking trouble. And even more so if one asks them to consider critically the very theoretical basis of their disciplines — Hobbes for political scientists and Wilson for sociobiologists. The other danger of a holistic work such as the present one is in attracting criticisms from academic specialists, who see concepts in their discipline reduced to simple statements. The distinction between simplifying and being simplistic is important, but not always clearly demarcated. If we have misinterpreted concepts and factual information, comments from colleagues from the different disciplinary specialisations are welcome.

We will try and use only those basic concepts that a first-year university students would be expected to know, just as they are presented in textbooks. It is the very comparison of basic textbooks from different disciplines that reveals the inconsistency of theories on human beings, particularly on the origins of violence in humans.

1.3.3 The interdisciplinary style of writing

Modern trends in secondary and tertiary education have promoted the idea of specialisation as a necessity for quality and productivity. As a consequence, concepts which are well known and widely accepted in a given discipline remain unknown, controversial or superficially dealt with in other disciplines. This causes an unfortunate 'fragmentation' of human beings, whose kidneys are understood by a renal specialist and whose poems are understood by a literary expert, but whose total humanity is unsuccessfully gazed at from limited perspectives.

The style of writing adopted in an interdisciplinary work can be contrasted with specialised academic writing and academic popularisation. Communicating with colleagues from the same disciplinary specialisation is easy; technical terminology, accepted idiomatic forms, known acronyms, and reference to familiar concepts facilitate the task. Communicating with the lay public is more difficult, but if one has the gift for colourful expressions,

attractive metaphors and stunning predictions, the audience will be captivated and entertained. Communicating with colleagues from different disciplines is the most difficult. Besides having to overcome prejudices and the general unwillingness of the audience to move away from safe ground (Section 1.3.2), style and terminology must be tailored to the occasion. As opposed to popularisation, the level of discussion must be academic, but specialist jargon and complicated learned considerations must be avoided. Therefore, a level which would be used for first-year university students seems appropriate.

1.3.4 Different approaches

Besides the special style required for an interdisciplinary work (Section 1.3.3), several conceptual and methodological characteristics of our work differ from other reviews about human nature and violence.

The innovative features are as follows:

a) *The definition of human beings is extended to the proposed origins of the species (ca. 100,000 BP).*
Much discussion on violence, especially when it concerns war, is typically limited to the analysis of human affairs from the period of recorded history which began about 5-6,000 BP.[2] This myopic view of ourselves, together with gross prejudices about prehistorical humans (Sections 3.3.3), continues to influence popular ideas on human nature and views on the origins of violence. The present work breaks away from this limitation.

b) *The terms aggression, aggressiveness and violence are clearly defined*
The literature on aggression in humans is marred by semantic problems (Section 1.1.2 and 2.5.2). A serious discussion on origins and causal relationships must rely on clear terminology and concepts.

c) *The concepts of functional potentiality, congenital predisposition and behaviour are clearly distinguished*

This area also needs clear terminology. These three concepts are defined in Section 1.1.2, and discussed in Section 2.3.8 by using speech as an example. Briefly, functional potentialities are typical of a species, congenital predisposition is typical of an individual, and behaviour is typical of a culture. All humans are born with the *functional potentiality* for speech: a larynx, a respiratory system and some primordia in the brain stem and cerebrum ready to link together functionally to generate articulate speech. If the child does not hear adults talking between 1 and 4 years of age, that functional link will never form and those structures remain undeveloped. Some persons can have a *congenital predisposition* to sing better than others: the right size of the tongue, a higher level of neurotransmitters involved in speech pathways, better shaped larynx, etc. This only means that they will perform better at singing with less training. Everybody is able to sing and speak: *what* they sing and say is *behaviour*.

d) *The social behaviour of the human species is discussed in the context of its unique adaptive radiation, not in the context of common traits with other mammals or primates.*
Against a well-established tradition in the literature on human nature, this work makes very little reference to animal behaviour. This is not to deny that we are a species of primates, but behavioural concepts discussed here — with the exception of cultural transfer and biocultural evolution — are unique to our species and any reference to other species would be inappropriate. Although one can make interesting generalisations about evolutionary solutions among vertebrates (Wilson, 1975; Lumsden & Wilson, 1981; Eibl-Eibesfeldt, 1979, 1989), the adaptive significance of behavioural traits unique to a given species can only be discussed in the context of the natural history of that species (Section 3.1.2). This is a case for speculation on the origins of violence as defined above.

e) *Corroborative evidence is drawn from the fields of neurobiology, evolutionary biology and anthropology in support of an optimistic view of human nature.*
The optimistic view of human nature was discussed in Section

1.2.3. Kropotkin (1914), Montagu (1957, 1968), Fromm (1973), Hind (1974), Barash (1991) and Sponsel & Gregor (1994) have already defended the idea of a nonviolent human nature. As indicated several times in this work, this idea has nothing to do with Rousseau's 'noble savage' (Sections 1.2.5 & 5.2.5). Attributing a nonviolent nature to humans is a negation, it does not necessarily mean that humans have a special predisposition to 'goodness' or 'altruism'.

f) *The need for a hypothesis on the origins of human violence is recognised, if the pessimistic view of human nature is found unacceptable.*
The strongest statement proposed so far against the idea that humans are naturally violent was drafted in Seville in 1986 by twenty scientists and humanists (Section 4.1.2). However, one cannot deny the popular idea of violence in our genes without exposing explicit hypotheses to possible falsification (Popper, 1959). Even in the rare cases when authors recognise the curse brought upon humanity by agriculture (Bronowski, 1973, p. 88; Fromm, 1973, 185-193; Diamond, 1991 pp. 163-172) no explanation is offered on how structural violence developed in the new food-producing communities.

g) *Food surplus, community size and division of labour are identified as the ancient initiating factors responsible for the cultural evolution of violence.*
Part 4 of our work is purely speculative. As indicated above, if the idea of congenital violence in humans is refuted, one needs a hypothesis to explain the origins of violence.

h) *A chain of events are identified that lead to the development of structural violence and war soon after the domestication of nature.*
As part of the hypothesis on the origins of violence, a novel approach is taken by suggesting that structural violence existed before wars of defence, which in turn pre-existed wars of conquest.

i) *This work was conceived as a trigger for further study, not as a purely*

academic exercise.
Briefly, the present work offers a criticism of the idea of congenital violence in humans (Sections 2 and 3) and proposes hypotheses (Sections 4.3, 4.4 and 4.5) on how agricultural communities developed structural violence and war. The step-by-step theoretical model presented here will hopefully stimulate further investigation to support or disprove its component items.

Most of the concepts used in this work are widely accepted in the literature on neurobiology and anthropology, archaeology and history, but they needed to be presented in a comprehensive, interdisciplinary discussion. On the other hand, the hypotheses on the origins of structural violence and war are only educated guesses; these speculations will hopefully stimulate criticism and research in order to improve, modify or refute them.
For the benefit of a wider audience, references from specialist literature have been avoided as much as possible. The academic level one would use for first-year university students seemed appropriate for an interdisciplinary discussion (Section 1.3.3).

NOTES

1 As indicated in Sections 1.1.2 & 1.1.3, aggression (or direct violence) is used in this work to refer to individual behaviour, while structural and cultural violence are used to refer to their manifestation in society or an institution.

2 The oldest written records found so far, are the Sumerian tablets of Uruk (Jean, 1986). The acronym BP stands for '(years) before the present (time)'.

Evidence from neuroscience

2.1 The human nervous system

2.1.1 Introduction

Discussion of this part on human neurobiology is based on the assumption that *the behaviour of individual persons represents the functional aspect of their nervous system* and that changes in behaviour (learning, memory, new ideas, new attitudes) are the result of structural changes in the cells of the nervous system. A wealth of clinical evidence shows that structural modifications of molecules and cells in the nervous system lead to altered behaviour (Kolb & Whishaw, 1990), in the same way that modification of liver molecules and cells leads to altered hepatic functions and metabolism.

The inclusion of such a simple and apparently obvious statement is justified by the distinction still made in psychiatry between so-called 'organic' and 'psychological' causes of mental disorders. This terminology and the conceptual framework behind it are, in the opinion of many neuroscientists, anachronistic remnants of the old dualism of brain and mind (Changeaux, 1985).

A monistic view of brain and behaviour is adopted here for the practical purpose of communication, but it is not intended to deny the value of a more profound discussion on the brain-mind relationship (Popper & Eccles, 1977), which is beyond the scope of this work.

For some strange reason, we seem to invest more energy and time in finding out about machines and social trivia than about our own body. Medical issues, sport and an increasing preoccupation with physical appearance have led to a superficial understanding of certain aspects of our body, but the nervous system still remains a great mystery to the average person. This leads to a lack of personal control over our behaviour, especially our social behaviour; it also allows the perpetration of folk

mythologies about behaviour, despite evidence to the contrary in modern textbooks of neurobiology.

Unfortunately, folk mythologies about brain and behaviour often also act upon the mind of academics who discuss sociology and politics — hence human behaviour — without even the most basic information on the origins of behaviour: brain development and brain evolution. This is the reason for including this section on neurobiology. A very simple presentation of the structure and function of the human nervous system (Section 2.1) should be sufficient to appreciate basic concepts about fetal development (Section 2.2) and the post-natal definition of behaviour (Section 2.3).

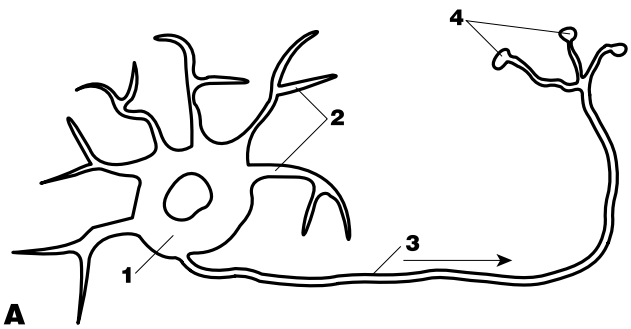
Illustrations and text of Sections 2.1 & 2.2 are taken from Giorgi, P. P. (2000) *Functional neuroanatomy - Lecture notes*. Minerva E & S, Brisbane, with changes only in typsetting.

2.1.2 The neuron

The neuron **A** is the functional unit of the nervous system. Here we discuss its most basic features, in order to appreciate certain aspects of the design of the nervous system.

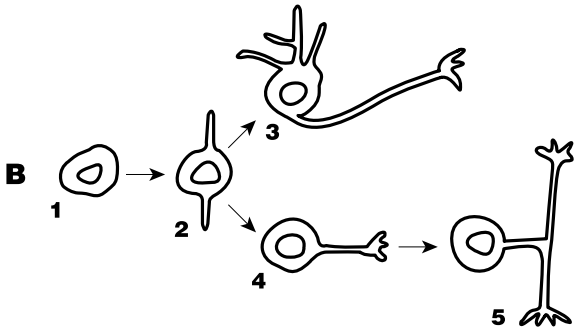
The neuron is a cell and as such it consists of a nucleus, which is surrounded by cytoplasm, while the whole cell is delimited by a cell membrane. A neuron has a *cell body* **A1** and two types of cellular processes, the *dendrites* **A2** and the axon **A3**. The dendrites radiate in many directions from the cell body. The axon conducts the electrical activity of the neuron up to the point of contact of its *axon terminals* **A4** with the dendrites or the cell body of another neuron (or a muscle) to transmit that activity.

During *development* **B**, all immature neurons **B1** initially develop

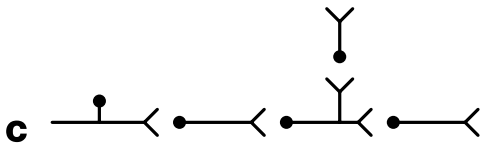


only two processes at the opposite ends of the cell body **B2**. This initial bipolar design is maintained until maturity in some special neurons, while the majority of them develop dendrites at one end and the axon at the other **A, B3**. In other special neurons the two initial processes merge together to form a unipolar neuron **B4,** whose single process later divides into a T shaped axon growing in opposite directions **A5**.

Neurons are protected and nourished by accessory cells, the *glial cells* which in the adult brain can be as much as ten times more numerous than the principal functional cells which they support.



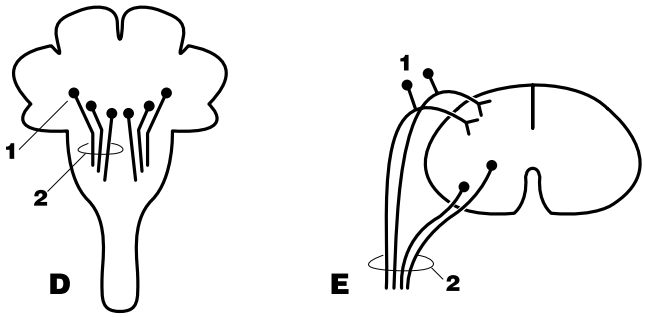
In diagrams of the nervous system and its connections **C**, neurons are simply represented as a round cell body without dendrites, with an axon leaving the cell body and with a contact, represented by a V shaped end, with the next neurons in the circuit.



2.1.3 Regional classification

The classification of the nervous system, whose basic function has already been defined, involves the initial distinction between central nervous system **D** (idealised frontal section) and peripheral nervous system **E** (transverse section of the spinal cord).

Inside the central nervous system, aggregations of neuronal cell bodies are called *nuclei* **D1** and the aggregation of axons carrying similar functional signals are called *tracts* **D2.** Regions rich in



nuclei are referred to as *grey matter*, while regions rich in tracts are referred to as *white matter*, because of their grey and white appearance in the dissected brain.

In the peripheral nervous system, aggregations of neuronal cell bodies are called *ganglia* **E1** and the aggregation of axons carrying functional signals from, or to the same periphery of the body are called *nerves* **E2**.

2.1.4 Major divisions and regions of the nervous system

The *major divisions* of the nervous system are:

Peripheral nervous system: *ganglions* and *nerves*
Central nervous system: *brain* and *spinal cord*
Brain: brain stem and cerebrum
Spinal cord: cervical, thoracic, lumbar, and sacral segments

The *regions* of the nervous system are internal components of these major divisions.

2.1.5 The central nervous system

The *central nervous system* **A** (here represented in midsagittal section) includes the *brain* **A1, B** and the *spinal cord* **A2**.

The spinal cord, which is relatively thin and long, continues the central nervous system within the neural canal **A3** of the vertebral column (here represented only by three vertebrae). The spinal cord maintains the communication between the rest of the central nervous system and the peripheral nervous system at the level of the trunk, and has a very limited repertoire of independent sensory-motor functions (reflexes).

The brain **B**, here shown as a medial view of the right side separated with a paramedial section, represents a major proportion of the central nervous system rostral to the spinal cord, the border being approximately at the level of the joint between skull and the vertebral column **A4**. The brain occupies the cavity of the skull and is subdivided in *brain stem* **B3-5** and *cerebrum* **B6-8**. The brain stem has functions similar to the spinal cord, but with reference to the head and neck region of the body. In addition, the brain stem fulfils particular functions of high-level integration in its different subdivisions.

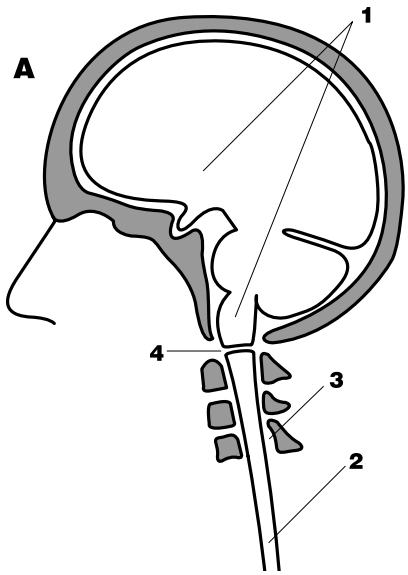
The *medulla oblongata* **B3** contains nuclei regulating vital body functions, such as breathing, the heart beat and blood pressure. Therefore this is the only region of the central nervous system in

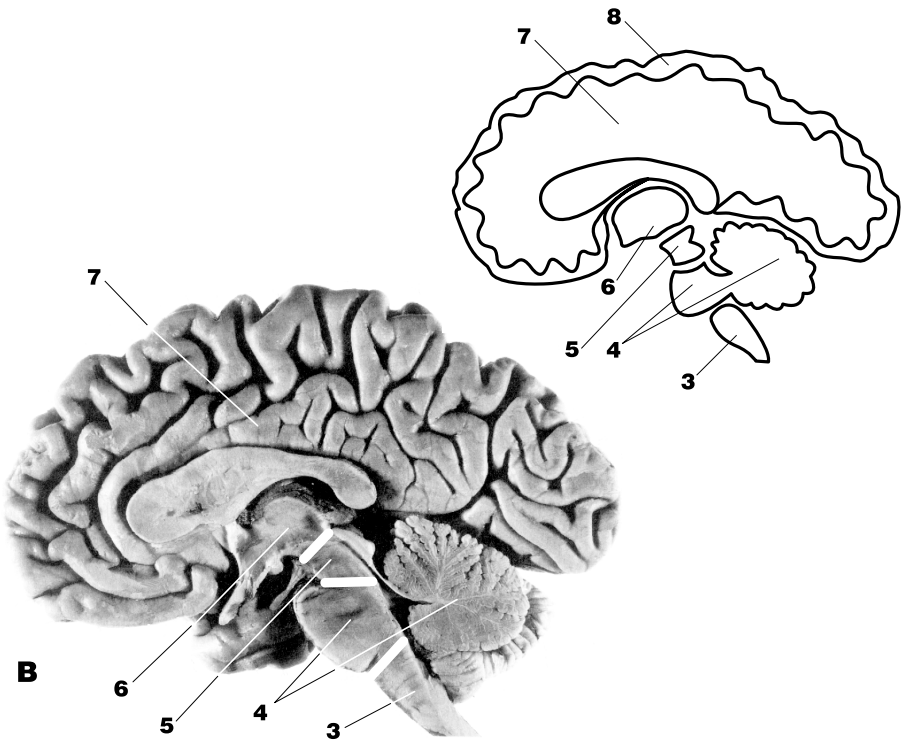
which a lesion can lead to immediate death.

The region of the *pons* and *cerebellum* **B4** contains parts of the brain that control the coordination of body movement, as well as a great deal of sensory functions for the head and neck. The cerebellum is normally presented as a subdivision on its own in the brain stem. In reality it develops from the same embryonic region of the pons and it shares with the pons the function of motor regulation.

The *midbrain* **B5** is located approximately at the centre of the brain (hence its name) in the fetus (Section 2.1.8), but not in the adult anymore. On the dorsal side it has four round protuberances, called *colliculi*, which are relay centres for visual (*superior colliculi*) and auditory functions (*inferior colliculi*). On the ventral side of the midbrain one can observe *the cerebral peduncles*, two large columns of tissue that join the brain stem with the cerebrum. They contain several tracts, mostly connecting the cerebral cortex with the brain stem and the spinal cord.

When seen from a medial view, the cerebrum **B6-8** consists of a central region, the *thalamus* **B6**, which is surrounded by the *cerebral hemisphere* **B7-8**. This consists of large amounts of central white matter called *medullary centre* **B7**, which is in turn surrounded by a





thin layer of grey matter, the *cerebral cortex* **B8**. The thalamus is an important centre of higher-level sensory-motor coordination as well as regulation of hormonal functions. The cerebral cortex represents the highest level of sensory-motor coordination, and the likely substratum of the poorly understood function of consciousness.

2.1.6 The peripheral nervous system

The peripheral nervous system can be simply subdivided in *ganglia* and *nerves* (Section 2.1.3) — not 'peripheral nerves', as they are often called, because there are no such things as 'central' nerves. Ganglia contain the cell body of specific sensory and motor neurons, as indicated below. Nerves establish the communication between the central nervous system and the

peripheral nervous system.

Sensory ganglia are associated at regular intervals on each side of the spinal cord (*spinal ganglia*) and at irregular intervals on each side of the brain stem (*cranial ganglia*). Motor ganglia are distributed on each side of the vertebral column (*sympathetic chain* of ganglia) and in various locations in the viscera. Some peripheral neurons are irregularly associated with the viscera without forming defined ganglia (*intramural or enteric plexus*).

2.1.7 Evolution

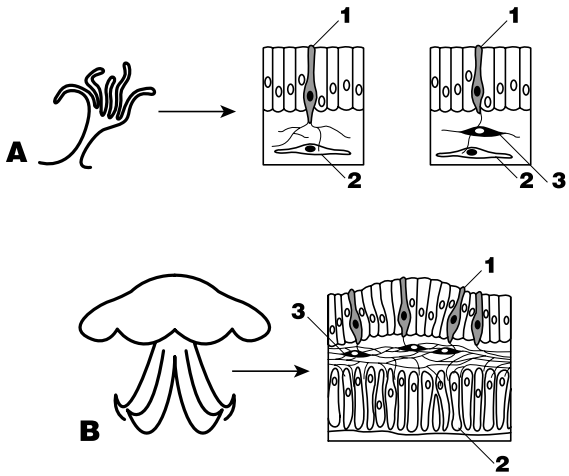
A nervous system exists even in the most simple animal forms. The ability of plants to detect changes in their environment is not mediated by a nervous system, but it can be very sophisticated all the same.

As the general function of the nervous system is to relate the animal to its environment, it is of no surprise to find that it originated on the surface of the body. This is true from the evolutionary (phylogenetic) point of view, as well as from the developmental (ontogenetic) point of view.

The first multicellular animal life forms to acquire a simple nervous system probably looked like today's hydra **A** (a microscopic freshwater polyp) or the larger jelly fish **B**. On the surface of their body these celenterates have specialised sensory cells **AB1**, interspersed among normal skin cells, which are able to detect physical changes in the environment. Their deep processes come into contact with contractile cells **AB2** (simple muscles) which become activated, contract and induce appropriate changes in the shape of the body. The presence of an interposed neuron **A3**, or a network of neurons **B3**, adds an element of integration in this primitive nervous system. This neuro-muscular arrangement may be able to cause simple modifications in body shape to avoid noxious inputs, or may even set in place a rhythmic pulsation of the whole body which moves away from the stimulus. The former case suits a small organism fixed to the substratum (the hydra **A**), while the latter one suits a more complex swimming organism (the

jelly fish **B**) with a diffuse network of nervous tissue **B3** between the skin **B1** and the underlying muscle layer **B2**.

The initial radial plan of early animal forms (**A**, **B**) was not suitable for the fast movements needed to avoid danger and to capture food. The bilaterally symmetrical plan **C** of later animal forms living in water and land was more adaptive for fast unidirectional movement and involved a corresponding re-

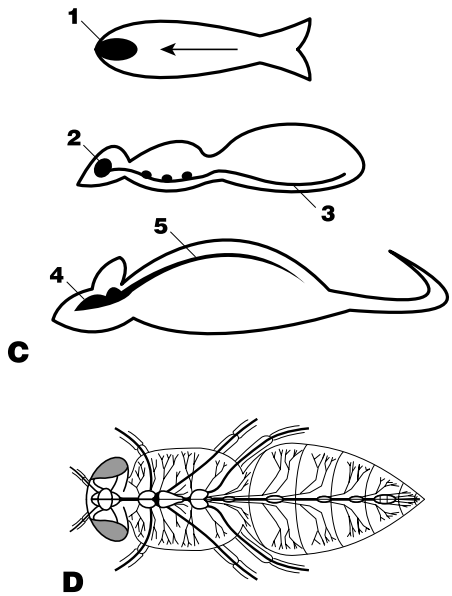


organisation of the nervous system. At this point it became more advantageous to concentrate sensory elements on the front of the body **C1-2**, while keeping some of them distributed throughout the body **C3**. This aggregation of sets of sensory, integrating and motor neurons in the anterior part of the body resulted in the evolution of head (cephalic) ganglia **C2** in worms and insects (invertebrates), and the brain **C4** in backbone animals (vertebrates) such as fish, reptiles, birds and mammals.

The basic plan of animals with bilateral symmetry is represented by a line of segments from head to tail, as clearly seen in worms and insects **D**. The human body has this plan during early development and retains it in the segmental organisation of the adult vertebral column and the ribs. In the invertebrate forms this segmental plan is represented in the nervous system as a

bilateral chain of longitudinally connected ganglia **D**. In the central nervous system of the vertebrates, like us, the same plan can be seen in the segments of the spinal cord and brain stem, which are accompanied by segmental spinal and cranial ganglia and nerves.

The axial organisation of the nervous system is common to all



animals with bilateral symmetry. It is located dorsally **C5** in all vertebrates, from fish to humans. In the case of worms and insects (invertebrates), however, the chain of ganglia is situated ventrally **C3**.

The segmental nature of the spinal cord is obvious from the regular insertion of the spinal nerves. The complicated developmental re-organisation of the head and neck, especially in mammals, causes the loss of the initial embryological segmentation in the brain stem. The cerebrum has no obvious segmental plan even at early stages of development.

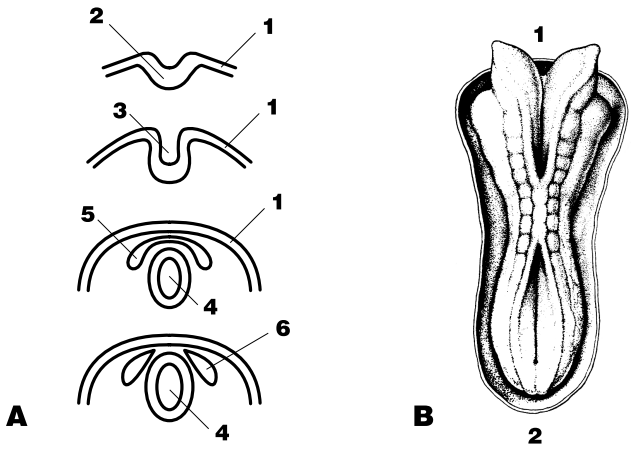
2.1.8 Development

In the early stages of development (2 weeks of gestation) the outer layer of the human embryo begins to undergo changes leading to the formation of the nervous system **A** (transverse section of the dorsal region). In the dorsal region the outer layer, *ectoderm* **A1**, becomes thicker to form the *neural plate* **A2**, which folds on itself until the lateral edges come closer to form the *neural groove* **A3**. The fusion of these edges leads to the formation of the *neural tube* **A4**, which become covered by the ordinary ectoderm, and to the segregation of a population of cells **A5** which will later form the bilateral *neural crests* **A6**.

The **central nervous system** (brain and spinal cord) develops from the neural tube, while the **peripheral nervous system** (cervical, spinal and visceral ganglia) develops from the neural crests, which have a strong predisposition to migrate.

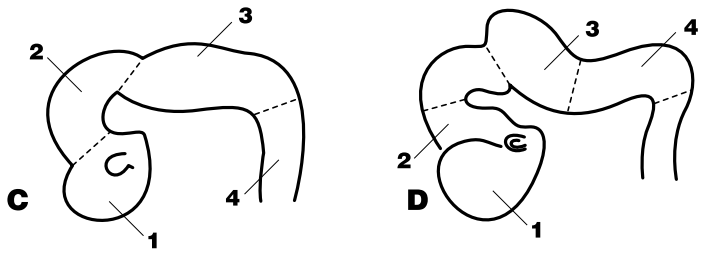
At about 3 weeks of gestation **B** (dorsal view) the neural tube is still open at its cranial **B1** and caudal **B2** ends (*neuropores*).

At 4 weeks of gestation **C** (lateral view) the neural tube is completely closed and the general plan of the central nervous system is already laid down in the form of discrete enlargements or *vesicles*. These embryonic vesicles are committed to form the



major regions of the brain **C1-3** and spinal cord **C4**. The most rostral vesicle **C1** becomes the *cerebrum*. Unlike the brain of earlier vertebrates, the human brain is complicated by two 90-degree bendings, the *cephalic flexure* at the level of the future *midbrain* **C2**, and the *cervical flexure* between the future *pons-cerebellum-medulla* **C3** and the future *spinal cord* **C4**.

At 6 weeks of gestation **D** (lateral view) a further subdivision of vesicles occurs. **C1** subdivides into **D1** (future *cerebral hemispheres*) and **D2** (future *thalamus*), while **C3** subdivides into **D3** (future *pons* and *cerebellum*) and **D4** (future *medulla oblongata*).



Certain regions of the peripheral nervous system (e. g. olfactory mucosa and internal ear) do not originate from the neural plate **A2** and neural crest **A6**, but from local thickening of the ectoderm called *placodes*.

Just as the earliest nervous systems can be found in the skin of simple animals living in the sea (Section 2.1.7), the earliest sign of nervous system development can be recognised in the outer covering of the embryo **A**. The nervous system has therefore a clear ectodermal origin, from both phylogenetic and ontogenetic points of view, i.e. it has the same embryonic origin of the skin. The late Hendrik Van der Loos, Professor of Anatomy at the University of Lausanne (Switzerland), defined the nervous system as a glorified piece of skin, elected by evolution and development to serve the important function of being a meaningful interface between the body and its environment.

Besides being a colourful biological statement, this view of the

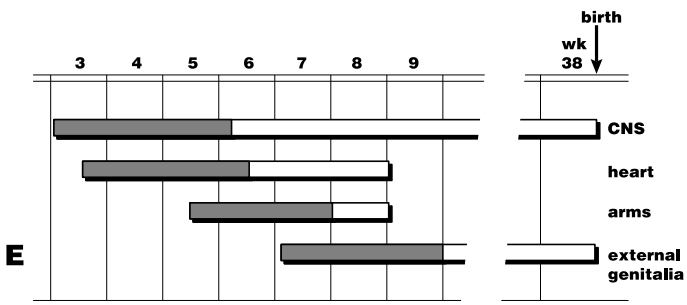
nervous system relates to important functional and clinical aspects. As discussed later in this course, some aspects of the cell biology of neurons are typical of cells of ectodermal origin.

2.1.9 Congenital malformations

Congenital connotes being 'born with', i.e., a condition not caused by the post-natal environment. As discussed in detail later in this course, the causes of congenital malformations can be genetical (single gene mutation), chromosomal (defects in number or composition of chromosomes) and environmental (toxic substances crossing the placental barrier and metabolic problems of the mother). The human nervous system is the most vulnerable organ system of our body as far as environmentally induced congenital malformations are concerned. The chart **E** represents the *critical periods* (dark bars = major defects, light bars = minor defects) during gestation and shows that, unlike other organs, the central nervous system (CNS) is vulnerable throughout gestation.

The congenital defects of the central nervous system are mainly due to the failure of the neural tube to close and/or to the failure of the skeletal system to grow over the neural tube. These defects tend to occur at the superior (rostral) and/or at the inferior (caudal) end of the neural tube, the regions where the neural groove closes last (cf. **B**).

The most dramatic case of neural tube malformation is *anencephalus* (Latin for 'no brain') where, in reality, the embryonic

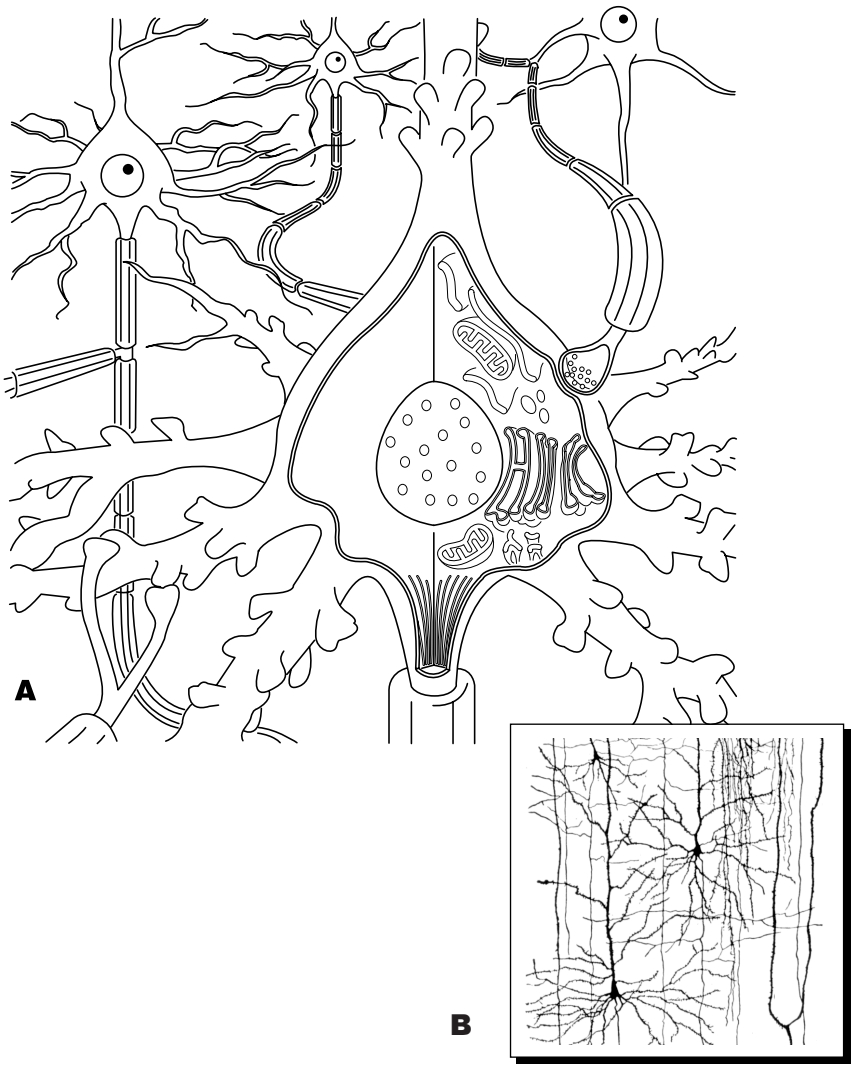


cerebral hemispheres are not missing but rather left open, flat and exposed to the surface of the head without a skeletal protection, because **B1** does not close. This relatively common condition (1:1000) is accompanied by other severe malformations and is incompatible with life.

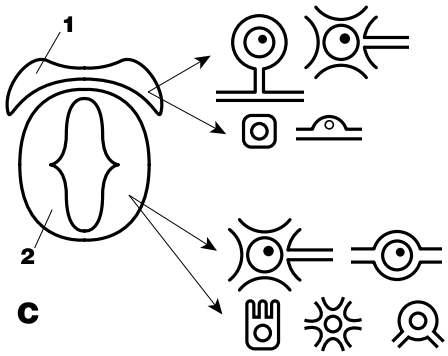
With *spina bifida* one refers collectively to a variety of conditions due to defects in the closure of the caudal end of the neural tube (cf. **B2**). They range from quite mild, where a normal spinal cord lacks a dorsal skeletal protection, to very severe, where an open spinal cord is exposed to the surface of the lumbar region.

2.1.10 Cellular aspects of the nervous system

As we have seen in the previous sections, the central nervous system is unique, among all organ systems of our body, in having a complex regional specialisation. The structure and function of a cubic centimetre of tissue taken in one region of the liver, for example, is the same as that taken a few centimetres away. The same generally applies to all organs. But in two small



adjacent regions of the brain, for example, one is likely to find very different cellular and biochemical compositions. More importantly, very small and discrete lesions in the nervous system can cause serious functional impairments, while this would not generally happen in other organs. This means that the microanatomy of the nervous system is of paramount importance.



One cannot, therefore, gain a critical understanding of the nervous system in health and disease without becoming familiar with different cell types (morphology), their different organisation in space (cytoarchitecture), the different internal organelles responsible for function (ultrastructure), the molecular basis of that function (biochemistry) and the physical basis of changes occurring during function (physiology). This requires a multidisciplinary approach to neurobiology.

Students of the nervous system must develop the skill of visualising structures in space, both at the regional and cellular level. The spatial organisation of the basal nuclei in the cerebrum, for example, is very complicated, yet it is much simpler than the spatial organisation of neurons and glial cells in a volume of grey matter of the size of a pencil tip, which can contain about 1,000 cells.

One normally portrays neurons and their connections in two-dimensional diagrammatic illustrations. In reality the complexity

of their interactions is best visualised in space **A**. However, one is obliged to represent only a small number of them, because the reproduction of all cell bodies and processes would make the analysis of specific structures impossible. There are techniques to obtain the same result in histological preparations **B**. Both **A** and **B** intend representing pyramidal neurons in the cerebral cortex. **A** offers a pictorial view of how processes (dendrites and axons) mediate communication by way of contacts and chemical transmission (synapses). **B** represents a silver impregnation view of real tissue, which makes the same point.

As indicated (Section2.1.8), the central nervous system derives from the *neural tube* **C2**, while the peripheral nervous system derives from the *neural crest* **C1**.

In cellular terms, this implies two types of *neurons* (multipolar and bipolar) and three types of *glial cells* derive from the neural tube **C2,** while two types of *neurons* (unipolar and multipolar) and two types of *glial cells* derive from the neural crest **C1**.

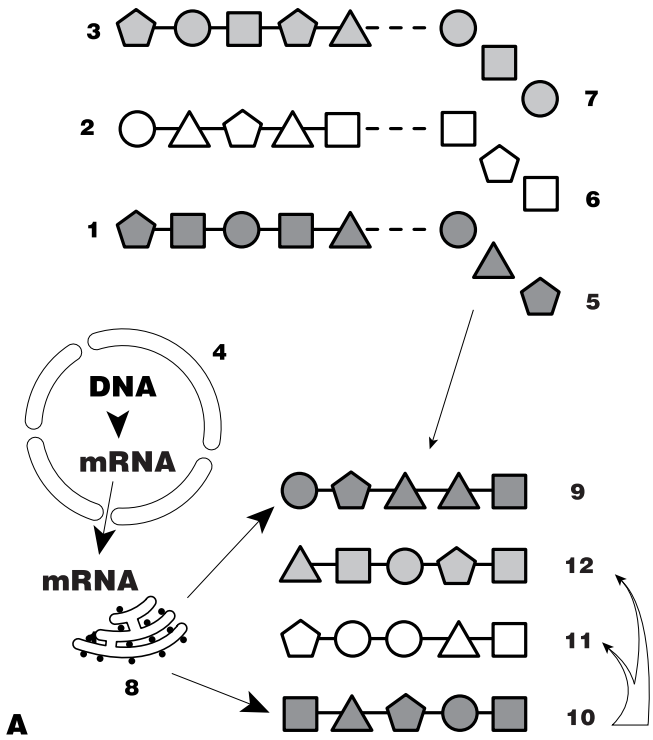
2.2 Fetal development

Before analysing the fetal development of the nervous system, it is necessary to offer a critical discussion on information in development. Discussion in Sections 2.2.1 to 2.2.3 represents a summary of basic ideas for the reader that has no previous knowledge of biology. The same topic is discussed in more depth and technical details in Section 2.2.4.

2.2.1 The role of genetic information in living organisms

The structure and function of living organisms depends upon four types of large molecules which are present in all cells (p.41) : proteins **A1**, lipids **A2**, carbohydrates **A3**, and nucleic acids (DNA and RNA), which are inside and outside the nucleus **A4**. Cells are able to build (synthesise) these macromolecules from smaller precursors **A5-7**, by assembling them into long chains again **A9-12**. The small precursors are obtained from the breaking down (digestion = dashes **A5-7**) of foodstuff or from the natural turnover of the body's molecules. The specific properties of the macromolecules resulting from the assembling (synthesis) is defined by the relative proportion of precursors used and, particularly, by their order in chains. Genetic information is all about such an ordered assembly of precursors.

The genetic information of a given individual is able to control the properties of macromolecules in the following way. Inside the nucleus **A4**, one type of nucleic acid, the deoxyribonucleic acid (DNA), is able to replicate itself, i.e. to impose the same sequence of precursors onto the daughter molecules being assembled next to it. DNA is therefore the molecule that carries genetic information in the form of specific sequences of its own precursors: the genetic code. This code remains almost intact when new organisms are generated by sexual reproduction (union of the DNA of egg **B1** and sperm **B2**) and when new cells are generated by cell multiplication (duplication and separation of DNA into daughter cells).



Genetic information controls the properties of all macromolecules in an organism by the direct definition only of proteins: structural proteins **A9** and catalytic proteins (enzymes) **A10**, which in turn define (white arrows from 10) the composition of lipids **A11** and carbohydrates **A12**. The assembly of precursors to form proteins is controlled by DNA through its genetic code and a special assembling machinery **A8** outside the nucleus, which also involves different types of ribonucleic acid (RNA), such as mRNA, and specialised organelles (ribosomes), which are represented by black dots on membranes in **A8**. It is important to realise that genetic information (**large arrow heads**) defines only the sequence of precursors of proteins, i.e. their functional properties, and nothing else. Genes are not able to define the shape of cells and organs, the time sequence of events, health, diseases or behaviour;

they just define proteins.

The assembly of lipids **A11** and carbohydrates **A12** is regulated, instead, by a myriad of specific enzymes. As the enzymes are themselves proteins, genetic information can indirectly influence (**arrows** from 10 to 11-12) the functional characteristics of other macromolecules as well. Enzymes are also responsible for the turnover (digestion) of all macromolecules mentioned above.

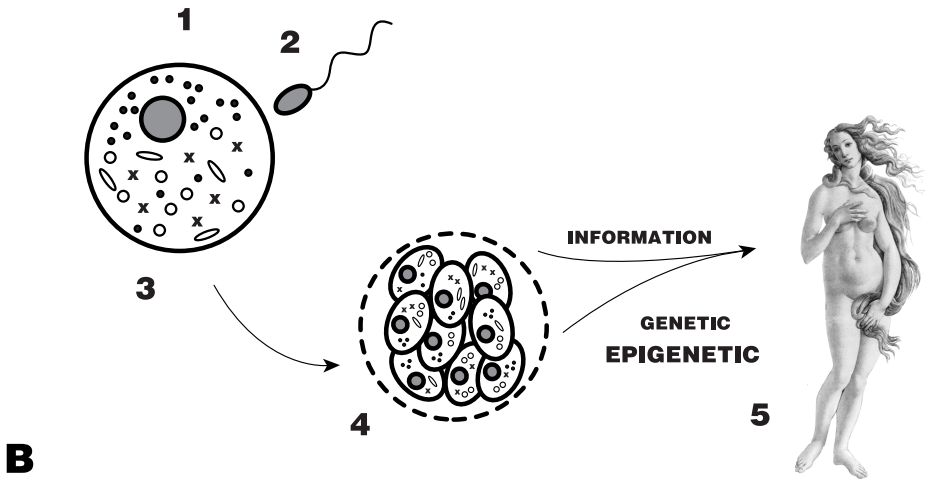
2.2.2 Information for development

If genes define only proteins, one may wonder whether some other type of information is needed to define complex events leading to an adult life form **B5** (p.43).

At the initial stage of development, the egg carries the genetic information of the mother in its nucleus **B1**, as well as a considerable amount of a different type of information which is expressed in the heterogeneous distribution of organelles within its cytoplasm **B3**: ribosomes, mitochondria, vesicles and other types of organelles, as well as important molecules such as mRNA and specific factors for genetic activation (see 2.2.4). These egg cytoplasmatic components will become differentially localised in the first cells of the embryo **B4** resulting from the segmentation of the egg. We know very little about the contribution of the egg cytoplasm to the characteristics of the offspring **B5** in mammals

and humans, so this other source of information is not normally discussed with students, who are left with the simplistic impression that genetic information controls all aspects of development. Unlike the egg, the sperm cell **B2** contributes only its genetic information to the formation of the embryo, as only its nucleus (not its scanty cytoplasm) enters into the fertilised egg.

The other non-genetic information necessary to initiate and guide development will be discussed in section 2.2.4, together with the hypothesis of the stereo blueprint of development. This introduction is necessary in order to understand the source of information responsible for the pre-natal and post-natal development of the brain, thus the origins of behaviour.


1
2
3
4
5
INFORMATION
GENETIC
EPIGENETIC
B

2.2.3 The environments of the genes

An erroneous idea that students are often left with is that genes operate in a kind of neutral environment, as in the test tubes used by molecular biologists in their laboratory. In real life genes are, on the contrary, surrounded by many controlling factors and become activated (expressed) only after specific external inductions. We now consider these **factors outside the genes** that control the transcription of DNA sequences (DNA to mRNA) and their translation (mRNA to protein), as they appear in the cell in order of distance from the DNA molecule. The text below refers to illustrations **A** to **D** that are on the next pages.

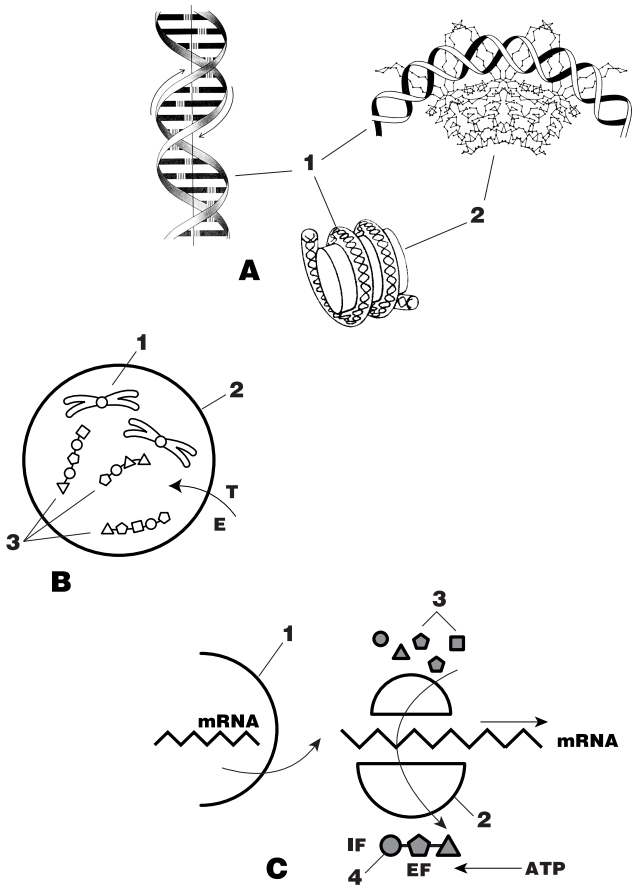
A) Special proteins **A2** form the scaffold around which the helix of the DNA chain **A1** is tightly twisted to form the nuclear structures called chromatin **A1-2**. These proteins (histones) are responsible for the compaction of DNA, a physical arrangement that prevents DNA transcription into mRNA (see **A** on p. 41 and **C** below). Chromosomes **B1** are formed of compacted chromatin and are visible at the optic microscope. Humans have 26 pairs of chromosomes containing the genetic information necessary to define only about 40,000 protein sequences necessary for events in development and adult functions (see **A9-10** on p. 41 and **C** here).

B) The chromosomes **B1** are contained within the cell nucleus **B2**, where a number of molecules **B3** influence genetic expression. Some of these regulatory molecules are called *transcription factors*, as they induce genetic expression; without their action genes would remain dormant inside the chromosomes. Some molecules such as steroid hormones, for example testosterone **BT** and estradiol **BE**, are present in the blood stream and cross both cellular and nuclear membranes **B arrow** and determine which ones of the genes are being activated or expressed (i.e. DNA transcribed into mRNA) to form specific proteins, while other genes remain silent.

C) Once induced, the specific genetic code is transferred (transcription) to a messenger nuclei acid mRNA **C** that leaves the nucleus **C1**. In the cytoplasm the machinery for protein synthesis **C2** (ribosome) may or may not assemble small precursors **C3** into proteins **C4** (translation of the genetic message into a sequence of

precursors of proteins), because it is under the control of cytoplasmatic regulating factors. These factors, which are themselves proteins, control the beginning of the assemblage (initiating factor **CIF**) or its continuation (elongation factor **CEF**). Phosphorylated molecules provide the energy **CATP** (adenosine triphosphate) necessary for the release and three-dimensional folding of the newly synthesised proteins **C4**. The control of protein synthesis also occurs at the quantitative levels (rate of synthesis) in various ways.

D) All cells are located near other cells in the embryo **D** (figure below). Cells can control each other's genetic expression and protein synthesis **C**, by releasing substances that bind to the

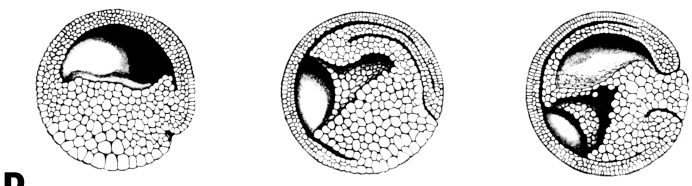


surface of neighbouring cells and, through internal secondary messages, can control metabolic events inside other cells and, as a consequence, morphogenetic events in the embryo **D1-3**.

It is therefore clear that the genes are not operating in isolation during developmental. More importantly, they are always under the control of outside factors, which carry very important information about time, space and specific genes to be activated. As a consequence, genes are more like tools waiting to be used, rather than being a primary source of information. Whether, when, where, and how much they are being used is decided by many **factors outside DNA**, which act at various cellular levels and are the most important parts of information in developmental biology.

The cytoplasm of the fertilised egg begins to divide exponentially into many embryonic cells, each of them containing a precise replica of the mixed genetic code inherited from the egg and sperm nuclei, as well as a portion of the egg cytoplasm (Section 2.2.2 **B**). The processes that follow involve various types of movements by the initial population of embryonic cells — separation into layers, migration, sliding, folding into tubular shapes, etc. as shown in **D** (gastrulation in frog) — that are caused mainly by specific cell-cell interactions which follow a precise sequence of events occurring in time and space. The fact that two types of cells are in contact in a given moment and in the same place of the embryo is not specified by genes, but by the three-dimensional complexity of the developing embryo.

The importance of location in space and time of molecular events was emphasised by Gerald Edelman who named this field of developmental research *topobiology* [*topos* is Greek for 'place'].



During embryonic development, morphogenetic events **D** must occur at a specific stage and in a specific location, otherwise they are useless or even deleterious. The recognition of time and space is beyond the capacity of the genetic code and depends totally on spatial information of the type mentioned above **ABCD** and further discussed below. This is the essential concept of the stereo blueprint hypothesis discussed in more details in the next section.

2.2.4 The stereo blueprint of development
(notes are at the end of this section)

The previous three sections introduced in general term new ideas about information in development. This section formalises them by presenting a new hypothesis on the *causal interpretation of development*. The basic premise is that genetic information alone cannot define the cellular and molecular mechanisms responsible for the development of a multicellular organism. The terminology used here is forcibly more technical than that used previously, as here I am addressing readers with some previous knowledge of biology. Alternatively, the abridged information provided in the previous three sections should suffice. In either case, these new ideas about development provide a necessary theoretical background for concepts presented later in sections 2.3 and 2.4 concerning the origins of behaviour.

A few years ago Marcello Barbieri (1) proposed an interesting interpretation of evolution, which was based on the appearance of new types of organic codes at the beginning of major evolutionary steps of life forms. He identified (p. the genetic code (origin of life), the splicing codes (eukaryotes), the adhesion codes (multicellular organisms), the pattern codes (animals), and the language codes (mammals and *Homo*). One important idea was that DNA is not alone in providing information for living organisms that are more complex than bacteria.

Two years ago (2) I developed a similar approach even further, by suggesting that DNA, in spite of being an important source of information, occupies a subordinate position within a complex set

of information responsible for the definition of a multicellular organism. This idea arose while studying the development of brain and behaviour, but the hypothesis presented here (*stereo blueprint of development*) concerns development in general. This is an abridged presentation of the new theoretical model. (3)

DNA represents a very good system of cellular memory to define specific proteins, hence functions; it has served prokaryotic organisms (bacteria) for 4 billion years; it was so efficient that 2 billion years ago eukaryotes (one-cell organisms) kept the genetic code practically unchanged. But 500 million years ago, the appearance of multicellular organisms coincided with the evolution of additional information systems; this was necessary for cell differentiation, pattern formation and organogenesis, processes that do not exist in bacteria, and are of lesser importance in one-cell and colonial organisms. The evolutionary solution was to have a new information system initiating and guiding the synthesis of new proteins (genetic information) toward the construction of cell diversity and body plans. (4)

This new evolutionary trend was very successful and led to a large variety of cell types and complex organs. The last 40 years of research have shown that the mechanisms of genetic regulation are extremely complicated, even in small multicellular organisms. As a consequence, modern textbooks of molecular biology dedicate a few initial chapters to DNA structure, replication, transcription and translation, while the best part of the text is used to discuss (or guess) how genes are activated, repressed, up-regulated and down-regulated by information placed **outside** DNA. This should have raised, by now, some doubt about DNA being itself the blueprint of life; but it did not. In fact, these regulating mechanisms are mediated by proteins, which are themselves defined by genetic information. This situation has led to the belief that genetic information does, ultimately, define the development of an organism, the very tenet that is disputed in this section. The unfortunate use of the term 'epigenetic' to refer to the regulating factors located outside DNA has only added more confusion. (5) It is hoped that the critical analysis and the new hypothesis presented below may add a better insight about information in

development.

As explained in section 2.2.3, the DNA of embryonic cells stays in its chromatin jail, quiet and ignorant of external events, *waiting to be instructed* by the external cellular environment about three very important aspects of development: a) which one of its sequences is to be transcribed (the **what** of differentiation), b) in which cell is this occurring (the **where** of pattern formation), and c) at which stage of development is this occurring (the **when** of critical periods). These are very important pieces of information, in view of the definition of embryonic development as *a series of predictable (species-specific) events that occur in space and tim*e.

One generally relates species specificity to DNA. But this molecule, albeit powerful, can only define the linear sequence of amino acids in proteins; it has no internal mechanism to decide which sequence has to be transcribed or to define time and space, the essential features of development. It seems therefore legitimate to wonder whether genetic information – a source of information that is sufficient for bacteria – is also sufficient to define the development of multicellular organisms. We are certainly dealing with a controversial issue, as DNA is considered the blueprint of life by modern molecular biologists (6) and by the public at large. (7)

The present hypothesis represents an attempt at identifying another source of information outside DNA, which has the power of defining the essential mechanisms of development (the *what*, *where* and *when* mentioned above). The approach used here is to analyse processes and their causal mechanisms, not just end products (or events). At this point terminology becomes important.

Information refers to cellular memories in general, not just the genetic one. A *code* is that special language used to transduce a cellular memory into a cellular event; one of these, the genetic code, was deciphered in the 1960s, while the other ones have been neglected so far. A *blueprint* (building program, *Bauplan*) is made of several sources of information. A blueprint of development must have the power of defining time and space as well, not just

amino acid sequences.

I am suggesting that *the three-dimensional structure of the embryo* is, in itself, the source of information that can define events in space, in such a way as to lead to the next stage of development (time). I am calling this *stereo information*. (8)

For example, during development cell movements bring together two types of cells that previously were not in contact (see Fig. 1). The membrane molecules of one cell can now induce changes in the membrane molecules of the other cell (Fig. 1, signal-receptor); this initiates an activation pathway (white arrows) leading to new genetic expression (Fig. 1, transcription), as already described in section 2.2.3; new proteins are then assembled into the external membrane, and the selective adhesion of that cell changes; new cell movements occur, new cell-cell contacts are established, which in turn induce new molecular and/or genetic events, etc. Gerry Edelman already discussed this sequence of

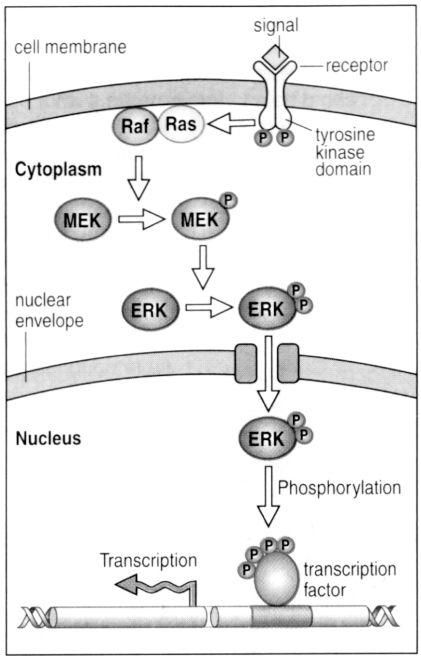


figure 1

events in molecular terms in 1988. (9)

I am suggesting that in this cascade of molecular induction DNA provides limited information, because it cannot define the *specificity* of external activating systems, which are those that define *what*, *where* and *when* in development, as mentioned above. In fact the position of embryonic cells that initiates external activating systems (see 2.2.3 figures D & E) define not only time and space, but also which genetic sequence is going to be used on that occasion. (10) DNA is only left with the task of defining the order of amino acids in proteins; and even that genetic end product is modified by several mechanisms outside DNA, before the protein is finally assembled in loco. (11)

A dramatic evidence that genes themselves do not define developmental events can be obtained from grafting experiments carried out since the 1930s (see Fig. 1, reproduced from Wolpert et al., 1998). In the early frog embryo (as in 2.2.3, **D1**) a small dorsal region, called *primary organiser*, can be removed and grafted onto the ventral region of another embryo. The host embryo then develops a second dorsal region on its belly, complete with head, eyes and gills. This dramatic departure from a normal developmental plan is obtained by altering stereo information, not genetic information. The same result can be obtained in the chick embryo (Fig. 2b, reproduced from Wolpert et al, p. 112). A similar alteration of the early human embryo occurs naturally when monozygotic ('true') twins are formed.

For a correct *causal interpretation of development* (study of the chain of causes and effects) one needs to identify the *origins* of the three-dimensional structure of the embryo that guides developmental events, by moving backward in development. For practical reasons, I refer here only to the development of vertebrates, but the hypothesis in question would apply to all forms of sexual reproduction involving differentiated germ cells.

The role of the egg in defining developmental events varies considerably from the mosaic types (some invertebrates), to the intermediate cases (amphibians), to the regulative types (sea urchin, mammals). (12) The frog egg is a good example to outline the hypothesis, as it is an intermediate case; quantitative and

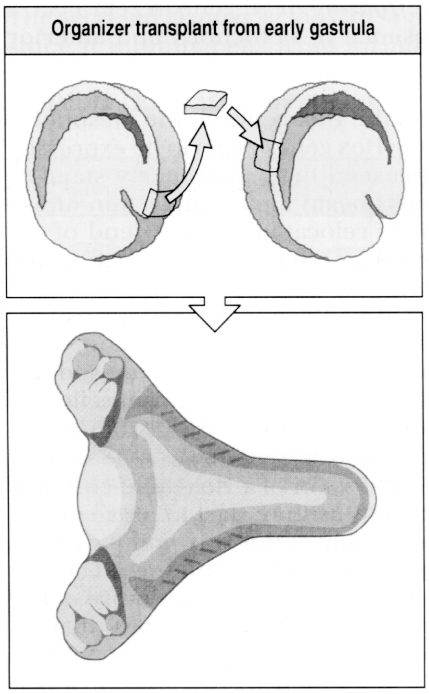


figure 2a

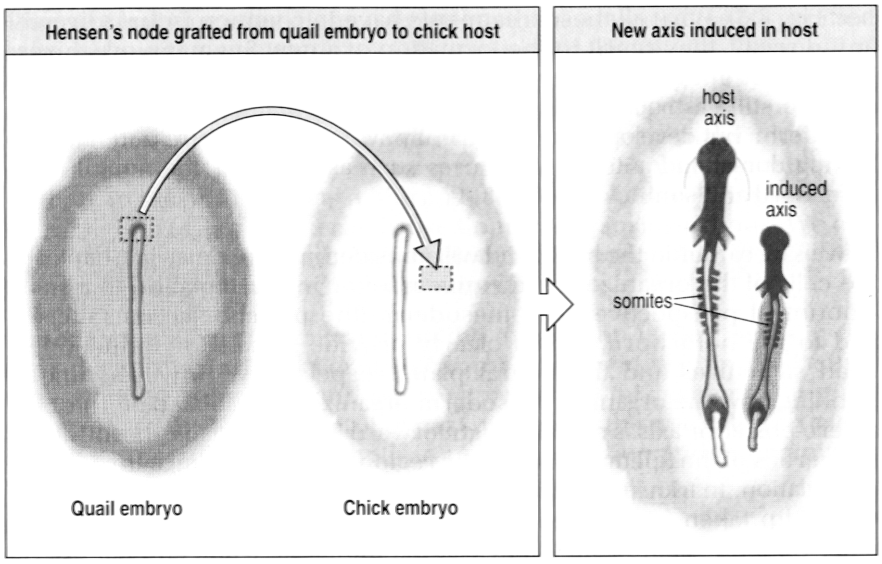


figure 2b

temporal (but not conceptual) aspects would change if other egg types were considered.

The egg cell contributes to the embryo with a much richer package of information than the sperm cell, whose nucleus is actively internalised by the egg at fertilisation (see section 2.2.2). I suggest that the *specific, heterogeneous and asymmetric distribution in space* of a great variety of molecules and cellular organelles within the egg cytoplasm represent the *initial source of three-dimensional information for the stereo blueprint of development*. The frog egg has a higher concentration of ribosomes and mitochondria in the animal pole and a higher concentration of yolk platelets in the vegetative pole (2.2.2, **B3**).

Fertilisation and the first few divisions of the egg (segmentation) define the future axes of the embryo, by establishing a specific and heterogeneous distribution in space of different embryonic cells (morula stage, section 2.2.2 **B4**), which can then set in motion the first simple systems of genetic activation. In frog, the *genetic expression* of the embryo (transcription of zygotic genes) begins only at the mid-morula stage; significantly, this occurs in conjunction with the *compaction of cells*, which allows cell-cell contacts and the beginning of the cascade of induction, i.e. step-wise genetic activation.

Fig. 3 represents in graphic form the hypothesis of the *stereo blueprint of development*. Three types of information are represented: **A** (continuous line) shows the level of stereo information that increases in time, **B** (large dash line) the level of potential genetic information that is stable, and **C** (small dash line) the level of expressed genetic information that increases in time. The egg cytoplasm provides an initial three-dimensional (stereo) information **1**, which is simple but able to self-generate information, (13) i.e. it leads to a progressively more complex three-dimensional organisation of the embryo **2**. Genetic expression *follows* soon after under the activating effect of the first cell-cell contacts (see Fig. 1). The three-dimensional structure of the embryo *guides* (**arrows**) the subsequent stereo and genetic events (in that order) and, in the process, it increases its own informational power at each subsequent stage of development.

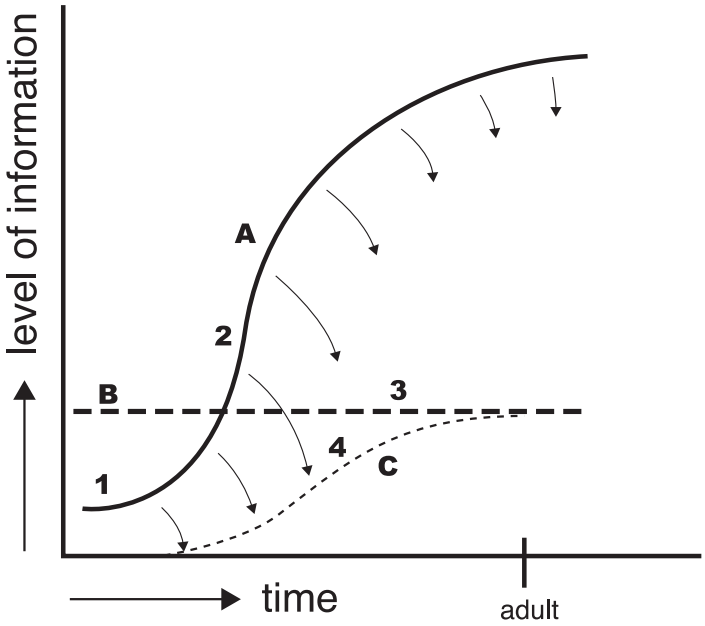


figure 3

The amount of potential genetic information, on the contrary, remains the same from fertilisation to adulthood **3**, while the amount of expressed genetic information **4** increases *under the activation and guide* (**arrows**) of stereo information.

The capacity of a) preceding and inducing modular episodes of genetic expression and b) self-generating new stereo information, puts stereo information at a superior hierarchical level, when compared to genetic information. The latter is relegated to a subordinate role in development, that of a tool waiting to be used according to a plan (blueprint), which is not initially 'defined' by the tool itself. DNA may be considered the only source of biological information in bacteria, but the evolution of multicellular organism implied the establishment of a new (stereo) source of information that made use of the pre-existing one (genetic) for the purpose of defining cell diversity and body plans.

Importantly, stereo information could not, alone, define development. In fact, if one eliminates a gene – by natural mutation or experimental knockout – a given developmental event does not occur anymore. This has led researchers to conclude that that gene was 'informing' the event in question. This conceptual mistake is understandable, but not justifiable if one adopt a correct *causal interpretation of development*.

In fact (Fig. 4a), if a specific event **A** occurs (cell movement, for example), which bring two cells into contact and causes the activation of **B** (a transducing factor, for example), which activates **C** (a transcription factor, for example), which triggers the expression of **D** for DNA (in the form of a specific mRNA sequence), which codes for the synthesis of a functional protein (a new cell adhesion molecule, for example), a new specific event **E** will occurs (cell movement, for example). Genetic expression **D** is in the middle of a chain of events initiated by another source of information, thus it cannot be initiating and causing element of that final event. If one eliminates (Fig. 4b) the gene D (**Xd**), the

4a

A → B → C → D → E

4b

A → B → C → Xd → Xe

figure 4

event E does not occur (**Xe**), but not because D would have been the initial causal factor of that event. With a very crude metaphor, it would be like saying that the spanner (gene) used by a mechanic (stereo information) would inform the assemblage of the car's carburettor (developmental event). Of course, if the spanner was missing (gene knockout) or it was not of the right size (mutation) the car would have no carburettor.

The validity of the conclusion reached above relies on five

conditions: a) development proceeds by modules; b) development has a time vector; c) a given spatial structure pre-exists each module, that of the egg being the first one; d) a given signal transducing mechanism pre-exists each module as a product of the previous module; e) genetic expression does not occur spontaneously in differentiating eukaryotes. Modern textbooks of developmental biology carry the supporting evidence for these conditions.

As already indicated, biological information must have a *code*, a language that specifically transduces a physical reality (cellular memory) into another. Genetic information uses a code to transduce specific sequences of nucleotides into specific sequences of amino acids. Stereo information transduces specific three-dimensional positions of cells into specific DNA transcription factors, through the molecular code of the activating system. Traditionally one refers to this transduction of information as 'induction', without associating any specific coding mechanism with it. (14) One should note that hormonal induction at distance also relies on a three-dimensional (stereo) code, as receptors (or concentrating molecules) need to be specifically localised on the surface (or inside) target cells.

I suggest that *the hypothesis of the stereo blueprint of development provides a convenient approach to investigate theoretically and experimentally causal mechanisms of development* by referring to an initial stereo information in the egg, which self-generates more complex stereo information by guiding genetic expression in time and space. (15) Thus, stereo blueprint = stereo information + genetic information. Genetic information alone cannot define the development of a multicellular organism. (16) This hypothesis also eliminates the inappropriate terminology and ambiguous concepts that seem to confuse discussions about genetic and epigenetic information. (17)

The collaboration between stereo and genetic information suggested above may, at first glance, resemble the old concept of 'nucleo-cytoplasmatic interaction', (18) but there are important differences. In this context, one should note that modern textbooks of developmental biology (19) do not state that DNA is

the only source of information in development, while textbooks of cell biology do so rather outspokenly. (20) Modern developmental biologists acknowledge the 'regulating role' of factors outside DNA without, however, speculating about the hierarchical chain of causes and effects interposed between them and genetic information. (21) I suggest that one has practically not moved forward from the old idea of an egalitarian and vague collaboration between nucleus and cytoplasm. The present hypothesis, on the contrary, states quite clearly that stereo information *initiates and guides* development, while genetic information *is subordinate* to it. (22)

Two objections could be raised against the stereo blueprint hypothesis: a) factors outside DNA activating genetic expression are themselves proteins, and b) the stereo information present in the unfertilised egg could have been defined by genetic information in the ovary. As the first question relates to the second, the latter becomes of crucial importance.

The answer to the first question is that, in the absence of an external spatial-temporal information, DNA cannot define what, where and when to contribute to development, the *proteins mediating activation systems included*. In fact these regulating proteins features prominently in the cytoplasm of the egg (see second question) and among the products of the early activation of the embryo's DNA by stereo information. (23) For this particular aspect, it is important that genetic expression of the zygote (embryo) in frog begins only after initial segmentation, and at the same time of cellular compaction, when cell-cell interactions begin to induce the first DNA activating systems.

The second and more important objection concerns the famous chicken and egg dilemma of origins: the embryo's stereo information originates in the egg, which in turn originates in the ovary. The egg cytoplasm is assembled through complex cell-cell interactions between maturing oocytes and the somatic cells of the ovary; if these processes were initiated and guided simply by DNA, the stereo blueprint hypothesis would be invalid.

With the exception of the fruit fly, (24) we know little about the asymmetric distribution of molecules within the egg cytoplasm,

and very little about the mechanisms that define important process during oogenesis. (25) The crucial aspects to investigate would be activation systems of DNA transcription and *their distribution in space* within the ovary. Until more information is available, it seems reasonable to suggest that, just as during embryonic development in general, spatial-temporal features of the differentiating ovary would represent the *stereo information* that guides specific *genetic expression* and finally defines the asymmetry of the mature egg cytoplasm. These mechanisms must be investigated, instead of assuming that sequences of nucleotides in DNA alone are able to define parameters of that type. In this optic, the development of the ovary would become a biological memory for egg structure, which could be transferred from generation to generation as a species-specific characteristic.

In summary, an embryo inherits from its mother *specific egg cytoplasmatic molecules, their asymmetrical distribution, mitochondrial DNA and nuclear DNA*; its father contributes *only nuclear DNA*. Therefore, I suggest that *development begins during oogenesis*, not at fertilisation. Furthermore, as oogenesis is itself the outcome of ovarian differentiation, it follows that *development never actually starts or finishes*; it represents a continuing chain of causes and effects across generations. Importantly, in this species-specific circular repetition of events, *stereo information always precedes, activates and guides genetic information*. Such a continuum would imply that the mechanisms of *ontogeny and phylogeny* should be discussed together as part of the same biological process, a concept not fully digested in biology. (26)

To conclude this discussion about information in development, we can compare the characteristics of stereo information with that of genetic information, within the hypothesis of the stereo blueprint of development. *Stereo information* is three-dimensional, self-generating at each stage of development, and located at the beginning of the causal chain of developmental events. *Genetic information* is one-dimensional, constant in time, and located inside the causal chain of developmental events. The stereo information occupies therefore a higher hierarchical level than the genetic information; these two sources of information do not have just a

relationship of cooperation – the vague concept of 'nucleo-cytoplasmatic interaction'. They are both robust cellular memories that can be transmitted from generation to generation, and contribute to the stereo blueprint of development; but genetic information does so in the subordinate position of an executor.

Other biological processes can be also revisited through this critical understanding of the role of genetic information: cellular function in adult, cellular dysfunction (disease), and behaviour. This author proposed a causal classification of diseases three years ago. (27) Understanding the origins of behaviour is, of course, the very aim of the present work, as discussed in sections 2.3 and 2.4. Concepts later presented in those sections would have lacked a solid theoretical background without this discussion about development in general.

Notes of Section 2.2.4

(1) Barbieri, M. (1985) *The semantic theory of evolution*. Harwood Academic Publications, London.

Barbieri, M. (1999) *I codici organici - La nascita della biologia semantica*. PeQuod, Ancona. English translation (2001) *The organic codes – The birth of semantic biology*. PeQuod, Ancona (the electronic version is available at www.biologiateorica). In notes referring to this work below, page numbers are from the printed version, while citations are from the electronic version.

(2) Giorgi, P. P. (1999) *The origins of violence by cultural evolution*, pp. 41-44 (first edition). Minerva E&S, Brisbane.

(3) Full length presentation in Giorgi, P. P. (2001) "The stereo blueprint of development – A new hypothesis" in preparation (July). A brief presentation of the stereo blueprint of development is in Giorgi, P. P. (2001) "Informazione genetica – E' veramente il programma della vita?" *Bollettino della Comunità Scientifica in Australia*, Marzo 2001, pp. 11-18, and was discussed at a public seminar organised by the School of Biomedical Sciences of the University of Queensland on 8 June 2001.

(4) The strategy of using cell-cell interaction, signal transduction and transcription factors to induce cell diversity and pattern formation proved a success. This probably happened 520-530

million of years ago during the geological period called Cambrian (Tommotian and Atdabanian phases), because basic phylotypic models of body plans appeared all at that time (the so-called 'Cambrian explosion') and, interestingly, no new animal phyla probably appeared ever since. See Barbieri, M. (2000), *op. cit.*, note (1), p. 192-195, and Gould, S. J. (2000) *The lying stones of Marrakech*, pp. 321-324. Harmony Books, New York.

(5) The term 'epigenesis' was still used in the first edition (1999) of the present work, *op. cit.*, note (2). I am indebted to Marcello Barbieri for warning me against its current inappropriate usage. Aristotle first described the step by step increase in structural complexity of the embryo, as opposed to the simple increase in size of a pre-formed organism. Eighteenth-century scientists used this term in the famous debate about the contrasting theories of epigenetism and preformism. In the 1940s Waddington coined the term 'epigenetics', an amalgam of epigenesis and genetics, to describe the discipline that studies the causal analysis of development comprehensively. In the 1960s he was already criticising the reductive use of the adjective 'epigenetic' to refer only to molecular processes outside DNA. However, this usage has now become common by referring to DNA activating pathways, and the post-translational (RNA editing) and post-transcriptional (see note 7) modification of genetic information. For a discussion on epigenesis see Lövtrup, S. (1974) *Epigenetics*, pp. 1-16. John Wiles, London. Brian Hall offered the following reminder of Waddington's original definition: "Epigenetics, or epigenetic control, is the sum of the genetic and non-genetic factors acting upon cells to selectively control the gene expression that produce increasing phenotypic complexity during development." Hall, B. K. (1992) *Evolutionary developmental biology*, p. 89. Chapman & Hall, London. I am not using the adjective 'epigenetic' anymore because of the ambiguity it has acquired with time. Moreover, the concept of 'non-genetic factors' is too vague for the study of causality; stereo information refers instead to precise three-dimensional parameters. The concept of 'sum of factors' is also not appropriate, when one deals with one type of information that is subordinate to another, not just added to it.

(6) "The human genome is touted as *the master plan for building*

an organism. But it is up to molecular biologists to decipher how the *'master plan' directs construction*." (my italics) Fogel, G. (2001) *Science*, vol. 291, p. 1181.

(7) At world-famous science museums visitors of the section dealing with heredity and genetic information are invited to "Come and see what defines you".

(8) Barbieri, *op. cit.*, note (1), pp. 210-211, also suggested the existence of additional information in development, by referring to the "body plan … used as supracellular memory". However he seems to say that this supracellular information is the result of a genetically determined body plan. This is almost the opposite of what stated in the present hypothesis: stereo information initiating and guiding genetic expression. The term 'stereo' derives from the Greek word for 'solid', thus three-dimensional. The secondary usage adopted in vision and hearing research – stereoscopic vision and stereo sound perception – involves the cognitive reconstruction of an external three-dimensional world from information delivered to the brain by two (bilateral) channel systems.

(9) Edelman, G. M. (1988) *Topobiology – An introduction to molecular embryology*. Basic Books, New York.

(10) The molecular mechanism through which a specific transcription factor can recognise the correct DNA sequence to be transcribed is very poorly understood. Wolpert, L. et al. (1998) *Principles of development*, pp. 282-286. Oxford University Press, London.

(11) After mRNA has specified the sequences of amino acids in the newly assembled protein (see 2.2.3 **C4**), post-transcriptional events lead to the actual functional state of that protein: possible enzymatic digestion into smaller segments, transport into the appropriate cell compartment, organisation into dimers or larger functional units, phosphorylation, etc. See Karp, G. (1996) *Cell and molecular biology*, pp. 532-533.

(12) Wolpert, L. et al., op. cit., note (10), pp. 6-7 & 16-17.

(13) The capacity of embryos of increasing their own complexity is a classic concept in developmental biology (see note 5) and was recalled by Barbieri, *op. cit.*, note (1), p. 202. He also suggested that scientists would understand and accept the role of 'epigenetic'

information in development only if they had a machine able to increase its own complexity, just as we can understand genetic information through the use of a computer. On the same note Jonathan Slack wrote a program for the development of an imaginary simple multicellular organism. His 'Crendonian snapper' took form from an asymmetric egg with 6 cytoplasmatic determinants and a nucleus with 14 genes. He explained: "The justification for this [mathematical exercise] is that, in final analysis, you only really understand something when you can make one yourself." Slack, J. M. W. (1991) *From egg to embryo*, p. 296 (second edition). Cambridge University Press, Cambridge. Of course, there is a difference between an automaton created by a computer – see also Arbib, M. A. (1969) "Self-reproducing automata – Some implication for theoretical biology" in C. H. Waddington (ed.) *Toward a theoretical biology,* vol. II, pp. 204-226 – and a real machine made of artificial cells that can replicate and repair themselves, as described in Tempesti, G. et al. (1998) "Il Progetto Embryonics – Una macchina fatta di cellule artificiali" *Systema Naturae*, vol. 1, pp. 41-82.

(14) The concept of positional information has mainly been discussed in term of chemical gradients, polar coordinates and body axes. Malacinski, G. M. & Bryant, S. V. (eds.) (1984) *Pattern formation – A primer in developmental biology*. Macmillan, New York. Wolpert, L. et al., *op. cit.*, note (10), pp. 19-20; Gilbert, S. F. (1997) *Developmental biology* (5th edition), pp. 701-702. Sinauer Ass. Pub., Sunderland (Mass.).

(15) The semantic theory of embryonic development proposed by Barbieri, *op. cit.*, note (1), pp. 219-221, was summarised as follows: "Embryonic development is a sequence of two distinct processes of reconstruction from incomplete information each of which increases the complexity of the system in a convergent way. The first process builds the phylotypic body and is controlled by cells. The second leads to the individual body and is controlled not only at the cellular level but also at the supracellular level of the body plan." (p. 221) Further to what indicated in note (8), this hypothesis describes two types of information that converge. The stereo blueprint hypothesis holds instead that stereo information *initiates* cell diversification in early development and *guides* step by

step the specific genetic expressions needed to progress to subsequent stages (modules) of development. The presence of two types of information and the relevance of cellular context are common to the two theoretical models, but the nature of the information involved and its causal interpretation differ considerably.

(16) This is why the science-fiction story of extracting DNA from the remains of an extinct animal and re-creating that organism, is just a story – sometime supported by over-enthusiastic scientists as well. Without a live egg of that same species nothing can be achieved, because the egg carries the necessary stereo information that initiates development.

(17) Hall, B. K., *op. cit.*, note (5).

(18) Gilbert, S. F., *op. cit.*, note (14), p. 197-198.

(19) For example, Wessells, N. K. (1977) *Tissue interactions and development*. Benjamin, Menlo Park (Cal.); Russo, V. E. A. et al. (1992) *Development – The molecular genetic approach*. Gilbert, S. F., *op. cit.*, note (14); Wolpert, L. et al., *op. cit.*, note (10).

(20) For example, Albert, B. et al. (1994) *Molecular biology of the cell*, p. 1050. Garland Pub., New York; Lodish, A. (1995) Molecular cell biology, p. 305. Scientific American Books, New York. See also note (6).

(21) In this context, the modern literature of developmental and molecular biology displays an interesting semantic ambiguity. One seems to use the expressions 'genetic regulation *of* development' and 'genetic regulation *in* development' as if they were interchangeable, while they actually carry opposite meanings. Moreover, the word 'regulation' itself is ambiguous, because information should *define* new structures and functions, not just regulate or modulate them. This semantic ambiguity may betray uneasiness in establishing a clear role for genetic information in multicellular organisms. Developmental biologists may not be able to sit on the fence for much longer. They should commit themselves on the issue of what defines what in multicellular organisms – just as molecular biologists do (see note 20) – and be prepared to defend their choice on a sound theoretical ground.

(22) Results from nuclear transplantation and cloning

experiments seem to argue against the idea of information provided by the egg cytoplasm, because the resulting individuals look all the same and resemble the donor of the nucleus. The aphorism "genetic information proposes, stereo information disposes" may provide some answer, but this important objection deserves a better explanation. Of the three developmental features defined by stereo information ('what, where, and when', as explained earlier) the 'what' means 'what genetic sequence is going to be expressed'. Genetic expression is activated and guided throughout development in an hierarchical manner, from early cell-cell interactions in the morula to the final cell differentiation in different organs. The final phenotypic details of such genetic expression represent the very features we analyse to conclude that cloned individuals resemble the nuclear donor. We are therefore dealing with a selective analysis. For example, stereo information specifies that iris pigment granules will be formed in the cells of the iris (not in those of the tongue), while genetic information specifies (when told to do so) that the pigment will be blue (not black). More generally, the stereo blueprint is responsible for a fertilised hen's egg becoming a *Gallus gallus*, while genetic information is responsible for it becoming a hen (not a cock), being large (not small), and having white feathers (not brown). The observer is obviously impressed by the fact that cloned individuals carry the same phenotypic details of the nuclear donor, not that they belong to the same species, the complex outcome of the stereo blueprint. Cloning is therefore an exercise in final details, not in body plan. Unfortunately, the critical experiment – transplanting a nucleus into the egg of a species with a different body plan – does not lead to full development because of the lack of specific recognition between nuclear macromolecules and the host's cytoplasmatic macromolecules supposed to interact with them.

(23) One important fact undermining the idea of genetic information being able, alone, to define development is the repeated use of the same signal transducing molecules at different stages of development and in different locations. Proteins belonging to the TGF and FGF families are typical examples. If these molecules really carried *descriptive* information – as they should, if they operated outside the context of stereo information –

development would be a very messy operation. A similar consideration applies to the limited number of neurotransmitters and the large number of pathways (functions) in the nervous system.

(24) Wolpert, L. et al., *op. cit.*, note (10), pp. 127-134.

(25) Wall, R. (1990) *This side up – Special determination in the early development of animals*. Cambridge University Press, Cambridge.

(26) "I am aware that I treat a subject currently unpopular … I tell a colleague that I am writing a book about parallels between ontogeny and phylogeny. He takes me aside … and admits in markedly lower voice: "You know, just between you, me, and that wall, I think that there is something to it after all." Gould, S. J. (1977) *Ontogeny and phylogeny*, p. vii-viii. Harvard University Press, Cambridge (Mass.). See also Hall, B. K., *op. cit.*, note (5).

(27) Learning resources for the Graduate Medical School, University of Queensland. See appropriate link at www.uq.edu.au/anatomy/StaffInterests/giorgi_p.html.

2.2.5 The stereo blueprint in the development of the nervous system

If stereo information is important in development in general, it is particularly so in the case of the nervous system because of its high level of three-dimensional complexity. Detailed aspects will be discussed in later sections of this course. Here we simply identify the origin of stereo information for the differentiating neurons in the fetus as being represented by other neurons and glial cells (for central neurons), skin and mucosae (for primary sensory neurons) and muscles (for motor neurons). Another source of stereo information for the fetal nervous system as a whole is the uterus and the substances that can cross the placental barrier. The post-natal developing nervous system then relies on considerable stereo information from its social environment (mother, family, school, etc.) which does literally modify the child brain, as discussed later in this course.

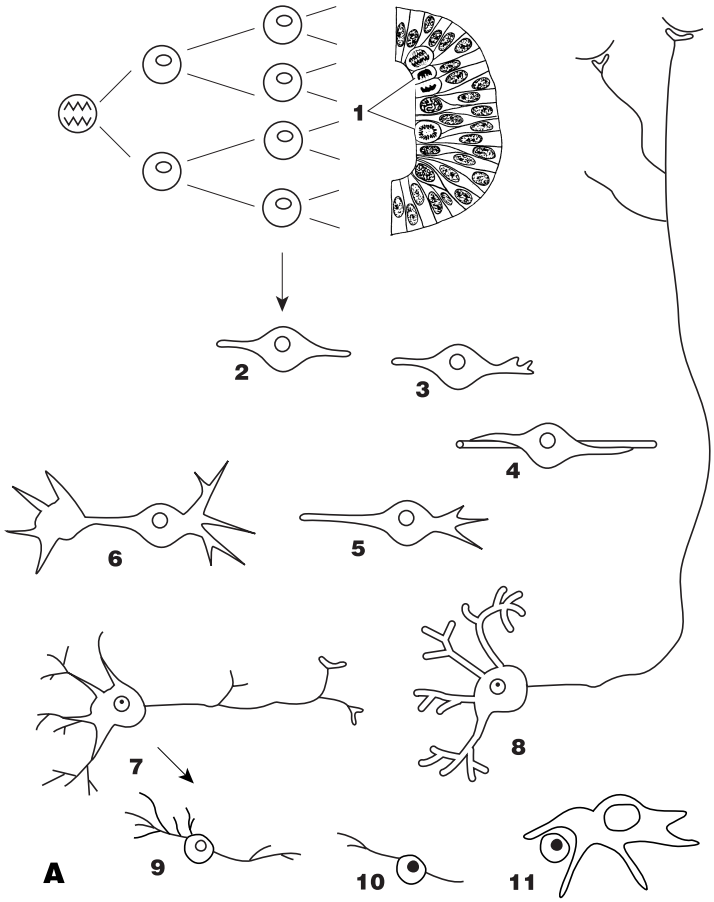
After acknowledging the importance of stereo information, one should remember that neurons have the highest level of genetic

expression among all body cell types. This means that the differentiation of brain and behaviour requires many specific proteins to fulfil sophisticated functional requirements. This does not mean, however, that those genes and proteins represent, alone. the source of information that define the nervous system, as discussed above: they are specific tools called into action by stereo information which operate in the correct place and at the correct time (Section 2.2.4).

2.2.6 Main mechanisms of early development

As for most organs, the nervous system develops from early embryonic stages to adulthood through four major cellular processes **A**: (illustration on p.67):
Cell multiplication: cell division (mitosis) **A1** provides the necessary number of cells to construct a given region of the nervous system.
Cell migration: immature neurons **A2-4** move **A3-4** to a location which is different from the one in which they stopped dividing **A2**.
Cell differentiation: once having reached their appropriate location, immature cells undergo a process of differentiation, which in essence is the acquisition of adult structure and function, i.e. becoming larger and acquiring dendrites and an axon **A6-8**.
Cell death: the differentiation of maturing neurons can become aborted **A9** if they do not establish a sufficient number of connections; in this case their nucleus becomes condensed **A10** and macrophages eliminate them **A11**. The elimination of certain immature or partially differentiated cells is part of the normal process of development.

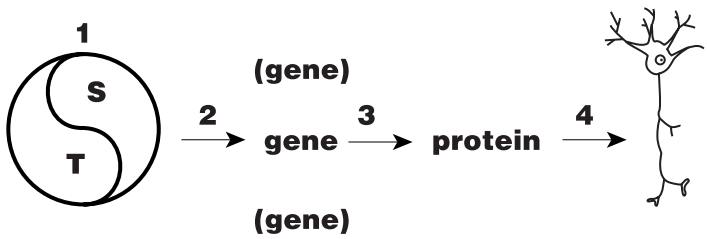
In the case of the nervous system, these four processes manifest themselves in unique ways and the interplay between stereo and genetic information becomes particularly important, as discussed in some detail below.



2.2.7 Heterogeneity in time and space

The cell processes listed above do not occur uniformly throughout the embryo, the organ systems, the individual regions and their tissues. Regional differences in cell multiplication, migration, differentiation and death **A1-10** and the ordered timetables of these processes are responsible for the final design of the nervous system. The complex events of development are caused by cell-cell interactions and inductions occurring in time and space.

When time **T** and space **S** interplay correctly and in step with each other, like the yin and yang of Chinese philosophy **B1** (below), the plan of embryonic development proceeds normally and the chain of causal events leads to a structure that is complex but predictable, as stated by the stereo blueprint hypothesis (Section 2.2.4). The blueprint of development, or basic plan of the future nervous system, is primarily enshrined in the three-dimensional complexity of the embryo, fetus and newborn organism, not in the genetic code contained in the nucleus of individual cells. The three-dimensional complexity established at a certain stage of development becomes the informational basis for the events leading to the next stage of development, whose higher degree of complexity will, in turn, become the informational basis for the establishment of an even higher degree of three-dimensional complexity. In the fantastic choreography of events taking place in the embryonic development, the genetic code only provides the tools (specific proteins) requested from time to time by the stereo information. In summary, stereo information **B1** is the only source of information able to activate and guide **B2** the correct genetic expression of a specific protein **B3** in a given cell and at the right moment. Other genes not required for the differentiation **B4** of that cell type (a multipolar neuron in this case) remain inoperant (repressed). Whether the interplay of space (three-dimensional information) with time (a vector) represents a time-oriented three-dimensional information or a four-dimensional one, is an



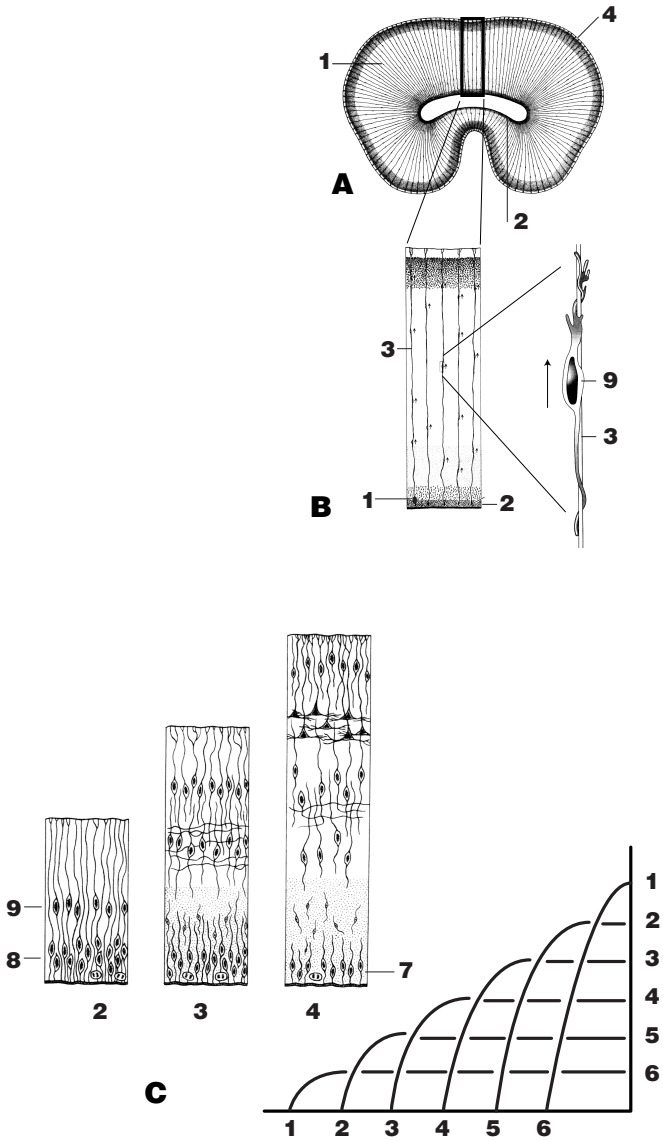
B

interesting philosophical point which deserve future discussion.

2.2.8 The formation of neuron layers in the cerebral cortex

Like most regions of the central nervous system, the fetal cerebral cortex (illustration on the following page) has a special type of glial cells called *radial glia* **AB1** (transverse section), which have their cell body in the ventricular zone **AB2** and a long process **B3** that spans the thickness of the wall of the neural tube. These cells can be found only at fetal stages, when they establish a radial scaffolding which represents the substratum for migrating immature neurons. Their migration occurs in subsequent waves, from the ventricular zone to the pial surface **AB4** of the developing cerebral cortex. The sequence of events is described below and symbolised in graphic form **C**. The y axis represents the increasing thickness of the fetal cortex; the x axis represents time; lines symbolise the six subsequent waves of migration of the immature neurons. The three insets represent a more realistic view of immature neurons that begin to form layers in the developing cerebral cortex **C7-11**.

a) A cohort of neuroblasts **C1** stop dividing and move away from the ventricular zone **C7** to the subventricular zone **C8**. The day when neuroblasts synthesise DNA (i.e. divide) for the last time represents the birth day of the resulting immature neurons. The date of birth can be determined experimentally for all neurons in the nervous system.
b) Immature neurons in the subventricular zone make contact with the radial glia **B2** and start sliding outward **BC9** along their processes **B3**, i.e. away from the ventricular zone.
c) While the above cohort of immature neurons climb their way outward to gather underneath the pial surface, a second cohort of immature neurons **C2**, which have recently been born (i.e. stopped dividing), begin to climb in the same direction.
d) When the second cohort of immature neurons reach the layer formed by the first cohort, the newly arrived migrants slide pass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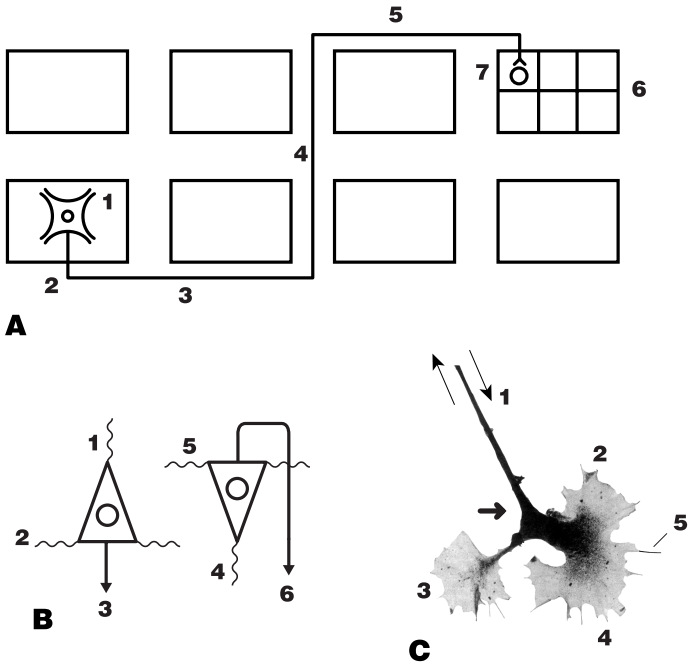
the others and localise themselves underneath the pial surface. By then, a third cohort of immature neurons **C3** have started their migration outward.
e) These subsequent waves of immature neurons **C2-6**, slide along the radial glia and through the layer(s) of cells that preceded them **C10** until the six layers of the future cerebral cortex are formed **C11**. The final result is that the sixth (deepest) layer of the cerebral cortex is formed by the first wave of immature neurons **C1**, while the first (most superficial) layer is formed by the last wave of immature neurons **C6**.
f) The timetable of differentiation of these neurons (i.e. the growth of processes, as discussed later) follow the same pattern (cf. **C7-11**). As a consequence, by the time the first layer of neurons has formed (the last ones to arrive below the pia mater) those in the sixth layer have already started to grow processes.

2.2.9 Differentiation of neurons

Once immature neurons have completed their migration and have reached the embryonic region where they become functional units of the nervous system, differentiation takes place. As anticipated (illustration in the next page), the differentiation of a neuron essentially consists of forming processes: dendrites and axons. The distribution in space of dendrites is typical of each type of neuron and is part of its specific differentiation plan which, in turn, is conditioned by its position in the developing nervous system. The same plan also defines the position in the cell body from where the axon grows out. The complex stereo information needed to guide the growth of the axon into the correct direction resides in the three-dimentional structure of the fetal nervous system.

2.2.10 Axonal guidance

The very circuitry followed by the axon of an adult long-axon (tract) neuron **A** (illustration on the next page) indicates that



during development the growing axon must have made precise choices concerning direction (boxes symbolise different regions of the central nervous system). At the moment of leaving the region of origin, the axon selected the correct direction along the neural axis. On its way it ignored a number of regions, decussated into the contralateral side of the neural axis, eventually entered one particular region and made synaptic contacts with one particular subset of neurons in that region.

The complex cellular interactions needed to guide axons to their correct target neurons require sophisticated molecular mechanisms, otherwise the basic circuitry of the nervous system fails to be established. The structure used by the growing axon **C1** to explore the environment and make directional choices is called *growth cone* **C2-5**, because of its expanded set of membranes in front of its terminal tip. The basic functional characteristics of the growth cone are:

a) an active traffic of anterograde and retrograde axonal transport **C arrows** , in order to carry building blocks for axonal growth and

to carry back to the cell body regulatory molecules picked up in the environment;
b) assemblage of building blocks for growth occurs only at the terminal end of the axon **C arrow head**, in order to respond to directional guidance from the environment;
c) the surface of the membrane expansions of the growth cone, the *lamellipodia* **C2-4** and the *fillopodia* **C5** is very rich in glycoproteins, which mediate selective adhesiveness to the substratum;
d) the fillopodia of the growth cone undergo alternate movements of expansion and retraction, in order to explore the substratum and to establish patterns of differential adhesion which are responsible for changes in direction of growth.

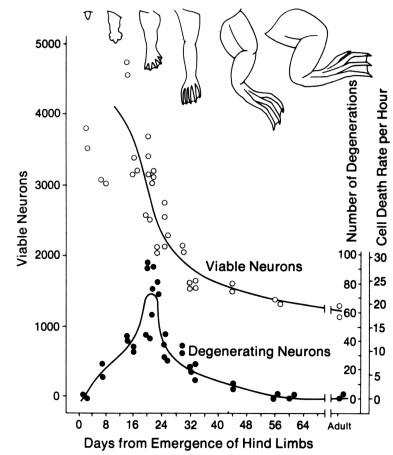
An example of axonal guidance by the embryonic environment is the growth of the axons of pyramidal neurons that end up, by a rare mishap of migration, with an inverted polarity of their cell body **B2** (here the pial surface of the cerebral cortex faces upward). Unlike normal neurons **B1**, inverted pyramidal neurons grow their axon from the correct (but inverted) side of the cell body, i.e. initially toward the pial surface. After a while the growth cone turns 180° and grows correctly towards deeper layers and the white matter. This is the result of its preferred adhesiveness being toward the opposite direction to its initial growth.

2.2.11 Cell death

As mentioned earlier (Section2.2.6), many neurons abort their differentiation and die during development. This physiological process of elimination of differentiating neurons is very important for the correct design of regions and circuitry in the nervous system. Again, development relies on simple spatial (stereo) information for fine tuning the nervous system, instead of complicated genetic instructions. The basic principle of selective cell death is that neurons must establish synaptic contacts with other neurons (or neuromuscular plates with muscles) in order to survive: those immature neurons that do not establish functional connections are eliminated. This mechanism of 'natural selection' within the developing nervous system implies that the initial

production of neurons must exceed the approximate number needed and that an advanced fetal brain has more (immature) neurons than the adult individual.

Much of the evidence concerning physiological cell death has been obtained by studying motor neurons **DE** (below). In the spinal cord of the advanced tadpole, the number of motor neurons in the ventral horn decrease, rather than increase, during the growth of the limbs soon before metamorphosis **D**. Experiments with grafted limb buds led to the conclusion that motor neuron death is due to competition for contact space on muscle fibres. Initially all motor neurons **E1** establish temporary, limited and inappropriate contacts with developing muscle cells **E2**. As muscles grow only some of them **E3** succeed in maintaining their neuromuscular plate with the appropriate muscle fibres **E4**. Those that fail to do so degenerate (dark cell body) and are eliminated by macrophages (Section 2.2.6).



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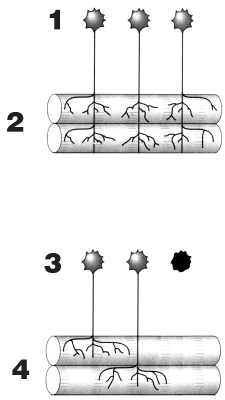


E

2.3 Post-natal development, learning and cultural transfer

2.3.1. Introduction

The principles of developmental neurobiology concerning the fetal and post-natal period are taught to university students of biology and medicine throughout the world. These concepts have been established in the disciplines responsible for critical research on brain and behaviour — neurobiology and ethology — but they remain controversial or ignored in the very disciplines that should apply modern concepts on the origins of human behaviour — anthropology, sociology and political science. Exceptions to this barrier in academic information transfer are concepts of sociobiology, especially hard sociobiology.[1] The success of genetics in biomedical sciences and a general climate that favours biological determinism (Section 5.1.11), have facilitated an inappropriate, in the view of many,[2] assimilation of sound concepts of animal sociobiology into sociology.

2.3.2 Nature/nurture — not a scientific debate

The popular literature refers to the debate about the relative importance of congenital factors and post-natal learning as the nature/nurture debate. Unfortunately this debate has been marred by vague terminology, ill-defined concepts and popular assumptions that are not supported by modern neurobiological research.[3] One hopes that the information provided in this section may clarify a very important aspect of ourselves: what defines the adult structure of the nervous system of a person and, consequently, her/his behaviour.

Three unfortunate trends keep the nature/nurture debate outside the realm of a healthy scientific speculation.

(1) The persistent *dualism of brain and mind*. While rapid advances are being made in the understanding of molecules, cells, functions

and disfunctions in all human organ systems, including the nervous system, the understanding of human behaviour is still hampered by a shroud of mystery, unjustified dualism (Section 2.1.1) and reticence by including behaviour with other biological parameters of *Homo sapiens*. (Sections 3.1.2 & 3.1.3).
(2) The *exaggerated disciplinary fragmentation* of academic research. Speculation on human behaviour is carried out separately by philosophers, literary scholars, physical anthropologists, sociologists and political scientists — all trained in humanities — as well as ethologists, neuroscientists, clinical psychologists, neurologists and psychiatrists — all trained in biomedical sciences (Section 1.3).
(3) The *inappropriate role assigned to genetic information*. Since the 1960s-70s the biomedical world has enthusiastically elevated genes to the role of all-powerful controllers of living beings. This genomania, with its obvious political and commercial support, will be recorded by future science historians alongside of medieval astrology, 18th century vitalism and 19th century phrenology. The belief in uncontrollable forces that determine our destiny — stars, fate, vital spirits, cranial bumps and genes — relieves us from personal and political responsibilities (Giorgi, 1994).

The consequences of exaggerated academic specialisation, disciplinary territoriality and interdisciplinary barriers are particularly evident when post-natal brain development is discussed. Medical textbooks of neuroanatomy allocate very little space to development and do not examine the post-natal period. Medical psychology provides classifications and attempts generalisations about human behaviour, without discussing ontogenesis and causation — what we call 'the origins' (Section 1.1.3). Science-based textbooks of neurobiology cover developmental mechanisms well, but only those concerning fetal life. One exception is Alberts et al. (1994), as discussed below in Section 2.4.8.

For the purpose of the present discussion, the richest sources of information on post-natal development are the texts of human developmental psychology and, interestingly, those of ethology, the science of animal behaviour and, more recently, of human behaviour (Eibl-Eibesfeldt, 1989). Of course, important concepts

generated in these disciplines do not filter through medical psychology and psychiatry, let alone sociology and political science.

2.3.3 Stereo information continues after birth

As discussed in Section 2.2.4, stereo information activate and guide genetic information in development in general, and particularly so for spatio-temporal events occurring during the definition of the nervous system (Section 2.2.5).

Stereo information continues to operate after birth in the nervous system (Changeaux, 1985, pp. 253-304). As during late fetal life, after birth axons grow longer, axon collaterals branch out, new synapses are formed and established ones are strengthened, unsuccessful axon collaterals and weak synapses are eliminated, weakly connected neurons die out, and more glial cells and myelin sheets are added (Section 2.2). Thus the post-natal nervous system does not just increase in size, it still undergoes much structural specification. In fact, the growth and development of an organ does not only entail an increase in size, it also involves substantial aspects of internal design, structural definition and acquisition of new functions. This general strategy is particularly true of the post-natal development of the nervous system.

Thus, for many years after birth, stereo information continues to activate — at the appropriate time and in the appropriate place of the nervous system — the expression of specific genes that in turn synthesise specific structural or enzymatic proteins, the tools necessary for the on-going neuron and glial cell differentiation. This leads to an easily mistaken interpretation of causation: genes allegedly define brain and behaviour. In reality genes are only tools under the guide of stereo information, they do not carry developmental information as such (Sections 2.2.1-2.2.5).

Thus, after birth, the same fetal mechanisms of spatio-temporal information (Section 2.2.5) continue at the cellular and molecular levels of the nervous system, except that now a powerful sensory input is added to the already rich information built into the three-dimentional complexity of the newborn nervous system. Details

of this new source of information will be discussed in Section 2.3.6.

2.3.4 The nervous system does not develop uniformly

As in other mammals, the human nervous system develops in fetal and post-natal life in keeping with a regional timetable of maturation (Section 2.3.7). Generally speaking, the spinal cord and the brain stem (the most caudal regions) differentiate earlier than the cerebrum (Gilles et al., 1983; in Gibson & Petersen, 1991 pp. 29-63 and 181-223). More precisely, functions (circuits and their connections), not regions, mature earlier than others in order to be present at appropriate stages of life. Hence certain functional aspects of smell, sucking, taste, neck movements, hearing and vision are quite mature at birth, in order to interact with the mother. Later in infant life initial functional aspects of limb and trunk motility develop, and a predictable, but individually variable, timetable of events takes place as the child grows.

In humans the developmental timetable is such that the higher integrating region of the brain (the cerebral cortex) defines its functions well after birth, when it is exposed to substantial environmental influences. In particular, the cortical regions in the frontal and temporal lobes concerned with memory, emotions and socialisation (the limbic system) are the last to reach their adult level of differentiation quite late in post-natal development (Gilles et al., 1983; in Gibson & Petersen, 1991 pp. 127-180). Some structures are still differentiating at 20 years of age (Pujol et al., 1993).

Unlike other regions of the cerebrum, the cerebral cortex of the human frontal lobe has an almost fetal structure during the first year of life **(Fig. 1 on p.79)**. The frontal lobe is part of the important circuitry called *limbic system* **(Fig. 2 on p.79)**. These neural pathways **(Fig. 3 on p.80)** mediate functions associated with emotion, memory and socialisation, functions needed for meaningful inter-personal communication (Cummings, 1995). The connectivity of the limbic system becomes gradually more complex probably during the critical period when a child acquires an understanding of the social context and its rules – from within the family to the wider society – , i.e. between ca. 5 and 15 years

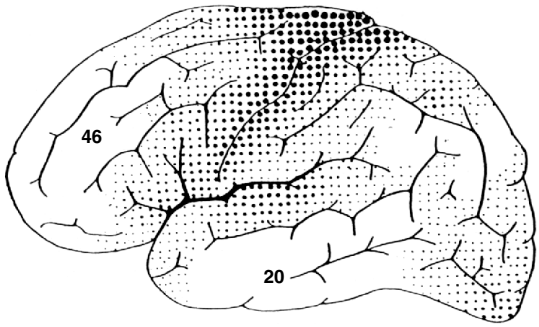


Fig. 1. Lateral view of the cerebral hemisphere of a 19-day-old child showing one example of brain structure not developing uniformly. The size of dots represents the degree of myelin deposition in that region, a general indication of the degree of maturation of neuronal circuits. Note that the very regions involved in limbic functions (cortical areas 46 and 20) are not myelinated at birth. They will complete their maturation later in life when the child is exposed to the post-natal stereo information appropriate to his/her culture. Anterior is on the left. Illustration from Eccles (1991, p. 97).

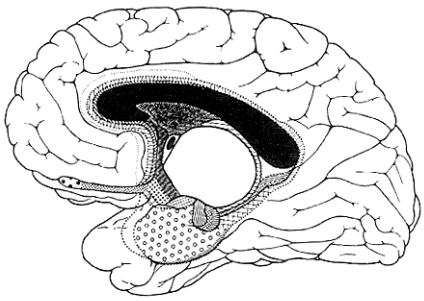


Figure 2. Medial view of the cerebral hemisphere (see Section 2.1.5) outlining some of the structures involved in limbic functions (memory, emotion and socialisation). The large corpus callosum and the small anterior commissure (black) connect the two sides of the cerebrum. Neurons in the olfactory bulb (closed circles) and the hippocampus (open circles) participate in the circuits of the limbic system (cf. below). Anterior is on the left. Illustration from Eccles (1991, p. 97).

according to Piaget's timetable of psychological development (Section 2.3.7).

This belated structural specification of the human brain and the

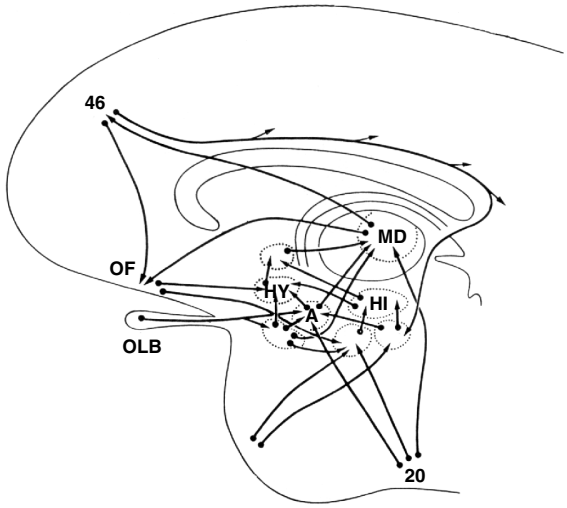


Fig. 3. Medial view of the cerebral hemisphere (cf. Fig. 2) showing a schematic drawing of part of the neural circuits between the cerebral cortex — area 46 in the frontal lobe and area 20 in the temporal lobe — and the hippocampus (HI), amygdala (A), hypothalamus (HY), mediodorsal thalamus (MD), olfactory bulb (OLB), and the orbital surface of the prefrontal cortex (OF). Lesions in these regions affect, in different ways, memory, emotion and socialisation. Amnesia, aggressive behaviour and schizophrenia are among the most debilitating psychiatric conditions. Anterior is on the left. Illustration from Eccles (1991, p. 100).

correlation in time between environmental instructions and formation of the appropriate pathways in the cerebrum is very important. There seems to be no other possible explanation other than a stereo blueprint (Section 2.2.4) for the post-natal specification of brain and behaviour; this may be particularly so in the case of social behaviour and the limbic system. Current investigative methods do not allow a direct observation of the development of specific pathways in the cerebrum, so we must relay on a correlation between general regional features, as in **A**, and the acquisition of higher cognitive functions, appropriate social behaviour in particular. Failure in developing appropriate connections between the frontal lobe and other regions of the limbic system is probably one of the neurological correlates of schizophrenia (Cummings, 1995).

A dramatic empirical evidence that the specific wiring of brain regions mediating social behaviour occurs under specific

instructions (stereo information) from the particular social environment of the adolescent can simply be found in the extreme diversity of human social behaviours in different cultures. Moreover, the social behaviour of children adopted at early age becomes that of the adopted culture; the same phenomenon occurs in the case of the social behaviour of second-generation migrants. This developmental strategy turned out to be much more convenient for species, such as *Homo sapiens*, that have sophisticated social interactions (Section 2.3.12).

2.3.5 Higher brain functions are very plastic

Another important developmental pattern is superimposed onto the general trend of the caudal-rostral timetable of development discussed above. The design and the circuitry of connections in the spinal cord and brain stem is relatively simpler than that of the cerebrum, and its design is more rigidly defined by a congenital stereo blueprint. The cerebrum, on the contrary, is relatively more dependent upon stereo information located outside the body of the baby, i.e. sensory inputs from, and motor interactions with its environment. This developmental property is called *plasticity*.

The developmental plasticity of the brain reaches its maximum expression in the cerebral cortex; its extraordinary dependence upon external stereo information for structural definition represents the true basis of personal uniqueness. Therefore, *the fact that each adult underwent unique post-natal experiences is by far the principal basis for her/his behavioural uniqueness*. This very important aspect is well documented scientifically, as discussed below, and it will be taken up again in the discussion on the origins of violence (Section 3.3.4).

The high level of plasticity of the structure of the cerebral cortex (Kandel, 1999, pp. 1024-1027) is not unique to humans. It only represents the latest — humans are only 50-100,000 years old — expression of a very well established evolutionary strategy initially adopted by early mammals. Phylogenetically recent species invest in some degree of parental care for a smaller

number of offspring (e.g., crocodiles, birds and rodents), rather than abandoning numerous offspring at the mercy of a dangerous environment (as fish and turtles do). Parental care became particularly advantageous to social mammals (e.g. gazelles, wolves, chimpanzees), as the group also provided further protection and, importantly, post-natal stereo information for the appropriate definition of developing brain structures and thus behaviour. These mechanisms of in-group stereo information for brain development and behaviour are collectively referred to as *cultural transfer* (Section 2.3.12).

2.3.6 Post-natal sensory input constitutes information for brain structures

As discussed in Section 2.3.3, the stereo blueprint of development (Section 2.2.4) continues after birth with the additional richness of sensory input.

There is a wealth of information on the effect of environmental deprivation on the development of the nervous system. Research started about forty years ago simply by offering a richer environment to rats in large cages with 'toys', and demonstrating the development of a thicker cerebral cortex (Diamond, 1988) More information was provided by more complex experimentation that proved that sensory input is more than just a generic growth stimulus, but it is necessary to complete the differentiation of neurons and the establishment of important functional connections leading to adult brain and behaviour. A selection of the most striking evidence is listed below.
a) Binocular neurons in the visual cortex of carnivores and primates (species with frontal eyes) differentiate during a precise post-natal critical period (e.g. one week in cats, eight months in babies) only if the two eyes are correctly aligned on the same visual field; there is no congenital information for the development of the important function of binocular vision (Kandel & Jessell, 1999).
b) Species of birds that sing during courtship need post-natal cultural transfer (Section 2.3.12) to acquire the appropriate

behaviour necessary for mating; congenital information only provides a rough and insufficient vocalisation (Cherfas, 1979).
c) Young carnivores need to learn from their mothers the skills necessary to capture prey; congenital information only provides the instinct to chase smaller animals, but not the specific strategies necessary to capture them (Chesler, 1973).
d) Young female monkeys need to see adult females nursing a newborn in order to acquire the specific behaviour necessary for maternal care; there is no congenital information (instinct) for this important reproductive behaviour (Swartz & Rosenblum, 1981).
e) Babies need to be taught how to walk on two legs by encouragement, help and example; bipedal gait is not an instinct in humans (Halliday & Slater, 1983; Gallagher & Ramey, 1987).
f) Babies need the opportunity to use their hands with the encouragement, help and example of adults, before completing the neuromuscular development necessary for opposing thumb and fingers; hand dexterity is not an instinct (*ibidem*).
h) Babies need rich post-natal input in order to develop verbal communication; articulate speech and language are not instincts (*ibidem*).

2.3.7 Time is an important developmental factor before and after birth

As in the case of fetal life, timing is very important for sensory input and development after birth. The main concept here is that of *critical periods* (Section 2.1.9), i.e., periods within which exposure to post-natal stereo information must occur for otherwise it becomes useless.

In the 1950s Jean Piaget defined the main stages of psychological development in humans (Flavel,1966; Maier,1969; Piaget, 1977). During the *sensory-motor phase* (from birth to about 48 months) the infant creates a world entirely linked to his desires for physical satisfaction through egocentric experimentation; the *preconceptual phase* (from about 2 to 4 years of age) is characterised by a continuous investigation of the environment and possibilities of the child's activities within it; during the phase of *intuitive*

thought (about 4-7 years of age) repeated contacts with others reduce egocentricity and increase social participation; during the phase of *concrete operations* (about 7-11 years of age) the child reaches the level of operational thought and can understand activities from different points of view; the phase of *formal operations* (about 11-15 years of age) is characterised by a qualitative understanding of objects and events, a comprehension of metrical activities and a mental operation of symbols. According to Piaget, mature aspects of behaviour originate in infant behaviour and evolve through a subsequent pattern of development. This development proceeds in a unitary direction and in a sequence such that the completion of a phase is the prerequisite for the successful development of the next. Just as in fetal life, the interplay of time and space is critical.

The above information leads to the conclusion that the blueprint for the definition of human behaviour resides in the *three-dimentional complexity of the developing brain itself* (Section 2.2.4 & 2.2.5) and in precisely timed *post-natal sensory inputs*. Both these sources of information are able to activate specific spatio-temporal expression of DNA sequences, which are necessary to define structural and enzymatic proteins. The individual characteristics of these proteins (genetic characteristics) may determine the effectiveness of functions (quantitative differences) but they are not responsible for defining specific behaviour (qualitative differences). This is our central argument to refute the notion of a role of genetic information in specifying human behaviour. According to information theory (Ash, 1990) the DNA code cannot be the blueprint for behaviour, but just a tool used by the stereo blueprint of development (Section 2.2.4) that continues to operate after birth.

2.3.8 Functional potentiality, congenital predisposition and behaviour are different concepts

The conclusion we arrived at in Section 2.3.6 is very important for the purpose of this work. Here we use the example of speech (Jablonski & Aiello, 1998) to clarify terminology and concepts

which have already been defined in Section 1.3.4 and are essential to provide the nature/nurture debate within a scientific basis (Section 2.3.2).

Many species of animals use vocal sounds as important tools of communication. Simple calls (herbivores), a complex repertoire of sounds (carnivores), modulated songs (birds), yet undeciphered pseudo-languages (marine mammals) and human languages represent an increasingly complex continuum of the same strategy. The sophistication of human languages is subserved by congenitally defined structures (laryngeal cartilages and their muscles) and post-natally defined structures (upper and lower motor neurons regulating the function of the vocal cords). We now consider the concept of functional potentiality, congenital predisposition and behaviour in this context of speech.

Speech is a *functional potentiality* of the human species. This function is only a potential because if congenitally defined structures are not combined with appropriate stereo information (hearing adult speaking) at the critical period after birth, the child does not speak. The child may have normal laryngeal cartilages, but she/he does not speak because the auditory system has not conveyed to the cerebral cortex the information necessary to complete the development of cortical language centres (upper motor neurons), and these in turn cannot instruct brain stem centres (lower motor neurons) responsible for innervating laryngeal muscles (nucleus ambiguus). The post-natal stereo information would in fact have provided a child of 1-3 years of age with a language (Baverian, English, Cantonese, Welsh, etc.), the functional potentiality of speech not being sufficient for function.

If a functional potentiality is the characteristic of a species, *congenital predisposition* is characteristic of an individual. To continue the practical example of speech, a child may have a congenital predisposition to high-level articulate speech, if its fetal development has provided it with certain structural features conducive to a better-than-average skill in speech: a favourable shape of the tongue, rich innervation of its muscles, well shaped lips and teeth, richly innervated laryngeal muscles, well shaped laryngeal cartilages, appropriate brain stem and cortical areas well supplied with blood. A congenital predisposition to speech

disfunctions can perhaps be corrected with the early intervention of a speech therapist.

Both functional potentiality and congenital predisposition would result in no practical outcome, i.e. *behaviour*, in the absence of the stereo information (hearing adults speak) necessary to complete the development of speech. In this case the practical behavioural outcome is the language acquired by the child, first in its elementary components, then its increasingly more sophisticated lexical and grammatical expressions. During the acquisition of a language (from the age of two to twenty years) the developing brain undergoes structural changes in neuronal processes, connections and associated glial cells (Sections 2.2.5). The dendrites of neurons in area 22 of the cerebral cortex (Wernicke area) become longer, ramify and receive many synapses from the axonal terminals of neurons in sensory areas (hearing and vision). Their axons grow branches and establish connections with several other associational areas and with the speech motor area 44 (Broca) of the cerebral cortex. The structure of the whole brain (brain stem included) becomes radically changed during those 2-3 critical years of initial language acquisition.

The process described above entails a certain growth in size, i.e. more neuronal processes, glial cells and myelin, not more neurons (2.2.11). It is indeed the creative completion of a potential design, and the blueprint of this restructuring of the brain is in stereo information: adults speaking to, or in the presence of a child and in the context of the pre-existing three-dimentional complexity of the child brain. If a child is not exposed to the rich sensory input of adults speaking to each other and to her/him, the nervous connections described above do not form, i.e. the design of brain structures cannot benefit from the stereo blueprint that was assumed by a relatively recent evolutionary process (about one million years ago).

Linguists know that there are large differences between *language acquisition* by a child, and *learning a language* as an adult. From the neurobiological point of view, the difference is that a child is acquiring a language (or more than one) at a critical time when its brain is developing the brain neurons and laryngeal muscles responsible for speech, while the adult learner must add an

additional set of semantics and grammatical detail after the critical period of language acquisition, and onto a brain which has lost its infant plasticity. One could therefore suggest that a child does not *learn* a language, that it *develops* it, just as a child does not learn to walk, but it develops neuronal connections and muscle functions necessary for bipedal gait (Section 2.3.6).

The practical example of developing speech and language in infancy outlines very well the idea that the stereo blueprint of development (Section 2.2.4) operates after birth with the same mechanisms of fetal life. In particular the concept of spatial (stereo) information applies to all cases of post-natal specification of the brain and behaviour. For example, primary sensory neurons involved in hearing receive a type of information that is structured in time and space, as the adult speech guiding the development of speech functions of the baby have spatio-temporal characteristics: pitch, harmonics, sequences of sounds, perhaps even grammatical features, are transduced into specific neuronal parameters that reproduce topologically the outer world of the spoken language. This stero information activates and guides the genetic information necessary to construct a more complex brain that becomes able to speak, just as the stereo information inside the embryo operated to activate and guide the production of new proteins for pre-natal development. Genetic information contributes as a subordinate component of the stereo blueprint of behaviour. A possible genetic lesion (mutation) would of course disturb language acquisition or even prevent it, but not because the genes in questions carry *descriptive instructions*, as their contribution resides in the middle of the chain of causes and effects leading to behaviour (see Section 2.2.4).

2.3.9 Adult humans have no instincts

As the term *instinct* is one of the most misused words in popular parlance, it may be useful to review its meaning in scientific terms.

Renaissance philosophers contrasted instinctive behaviour to volition and thoughts. Charles Darwin viewed instincts as inherited complex reflexes which were subject to natural selection.

Sigmund Freud identified instincts with irrational forces in man's nature. Konrad Lorenz associated instincts with fixed-action patterns which were characteristic of species, hence congenitally defined.

As discussed earlier, in animals culture is transferred faithfully from generation to generation and represents a characteristic of the species, without being defined by genes. Following changes in the environment, cultural transfer may change through adult learning and Lamarckian evolution, i.e. through cultural inheritance of learned characters (Section 2.4.5). Hence the statements of Freud, Darwin and Lorenz are too vague to be accepted as such. They may apply to earlier forms of animals or to basic physiological functions in humans, but certainly not to human social behaviour.

Ethologists correctly define instincts as a part of congenital behaviour, i.e. one that is displayed after birth in the absence of cultural transfer (Kupferman, 1999). Results from human ethology and comparative cultural anthropology indicate that humans have a very limited set of instincts.

A baby is born with a set of congenital behaviours necessary to establish a special bond with its mother, locate her breast and recognise her voice and face. The mother, on the contrary, learns maternal care by cultural transfer (Section 2.3.6). No other congenital behaviour is known in humans concerning personal and social interactions, a very critical point for the study of the origins of violence.

Another aspect of congenitally defined behaviour is *reflexes*. Humans have very few reflexes: the pupilary reflex, the knee tendon reflex, the plantar reflex, the auditory startling reflex and all propioceptive (autonomic skeletal muscle regulation) and visceral functions (autonomic visceral muscle regulation). These behaviours play a trivial role in personal and social behaviour.

2.3.10 I can't help it

Despite the evidence presented in Section 2.3.9, the existence of instinctive behaviour in humans is common folk belief. Statements such as "I did it instinctively", "I was born that way",

"That's me, I can't help it", etc. are not just colloquial expressions. If asked to expand on that note, a candid belief in instincts often surfaces. This belief in instincts has its basis in widespread ignorance about cultural transfer in babies and children and about non-verbal cultural transfer at all ages (Hinde, 1974; Wieman & Harrison, 1983). This is probably the major source of confusion in the nature/nurture debate concerning human social behaviour.

The basic misunderstanding springs from the difference between the popular meaning of 'behaving instinctively' — doing something without a strong cognitive input because of familiarity with the situation — and the scientific meaning of 'instinct' — a behavioural trait defined by congenital information. Many behavioural traits and attitudes acquired early in life by imitation and without explicit verbal instruction (Wiemann & Harrison,1983; Barnett, 1988 p. 251-253) are retrieved subconsciously, hence the conviction that they are congenital or 'instinctive'. The memory of events and situations lived in infancy (up to 5-6 years of age) is lost by the time adulthood is reached, and so is the consciousness of how information was acquired.

2.3.11 The forbidden experiment

Zoologists and ethologists prove that a given behaviour of a species is an instinct, by raising newborn animals in isolation and showing that the normal behaviour is displayed despite the absence of cultural transfer.

Ethical principles forbid carrying out such an experiment with newborn babies, but we have accurate reports of a few cases of children who lived in severe isolation or in the total absence of human contact. The 'wild child of Aveyron' (late 18th century France) was very well documented by Itard, the founder of speech therapy (Lane, 1979). A substantial amount of information about Kaspar Hauser (early 19th century Germany) was also collected (Candland, 1993, 38-53). In all these cases the poor or even zero input from other humans caused severe disability of the cognitive and sensory motor functions of these children. They were not cases of congenitally disabled babies, because of their ability to

recover part of their normal human functions when exposed to remedial treatment. The amount of recovery was inversely proportional to the length of isolation experienced.

But the most dramatic case of wild children was the well documented findings of two girls who lived in a wolf's den until the age of about 5 and 7 (Maclean, 1977 pp. 70, 79, 83; Candland, 1993, 53-68). Amala and Kamala walked on all fours, howled instead of speaking and ate food on the ground without using their hands. One of them, who was subsequently looked after by a Church minister, learned to walk, dress herself and use her hands, but she never learned to speak.

The question raised by these cases concerns the sources of information necessary for human behaviour. Without post-natal cultural transfer we cannot even demonstrate the very behavioural characteristics that make us human: speech, bipedal gait and hand dexterity. If there is so little congenital information for these basic characteristics, scepticism is justified about the substantial congenital information claimed for intelligence (Plomin, 1990), violent behaviour (Harth, 1991) and even political attitudes (Martin et al., 1986).

2.3.12 Cultural transfer is more adaptive than congenital behaviour

Cultural transfer is a general concept referring to a post-natal mechanism that defines brain structures, hence behaviour, as discussed above. Language acquisition and the examples (b) to (g) offered in Section 2.3.6 are all cases of cultural transfer. As indicated in Section 2.3.5, primates and humans are part of the adaptive strategy of having few offspring and providing them with a great deal of parental care. One important aspect of parental care is cultural transfer, i.e., providing the developing brain of the offspring with a stereo information (Section 2.2.4) appropriate to the environment of the species. Cultural transfer occurs, to a limited extent, even in earlier vertebrates,[4] such as rodents, and reaches its maximum expression in later mammals such as carnivores and primates, especially apes and humans

(Martin & Pear, 1992).

Hunting is a good example to explain the advantage of post-natal definition of brain structures, thus behaviour, as opposed to the congenital definition (instinctive). Different populations of cheetahs may live in regions with different types of game, generally smaller herbivores. If the whole set of behaviours necessary to capture a given species of gazelle was defined congenitally (by the pre-natal stereo blueprint of development of the cheetah), it would have not been adaptive. If a population was forced to move to a different region, the special strategies to capture one type of game would have not been suitable to capture a different type of game, and no alternative solution would have been at hand. On the contrary, hunting carnivores have only the rather simple instinct (congenitally defined behaviour) of chasing a moving smaller animal; for the rest they imitate what their mother does when she hunts. This cultural transfer of hunting skills from mother to offspring is very effective and always appropriate to the local environment. Rapid changes of environment would involve adult learning — with some degree of failure and natural selection — followed by appropriate cultural transfer by successful reproducing adults (or mothers, in this case).

In the case of humans, cultural transfer occurs through verbal instruction and non-verbal example of parents, extended family, peer groups, formal education, popular entertainment and the media. Particularly during the important period of socialisation (5-15 years of age), a great deal of conscious verbal and subconscious non-verbal information contributes to the definition of brain structures (neuronal processes, connections and associated glial cells) in the cerebral cortex and especially in the limbic system (Section 2.3.4).[5]

When some mammals began to evolve sophisticated social interactions, it became more effective (thus adaptive) for the young to learn the appropriate social behaviour by observing adults, rather than continuously updating the congenital information of the species (by instinct), hence the biocultural evolution of a more complex limbic system (Section 2.4.7).

The evolutionary strategy of defining the brain by post-natal

cultural transfer required no additional genetic information (beyond an increase in general learning potentiality) and was more advantageous to animal species that adapted to the changing environment by enhancing social complexity and behavioural flexibility. The opposite strategy for survival was adopted by social insects (e.g. ants and bees) which evolved complex social interactions built in their genes (Section 2.4.3). As humans are not insects, their genes play no role at all in defining specific behaviour (Section 5.1.7).

NOTES

[1] Wilson (1975, 1978) and Trivers (1985).

[2] Gould (1978), Kitcher (1985), Melotti (1990), Ruse (1985), and Van der Dennen & Falger (1990)

[3] Interestingly, the poor and misleading information provided to the public about the nature/nurture debate has a parallel with the poor information provided on nutrition. Medical authorities issue regular but weak statements about good nutrition, but these are largely overridden by expensive, pervasive advertising by commercial outlets which convince the public to do the contrary,

[4] The adjectives *earlier* and *later* are preferred here to *lower* and *higher* traditionally used to refer to vertebrate species that appeared earlier or later in evolution. The traditional terminology implies qualitative ranking, an inappropriate concept in modern evolutionary biology. With the exception of parasitic forms, all species which appeared later in evolution are only more complex, not superior to those which appeared earlier but were equally successful in surviving natural selection (Giorgi, 1989).

[5] The *limbic system* (Eccles, 1991; Barr & Kiernan, 1997) is intimately connected with the frontal lobe and both are of central importance in cultural transfer (Halliday & Slater, 1983 pp. 82-113) and thus for socialisation (p. 57).

2.4 Biological, biocultural and cultural evolution

2.4.1 Introduction

Having discussed the development of brain and behaviour (Section 2.3), in this section we will discuss relevant aspects of the evolution of human behaviour by adopting the modern approach of considering evolution and development as one integrated process (Edelman, 1988).

Human evolution cannot be directly investigated in the field or in the laboratory as it took place during the last 200,000 million years or so; fetal and post-natal development can also not be checked experimentally in humans due to obvious ethical limitations. Therefore the principles of extrapolation and of corroborative evidence from different sources apply, as in the case of the general theory of evolution (Futuyama, 1986).

2.4.2 Human beings did not evolve from monkeys

The erroneous folk interpretation of evolution that humans evolved from monkeys is normally corrected by stating that both hominids and anthropomorphic primates evolved from a common ancestry about 50 million BP. For our purpose, a more appropriate statement would be that a number of forms of humans (*Homo sapiens*) probably evolved from one or more forms of *Homo erectus* about 100-200,000 BP.

The essence of the question pertains to what we mean by the term *human beings*. Some popular accounts of human evolution use the term 'we' even to refer to *Homo abilis* and *H. erectus*, forms of hominids that were by no means human beings. In this work, humans refer to modern forms of *Homo sapiens* that first appeared in East Africa, Middle East and the Mediterranean coasts around 100,000 BP (Section 1.1.2 & 3.1.2). The term 'we' can also be incorrectly used when one refers only to historical time, or even to one's own culture.

The mechanism of speciation is far from being elucidated even

for contemporary species (Turner & Paterson, 1991); the pattern of speciation of extinct taxa is far more difficult to unravel. Briefly, *Homo sapiens* evolved out of a group of 'species' (*H. antecessor*, *H. heidelbergensis*, *H. neanderthalensis*) which had a wide distribution in Africa, Asia and Europe around 500,000 BP (Tattersall, 1997). The exodus from Africa occurred in parallel with considerable anatomical diversification. But, since about 30,000 BP *Homo sapiens* remained the only hominid species on earth. A number of hypotheses are still under consideration for the disappearance of other 'species' of *Homo*, including cultural transfer of behavioural novelty, mating and aggression. Later movements of the ice cap may have led to geographical and cultural adaptations

Three skulls of *Homo* (from left): *Homo erectus* (Beijing Man) used fire about 1 million years ago. *Homo neanderthalensis* (Neanderthal Man) used to bury the dead about 100,000 years ago. *Homo sapiens*, contemporary Man, uses violins and computers, but also deadly weapons against fellow human beings.

2.4.3. Human beings are not insects

In the context of the evolution of brain and behaviour it is useful to compare the evolutionary strategies of humans to those of insects, or rather invertebrates, and fish to mammals. The former have adopted the reproductive strategy of numerous offspring, while the latter produce less offspring but nurture them. Carnivores and primates also benefit from extensive cultural transfer (Section 2.3.12). Importantly, genetic mutations related to

specific behaviour have been found in invertebrates, but not in vertebrates or mammals (Halliday & Slater, 1983; Kupferman, 1999).

The identification of behavioural mutants in insects (which have only a few thousand neurons) and in nematodes, one species of which have just 302 neurons, is very significant (Herman, 1993). This implies that these species have adapted to a specific environment by defining congenitally simple and stereotype behaviours. Insects are capable of limited post-natal learning, but they are basically born with a specific behaviour appropriate to the environment that selected them in the first place. Should this environment suddenly change, the insect population living there would probably disappear. Slow environmental changes would be accompanied by a gradual natural selection in the population by favouring the minority of mutants that have behaviours more appropriate to the new environment.

The one-to-one relationship between a gene and a behaviour in insects should be interpreted in the causal framework discussed in Section 2.2; structures of the nervous system and behaviour are defined by the stereo blueprint of development typical of that species, with genetic information playing an important but subordinate role. The easy creation of behavioural mutants in insects, and invertebrates in general, indicates that they use genetic information as an adaptive strategy.

Equally significant is the absence of behavioural mutants even in mice, let alone primates and humans. Mice too have simple and stereotyped behaviours, although somewhat more complex than insects, and are combined with a higher level of learning capacity.

In light of the above, one can safely suggest that the evolutionary strategy of primates in general, and humans in particular, has clearly been that of adapting to a changing environment by post-natal learning, not by modifying congenitally defined behaviours.

As discussed in Section 2.3 , it is widely accepted that specific traits of the social behaviour of primates are not defined congenitally (Halliday & Slater, 1983; Rose at al., 1985; Gould, 1987b pp. 107-123; Barnett, 1988; Eccles, 1991) and certainly not genetically (Sections 2.2 & 2.3.9).

2.4.4. Humans do not retain old brain regions

One of the arguments used by the proponents of a pessimistic view of human nature — human beings are congenitally violent — is that they retain brain structures (and instincts) inherited from a violent past. Such regions would be the limbic lobe and the olfactory cortex. Such a belief implies two misconceptions that would fail any student of functional neuroanatomy: different functions would be related to different regions; the brain would be stratified, with phylogenetically new regions side by side with old regions. In reality functions are related to circuits and sets of pathways, not regions (Section 1.1.2). Moreover, even if some regions of the human brain can be recognised as structurally homologous to regions similarly placed in the rat or cat brains, their functional significance is unique to humans as they are connected in totally different ways.

The evidence for this is simple: human behaviour (the functional result of brain structure) is totally different to that of a cat. For example, the nucleus ambiguus is located in the human brain stem in both the human and cat brain. The brain stem is far from being a phylogenetically recent region: it represents a major proportion of the brain of sharks, for example. But in humans its neurons are connected with language centres in the cerebral cortex that are not present in cats, and innervate laryngeal muscles that do not exist in cats. Just because humans have a nucleus ambiguus, does not mean they should meow like cats. On the same note, just because humans have an amygdaloid nucleus (Section 2.3.4) and a neural pathway for aggression (Aggleton, 1993), in the same region as lions do, does not mean they should jump on a gazelle when hungry.

The brain circuitry specifically involved in memory, emotion and socialisation — the limbic system connected with the prefrontal cortex — is not an ancient relic or evidence of our reptilian evolutionary past, as suggested in some popular literature (e.g. Sagan, 1977 pp. 149-151), but the product of a very recent adaptation for sophisticated social interactions (Eccles, 1991; in Gibson & Peterson, 1991 pp. 107-124; Barr & Kiernan, 1997). This aspect is relevant to the biocultural evolution of human

aggressiveness and cooperation (Section 2.4.4).

It is true that evolution makes use of the same organs or brain regions or molecules to serve completely different functions. Nature recycles molecules, embryonic primordia, sets of neurons, and uses them for different purposes at different stages of evolution. This does not mean that the old functions are potentially retained in the new adaptive solution: they are simply lost by substitution. The modern interpretation of the nervous system is based on connectivity, not regional localisation of functions, as one thought only fifty years ago. If some regions homologous to the human limbic system mediate aggressive behaviour in other animals, that does not mean they should have the same connections and thus mediate the same type of behaviour in humans.

The stratified ideas of the human brain, with fish and reptile layers coexisting below a human cerebral cortex, which allegedly keeps a check on irrational animal instincts, has been well popularised and easily associated with the pessimistic view of human nature (Section 1.2). It is much more likely that our limbic system has undergone a unique biocultural evolution in conjunction with the social organisation of hunter-gather humans (Section 3.2.1), which has little to share with fish, reptiles and even chimpanzees and early *Homo* species.

2.4.5 Cultural evolution is Lamarckian evolution

Textbooks of anthropology and history attempt to determine periods and places where 'civilisation' started. These places coincide with the local adoption of agricultural practices 5-10,000 BP (Section 4.2). These textbooks also point out that the beginning of ancient civilisations coincided with a sudden quickening of changes in human affairs. The previous world of hunter-gatherers lasted for about 90,000 years and saw limited changes, mainly related to slow population movement and adaptation to local climatic conditions.

Food surplus in agricultural settlements allowed some persons to apply themselves to manufacturing, invention, art and bartering

(Section 4.3). Trade between settlements caused the spread of cultural novelties. Human life style, ideas and behaviours began changing very quickly. Anthropologists called this phenomenon cultural or social evolution, because it involved only behaviour and not physical characteristics of humans.

The mechanism of *cultural evolution* is very different to that of biological evolution (Section 2.4.6). It does not depend upon slow changes in congenital characteristics of the body; it does not rely on random genetic mutations or slow modifications of the stereo blueprint of development (Section 2.2.4) of the fetus. It is based on adult post-natal learning and cultural transfer to the next generation; thus substantial changes may take as brief a time as one generation. The strong influence of modern mass media on youths can change a nation's old traditions in even less than a generation.

Only a few anthropologists have recognised cultural evolution as a Lamarckian type of transformation. Well before Charles Darwin, the French naturalist Jean Baptiste de Lamarck followed contemporary ideas on the transformism of species, and proposed that species were not fixed and that the very 'need' for a new organ was causing a modification of the body — the popular example being a giraffe growing a longer neck because it needs to reach leaves on higher branches. Lamarck proposed that new characters acquired by adults could be inherited by the offspring. About fifty years later, the inheritance of acquired characters was accepted by Darwin in order to adapt his hypothesis on natural selection to contemporary ideas on the age of the earth. A few years later August Weismann corrected this misconception by stating that bodily changes do not modify germ cells (sperms and eggs), therefore acquired characters cannot be inherited by the offspring.

This barrier between germ cells and somatic cells prolong considerably the time necessary for transformations to occur during microevolutionary processes. Small changes in body characteristics of a species my take thousands of years before producing a different race by natural selection, or tens of thousands of years before leading to a new species. Of course, the artificial selection practiced by farmers on domesticated animals

produces new races much quicker.

Not long ago, Niles Eldredge and Steve Gould (Gould & Eldredge, 1993) proposed that evolution occasionally undertakes quick steps of transformation in concomitance with sudden radical changes in the environment (*punctuated equilibrium*). The actual mechanisms underlying this phenomenon are still the topic of debate (Eldredge, 1995). One way to speed up evolutionary changes is cultural evolution, but this can only occur in animals with a sufficiently sophisticated brain such as mammals.

As a matter of fact, cultural evolution corresponds to a true inheritance of acquired characters; if the story of the giraffe's neck does not make good biology any more, cultural transfer is a Lamarckian concept in agreement with modern biology. When adults learn new tricks that improve their chances of survival and reproduction in a given fitness landscape, their brains change and they can transmit this acquired characteristic to their offspring through cultural transfer. If this cultural inheritance becomes transmitted faithfully from one generation to the next, the new behaviours become part of the characteristics of that population (Hinde, 1974). Their germ cells do not change, only a few neuronal connections change, as part of the post-natal stereo information of brain development (Sections 2.3.8 to 2.3.12). It is Lamarckian evolution at his best.

The power and speed of cultural evolution is evident in the rate at which cultural innovation occurred throughout history. If human social behaviour had even a limited congenital component, this feast of cultural diversity would not have occurred.

2.4.6 Biological evolution and cultural evolution present confusing analogies.

The transmission of behavioural traits from one generation to the next through cultural transfer (Section 2.3.12) is so effective and conservative (in a stable environment) as to be easily confused with the inheritance of congenital behaviour. Several analogies existing between the mechanisms of biological and cultural evolution make the confusion even more likely.

Examples of analogies are as follows (for biological terminology cf. Futuyma, 1986):
- New trends and ideas are analogous to genetic mutations; intellectual debates, political campaigns and religious proselytism are analogous to natural selection.
- Indoctrination and persuasive advertising are analogous to artificial selection.
- Media control is analogous to isolation.
- Cross-cultural exchange is analogous to gene flow.
- Multiculturalism is analogous to hybridisation.
- New religious revelations are analogous to punctuated equilibria.
- Assimilated migrants are analogous to adaptive radiation.
- Fads are analogous to genetic drift.
- Nationalistic movements are analogous to speciation.
- Conservatism is analogous to stabilising selection.

However, the major difference between biological and cultural evolution is that the inheritance of acquired characters occurs only in cultural evolution (Section 2.4.5), which explains the exceptional swiftness of this process as compared to biological evolution.
This rather simple matter of evolutionary biology is probably the major source of confusion in the nature/nurture debate concerning human social behaviour. In fact, the analogies between biological and cultural evolution encourage erroneous biological deterministic interpretation. The elimination of this confusion would be very simple, even in the context of the high school curriculum.

2.4.7 Social species are the result of biocultural evolution

Although certain general principles of social behaviour may apply to all social species, from ants to humans, it does not mean that the origins of their brain and behaviour are even similar. Charles Darwin's intellectual children, Konrad Lorenz and Edmond Wilson (Section 1.2.3), would like us to believe that the human social behaviour has the same origins as that of Lorenz's ducks and of Wilson's ants. In reality, humans are not ants, nor ducks,

nor chimpanzees for that matter. There is, however, a general concept that applies to all social mammals: their social behaviour was shaped by a process of biocultural evolution (Lopreato, 1984), not simply by biological evolution.

Biocultural evolution is a term not often used by evolutionary biologists or anthropologists, who prefer the term cultural or social evolution. Although the prefix 'bio' may be interpreted by some in terms of biological determinism, it is a worthwhile risk, as we can clarify differences between three different types of evolutionary processes: classical neodarwinistic biological evolution (Futuyama, 1986), pure cultural evolution (Section 2.4.5) and biocultural evolution. This distinction is very important for the discussion on the origins of violence (Section 4.3.7)

The concept of biocultural evolution refers to a *parallel modification* of congenital brain characteristics and cultural traits which are appropriate to these congenital predispositions. The two processes of evolutionary changes — pre-natal developmental programs and their post-natal completion by cultural transfer — occur in parallel and influence each other in both directions. The concept of biocultural evolution is best explained by examples. One, concerning hunting cheetahs, was discussed in Section 2.3.12. The evolution of speech in humans is another good example (Leakey, 1981, pp. 127-141; Leakey & Lewin, 1992, pp. 239-251; Jablonski & Aiello, 1998), as changes in the anatomy and neurology of speech occurred side by side with cultural transfer of language and advantages in improved communication. Another useful example relates to environmental changes and herbivores. If a new predator moves into a region with herbivores, they must undergo biocultural changes in order to survive; neuronal connections dealing with attention, fear and vision must modify side by side with cultural transfer relating to guardians at the periphery of the herd, recognition of predators, and alarm signals.

The key concepts of biocultural evolution are the following:

- changes in congenital predisposition result in advantages for certain individuals with respect to a new behaviour that is being transferred culturally in that population;
- cultural transfer of the new behaviour is very important for survival and becomes the driving force of positive selection for

further congenital changes which are appropriate for the new behaviour;
- the new behaviour becomes better specified and consolidated by increasing levels of predisposition to it;
- the whole process is slow because biological changes, the limiting factor, are much slower than cultural changes.

An important aspect of biocultural evolution concerns the limitation in cultural changes imposed by congenital predisposition, i.e., neurological imperatives (Section 3.1.3 & 3.2.5). They set a limit to potentially fast and diverse cultural modifications (Section 2.4.5). Beyond those limits the mismatch between nature and nurture may become non-adaptive. In natural conditions the inappropriate cultural transfer would be negatively selected; this is not true in the artificial selection of domesticated animals, as in the case of stress and diseases caused by crowding in industrial breeding of chicken, a disturbing analogy of the 'discontent of civilisation' suggested by Freud and discussed in Section 5.2.3.

2.4.8 Social behaviour is not defined by congenital factors

In summary, the evolution of behaviour in social mammals occurred through substantial changes in congenital neurological predisposition fine tuned by cultural transfer (Halliday and Slater, 1983; Lopreato, 1984; Eccles, 1991). As social complexity increased, behavioural flexibility became an important strategy for survival, and congenital behaviour (instinct) consequently decreased in importance. In carnivores and primates the cultural definition of social behaviour is so important that experimental rearing in an inappropriate social context prevents the appearance of basic patterns of behavioural characteristics of the species (Candland, 1993).

A simple, terse statement about the alleged genetic basis of behaviour can be found in a modern textbook of cell biology: "Clearly, no behaviour is inherited. What is inherited is DNA" (Alberts et al., 1994, p. 985).

Evidence from neuroscience and evolutionary biology presented here suggests that social behaviour of adult humans may depend very little, if at all, on congenital information. If that was not the case, one would not have such a diversity of social behaviours in past and present human cultures.

2.4.9 Humans cannot be congenitally violent

In light of the evidence from developmental neurobiology and evolutionary biology, one finds it very difficult to imagine that a very sophisticated aspect of our social behaviour such as violence could be congenital or instinctive.

The biological arguments discussed in this section (Part 2) add to the anthropological arguments presented in Part 3, as both arrive at the same conclusion (i.e., we are not naturally violent) from two different perspectives. In theoretical biology a hypothesis becomes strengthened by evidence drawn from different fields of speculation but lead to the same conclusion (Popper, 1959).

When appealing to biological determinism, proponents of a pessimistic view of human nature may in fact have aggressiveness in mind, rather than violence, because of semantic confusion (Sections 1.1. & 2.5.2). Even so, anthropological research does not support the idea that humans would have a particularly high level of aggressiveness (Section 3.3) Moreover, aggressiveness is not behaviour (Section 2.5.10) and cultural information is needed to translate it into specific aggressive behaviour (aggression). It now becomes clear how important is to adopt a precise terminology when discussing the origins of human behaviour and violence.

2.5 Aggression, aggressiveness and violence

2.5.1 Introduction

In the last two decades both supporters of congenital determinism and cultural determinism in the so-called nature/nurture debate have acknowledged the existence of both sources of information for human behaviour. While extreme positions are being abandoned, one still differs with regards to the relative weight allocated to each source. As a matter of fact, the difference between congenital factors and post-natal factors may well be *qualitative*, not quantitative, as discussed below.

When discussing the origins of human behaviour, the specific case of aggressive behaviour and cooperative behaviour is appropriate in the light of the aim of this work. In Section 2.3.8 we discussed the difference between *functional potentiality*, *predisposition* and *behaviour*. These general concepts can now be applied to the specific case of aggressive behaviour.

2.5.2 The current discussion on violence is a semantic jungle

Academics often criticise the popular press for misleading information, selective quotations and sensationalism. But when they themselves engage in science popularisation the same problems seem to exist. The topic of violence is probably the one most affected by this problem, with that of race and ethnicity running a close second.

In this context one should be reminded of the distinction between *basic concepts* and *complex concepts* (Section 1.1) Any discipline or field of speculation needs clear basic concepts for its theoretical foundation. Consensus on the terminology of basic concepts is necessary, to ensure that possible disagreements on complex concepts are not simply due to semantics.

Unfortunately the terms aggression, aggressiveness and violence seem to be used interchangeably even in the academic

literature. The existence of synonyms would be a problem in itself, if they carry different meanings for different authors and their use affects communication.

Aggression, aggressiveness and violence are different concepts; by using them as vague and confusing synonyms, the discussion on the origins of violence would lose in effectiveness. Below aggression and aggressiveness are discussed as basic concepts, while violence is proposed as a complex concept.

2.5.3 Aggression is behaviour

An act of aggression is a case of aggressive behaviour. It is not a concept, or a thought, or a tendency; it is behaviour, as defined in Section 1.1. More precisely, behaviour is an action carried out by muscle contraction, which in turn is caused by the activity of lower motor neurons, which are regulated by an extraordinary network of sensory-motor integration, cognitive functions and descending motor control pathways (upper motor neurons).

Thus, aggression is a behaviour carried out to compete against, physically or psychologically damage, or physically eliminate other living beings. The aim of aggression can be *competition for resources* or *nutrition* or *defence*.

Behaviour is the functional outcome of the nervous system and the most important characteristic of a person, far more important than other aspects that are of concern to us: body shape, face structure, colour and texture of the hair, skin and eye colour. Individual behaviour is the most important aspect of social animals and humans. When a similar behaviour is carried out by a considerable number of individuals of the same population, one talks about collective behaviour. On collective human behaviour depends the well-being and future of a nation. For example, the fact that an increasing number of school children in the USA are using fire arms to kill other children, is probably the most significant behavioural trait of that country, a major warning for things yet to come.

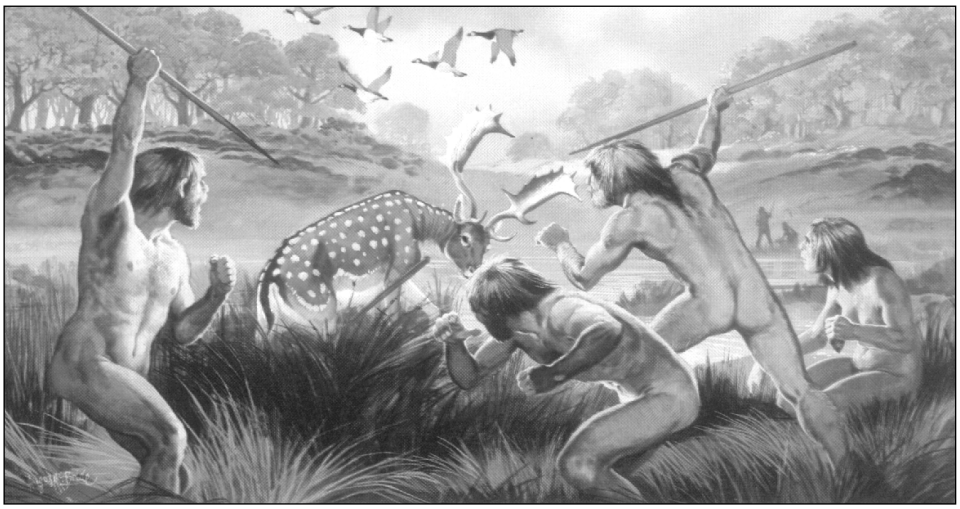
When a person decides to adopt aggressive behaviour, from several options, a number of factors can be taken into

consideration in trying to understand the *origins* (Section 1.1) of that behaviour. Aggressiveness and violence are among those factors, and they are not equivalent to aggression.

2.5.4 The origins of aggression differ in different species

As indicated above, the aims of aggression can be competition for resources or nutrition or defence. Let us consider these cases separately by comparing animals with humans.

A large male bearded dragon chases a smaller one out of its own established territory, to have more opportunities for mating with local females (*competitive aggression*): this behaviour is very stereotypic, defined by congenital factors (instinct) and enhanced by seasonal hormone levels. Two male deer butt and lock their antlers to demonstrate to the female which one is fitter for reproduction: the aim of reproductive competition is the same as that of the dragon, but the strategy is different; in the case of the deer a general instinctive behaviour may need to be completed by post-natal learning and training in the form of imitation of adults while playing juvenile games. An extreme case of post-natal learning in competitive aggression is the game of arm wrestling performed by two sailors in a caffé of Marseille, right on the table in front of the bar maid whom both like. For humans, mating



behaviour is only a functional potentiality, which needs a considerable amount of post-natal cultural transfer to reach its appropriate adult definition. Of course, hormones regulate the level of behavioural performance, but they do not *define* it (Section 5.1.6), and genes do not either.

A green lizard squats behind a stone, then jumps on a butterfly, seizes it with the mouth and swallows it (*nutritional aggression*): this behaviour is very stereotypic, defined by congenital factors (instinctive) and enhanced by visceral stimulation of hunger. A lioness chases a gazelle, wounds it, kills it and sits down to eat it: the aim is the same as that of the lizard, but the strategy is different, and that specific behaviour needs a good degree of post-natal learning and training in the form of imitation of adults (Section 2.3.12). An extreme case of post-natal learning in nutritional aggression is that of a Kalahari Bushman stalking a giraffe together with four hunting mates, then shooting a poison arrow at it, following it for a day, sitting next to the dying animal to explain why they are going to kill it, and sharing the meat with others according to precise cultural rules. For humans, hunting behaviour is only a functional potentiality, which needs a considerable amount of post-natal information (cultural transfer) to reach its appropriate adult definition. Of course, males have congenital characteristics that make them better hunters of large game than women; hormones regulate the level of behavioural performance, but they do not *define* it, and genes do not either (Sections 2.3.8 to 2.3.12).

When threatened by a dingo, a frilled lizard displays its neck membrane and hisses, in order to discourage a possible attack (*defensive aggression*): this behaviour is stereotypic, defined by congenital factors (instinctive) and initiated by fear of a potential predator. If a cheetah approaches a young zebra which is trotting along the edge of its herd, a few adults gather around the predator, turn their back and aim strong kicks at it, in order to discourage a possible attack: the aim is the same as the lizard's, but the strategy is different; the behaviour needs a certain degree of post-natal learning for predator recognition and cultural transfer for group behaviour. An extreme case of post-natal learning for defensive aggression is a person attending a martial arts course for

protection against possible street violence. For humans, defensive behaviour is only a functional potentiality, which needs a considerable amount of post-natal information under the form of cultural transfer (Section 2.3.12) to reach its appropriate adult definition. Of course, males have congenital characteristics that make them better fighters than women and hormones regulate their level of behavioural performance, but they do not *define* it and genes do not either.

2.5.5 In humans aggression is only a functional potentiality

After this comparative analysis of aggression in animals with an instinctive repertoire of behaviours (reptiles), in animals with a degree of post-natal definition of behaviours (mammals), and in humans who have almost no instincts, it is obvious that the three types of competitive, nutritional and defensive aggressive behaviours are present in humans as well. The unique aspect of humans is, however, that behaviour in general, and thus aggression, is only a functional potentiality at birth and its completion into *specific actions* totally depends upon strong and clear post-natal information (cultural transfer). This is the result of a long evolutionary strategy of mammals and primates that gradually reduced congenital definition of behaviour in favour of post-natal learning.

If one listed all the ways of being aggressive in different cultures and in individual persons, one would end up with an enormous list of options. The option adopted by a person in a particular situation has been *defined* by post-natal experiences, not congenital information.

In Part 3 of this work, we will discuss the existence of three types of aggressive behaviour in humans since their appearance on earth about 100,000 BP. Hunter-gatherers needed mild competitive aggression for mating, vigorous nutritional aggression for their omnivorous diet and a substantial level of defensive aggression against predators. Interestingly, their defensive aggression was directed at predators (mostly carnivores), not

'enemies', that is, other humans. In fact there is no evidence whatsoever that pre-agricultural humans engaged in war or systematic inter-group aggression (Section 3.2.6). Their functional potentiality for aggression evolved, as in other animals, for other purposes. Animals too do not have intraspecific enemies. 'Wars' between chimpanzees are very rare and still poorly investigated instances (Wrangham & Peterson, 1997, 12-21).

There is clear evidence, however, that since historical times (about 7,000 BP) humans have engaged in systematic aggression towards other humans. The very aim of this work is to understand the origins of this departure, i.e., the redirection of a functional potentiality for interspecific aggression (hunting and defence) toward intraspecific aggression, in the form of in-group aggression (violence) and out-group aggression (war), as discussed in Part 4.

2.5.6 Aggressiveness is a predisposition

The existence of functional potentialities for aggression in humans (Aggleton, 1993; Barr & Kiernan, 1997) offers the possibility of individual variations in congenital predisposition.

A baby is born with regions of the brain (limbic system) already laid down and ready to be connected with associational areas of the cerebral cortex to establish the neurological substratum for aggression; specific behaviours are gradually defined by post-natal information (cultural transfer) that induces the formation of those connections. Below we consider possible options for different levels of predisposition to aggression, i.e., the degree of aggressiveness of an individual. The main point is that this predisposition will have *quantitative,* not qualitative, effects on aggressive behaviour.

At this point we must deal with a problem of terminology again. Most academic and popular literature makes the unfortunate distinction between *biological factors* and *psychological factors* regulating behaviour, as if psychology was not a biological parameter of animals and humans. This dualistic terminology (Section 2.1.1) is particularly established in psychiatry, the science

that deals with deviations from 'normal' behaviour. But it is also used in other medical specialities to discuss possible causation or correlation in disease.

The phrase 'biological factor of a disease' in the medical literature implies an association between that particular disease and a pathogen and/or a detectable alteration of a gene, protein, other macromolecule, metabolic function, cell structure or organ structure. A biological factor can be seen with the naked eye, or under the microscope, or it can be demonstrated indirectly in a test tube or from the output of a fractionation devise or automatic essay (a band in gel, a peak in a graph, a computer-generated value printed on paper). A biological factor may not necessarily be the primary cause of that disease, although it may be part of a chain of cause and effect. If it represents a known early event in that chain, it can be used as a test for an early diagnosis and more successful treatment.

When the patient presents the physician or the psychiatrist with a clear, definable syndrome, but no 'biological factor' can be detected, the medical literature may point to a 'psychological factor'. Psychological factors can be called upon, by default, as the causes of conditions for which medical sciences have no causal explanation. The lay person's analogous scapegoat is 'a virus'. Psychological factors are, of course, a common causation in psychiatric conditions, although sometimes the modern psychiatrist can also rely on a 'biological factor' as described above. A neurologist, on the contrary, needs a clear lesion in order to proceed with a diagnosis and possibly a treatment.

This short introduction to the philosophy of causation in medicine (Munson, 1981) was necessary to introduce the analogous dualism existing in the so-called nature/nurture debate on aggression.

2.5.7 Psychology is biology, not fairy tales

The term 'biological factors' of aggressive behaviour in the medical and popular literature normally refers to the same parameters listed above, but mainly to genes and hormones.

These so-called biological factors are, curiously enough, assumed to be congenital, i.e., built into the fetal development of the individual. Thus, when a special nucleus in the hypothalamus of homosexuals was found to be statistically smaller than the average heterosexual value (LeVay, 1993), mothers felt relieved of the burden of a possible nurturing responsibility for the 'evil' behaviour of their sons. In view of the tremendous plasticity of the human brain (Section 2.3.5), it is interesting that post-natal information (cultural transfer) received scant attention as a possible explanation for that morphological difference. Of course, soon scientists found evidence of a genetic 'causation' of homosexuality (Holmes, 1994). As not much notice was taken of post-natal cultural transfer as a possible explanation for the *definition* of gender preference (a social behaviour) suggests that there was a general poor understanding of the relationship between congenital predisposition and behaviour. The term 'psychological factors' of aggressive behaviour in the medical and popular literature normally refers to a post-natal input, the nurturing component of the debate. Interestingly, just as 'psychological factors' are an embarrassing, unexplored side of medicine, these same factors are an equally embarrassing and unexplored field of research in the causation of aggression. Whenever youths commit revolting crimes, accusing voices are raised against violent films, TV programs, violent families and a sensational press, as major channels of aggression. The voices are those of some educators, social workers, philosophers. The real social leaders — government, police, business — accept instead that "there will always be violence in society" and their "realistic aim is to deter it with legal punishment", an approach well known for having failed throughout history.

In the debate on the causes of aggression, we find the position of psychiatrists most puzzling. Psychiatrists have many psychopaths among their patients and their conditions are diagnosed as real diseases and treated with appropriate drugs. When one of these patients decides to kill a few people, the same psychiatrists are called on by a judge to assess whether the accused was able to understand his action when he committed the crime. When the psychiatrist states in court that the accused

understood his action and intented to act (the term 'clinically normal' is not actually used in court), thus guilty of a crime, she/he switches from a medical assessment to an ethical one. Without any scientific explanation, the status of the psychopath changes from patient to criminal. To neurobiologists this seems nonsensical, but not to judges, psychiatrists and the public, who seem quite happy, in this case, of condemning a person for having a disease in a particular organ called the brain. Most of the time psychiatrists deem the murderer a clinically 'normal' person and he has to go to jail, or be executed in some countries.

2.5.8 Some individuals can have higher levels of aggressiveness

An individual can be born with a predisposition toward aggression, i.e., she/he can have a congenital high level of aggressiveness. In this section we discuss the known parameters of aggressiveness in vertebrates and humans.

In vertebrates the production of testosterone by the gonads at early stages of development generally induces the differentiation of the male type of brain, which represents a modification of the basic developmental plan of the species, i.e., a female individual. Male individuals are born with a predisposition to be aggressive (higher level of aggressiveness). In adulthood it is not the type of hormone any more, but rather the type of brain and the level of either sex hormones (testosterone and estradiol) that determines the timing and level of aggression in animals (Groebel & Hinde, 1989 pp. 58-74). In humans the transition from aggressiveness to aggression is more complicated.

In the past one thought that chromosomal mutations with a multiple Y (men with XYY syndrome) caused violent behaviour. At present the most accepted interpretation is that this syndrome is responsible for lower mental capacity and higher growth rate, conditions which indirectly lead to aggressive behaviour even at school-going age (Lopreato, 1984, p. 50). Currently the most studied genetic correlate of human aggressive behaviour is a mutation of the gene coding for monoamino oxidase, an enzyme

involved in the metabolism of neurotransmitters in the brain (Morell, 1993; Craig, 1994).

2.5.9 Congenital and post-natal factors work differently

The mechanisms discussed above that are responsible for the functional potentialities of human behaviour and the predisposition of individual persons toward certain behavioural options are the same responsible for other characteristics of our body: size of the body, level of pancreatic enzymes, metabolism of lipids, etc. These mechanisms operate at the level of molecules and cell structures. However, the final definition of the adult nervous system and that of other organ systems occurs through fundamentally different processes. Let us compare muscles with the brain, for example.

The popular belief that the brain is like a muscle — they both need exercising to enhance their power — has some wisdom but can be misleading. The need for exercise is a fairly safe analogy, as all functional systems of the body need to be used to maintain good health. Muscle exercise sustains blood supply (especially venous return) and tonicity, the dialectic functional relationship between muscle fibres and motor neurons. Mnemonic exercise, reasoning and sensory-motor awareness maintain blood supply (through the nitric oxide system) and a basic electric discharge, the dialectic functional relationship between neurons. Here the analogy ends, as the human nervous system enjoys a unique level of plasticity, while the physiology of the muscular system does not differ from that of other mammals. Mental exercise leads to such structural changes in the brain (new dendrites, axon collaterals and synapses) that one's brain cannot be the same after reading just one book. This is not a quantitative change — more or less mass with the same structural characteristics, as in muscular exercise — it is a qualitative change leading to a different *type of brain*, a different machinery.

Again, people who played sport during their youth have larger muscle masses than sedentary people; they do not have additional types of muscle. Similarly, people who studied and reasoned

during their youth (or the day before an examination, for that matter) have connections in their brain that otherwise would not be there; they do not have larger brains, but additional types of connections, i.e., *qualitatively* different brains.

The concept of a qualitatively changing brain is fundamental to understanding that the so-called nature/nurture debate is about *qualitative*, not quantitative, differences between congenital and post-natal definition of behaviour.

2.5.10 Aggressiveness is not behaviour

As discussed in Sections 2.5.8, humans can be born with a predisposition to aggression. We now discuss the important question of whether aggressiveness necessarily develops into aggression.

In humans, sex hormones and the enzyme monoamino oxidase (Morell, 1993; Craig, 1994) seem to play the same biological mediating role. Unfortunately monoamines are common neurotransmitters in the human brain and a gene regulating their level must be an intermediate tool in many functions, not the initiating cause of behaviour.

A discussion on the factors mentioned above that predispose individuals to aggression should cover properly their mechanism of causation and their practical effect on nervous structures. To this end one should consider quantitative aspects and mechanisms.

We will first consider the *quantitative aspects*. Everyone has estradiol and testosterone circulating in their blood and everyone has the enzyme monoamino oxidase (Section 2.5.8) present in some of their neurons: these are normal components of one's body. It is not the mere presence of these molecules that causes high levels of aggressiveness, but their presence in high levels. In congenital and genetic terms, aggressiveness is not associated with a certain structural gene, but with a genetic regulation of the metabolism — a higher rate of synthesis and lower rate of degradation of the molecules in question. Metabolism is regulated by multiple genes and with a complex mechanism that is

understood by cell biologists in only a few special cases. The strength of current genetic studies is the understanding of the presence or absence of a certain gene-to-protein system, not the regulation of the amount of that protein, its localisation in critical sites of cells, its binding or enzymatic relationship with other molecules, etc. Thus, translating genetic make up into specific aggressive behaviour would have to overcome an immense ignorance in cell biology before making sense.

Second, the *mechanism of action* of these factors. Even if we managed, after decades of scientific investigation, to understand the jungle of cell biology mentioned above, we would at the end understand how higher levels of hormones and/or monoamino oxidase enzymes activate certain neurons in the limbic system, the part of the brain regulating memory, emotions and socialisation (Barr & Kiernen, 1997). By itself, this activation would arouse the individual, make her/him do something aggressive, but not *specify exactly how to do it.* The specific behaviour resulting from the arousal is defined by specific connections existing between the limbic system and different regions of the cerebral and, probably, the cerebellar cortex. These connections become specified during post-natal exposure to those particular social circumstances typical of a given cultural context.

In a nutshell, hormones and enzymes arouse and culture tells one what to do about it, because the *specific behavioural traits* expressed are defined by the specific culture to which individuals have been exposed after birth (Montagu, 1968; Eron et al, 1974; in Groebel & Hinde, 1989). For example, a high level of testosterone may 'facilitate' street fighting in a young man raised in a slum of Mexico City, while it would encourage enrolling as a political candidate in a young man raised in a middle class suburb of Paris. See also Section 5.1.6. That is the reason why aggressiveness, a vague predisposition, is not aggression, which is specific behaviour.

2.5.11 Violence is a complex concept

Humans have a much more complex social organisation than other

social mammals and primates. A complete discourse on the origins of aggressive behaviour should move from agreed basic concepts (aggression and aggressiveness) to a debate on complex concepts — the nature and origins of violence and nonviolence.

The use of the term violence proposed in the present work (Section 1.1.3 and below) can be justified in two ways: a specific term for a complex concept was needed and an appropriate definition was already available in the literature of Peace Studies, since its introduction by Johan Galtung thirty years ago.

As proposed by Galtung (1969), in this work the term *violence* refers to all institutions, cultural traits and behaviours that limit the development of people's potentials and deny people's aspiration to be in control of their body, their behaviour and their social environment. This definition goes beyond the common use, which is limited to verbal and physical abuse, by including structural (indirect) violence, cultural violence and personal (direct) violence.

The concept of limiting people's personal potential is a powerful, all-embracing concept that applies to all aspects of oppressing, hurting and eliminating others. This clear but rich definition of violence is necessary in order to develop a rational but comprehensive explanation of the *origins* of certain behaviours unique to humans:

- Men in uniform who machine gunned children in a village of Kosovo and were treated as heros on their return.
- Executive Directors of the tobacco industry who condemned thousands of people to lung cancers were promoted to higher positions.
- Education Ministers who condemned intelligent children of poor families to ignorance and crime became Prime Ministers.
- Diligent public servants who tortured prisoners to obtain the names of their comrades had their salary increased. *Et cetera, et cetera.*

The behaviours described above are not individual idiosyncrasies; they are the products of collective ideas, institutions and cultural trends, which generate and maintain them. Thus, we are not just dealing with functional potentialities of a species and individual predisposition of people. The *origins of*

violence (as defined here) is exclusively cultural and a discussion on this topic must be holistic, comprehensive and interdisciplinary: holistic by considering people in their entirety, comprehensive by considering people of all times and cultures, interdisciplinary by making use of various sources of knowledge.

To attempt an understanding of violence from a monodisciplinary discussion on hormones, *or* on the Yanomamö, *or* on religion, *or* on the limbic system, *or* on Hobbes, *or* on the Inuit, *or* on the mass media, *or* on Freud, is naive. But attempts of this type are more the norm than the exception in the academic and popular literature. There are the usual specialist discussions on violence 'from the point of view of ....'.

The present work, therefore, deals with both basic concepts (aggression and aggressiveness) and complex concepts (violence and nonviolence) in order to cover all aspects of the question, to distinguish qualitative from quantitative differences and to maintain the unity of human beings as individuals but also as members of a group, as discussed in Section 5.2.6.

2.5.12 Congenital predisposition results only in time differences in behaviour acquisition

When considering the relationship between aggressiveness and aggression it is important to notice that in practice a congenital predisposition is only responsible for delaying or accelerating the acquisition of behavioural traits which are, eventually, bound to be acquired by cultural transfer in any case. This is an important aspect of the difference between the quantitative character of congenital factors and the qualitative character of post-natal learning factors (Section 2.5.9). This limited, quantitative role of congenital factors regulating behaviour becomes particularly clear in the case of aggressiveness.

We propose to refer to the role that congenital predisposition has in generating aggression as the *time factor*. Let us consider, for example, a case of direct violence (physical abuse). In a city slum a street kid with a high congenital level of aggressiveness will acquire a specific violent behaviour (armed robbery) quicker than

one who has a low level of aggressiveness. But after probably a few months, they both will steal and kill as instructed by their specific sub-culture; the high level of aggressiveness of the first kid would simply result in an accelerating time factor, not in a different behaviour.

Likewise, one could associate a certain behavioural predisposition with a *skill factor*. To continue the same example proposed above, the street kid endowed with a high level of aggressiveness will become, given equal training, more skillful in handling weapons than the other kid. But he would need, nonetheless, to be trained because his DNA does not carry information for behaviour.

The same consideration can be applied to examples of structural violence. Non-verbal instructions about classism and racism are eventually adopted by all children brought up in a discriminating cultural environment, irrespective of congenital predisposition they may be equipped with at birth. A high level of aggressiveness would simply lead to discriminatory and oppressive behaviour being adopted quicker and more effectively. Prejudice and injustice will then be reinforced and maintained throughout the adult life so effectively, that they will even find it difficult to accept that they behave unethically when confronted with alternative social ideas.

Cultural transfer (Section 2.3.12) provides powerful post-natal information for the definition of adult brain structures and behaviour. This is particularly true of humans that have almost no instincts and have undertaken a clear evolutionary strategy toward adapting to new environments by post-natal learning. The evidence of this is simply there to observe in the extremely diverse behaviour displayed by different cultures of the past and present. Hence a congenital predisposition toward aggression is of little practical importance, as it expresses itself only as a time factor, not as a different behaviour.

2.6 Conclusion of neurobiological aspects

2.6.1 Introduction

Concepts discussed in this second part are generally accepted by biologists, ethologists, evolutionary biologists, neurobiologists and developmental psychologists. They do not represent controversial ideas of a few qualified scientists; they can be found in textbooks used for undergraduate teaching at university. They all point to the same conclusion: that social behaviour is not a congenital characteristic in humans, that aggression and violence represent an aspect of social behaviour, therefore they cannot be congenital characteristics of any human being. Interestingly, this rather simple concept does not seem to be known by the public (cf. Section 2.6.2 below).

If the present study was monodisciplinary work, we could now rest our case and draw conclusions from the point of view of neuroscience. But anthropology has a wealth of information, albeit more controversial than neuroscience, on the topic of the origins of violence and it should be considered too, as discussed in Section 3.

2.6.2 The average lay person should not be told

In this context an interesting barrier to information transfer exists between academics and the public; its selectivity makes it interesting. Advances in knowledge are made all the time in tertiary institutions, but what is told to the public and how it is presented by the media is quite selective. It looks as if some forms of ignorance must be eliminated for practical reasons, while some prejudices are retained for political reasons.

Why do neurobiology students get a bad mark when they do not know that connections in the frontal lobe of the human brain are formed post-natally through social learning, while the average person in the street is not told that social behaviour is not congenitally defined? The same question can be asked with

respect to simple, basic aspects of other scientific information concerning, for example, the effect of nuclear radiation on life forms (in the 1950s), the effect of insecticides on food (in the 1970s), soil degradation and agricultural practices at present..

In his book titled his *Why weren't we told?* Reynolds (1999) discussed the reason for the prolonged lack of information on genocide and ill-treatment of Australian Aborigines. Why indeed. In 1859 an English bishop's wife learned about Charles Darwin's *Origin of the species* and hoped it was not true that people had apes among their ancestors; but if it was true, she said, let's hope people don't get to know about it. Similarly, in 1986 the editors of media outlets decided to hold back information on the possible nonviolent ancestry of human beings. After twenty internationally acclaimed academics issued a statement that denied congenital violence in humans (Section 4.1.2), it became impossible to convince the media to publish such a 'harmless' piece of information (Adams, 1989).

2.6.3 Humans are not congenitally violent

To summarise, the biocultural evolution of *Homo sapiens* selected neurological mechanisms mediating aggression for the purpose of defence against predators (in both genders) and hunting (particularly in men). These functional potentialities need strong post-natal information to become defined into specific behaviour — *how* to defend yourself, *how* to hunt. The same functional potentialities have been used in structurally violent societies for thousands of years to instruct humans — through post-natal definition of their behaviour — to perform unnaturally violent behaviour against members of their own species. This behaviour is 'unnatural' because it is not adaptive in the context of human biocultural evolution — what we are designed for. Structural and direct violence is the result of purely cultural changes.

As discussed above, cultural transfer of structural violence begins very early in life and it is wrongly interpreted as instinctive (congenital) behaviour, hence the widespread notion of natural violence in humans.

The other important conclusion that can be drawn from the discussion in Section 2.5.9 is that the nature/nurture debate cannot be solved simply by accepting a relative contribution from both sources to the definition of human social behaviour in general and violence in particular. In fact the concept of *time factor* implies a *qualitative* and not just a quantitative difference in the relative contribution of congenital components and cultural components of our social behaviour: nature may well predispose, but nurture finally defines behavioural traits. Children may be born with a cooperative and nonviolent predisposition stronger than their aggressiveness, but eventually participate in structural violence, if brought up in one of the violent cultures which are in the majority, since historical times.

Ironically, the unique plasticity of the human brain used for learning and cultural transfer was exploited after the invention of agriculture to re-direct natural aggressiveness against predators and prey toward unnatural forms of violence against members of the same species (Sections 4.3).

Evidence from anthropology

3.1 Ecce homo

3.1.1 Introduction

The evolutionary process that led to the current congenital characteristics of the human nervous system completed itself, presumably around 50,000 years BP, when modern *Homo sapiens* evolved (or diverged) from the archaic types of the same species (Haviland, 1987; Jolly and Plog, 1987; Tattersall, 1999).

The human biocultural evolution (Section 2.4.7), as with other social mammals, maintained substantial harmony between changes occurring in the social environment and changes occurring in the brain. In this way congenital predisposition (not specific behaviours) was selected to be adaptive for the types of social behaviour defined after birth by cultural transfer.

As indicated in Section 1.1.1, the aim of the present work is twofold: offering an interdisciplinary criticism of the idea of congenital human violence and proposing an alternative hypothesis on the origins of violence. At this point of the discussion, we need a possible model of social behaviour for humans, in order to use it as a theoretical framework for the aim just stated. We should address the question of defining human nature, but this would go beyond the scope of this work. Rather, we will limit the discussion to a smaller, albeit, very complex, aspect: behaviour and aggressiveness.

3.1.2 Zoologists can define animal species

Aristotle, Linneus and Haeckel, and many biologists after them, defined and classified living beings — individuals into species, species into genera, genera into families, etc. The aim of taxonomy is the recognition of common characteristics between taxa, in order

to determine phylogenetic distances. The latter can be arrived at with different approaches: morphological analysis of adults, physiological compatibility (reproduction), analysis of embryological strategies, molecular differences, geological dating of fossil forms, etc. (Gould, 1987a, pp. 155-214). As these approaches make use of different types of information obtained with different techniques, their concordance strengthens considerably the theoretical basis of phylogenesis, that is, the theory of evolution (Section 2.4.9).

The definition of a species generally consists of describing distinguishing characteristics: physical traits, habitat, nutrition, and behavioural traits. In this way, zoologists can classify a *Canis latrans* (coyote), an *Astacus leptodactylus* (Danube's shrimp), a *Pan paniscus* (bonobo chimpanzee, Linden, 1992).

For the purpose of the present work, it is interesting to note that, despite the wealth of biological concepts and methodological tools at their disposal, zoologists — or anthropologists, or sociologists, or philosophers for that matter — have not found, as yet, a consensus on the definition of one interesting primate species, *Homo sapiens*. Of the four groups of traits mentioned above, consensus only exists about distinguishing physical characteristics. No other living anthropomorphic primate has a hip joint allowing bipedal gait as an ordinary mode of displacement, hand muscles allowing a skillful opposition of the thumb, and a shape of the larynx allowing articulate speech. *H. sapiens* is also quite naked. There is no agreement concerning habitat, nutrition and behaviour; a poor set of systematic information. A zoologist coming from Mars would be annoyed about this lack of interest in such an interesting species.

Has the cultural diversity of humans confused zoologists and anthropologists? This is unlikely. Is the definition of *H. sapiens* such a hot political issue to be left alone? Perhaps it is. For the purpose of the present work, we will address only the issues concerning behaviour (not habitat and nutrition) and, later, aggressiveness.

As discussed earlier (Section 2.4.7), when one considers the behavioural options of a species which has a substantial component of cultural transfer, one needs to define congenital

predisposition. We use the term *neurological imperatives* to refer to the behavioural predisposition of *Homo sapiens*.

3.1.3 Neurological imperatives should be investigated

Neurological imperatives encompass those characteristics built into the developmental plan of the human nervous system that evolved up to about 40-50,000 BP in parallel with adaptive characteristics of the social environment through biocultural evolution (Section 2.4.7).

H. sapiens must have a distinguishing behavioural predisposition — all other species have them. Any attempt at defining the neurological imperatives of humans goes in the direction of defining human nature, hence the political implications of the exercise.

Interestingly, the definition of the neurological imperatives of *H. sapiens* , or human nature, is the unspoken assumption lying at the very heart of political projects. We have heard many time a suggestion beginning with the premise: "Human beings being what they are, ...". Although an attempt at defining them will provoke emotional reactions (even from normally phlegmatic scientists) and hostile comments from those who see it as a threat to their political agenda, it needs to be dealt with in order to understand the origins of violence. Suggestions put forward here are certainly open to debate, but we cannot continue to 'bury' our academic heads in the sand.

3.1.4 Humans are designed to live as hunter-gatherers

In this section we would like to suggest that the essence of human nature, and behavioural predisposition in particular, may be identified with the outcome of the biocultural evolution that selected a very successful human strategy: gathering and hunting. Pre-historical hunter-gatherers may be a good start when examining human nature (Section 3.2). This, as a matter of fact,is not a totally new idea, except that in the past prejudices about pre-

historical man prevailed and the conclusions drawn from that idea turned out to be, in my opinion, quite erroneous (Section 3.3.3).

The suggestion to use pre-historical humans as a discussion-model does not follow from a romantic view of 'good ancestors', 'unspoiled humanity', a naive pristine human nature. It is based on current anthropological data.

The validity of the hunter-gatherer model is based on the fact that humans have been living on the earth as hunter-gatherers from the very beginning (Haviland, 1987) and have done so for about 90% of their existence, i.e., for 90,000 years before the invention of agriculture (10,000 BP). But this argument is not sufficient, as the possibility exists, theoretically, that humans changed their behavioural predisposition (congenital plan of the nervous system) since 100,000 BP.

3.1.5 The biological evolution of humans stopped about 30,000 years ago

An important argument for the present discussion is that the biocultural evolution (Section 2.4.7) virtually stopped quite soon (relative to evolutionary time) after the appearance of the first human beings. Cultural evolution continued, but possible parallel biological changes could not be stabilised. Let us consider the evidence for this suggestion.

About 30-40,000 years ago the biological component of the human biocultural evolutionary process ceased to operate because of the active dispersal of nomadic hunter-gathering humans throughout the world (Cavalli-Sforza, 1991; Cavalli-Sforza *et al.*, 1994).

Briefly, as a consequence of geographical dispersal, the different populations of *Homo sapiens* have been interbreeding continuously, thus causing a considerable amount of gene flow between relatively large populations. This is a condition which is widely recognised as not being conducive to evolutionary changes in the developmental plan (congenital characteristics) of a species (Futuyma, 1986 pp. 218-249). This is because possible changes in the pre-natal stereo blueprint of development (Section 2.2.4) need

two conditions to become stabilised: isolation and positive selection by a changing environment. Dispersal and interbreeding was not conducive to isolation and changing environmental conditions were already successfully met by post-natal adaptive strategies (cultural transfer).

Therefore the human body, including the brain, has basically not changed in the last 30,000 years or so (Leakey & Lewin, 1978 p. 249; Lopreato, 1984 p. 27; Jolly & Plog, 1987 p. 239). Adaptation to different climatic regions has led only to minor and very graded differences in skin pigmentation, texture of hair and face morphology (Gould, 1987a pp.185-198). More importantly, this implies that today humans have basically the same brain functional potentialities and congenital predisposition of their palaeolithic ancestors (Ruffie', 1983, vol. 2 pp. 131-143).

This rather simple concept, which is well accepted among population biologists and anthropologists, has not been translated into popular knowledge, which would be essential to understand human nature.

3.2 The nature of human nature

3.2.1 Introduction

The biological evolution of *Homo sapiens* possibly stopped about 30,000 years ago (Section 3.1.5). Thus our *neurological imperatives* (congenital behavioural predisposition) may be suitably demonstrated by the social organisation and behaviour of both pre-historical humans, and contemporary hunter-gatherers (food-collecting cultures) *before* acculturation and colonial interference (Section 3.2.4).

Drawing information from the hunter-gatherer cultures that by-passed the agricultural revolution and retained a foraging economy until colonial invasion, **is not** subscribing to romantic Rousseaunian views of the 'noble savage'. It is simply drawing information from modern anthropological data, those very data that were not available to both Hobbes and Rousseau (Sections 1.2.3 & 5.2.5).

Admittedly, the diversity of human cultures and subtle variations of each social model make the task of a short presentation very difficult, but one general consideration is in order. The term 'hunter-gatherer' carries precise anthropological connotations. Many authors discussing human nature, and aggression in particular, refer indiscriminately to 'primitive people' or 'tribal people' or 'indigenous people' without distinguishing food-collecting from food-producing cultures, a *naïvité* which was acceptable to Jean Jacques Rousseau, who wrote 200 years ago, but is not appropriate for contemporary writers such as Freeman (1964), Eibl-Eibesfeldt (1975), Van der Dennen & Falger (1990) and Harth (1991).[1] This oversight has caused much misunderstanding in discussions about the origins of violence.

The tense used in the text that follows does not imply that one is referring to pre-historical hunter-gatherers. It only means that, regrettably, contemporary foraging cultures have been, or are being, eliminated by physical and cultural violence (Burger, 1990).

Hunter-gathering cultures are exclusively foraging (food-collecting) cultures, that do not keep domesticated animals, do not

cultivate even small orchards and do not store food beyond the small amounts that can be carried while moving between camps (Section 3.2.3).[2]

3.2.2 Information on hunter-gatherers

Much information can be extracted from the so-called material culture of neolithic agricultural settlements investigated by archeologists. But palaeolithic hunter-gatherers did not leave behind much stone implements, beyond arrow-heads and flints, and extrapolations about their social organisation and behaviour are difficult; one exception is rock art, i.e., paintings on rocks, carvings on stones and sculpturing small statuettes of stone (Section 3.2.6).

As a consequence, good models for discussing human congenital predisposition toward social behaviour are those hunter-gathering *Homo sapiens* populations that were met for the first time by colonialists in isolated regions of the earth in the 18th and 19th centuries.

In the 18th century ignorance about 'other cultures' was much worse than at present, and all 'indigenous people' were labelled as primitive, lazy and perhaps not real humans. From the middle of the 19th century, ideas about social Darwinism took ground very quickly — they actually served the purposes of colonialists quite well — and 'indigenous people' became evolutionary misfits, thus confirming that white humans controlled the destiny of the earth (Gould, 1981, pp. 30-72).

Despite the above prejudices, some diligent 19th century naturalists recorded — along with other data on flora and fauna — important information on hunter-gatherers, before or during the impact of colonialism, that is, being subjected to genocide or aggressive acculturation.

Hunter-gatherers' neurological imperatives can also be deduced from field studies carried out in the 1950s-1970s by modern anthropologists who were aware of old prejudices caused by social Darwinism. Data reported below derive from this latter type of source. There is, however, a modern version of social Darwinism,

in the form of, in my view, the erroneous biological determinism of hard-core sociobiology (Wilson, 1975, 1978; Trivers, 1985). As a consequence, there is little consensus in the field of anthropology on the origins of aggression, as compared to consensus in the field of neurobiology on the origins of social behaviour (Section 2.4). Hence the mitigating contribution of Section 3.2.4 below.

3.2.3. The !Kung Bushmen - A possible model of human nature

The !Kung [3] social structure could be used as a model representing general characteristics of hunter-gatherers. For other models see Bonta (1993) and Section 3.2.5. The !Kung culture is arguably the best studied culture among non-agricultural people and relevant information can be found in Leakey and Lewin (1993), Lee (1979), Lewis-Williams (1981), Haviland (1987 pp. 150-159) and Lee (1988).

For the sake of brevity, the view of hunter-gatherers presented here is abridged and simplified, and should be complemented with the critical analyses of Eibl-Eibesfeldt (1979), Leacock & Lee (1982), Ingold *et al*. (1988) and Wilmsen & Denbow (1990), in order to appreciate the diversity of cultures existing even in the same region, as well as departures from the general trend of nonviolence (Section 3.2.4).

The !Kung Bushmen live in South Africa on the border between Namibia, Angola and Botswana (Kalahari desert) and include different cultural subdivisions, such as the Dobe and the Xai/xai (Lee, 1979, p. 4). They are part of a more general grouping referred to as San, or *Zhu twasi* for 'real people' (Burger, 1990, pp. 24-25 & 183).

Below is a list of the essential aspects of their social structure before acculturation:

- The !Kung lived in small communities (bands) of about 25 individuals (7-8 families).[4]
- A reliable supply of food was obtained by gathering fruit, seeds, vegetable and hunting small animals; these were the tasks of women, together with caring for children. Men hunted larger

animals, and they could return empty-handed without affecting the essential nutritional needs of the band. The diet was heavily weighted toward plants (about 60-70%) and women were the main providers of food. This implied gender equality, if not a special standing for women.[5]
- The products of both gathering and hunting were shared with all members of the community. The food was consumed in a short time, while a small reserve of nuts and plants food was stored at camp or carried on the journey.
- The !Kung society had no hierarchical structure, no chiefs and no priests. Individuals recognised for excelling in a specific skill led the group for the relevant activity (hunting, trance dancing, medical treatment, etc.) but she/he did not enjoy any formal authority or privileges at other times.
- Different bands gathered and hunted in nearby territories without conflicts. A number of bands shared a language/dialect and special traditions, which together defined the so-called 'dialectical tribe'. When conflicts of interest arose, most hunter-gatherer cultures had effective nonviolent strategies to solve them (Barash, 1991 pp. 168-169).[6]
- The !Kung practiced incest taboos and male exogamy. Thus young men travelled long distances to find their spouses in another band. The consequent network of kin relationship increased cohesiveness and empathy within the dialectic tribe (Melotti, 1990).
- The !Kung had a very high standard of social life and as much as two thirds of their time was spent either visiting or being visited by friends, and feasting.
- They had no formal religion; they had, instead, a mythology to explain the origins of nature and themselves. Their relationship with nature was one of knowledge and respect for the environment that sustained them.

As a consequence of the cultural traits listed above, hunter-gatherers had very limited material possessions, a special form of communal territoriality[7] and almost no dominance, exploitation and violence - either direct,[8] structural[9] or cultural[10] - within and outside the community. Although occasional acts of physical violence occurred, the !Kung never adopted the social structures

and values (structural violence) that promote war, although they would have had the behavioural traits (hunting) and the material tools (hunting weapons) for out-group aggression.[11] On the contrary, the !Kung culture transferred from generation to generation complex social skills for the prevention of violence and for the nonviolent settlement of conflicts of interest.

3.2.4 A matter of degree

The anthropological literature shows a lack of consensus concerning the social structure of palaeolithic hunter-gatherers and the suitability of contemporary hunter-gathering cultures as reliable guides to answer that question (Ingold et al., 1988; Haas et al., 1990; Van der Dennen & Falger, 1990; Wilmsen & Denbow, 1990; Pain, 1993).

These controversial issues cannot be adequately reviewed here. Briefly, it is true that hunter-gatherers (both pre-historical and contemporary) were no angels, that one cannot ignore the variety of intermediate modes of food production adopted by different human cultures, and that contemporary hunter-gatherers are no relics of the past. But differences between *food-collecting* and *food-producing* cultures concerning violence, greed and competition are so striking that fine discussions of detail and exceptions should not overshadow this clear difference.[12] See also Section 3.2.6.

3.2.5 Human neurological imperatives can be investigated

As anticipated in Section 3.1.3, the aspect of human nature dealing with behaviour (neurological imperatives) can be investigated by studying the social behaviour of contemporary hunter-gatherers before acculturation.

The essentially cooperative and nonviolent cultures of hunter-gatherers would suggest that human biocultural evolution selected nonviolent social strategies for survival, thus they would be essential aspects of a scientific description of *Homo sapiens*, that

is of human nature (Section 3.1.4). It should be stressed here that nonviolent solutions to conflicts of interest necessitate intelligent and sophisticated social interactions (Lee, 1988; Barash, 1991, pp. 168-169, 299-322), not the simplicity of the peaceful idiots conceived in the mind of Rousseau (Section 1.2.5).

Contemporary models of hunter-gatherer cultures were studied until a few decades ago, before or during violent colonial encounters that changed their social behaviour (Yellen, 1990). There are several examples of documented hunter-gatherer cultures, such as the Polar Eskimos and the Desert Aborigines of Australia (Leaky and Lewin, 1978 p. 160; Leacock & Lee, 1982; Ingold et al., 1988; Sponsel & Gregor, 1994),[13] but the one best studied is that of the Kalahari desert Bushmen described above.

Bruce Bonta (1993) provided an extensive annotated bibliography of about 45 nonviolent cultures. The nonviolence of non-agricultural people is, therefore, not limited to a few esoteric cultures. Importantly, the general criterion to distinguish between nonviolent and violent cultures is the modality of food procurement.[14] As indicated in Section 4.4.6, food-production is pertinent to many so-called 'tribal' or 'indigenous' cultures, where small-scale horticulture of pastoral economies have led to various degrees of structural violence. Moreover, secondary adaptations may complicate the correlation between economic systems and violence (Section 5.2.9).

We suggest that *food-collection and nonviolence just happen to be the end-product of the human biocultural evolution* (Section 3.2.6). Therefore, zoologists should probably include congenital predisposition toward nonviolence — probably involving structural characteristics of the limbic system — in the definition of this species. Details about specific behaviour — how this predisposition is defined by post-natal information (cultural transfer, Section 2.3.12 — would depend on the specific culture analysed and the particular individual considered. But nonviolence (as a negation of a violent predisposition) would be a distinguishing feature of *H. sapiens*, just as bipedal gait is, for example. It is worth noting that an analysis of human neurological imperatives does fulfil at least one of the parameters that are overlooked in the definition of *H. sapiens* as a species

(Section 3.1.3).

3.2.6 There is no evidence that our ancestors were brutish people

Until the 1950s-60s most anthropologists were influenced by Freud's conclusion that "the tendency to aggression is an innate, independent, instinctual disposition in man" (Freeman, 1964 p. 109) and they assumed that hunter-gathering humans had a 'solitary, poor, nasty, brutish and short' life as Hobbes suggested.[15] Extensive anthropological research subsequently showed that, on the contrary, contemporary hunter-gatherers were happy and culturally sophisticated people, with better health than people in industrialised societies and with a similar life expectancy, perhaps depicting the 'original affluent society' (Lee, 1979; Haviland, 1987 pp. 150-159).

Eibl-Eibesfeldt (1979, 1989) has criticised the nonviolent view of Bushmen, who, he pointed out, have forms of territoriality, and at times even commit acts of aggression. However, this author does not discuss the possibility that the instances of warfare and violence observed or cited by him might be related to acculturation which occurred after ancient contacts with neighbouring food-producing cultures (Wilmsen & Denbow, 1990) and/or to more recent interferences from colonialists (Yellen, 1990). This is understandable, as this author belongs to a school of thought that tends, even in its modernised version, to view biological determinism as a *qualitatively* important component of behaviour (Section 2.5.9). He assumes, therefore, that an observed behaviour generally reflects a congenital characteristic.

Beyond possible departures from the nonviolent norm of food-collecting cultures, there is firm evidence that contemporary hunter-gatherers were far less belligerent than food-producing cultures (Wright, 1965) and that extant records of the art of hunter-gatherers of all times seem to lack images of man killing man and images of war.[16] A systematic study of art may provide important evidence on the origins of violence, as the theme of warriors is a dominant feature of the art produced by early agricultural

settlements. [17]

NOTES

[1] For example, Harth (1991 p. 154) described the Samoans, the Yanomamo and the !Kung as 'primitive' but violent. The Samoans had a horticultural and fishing culture with surplus food, a condition leading to structural violence, as explained in section 3.2. Amazonian Yanomamo also had an horticultural economy with social stratification and structural violence (Chagnon, 1977). !Kung *now* (as Harth says) may commit violent crimes because they have lost their culture (Yellen, 1990). As evidence of aggression among contemporary hunter-gatherers Eibl-Eibesfeldt (1975 p. 509) mentions the 25% of men who die in battle among the Waika Indians (upper Orinoco), whom he defines as hunters, gatherers and horticuluralists. This is probably one of the best examples of missing the importance of the relationship between food production and violence.

[2] Hunter-gatherers practiced *food-collection* because both gathering and hunting involved removing food from the environment without modifying or enhancing nature's products. On the contrary, horticulture, agriculture and pastoral practices involved *food production* beyond natural conditions. The mode of subsistence alone cannot define a culture. But evolutionary ecology — the contemporary theoretical approach in analysing variations in human social behaviour — considers the modalities of food procurement and consumption as being of central importance in the pattern of changes (Ingold et al., 1988; Melotti, 1984, 1990). The mode of obtaining food is important for the hypothesis on the origins of structural violence (Section 4.3).

[3] The exclamation mark symbolises a clicking sound typical of the !Kung language.

[4] Interestingly, the number of 20-25 people happens to be the optimum size for consultation as established by consensus-based

organisations (Leakey and Lewin, 1978 p. 159).

[5] Some authors have indicated gender segregation in hunter-gatherer cultures, especially in Australian Aborigines, as an example of social injustice toward women, while others considered it as evidence of women's independence and activism (for a discussion see the contributions of Annette Hamilton and Patricia Grimshaw in Grieve & Grimshaw, 1981).

[6] Many suggestions have been put forward to explain the evolution of language in humans and probably they are all jointly correct (Eibl-Eibesfeldt, 1975; Wilson, 1975; Lumsden & Wilson, 1981; Jolly & Plug, 1987; Leakey and Lewin, 1993; Facchini, 1985; Eccles, 1991; Jablonski & Aiello, 1998). The advantages of cultural transfer and of nonviolent resolution of conflicts of interest must have been a very powerful selecting force in the human biocultural evolution. Thus speech may very well be evidence of the evolution of nonviolence in human. The nonviolent settlement of conflicts of interest necessitates a sophisticated communication system, while the violent option only requires muscles and/or simple weapons. Moreover, community size is important; in villages and small towns of structurally violent cultures instances of aggression are proportionally fewer than in large cities.

[7] The concept of territoriality for hunter-gathering cultures is still being debated and it may represent a semantic problem (Eibl-Eibesfeldt, 1979; Leacock & Lee, 1982 pp. 85-108; Ingold et al., 1988; Rigsby, 1998).

[8] Eibl-Eibesfeldt (1975) considered Bushmen aggressive because of instances of children scratching and teasing each other. He later provided more examples of 'violence' occurring in putative nonviolent cultures especially among !Kung Bushmen (Eibl-Eibesfeldt, 1979), but the cases were isolated, of a mild nature and mainly related to a special interpretation of territoriality. But he also stressed that the culture of Bushmen, in contrast to that of farming and pastoral people, actively discourages direct violence. Thus, even the most pessimistic interpretation of this author is in

agreement with Wright (1965) who ranked hunter-gatherer cultures as the least belligerent ones. Of course scarcity of resources may retrieve aggression in all cultures (Homer-Dixon et al., 1993) (Section 5.1.4), but the violence of food-producing cultures is structural and it developed even in concomitance with a surplus of resources.

[9] Some possible departures from this trend concerning gender and territoriality are mentioned in Sections 3.2.6 and 5.2.9.

[10] Umberto Melotti (personal communication) suggested that elders could be seen as exercising cultural violence by being the sole depositories of mythology and rituals (gerontocracy).

[11] For a discussion on limited and ritualistic 'warfare', legal 'duels' and executions among hunter-gatherers see Fromm (1973 pp. 170-176) and Barash (1991 p. 166).

[12] One should also remember that anthropology is not physics. If the speed of light measured by Dr A in Paris turns out to be different to that measured with the same instruments by Dr B in Sydney, one should ponder the validity of related theories of physics. But the report of a Kalahari Bushman killing one person is not a reason for revising our ideas on the essentially nonviolent nature of the hunter-gatherer culture.

[13] The language of Eskimos has no word for war (Pei, 1968 p. 202). As far as violence is concerned, one should realise that the culture of Polar Eskimos is quite different to that of Eskimos living in Greenland, and that of Desert Aborigines is very different to that of coastal Aborigines (Montagu, 1957). This is because interactions with neighbouring food-producing cultures must have altered the social behaviour of hunter-gatherers already in neolithic periods (Wilmsen and Denbow, 1990), thus well before those recent encounters with colonial cultures monitored by anthropologists (Yellen, 1990). Moreover, reports of 'first encounters' by early colonialists are influenced by racism, prejudices and anthropological ignorance.

[14] Bonta (1993) also listed a number of 'peaceful people' who are nonviolent through religious affiliation. This aspect goes beyond the discussion of the present work, but it carries interesting implications. The essentially nonviolent teaching of most theistic religions — *do unto others as you would have others do unto you* — has important anthropological implications. Most theistic religions appeared during or soon after the neolithic period (Section 4.3). Why should the prophets of God translate the simple cultural rule of hunter-gatherers into a spiritual message? Why should, for example, Jesus exhort us to love each other, while 'naturalistic' religions do not? It could be that the very loss of nonviolent spirituality caused the spiritual need for nonviolent ethics, a form of remedial education for the new violent humans (cf. front cover).

[15] This often quoted citation from the 17th century philosopher Thomas Hobbes refers in fact to pre-state communities which he imagined were constantly disturbed by violence and wars (Hobbes 1958, p. 107).

[16] This form of art conveys to us the ideas that most deeply moved palaeolithic people: animals and hunting. Scenes of physical violence against fellow humans are not there, with the exception of two instances of small human silhouettes with several lines across the body, which are very difficult to interpret (Leroi-Gourhan, 1967 pp. 321, 324). Lewis-Williams (1981) described Bushmen's rock paintings as illustrating hunting and no war. But Eibl-Eibesfeldt (1975 p. 510; 1979 pp.143-145) reproduced some rock painting scenes interpreted as armed conflicts among Bushmen, and between Bushmen and Bantus, without however discussing the age of the artwork and the possible circumstances of the interaction between these two cultures, as Bantus were pastoral and violent.

[17] For a review on palaeolithic rock art see Wakankar, V. C. & Brooks, R. R. (1976) *Stone age painting in India*. Taraporevala, Bombay and Leroi-Gourhan, A. (1967) *Treasures of prehistoric art*. Harry N. Abrams, New York. Most reviews on the origins of war mention one (out of thousands) cave painting in Altamura (Spain)

which may have a (doubtful) hint of a person wounded by a spear (a line). Interestingly, when two archeologists (*Cambridge Archeological Journal*, vol. 24, 1994, pp. 211-248) suggested that a figure in Australian cave paintings may allude (very doubtfully) to violence (Fig. 2) and suggested (but with a question mark) that it may have been made 10,000 years ago (their Table 1) the popular press came out with titles claiming that humans have been making war since the beginning of their existence, hence war is in our genes. Unfortunately *New Scientist* did the same (10 December 1994, p. 7). In 1996 one tourist information plaque placed near ancient Aboriginal rock art in the Kakadu National Park (Australia) described as a scene of war an obvious parading of human silhouettes with shopping bags and hunting spears.

3.3 Implications for the origins of violence

3.3.1 Introduction

The discussion on the origins of violence needs a deeper analysis than a mere account of the !Kung society (Sections 3.2.3 & 3.2.4). Below the wider implications of a possible nonviolent human predisposition are considered.

3.3.2. There were north-south differences in the economy of food-collecting cultures

Of interest to the origins of violence is the increasing emphasis on hunting on the part of the hunter-gatherers that adapted to colder climates.

Even among contemporary hunter-gatherers, the diet varied from a prevalence of fruit and seeds in the tropics to the almost totally carnivorous diet of polar Eskimos.[1] Hunting became the dominant subsistence pattern among human populations during the Upper Palaeolithic period in northern Europe and Asia (40,000-10,000 BP) and the Paleo-Indian period in northern America (24,000-8,000 BP) (Haviland, 1987).

This new trend was enhanced by adaptation to subsequent waves of glaciation, a process which must have partially modified both the physiology and the social fabric of humans adapting to cold regions. Adaptation to hunting large mammals may have somehow modified the hunter-gatherers' social structure — as observed in contemporary tropical cultures — toward an increase in the size of bands and a decrease in consultation and gender equality.[2]

3.3.3. The European vision of pre-history is focused on cavemen

With the establishment of anthropology as an academic

discipline, European scientists became interested in the study of palaeolithic *Homo sapiens* in Europe.[3] This ethnocentric attitude, combined with racial prejudice and a male-oriented view of early humans, made the north-European hunter the main protagonist of anthropological thinking (Stanford & Allen, 1991). This skewed interest of academics is reflected in the topic of contemporary TV documentaries[4] and in the displays of modern museums.[5] The role of protagonist in both the biocultural and the cultural evolution of humans should, on the contrary, be given to the gathering woman in the tropics (Sections 3.2.3 & 4.2)

The stereotypic view of pre-historic humans is that of 'brutish', violent people covered with fur, living in caves and hunting mammoths and other large mammals. This influenced 19th century thinkers and Victorian social Darwinists,[6] and it continues today to be the most popular view of pre-historic people.[7]

Some populations of palaeolithic *Homo sapiens* in central and northern Europe may have fitted the above description, but it is more likely that cavemen had a nonviolent culture — in spite of being aggressive hunters like other hunter-gatherer cultures (Childe, 1936; Facchini, 1985 p. 199; Jurmain et al., 1987 p. 328) — rather than representing the violent heritage of contemporary humans, as popular belief has it. The current almost morbid interest in the Neanderthal type of *Homo sapiens* and in the possibility that these populations may have been violently eliminated by the modern sub-species, fascinates an audience habituated to violence and biblical accounts of fratricidal killing.[8]

However the hypothesis presented in Section 4.3 suggests that all forms of violence began around 10,000 BP by food-producing cultures which evolved in subtropical regions. Thus, hunter-gathering cultures of those regions, not European cavemen, were the most likely protagonists of this important event of cultural evolution, which later spread by imitation.

3.3.4. Our ancestors were very likely nonviolent

In conclusion, why should we assume that palaeolithic, pre-agricultural humans had an essentially nonviolent culture? With

the exception of cave paintings (Section 3.2.6) the few implements left behind by them is not sufficient evidence for such an inference (Jurmain et al., 1987). Plausible evidence supporting this idea comes from the following chain of reasoning:

- All palaeolithic humans were hunter-gatherers (Jolly and Plug, 1987).
- Evolution selected speech, cultural transfer and cooperation as the survival strategies for *Homo sapiens* (Montagu, 1957, 1968; Leakey and Lewin, 1993; Facchini, 1985; Futuyma, 1986).
- Too much interbreeding occurred among palaeolithic people to allow important changes in their cerebrum (limbic system) and their possible congenital predisposition toward cooperation (Ruffie', 1983; Futuyma, 1986; Haviland 1987, Leakey and Lewin, 1993).
- Contemporary hunter-gatherers had essentially cooperative, nonviolent cultures, in spite of very different geographical locations and economic strategies (Lee, 1979, 1988, Haviland 1987; Leakey and Lewin, 1993). Thus, under similar circumstances, one may suggest that palaeolithic humans adopted similar social strategies in association with appropriate (nonviolent) neurological imperatives (Section 3.3.1; Fromm, 1973 pp. 153-208).

The idea of violent palaeolithic humans, on the contrary, does not seem to be supported by either direct or indirect evidence (Section 3.2.6; Jurmain et al., 1987 p. 328; Barash, 1991 p. 160). It has so far been taken for granted by influential philosophers in the past (Section 1.2.3) without the benefit of modern information on human neurobiology and anthropology.

The reason for the persistence of this unsubstantiated idea in the current literature of political science and sociology may not be simply due to modern disciplinary barriers. For example, the public is being systematically informed about complicated advances in genetics, while kept ignorant about important knowledge on the origins of their own social behaviour. Thus, the mass media has the technology and the resources necessary to transmit rather complicated scientific issues, when the choice of doing so is made. The social mechanisms behind information policies of the media is a fascinating topic (Herman & Chomsky, 1988) but it lies beyond the scope of this review. However, the

reader may wish to ponder over it.

NOTES

[1] Catholic Eskimos have modified the Lord's Prayer into 'Give us this day our daily fish' (Pei, 1968 p. 222). Because of this variety of food-collecting economy, the term 'hunter-gatherers' seems inadequate and pre-agricultural peoples should be classified as *gatherer*-hunters, gatherer-hunters, hunter-gatherers and *hunter*-gatherers, as one moves from the tropics toward the poles (Section 3.3.2).

[2] Leakey & Lewin (1978 pp. 233-244) pointed out that in contemporary hunter-gatherers the greater the proportion of hunting and meat eating, the greater the dominance of men over women. In fact, among Polar Eskimos women play a minor role in economics and social affairs, without being necessarily subjected to the kind of structural violence found in food-producing cultures. In view of the popular myth that colonial Europeans were more violent than tropical native populations — therefore the former were destined to win the violent struggle for survival — because of meat consumption, one should be reminded that the meat-eating Polar Eskimos are basically non-belligerent. The present hypothesis on the origins of structural violence (Section 4.3) suggests that food surplus, community size and division of labour, not diet or male dominance, were the ancient initiating factors leading to violence.

[3] In this context the story of the joke played on British scientists by an anonymous forger, the Piltdown skull, is quite revealing (Walsh, 1996).

[4] TV producers discovered a long time ago that physical violence sells well (cf. violent films and law-and-order soapies). Therefore science documentaries are inclined to show fearsome dinosaurs such as *Tyrannosausus rex* (already known to viewers as *T. rex*) and Neanderthal men. Those curious about nonviolent human

cultures are left with the film *The gods must be crazy*, not the best documentation of Bushmen.

[5] The anthropological sections of the British Museum in Kensington (London) and the National Australian Museum of Sydney basically portray male European cavemen.

[6] One notable exception was the zoologist Chalmers Mitchell who presented an optimistic view on the biology of war in his 1915 book "Evolution and war", as reviewed by Crook (1989).

[7] For example, the exhibition "Man's place in evolution" of the Natural History Museum in London portrays only males and hunting to discuss the evolution from *Homo erectus* to modern *Homo sapiens* . This widespread, narrow-minded view of human evolution is questioned by some scientists (Reed, 1978; Stanford & Allen, 1991) but, again, with limited impact on the academic literature and the wider public.

[8] Even the recent review by Tattersall (1999) ends with this remark: "... we do know that a creature [Homo sapiens] armed with symbolic skills is a formidable competitor — and *not necessarily an entirely rational one*, as the rest of the living world, including *H. neanderthalensis*, has discovered to its cost." (my italics). *Genesis* , 4: 8 still dominates the public mind, even that of dispassionate scientists. But Leakey & Lewin (1993, p. 235) are more prudent: "Extinction [of *Homo neanderthalensis*] through violence or through resource competition remain competing hypotheses until direct evidence unequivocally supports one or the other, or something else entirely. It is too easy to favour a particular hypothesis simply because *it suits one's hopes for history or one's scientific turf*." (my italics).

A hypothesis on the origins of violence

4.1 The need for a working hypothesis

4.1.1 Introduction

In 1959 Karl Popper proposed a widely accepted hypothetic-deductive approach to scientific issues.[1] Although humans, as a research subject matter, are not amenable to the common philosophical assumption of testability, relatively recent statements about the intrinsic violent nature of *Homo sapiens* by Sigmund Freud and Edward Wilson (Section 1.2.3) are easily 'falsified' (Popper 1959) by the very existence of many nonviolent cultures (Bonta, 1993; Sponsel & Gregor, 1994).

If we need to address the issue of the origins of violence, beyond the anachronistic beliefs proposed centuries ago by Hobbes and Rousseau (Section 1.2.3), we should begin by formulating hypotheses and testing their validity, as Popper suggested. Without a testable hypothesis, any criticism of the widely accepted idea that humans are congenitally violent would stand on a pseudo-scientific ground.

Three hypotheses are proposed here to explain the origins of structural violence (Section 4.3), wars of defence (Section 4.4) and wars of conquest (Section 4.5). However, the core of the issue is structural violence, which in turn would establish the premises for various forms of out-group violence such as war. Thus, the term *the hypothesis* in this work refers to the hypothesis on the origins of structural violence (Section 4.3).

The chain of cause and effect described in this part of the work, does not rely on the assumption that humans have a congenital predisposition toward altruism, for which we have no evidence. The only assumption is that humans **do not** have a predisposition toward violence (as defined by Galtung, Section 1.1.3), as discussed in Parts 2 & 3. This is the significance of the term

nonviolent (see Section 1.2.4).

4.1.2 The Seville Statement is not enough

In 1986, the International Year of Peace, twenty world-renowned academics met in Seville,[2] discussed the widely accepted view of human congenital violence and concluded their business with a statement now known as the Seville Statement (Barash, 1991, pp. 140-141; Salla et al. 1995, p. 67). It states that it is *scientifically not correct* to say a) that we have inherited a tendency to make war from our animal ancestors, b) that violent behaviour is genetically programmed into human nature, c) that human evolution selected aggressive behaviour more than any other kinds of behaviour, d) that humans have a 'violent brain', and e) that war is caused by 'instincts'.

These conclusions concur with an optimistic view of human nature (Section 1.2.4). The same species that introduced violence and war should also be capable of re-discovering nonviolence and peace. This is not a fanciful suggestion, as documented by the existence of 45 contemporary nonviolent cultures (Bonta, 1993).

The issuing of the Seville Statement met with three types of problem.

Firstly, nobody seemed to want to talk about it. The media shied away from it and the academic world did not want to take up that hot topic. Secondly, the signatories took for granted that their own extant publications would have been enough to back up the statement. However, even if the ordinary people in the street had known about the Statement, they would have not rushed to a library to read about its scientific evidence. The third and more important problem was the lack of an alternative explanation. One cannot tell a public habituated to violence on TV news and fictional entertainment that humans are not congenitally violent, and leave it at that. One may ask: why then does humanity often engage in all forms of violence?

The very moment one critically addresses the idea of congenital violence in humans — as we did in the first three parts of this work — one is obliged to come up with an answer to such a simple, and pertinent, question as "What are the origins of

violence, if it is not our genes?".

4.1.3 Prevention is better than cure

Much of the literature on peace research deals with the analysis of violence itself, as if one had accepted its unavoidability and the only intellectual challenge was in trying to reduce it to a minimum.

Diplomacy, reaching peace agreements, and applying nonviolence even in the case of a ruthless opponent (Summy, 1994) are very worthy pursuits, but the causal study of violence and its prevention has now become far more important than its repression, in order to explore conditions that would prevent the manifestation of violence. In the case of violence, prevention takes the practical form of positive peace (Barash, 1991, pp. 9-11 & 459-461). In this context, the analogy with medicine is striking.

Modern medicine is obviously losing the battle against diseases, as the proportion of ill people keeps increasing. The bill for 'health' gets larger with every new budget presented by governments. 'Health' authorities are targeting the level of mortality of the big killers — cardiovascular diseases and cancer — not morbidity;[3] the latter being on the increase. The medical profession has obviously settled into the comfortable (and profitable) notion that diseases are unavoidable, and one should just try and control the damage.

As a rule, all social problems should be met with both short-term action (emergency crisis management) and long-term solutions aimed at prevention. The same approach of the medical profession seems to have been adopted by professional peace scholars and peace keepers, who concentrate on understanding wars and providing emergency crisis management, and neglect prevention.[4]

4.1.4 Violence is more than war

Even when the literature on peace deals with fundamental

questions, rather than details on violence (Section 4.1.3), too much emphasis is placed on war. Authors generally agree that war is the product of a sophisticated, hierarchically organised society (for a review see Barash, 1991). One cannot conceive that a society would wage war without the existence of a complex framework of structural violence in their culture.

Therefore, a hypothesis on the origins of violence should follow a logical line of causes and effects: from *structural violence* to *in-group direct violence*, then to *wars of defence* and subsequently *wars of conquest*. This is the sequence of hypotheses offered in Sections 4.3 to 4.5.

Section 4.2 sets the scene for the origins of violence, by discussing how *Homo sapiens* domesticated nature. There is an interesting biblical metaphor in the relationship between humans and nature and between humans and sin. *Genesis* tells us about the Fall in terms of the evil Angel, in the form of a snake, enticing Adam and Eve to eat from the tree of knowledge. Judeo-Christian readers may wish to reinterpret this Fall in terms of humans acquiring the 'evil' knowledge of food production. The banishment from the Garden of Eden may symbolise abandoning a foraging culture and settling down around artificial gardens, where the snake of violence has built its nest (see Sections 3.2, note 14 & 4.4, note 4).

NOTES

[1] The example of the elliptic orbit of planets is often used: "For Popper always took a sceptical Humerian stand on induction, as a result of which he claimed it is impossible to verify or even to confirm a universal scientific theory with any positive degree of probability. What we can do, though, is to disprove a universal theory. While no number of observations in conformity with the hypothesis that, say, all planets have elliptical orbits can show that the hypothesis is true or even that tomorrow's planets will have an elliptical orbit, only one observation of a non-elliptical planetary orbit will refute the hypothesis. Falsification can get a grip where positive proof is ever beyond us; the demarcation between science

and non-science lies in the manner in which scientific theories make testable predictions and are given up when they fail their test." O'Hear, H. (1995) "Karl Popper" in Ted Honderich (ed) *The Oxford Companion of Philosophy*, p. 702. Oxford University Press, Oxford.

[2] The signatories were: D. Adams (Middletown, USA), S.A. Barnett (Canberra, Australia), N.P. Bechtereva (Leningrad, USSR), B.F. Carter (Philadelphia, USA), J.M. Rodriguez Deldago (Madrid, Spain), J.L. Diaz (Mexico D.F., Mexico), A. Eliasz (Warsaw, Poland), S. Genoves (Mexico D.F., Mexico), B.S. Ginsburg (Storr, USA), J. Groebel (Landau, Germany), S.K. Ghosh (Calcutta, India). R. Hinde (Cambridge, U.K.), R.E. Leakey (Nairobi, Kenya), T.H. Malasi (Kuwait), J.M. Ramirez (Seville, Spain), F.M. Zaragoza (Madrid, Spain), D.L. Mendoza (Seville, Spain), A. Nandy (Delhi, India), J.P. Scott (Bowling Green, USA), R. Wahlstrom (Jyvaskyla, Finland). The Seville Statement is in agreement with Montagu (1957 pp. 12-67), Fromm (1973 pp.204-205) and with the present work.

[3] The level of morbidity is the percentage of people being diagnosed as having a certain disease, while the level of mortality is the percentage actually dying of that disease.

[4] In both cases of medicine and peace, prevention is an embarrassment for governments, because it involves the two very things they try to avoid: long-term projects and changes in life style. Governments prefer to deal with short-term superficial solutions that carry them to the next re-election, without rocking too much the boat of a politically ignorant electorate. In the case of nonviolence, there is the additional impediment that in the law-and-order issue, enforcement, not prevention, provides executive power of control. The idealists that suffered and died to introduce democracy in the 19th century must be turning in their graves at such an outcome of their efforts. They forgot to add compulsory political education (Section 5.3.4) as a necessary prerequisite of democracy. Democracy is like a car: it is not enough to acquire it, one needs a driving license to use it.

4.2 Domestication of nature

4.2.1 Introduction

Agricultural settlements were first formed about 12,000 BP in the Near East and — independently — 9,000 BP in Southeast Asia and 5,000 BP in Central America (Jolly & Plug, 1987 p. 389). The new practice of domesticating plants and animals spread in these regions by cultural evolution, that is, by imitation (Section 2.4.5).

The events described below refer to currently accepted hypotheses based on archeological evidence (Norton-Leonard, 1977; Renfrew, 1979; Haviland, 1987). A discussion on the domestication of nature represents a necessary introduction to the hypothesis on the origins of structural violence (Section 4.3).

4.2.2 Domestication of plants

The steps toward domesticating plants by tropical hunter-gatherers have probably been the following:

- While collecting kernel-bearing seeding grasses (wild wheat and barley in the case of the Near East) women must have chosen those plants with larger seeds.[1]
- Gathering women were not ignorant 'primitive' people, but sharp observers of nature. They saw their reserve of seeds growing in the ground (if left there during a temporary camp) or even in the baskets carried on their journeys.
- The increasingly drier climate of certain subtropical regions (Childe, 1952) must have made grass and other plant food gradually less available, forcing bands of hunter-gatherers to spend longer periods near a source of water.[2] This gave women the opportunity to observe the full growth of their seeds and to experiment with planting them, unwittingly carrying on the artificial selection of those with larger seeds.
- After residing in a few semi-permanent camps long enough to observe several complete cycles of plant reproduction, women learned (and passed the knowledge on to young girls) that storing

a part of the larger seeds would provide them with an easy source of food in the next camp.
- After many cycles of artificial selection these gathering women delivered to the world our current major nutritional sources of carbohydrates, i.e., the large-grain strains of wheat, barley (Old World), corn (America) and rice (Asia).

4.2.3 Domestication of animals

The steps toward domesticating animals by tropical hunter-gatherers have probably been as follows:
- When hunting men killed a nursing wild pig, wild goat or wild cow [3] they found the offspring left behind and took it back to the camp for children to play with. The real aim was to allow boys to become familiar with their future prey.[4]
- It soon became apparent that these pets represented living and walking sources of food and they were kept during the journeys to other camps.
- As they were growing, these pet animals were selected on the basis of size (with a preference for the fatter ones) and level of aggressiveness. They were probably children and women who created, after several cycles of unwitting artificial selection, the domesticated races of pigs, goats and cattle as we know today.
- Some cultures found domestication of animals so advantageous as to base their economy almost exclusively on pastoral products. Unlike farming cultures, they did not need to become sedentary and became nomadic pastoral cultures, living mainly on sheep and goats (Near East), cattle (Africa) or native herbivores (Asia).

4.2.4 Implications for Peace Studies

The invention of agriculture by hunter-gatherers led to the development of both sedentary and nomadic cultures that became dependent on domesticated plants and animals for their food supply (food-producing economy). The present hypothesis on the origins of structural violence holds that the new economy of food

production initiated a specific chain of events that caused changes which were exclusively cultural. The new society was not violent because of specific congenital characteristics of farming populations; it was an unavoidable consequence of the new economic system.

The present hypothesis on the origins of structural violence and war mainly concerns settled farming cultures, but it could be applied, with some modification, to nomadic tropical pastoral cultures. In fact, the central concept of the hypothesis focuses on surplus food and community size, not on sedentism as such. As a matter of fact, the extensive review by Wright (1965) indicated that pastoral cultures were the most belligerent ones. The discussion on the origins of wars (Sections 4.4 and 4.5) will however focus on agricultural settlements, as an unambiguous example.

NOTES

[1] The selection of larger seeds was also facilitated by the phenomenon of hybridisation that occurs naturally between wild grasses with doubling of chromosomes and polyploidy, a condition that often produces much larger kernels (Renfrew, 1973).

[2] The necessity of a climatic change for the invention of agriculture has more recently been questioned (Facchini, 1985; Jolly & Plog, 1987; Haviland, 1987).

[3] The oldest signs of domestication of cattle are from Greece and Turkey (8,500 BP), probably by artificial selection of a wild cattle called *auroch*, a large and aggressive animal that roamed the forests of Europe until the 17th century (Norton-Leonard, 1974, pp. 88-89).

[4] This practice is still popular, for example, among Amazonian Yanomamö (Chagnon, 1977) and its memory remains in the current Western tradition of giving dog pets to children, especially boys.

4.3 The origins of structural violence

4.3.1 Introduction

Domestication of plants and animals caused dramatic cultural changes in the populations adopting agriculture. Even authors who recognised the importance of agriculture in the history of violence (Bronowski, 1973, p. 88; Fromm, 1973, 185-193; Diamond, 1991 pp. 163-172) did not offer an explanation of how such an unnatural feature of our social behaviour may have come about. A hypothesis is however necessary in order to expose it to research, criticism, and possible falsification (Section 4.1.1).

Textbooks of anthropology describe the new sociopolitical organisation of large agricultural communities without offering causal explanations, as if social stratification was an unavoidable expression of our neurological design (congenital violence) within the new social environment.[1] The present hypothesis attempts, on the contrary, to explain how structural violence became the norm *in spite of* a lack of suitable congenital predisposition.

4.3.2 Agriculture caused a breakdown in biocultural evolution

The central argument of the present hypothesis on the origins of violence is that cultural changes brought about by surplus food (Sections 4.3.3-4.3.7) occurred through such a mechanism (cultural transfer), in such a short period (1,000-2,000 years in any given region), and in conjunction with such an extensive gene flow (Cavalli-Sforza, 1991; Cavalli-Sforza *et al.*, 1994) as to exclude parallel biological changes in the brain and its congenital predisposition (Section 2.4.7).

As a consequence, the basic mechanism of biocultural evolution which operated in all social mammals broke down in neolithic *Homo sapiens* , when culture overtook biology and humans created a social environment which was alien to their own neurological imperatives (Sections 3.1.3 and 3.1.4). In fact, in the last 10,000

years people in agricultural, horticultural, pastoral and industrial cultures — all producing surplus food[2] — have operated in a structurally violent society. As discussed more extensively later in this work (Section 4.3.8), this odd evolutionary process (in terms of animal biology) was made possible by the existence of a congenital predisposition toward aggression (hunting) which was creatively used for in-group and out-group violence — not what human biocultural evolution had selected aggression for.

The events listed below represent an attempt at causal explanations (Section 4.1.1 and 4.3.1) based on extant archeological evidence (Hamblin, 1975; Jurmain et al., 1987). A hypothesis should be described with the use of the hypothetical tense, but the text seems more readable with a simple — and immodest — past tense.

4.3.3 From surplus food to division of labour

The first steps leading to structural violence were probably as follows (key concepts are outlined in italics):

- Early agriculturalists had to abandon nomadic life in order *to settle near the source of food* they created, the fields of domesticated plants.

- The *size of communities* increased considerably for two concomitant reasons: the *surplus food* (leading to a higher population growth) and the necessary congregation around cultivated fields.

- Large communities were *not suitable for consultation,* one of the tools used by hunter-gatherers for nonviolent solutions of conflicts of interest (Section 3.2.3).

- Food production required the construction of permanent dwellings, tools, containers, granaries and pens. The surplus food enabled *division of labour*, the first step toward social stratification, as explained below.

- At the beginning everybody was engaged in food production and limited craft work: society was still egalitarian and probably small enough for consultation (Fromm, 1975 pp. 179-185). Later the need for field labour and animal care gradually decreased along with the increasing *efficiency of agricultural technology*, which in turn required more sophisticated craftsmanship.

- When food production became efficient enough, male individuals, who had a greater tradition of free time (discontinuous hunting) and craftsmanship (construction of weapons) gradually stopped attending to fields and animals and concentrated on the *production of artifacts*.

- A new social class appeared, the *professional artisans,* who began to barter their goods and services for food.

4.3.4 From secrets to social stratification

- Working in the fields was hard and required less skill and knowledge than craft work: *possessing knowledge* and embracing a profession became a strategy to climb the social ladder in an increasingly stratified community, in which status now provided a better life style.

- The new trends in *social stratification* carried the of breaches of social justice, which was not even an issue in hunter-gatherer cultures.

- An early trend in social stratification probably occurred at the expense of women. Since the hunter-gatherer culture already had a simple gender-based division of labour (Section 3.2.3), the transition to food production naturally saw women relegated to the role of field labourers, which was analogous to gathering. The *social standing of women diminished* as their knowledge of botany, and of the ecology for gathering became redundant and their new tasks were less prestigious than the emerging professions.

- Agriculture therefore conferred *social superiority to men* through division of labour, social stratification and withdrawing knowledge. *Craftsmen became the custodians of technological knowledge* , which provided them with a higher social standing.[3] However a few men continued to practice hunting in the neighbouring woods and plains, an important aspect for the advent of wars of defence (Section 4.4.4).

- The new society, based on the exchange of goods and services among individuals who were locked into job specialisation, did not promote skill sharing as in hunter-gathering cultures. The *secrets of one's profession* were passed on from father to son and guarded as a necessary feature of making a living: bartering goods and services for food and other goods and services.

- The new farmers found a need to understand the sequence of seasons in order to carry out agricultural tasks at the right moment. A few individuals acquired the *skill of interpreting seasons and forecasting weather* from the movement of stars and other signs in nature. This skill was particularly valued because of its relevance to agricultural practices.

4.3.5 From the fear of nature to institutionalised leaders

- A different relationship between humans and nature was established: from the *active search* for a favourable environment typical of nomadic hunter-gatherers, to the *passive dependence* on the benevolence of natural forces typical of sedentary farmers who had acquired fields and orchards. This dependency nurtured the idea of *external powers in the sky* that could dispense good or evil and needed to be appeased with rituals and sacrifices of plants, animals and even humans.

- The holders of knowledge about stars, therefore, acquired a higher social standing and special powers over other professions. This may also be explained by the fact that communities were becoming too large to accommodate consultation and were

developing a need for centralised coordination of their increasingly complex social activities. After social stratification based on gender, the power of men who knew about stars and made calendars heralded the *institutionalisation of hierarchical social structures*.

- Astronomers found themselves at the top echelon of a pyramidal system in which *a minority was able to control the whole community*.[4]

- Most stars appeared to the neolithic astronomers as fixed, while a few appeared to be moving along the sky (the planets of the solar system). It was logical to develop the idea that moving stars represented those external powers (gods) controlling seasons, the weather and food supply and, by extension, the destiny of human beings.[5] Hence *astronomers became high priests* .

4.3.6 From personal ownership to a dominant minority

- The egalitarian and sharing culture of hunter-gatherers gave way to social stratification of men on the basis of possessing something: the ears of gods, knowledge of stars, technology, good seeds, good breeders, knowledge of hunting. In fact, as division of labour entailed exchanging goods and services, *personal ownership of material goods and/or knowledge* became the main preoccupation of people in order to acquire bartering power — or capital when money was invented.

- The need to own something led to social ranking as we know it today: the 'haves' and the 'have-nots' belong to different classes, that find internal cohesiveness in similar professional activities and levels of property, and are segregated by *structural violence* (Galtung, 1969).

- The essence of structural violence was — and still is — represented by those values and institutions that enable a *minority of individuals to control the majority* of the members of the same community. This minority also had — and still has — a vested

interest in not promoting the full development of personal potential (Galtung, 1969) of the majority that belong to the lower classes; the latter just need to acquire the skills necessary to serve in the subordinate roles assigned to them.[6]

- In parallel with technological progress, large food-producing cultures developed structural violence not as a conscious evil plan of the dominant minority, but rather as an *inescapable consequence of food surplus (leading to division of labour and social hierarchy) and community size (causing the breakdown of consultation).*[7]

4.3.7 The cultural evolution of structural violence

- Violence took several different forms: from the mild withdrawing of knowledge (cultural violence) to the extreme case of physical subjugation (direct violence).[8] Humans began exploiting or oppressing each other not because of a congenital predisposition to violence, but because the new farming society provided an *advantage for the individual who practiced structural violence* in all its forms involving the limitation of other individuals' potential. In the hunter-gatherer culture, on the contrary, it was more adaptive for individuals to cooperate and to enhance the potentials of others, because food was shared (Section 3.2.3).

- Agriculture modified considerably the structure of the family, which was probably a more loose form of kinship within small communities, as among contemporary Bushmen (Lee, 1979). The need to employ a large number of children on the farm created a special concern for fertility and a need for men to gain control of their labourers (wife and children) and their property. The marriage contract (initially a commercial transaction), fidelity of the wife (to secure inheritance for the correct offspring) and paternal authority over children within a nuclear family (to maintain control of the property), all developed from the new requirements of agricultural societies. The relationship between food-producing cultures and the *patriarchical organisation of families and societies* is an important aspect of structural violence, in both

patrilineal and matrilineal descent systems (Haviland 1987 pp. 232-240; Reed, 1978 pp. 114-126).

Of course structural violence developed gradually in food-producing cultures, as discussed by Fromm (1973), who considered early agriculturalists as being nonviolent. The new violent society improved people's lifestyle, but not uniformly throughout the community.[9] Material progress and violence evolved in parallel and so did the malaise of those *Homo sapiens* living in a social environment that was not in harmony with their hunter-gatherer neurological imperatives, which did not change at the same time as the emergence of violent cultures.[10]

4.3.8 Advantages and limitations of violence

The market economy of farming cultures introduced social inequality and structural violence, but also sharpened people's mind to increase their personal wealth. For 10,000 years structural violence has been a powerful driving force behind technological progress, artistic sophistication and improvement of life style in general.

It may, therefore, be fair to say that we owe material civilisation to structural violence. At present, however, this strategy has reached a point of saturation, whereby more violence hardly leads to a better life style. In fact, the negative effects of violence (general social malaise) have reached such a level of saturation that they are rapidly destroying the social fabric of structurally violent cultures. Competition and greed do not pay any more.

Importantly, *violence still pays at the personal level*, hence the increasing emphasis on individualism during this decadent last period of uncritical violence.

Some intellectuals have already noticed that violence no longer procures advantages for society, at least not in proportion to the damage caused. This historical turning point is not much appreciated by social philosophers, but it sometimes surfaces in progressive religious thinking (Danesh, 1979). The appearance of Peace Studies as a relatively recent academic discipline (Galtung, 1990) is related to the historical turning point mentioned here.

NOTES

[1] This is, in our view, a very important aspect of the current attitude of mainstream anthropology. Social stratification and structural violence (anthropologists do not use this concept) are taken for granted. The critical reader cannot help extrapolating that anthropologists consider competition and greed as congenital components of human nature waiting only to surface when the opportunity arises in the form of large, complex communities. The possibility of a breakdown of harmony between biological and cultural evolution (Section 2.4.7) is not considered. In fact, the origins of structural violence is unwittingly concealed within the discussion on the origins of the 'State' or of 'civilisation' (e.g., Gross, 1992, Chapter 17; Bodley, 1997, Chapter 7).

[2] In the context of the present discussion it is important to define the term *surplus food* and to distinguish two different meanings. In hunter-gatherer cultures all members of the community were engaged in finding food. In food-producing societies - agricultural, horticultural, pastoral and industrial - only a certain number of individuals are engaged in food production — hence the *personal meaning* of surplus: the possession of extra food to use in exchange for other goods and services within the community. The personal surplus food led to division of labour and commerce in this new social system. Food-producing communities may also possess extra food left over after the internal exchange system and consumption have taken place, hence the *social meaning* of surplus: the possession of extra food by the community to use in exchange for goods and services possessed by other communities.

[3] The present hypothesis on the emergence of violence in agricultural societies does not necessarily require male superiority and the possible male higher congenital predisposition to competition and aggression (Groebel & Hinde, 1989), but this aspect should be explored in future research, especially with respect to the cultural evolution of hunter-gatherers living in cold regions (Section 5.2.9).

[4] The other classes might have been (in decreasing order of influence) the administrators (with knowledge of writing), the artisans (with technological knowledge), the farmers (with knowledge of domesticated plants and animals), the hunters and fishermen (with environmental knowledge) and the field labourers (with limited knowledge). The beginning of wars saw hunters climb up the social ladder considerably (cf. Section 4.4.)

[5] The special importance of moving stars and the influence of external powers (gods) for human affairs is demonstrated by the early development of astronomy in Mesopotamia 5-4000 BP, by planet/god names still used today to indicate the days of the week, by the great influence that astrology had until the 18th century on medical practice (Thorwald, 1962), and by the popular interest in medieval astrological superstition which is still surviving in our modern 'educated' societies (the 'stars' of popular magazines).

[6] This seems to be a major necessity of large, structurally violent communities. Different rhetorics have appeared throughout history to justify the subordinate state of lower classes. Generally speaking, aristocracy has used religious arguments (King for the will of God and coronations by popes or bishops) and, more recently, biological determinism (upper classes are more intelligent and should be in charge). Biological determinism is still an unspoken implication in the education system: the current competition among students only sustains the educational superiority of upper classes. Proper attention to the individual needs of students, beyond minimalist training, would lead to a more standardised performance of all students with a normal healthy brain.

[7] There is firm evidence that violence appeared as an inescapable consequence of food surplus and community size: the development of both agriculture and structural violence could in fact not have happened independently in three distant regions of the earth just by coincidence (Section 4.2.1).

[8] All forms of cultural, structural and direct violence have already been defined and reviewed by Galtung (1969; 1975, pp. 109-125; 1990). It is likely that high priests used their social standing to enforce obedience and to correct behaviour in the interest of the dominant minority (invention of the police force). The Old Testament seems to support this view (Numbers 25:6-13).

[9] The same pattern of an increasing gap between rich and poor is typical of the current wave of economic rationalism, except that Mr Market, when unleashed by greedy stakeholders, can be much more damaging than neolithic rulers.

[10] People's malaise in food-producing cultures, which is further discussed in Section 5.2.3, finds its most interesting expression in religion. Pre-agricultural and contemporary animism and shamanism are spiritual expressions of unity with nature and, more importantly, they lack an ethical component (Noss, 1974). The development of agriculture correlates with the appearance of institutionalised religions characterised by substantial ethical instructions. Instructions on how to behave were indirect and implicit in polytheistic religions, where the different gods represented role models for specific social aspects. Monotheistic religions and Confucianism provided direct and explicit behavioural instructions. Interestingly, the common ethical message revealed by the founders of these religions is *do unto others as you would have others do unto you*, almost a reminder of the natural nonviolent behaviour which humans had lost the moment they domesticated nature (Section 3.2, note 14). Unfortunately it is not clear whether 'the others' should include neighbouring nations. The Old Testament (mostly from Numbers 31 to Judges 21) does not seem to think so. Protochristians were clearly nonviolent, but the 'just war' doctrine appeared soon after Christianity became the official religion of the Roman Empire (Barash, 1991 p. 447).

4.4 The origins of wars of defence

4.4.1 Introduction

As discussed in Section 4.1.4, the most important aspect of a causal explanation for the origins of violence in humans is the origins of structural violence, that is, of those ideas and institutions that transformed small equalitarian hunter-gatherer cultures into large stratified agricultural (or pastoral) cultures (Section 4.3). In fact, this was the first cultural change to occur in time.

Now that we have set in place the structural requirements for systematic out-group violence, we can attempt an explanation for the origins of war. Most discussions on war, unfortunately, take structural violence for granted — as one would expect in light of the pervasive belief in violent congenital characteristics. Besides, there is probably a difference between wars of defence and wars of conquest insofar as their origins are concerned.

4.4.2 The idea of a genetical predisposition to war is historical myopia

The existence of war[1] since the beginning of recorded history led most social philosophers — especially those influenced by social Darwinism (for a review cf. Barnett, 1988; Crook, 1989) — to speculate that killing each other is a natural characteristic of humans and that wars are part of a general struggle for survival. By referring to man as a 'wolf to man',[2] Freud asked emphatically "Who, in the face of all his experience of life and of history, will have the courage to dispute this assertion?" (Freud, 1961, p. 58).

This myopic and pessimistic view of human nature has paralysed, for centuries, any attempt at finding alternatives to the violent solution of international conflicts of interest. If, on the other hand, one takes the sounder approach of analysing the plausible biocultural and cultural evolution of humans preceding recorded history, one comes to a different conclusion.

4.4.3 From High Priests to King Priests

The following list of events that probably led to the invention of war by agricultural societies is speculative, but the hypothetical tense of verbs has been avoided to render the text more readable.

- When the first large food-producing communities began to appear in the tropical regions (Section 4.2), most humans were still living as hunter-gatherers. When nomadic bands arrived near agricultural settlements, they found it quite natural to 'gather' crops and 'hunt' animals found in the precious gardens and zoos of early farmers.[3] They did not mean to steal — a concept quite alien to them — they just did what they had been doing for 40,000 years. The newly settled farming communities were confronted with the new social realities of *communal property and external threats*, but they had lost the mobility, consultative skills and rituals, that had earlier prevented violent solutions to conflicts of interest among hunter-gathering bands. The farmers had to stay put and defend their property.
- High priests were already in charge of dealing with external threats (the mystical forces of nature) and they naturally became the leaders in the struggle against the new unwitting external threat (of hunter-gatherers). The cultural setting (social stratification and structural violence) was already there to *elevate one of them to the role of King-Priest* with a consolidated spiritual and military authority.[4] Structural and possibly physical violence must have been necessary to keep the 'have-nots' within the lower social class.

4.4.4 From hunters to soldiers

- The material tools for physical violence were already available in the form of hunting weapons. Division of labour implied that only a minority of men continued to hunt in the neighbouring woods and plains (Section 4.3.4). They were transferring, only to their sons, their knowledge about weapon craftsmanship and animal behaviour, the secrets of their profession (Section 4.3.4). The responsibility of *defending the settlement's properties* obviously fell on the hunters, who were coming into contact with the offending

hunter-gatherers outside the perimeters of the settlement.[5] They were therefore elevated to the rank of the military elite, with the King-Priest as their leader.
- Hunter-gatherers, lacking a hierarchical structure and a tradition of violence, would have been no match for the *hunter-soldiers*. The practice of domesticating nature therefore spread to the surrounding regions, probably through a combination of cultural imitation on the part of hunter-gatherers, and/or violent displacement of hunter-gatherers by farming settlers.
- *Military aristocracy* soon became the top ruling class in close association with the high priests.

4.4.5 From habituation to institutionalisation of killing

Humans do not have a natural predisposition to kill other humans and even now powerful cultural mechanisms are necessary to create professional killers (Barash, 1991 pp. 144-152, 184-188). Therefore physical violence between neolithic hunter-soldiers and hunter-gatherers must have escalated slowly: from accidental wounding to accidental killing, which then became habitual killing and eventually instigated killing.

The instigation to kill was probably a cultural development born out of isolation, ignorance about 'other' people and a primitive form of racism.[6] It was therefore easy for the King-Priest to promote the idea of an external threat by alien creatures, hence the analogy between killing animals for food and *killing pseudo-humans to protect food*.

4.4.6 The roots of war lie in structural violence

The current anthropological (Haas, 1990), sociobiological (Van der Dennen & Falger, 1990) and peace research (Barash, 1991) literature on human violence focuses too much on war, while war is only the end product of a long chain of causal events that probably starts with withdrawing knowledge (Section 3.4.3). To

understand war it is therefore necessary to trace its roots in the evolution of cultural and structural violence. It should be emphasised that the factors responsible for the cultural evolution of in-group violence must be different from those responsible for out-group violence (wars), although wars could not have developed in the absence of a pre-existing culture of structural violence within communities.[7]

Eibl-Eibesfeldt (1979) reported cases of 'wars' between different cultures of Bushmen and between Eskimos and their neighbours. If the cases of warfare described by the above author were not due to acculturation (Wilmsen & Denbow, 1990; Yellen, 1990;) followed by severe ecological constraints (Homer-Dixon, 1993), they would represent evidence against the simplistic view of a nonviolent nature of humans, and in favour of the more sober conclusion that hunter-gatherers had the lowest level of belligerence (Wright, 1965, Galtung, 1976 pp. 25-37) without being absolutely immune to war (Section 3.2.4). Their low level of belligerence was not due to the lack of a State system, as often suggested, but to the lack of structural violence. The frequency and destructiveness of 'primitive wars' between horticultural communities with virtually no State organisation (Chagnon, 1977; Barash, 1991 pp. 159-173) support this suggestion.

NOTES

[1] War is here defined more broadly (for example, in Haas, 1990 p. 1) as the organised and institutionalised action of a community attempting to impose its own solution in a conflict of interest with another community. Thus a war can be equally waged with physical, cultural or economic weapons.

[2] The expression *homo homini lupus* was first used by Plautus and then by Hobbes.

[3] The origins of war due to cultural conflicts between hunter-gatherers and settled agricultural societies was briefly mentioned by Bronowski (1973 p. 88). Similar situations were re-created by

colonial Europeans who settled in lands populated by hunter-gatherers. For example, the unwitting 'hunting' of cattle by Australian Aborigines seemed a legitimate justification for European settlers to kill indiscriminately indigenous people up to the 1920s.

[4] The double character of chief priest and king of early leaders in agricultural city-states was obvious since early civilisations such as the Sumerian civilisation (Hamblin, 1975 pp. 106, 111-115) and continued later in the ancient Egyptian and Jewish cultures. This trend was taken to its extreme, for example, by Roman and Japanese emperors who were considered gods. Christianity promoted the concept of the divine right of Kings who reign by the grace of God. While emperor Hirohito of Japan renounced his divinity in 1945, Queen Elizabeth II of U.K. remains the Head of the Anglican Church, arguably the last King-Priest. The association of religion and its institutions with the present hypothesis of the origins of violence is not intended to discredit them. Section 5.1.5 carries a discussion on this topic that stresses the distinction between spirituality, religion and Church. Other pertinent references are in Sections 3.2.3, 3.2.14, 4.1.4, 4.3 notes 6 & 10, 4.3.8, 5.2 note 6, 5.2.8, 5.2.9 point 6.

[5] The hunters were also the only members of food-producing societies who continued to express the natural congenital aggressiveness of male *Human sapiens* , originally evolved for that activity. The cultural adaptation of applying this natural asset to a unnatural task (killing fellow human beings) was inevitable within an already structurally violent society (Section 4.3, note 8).

[6] Early racism may have developed from the inability of farmers to identify themselves with those human-like people who had no dwellings, no clothes, no tools and property. Some authors consider the cultural development of war simply as a consequence of pseudospeciation, i.e., agriculturalists did not recognise hunter-gatherers as human beings any more (Melotti, 1985, 1990; Van der Dennen & Falger, 1990).

[7] As a matter of fact internal cooperation is also needed to wage war against an external enemy (Barash, 1991 p. 210). But in this case cooperation must be of the uncritical and impersonal type, the one imposed by cultural violence (Galtung, 1990). This point was not missed by post-war educators in the U.S.A. who introduced a strong promotion of individualism in the school curriculum, after wondering how Hitler managed to rally so many fellow Germans behind himself.

4.5 The origins of wars of conquest

4.5.1 Introduction

The structural violence characteristic of neolithic large food-producing communities would have influenced their relationship with other similar communities, their foreign policy, in a sense.

A probable set of events leading to wars of conquest is suggested below. This part of the work is entirely speculative, but it may stimulate research to provide evidence for or against the hypothesis suggested.

4.5.2 From trade to taxation

- Organised military defence (Section 4.4) would have been invented in some communities before others. Agricultural settlements that had not yet organised an efficient army were likely to be offered *defence by their militarist neighbours in exchange for goods or services*.
- The supply of military services may have been just a commercial transaction when the agreement was renewed at every instance of need, but the practice had the obvious *potential for taxation*. It soon became apparent that rewards could be collected regardless of a continuing need for protection. Unarmed communities could not defend themselves against their 'protectors' and thus taxation was instituted.[1]

4.5.3 From demanding loyalty to economic necessity

- Occasionally an exploited community rebelled against taxation and its people were punished for *lack of loyalty* and alleged connivance with the putative enemy. The ultimate punishment was military annexation, which in turn led to wars of conquest.
- Besides direct military action, various forms of structural violence developed as a consequence of differences in the

economic and military capability of neighbouring communities. One example could be the *imposed trading*, the contemporary jargon in economics being 'opening up'.[2]
- Another occasion for food-producing cultures to wage wars against each other was when nomadic pastoral communities were moving into a fertile region already settled by farming communities.[3]

4.5.4 The imperatives of structural violence

A small number of people who dominate and exploit a large community need two structurally violent conditions to remain in control: internal ignorance and stress, and an external threat.

These political imperatives of hierarchical societies led to the situation that existed throughout historical times: the superior lifestyle which agriculture and industry would allow (food, technology, education and leisure) is withheld from the majority in order to keep them poor, ignorant and dependent.[4] The fear of an external threat is maintained by waging wars regularly, or by perpetrating structural violence between nations.[5]

NOTES

[1] More recent examples of imposed protection are the exploitation of the peasantry by feudal aristocracy in the Middle Ages, of shop keepers by the mafia and of tax-payers by the redundant bureaucracy of most States.

[2] For example the USA imposed trading by military force to an isolationist Japan in the early 1800s.

[3] The appropriation of the 'promised land' by the pastoral ancient Israelites, who had emigrated from Egypt and were settling down to agriculture in Palestine, is accurately described in early sections of the Old Testament (e.g. Numbers 21:21-35). In this case the rhetoric used for instigated killing (cf. Section 3.3.3.) was that the

'others' (heathen) were worshipping wrong gods.

4 This has been achieved not only through inequitable distribution, but also by diverting resources toward massive projects of national prestige, such as the ziggurat at Ur, the Great Pyramids at Giza, the Colossus of Rhodes, and of course 'great' wars of conquest. The most recent development of this old strategy is controlled economic recession: by maintaining a constant anxiety about employment and spending power - the 'economic insecurity' of Galbraith (1969 pp. 45, 95). Western governments have recently generated long-term conservatism in their large middle class. Hence the perhaps unwitting symbiotic relationship between mild economic recession and conservative trends which have dominated the last two decades.

5 Avoidable military confrontation is still providing substantial popularity to recent leaders and a justification for continuing militarism. A recent example was the rhetoric (Islamic aggressiveness) behind the war to liberate Kuwait, which followed closely the loss by the Western world of its traditional external threat (Communism). More subtle structural violence is currently maintained between industrialised countries through economic wars (e.g. U.S.A v. Japan) which in the past would have led to physical wars (e.g. Rome v. Carthagen).

Now and the future

5.1 Popular beliefs about violence

5.1.1 Introduction

As a way of summarising the main points discussed so far, we will address here some popular beliefs on human violence. This will expose the reader to those debates the author was engaged in with students during ten years of teaching Peace Studies, and with friends during many convivial discussions over spaghetti and wine.

A discussion on popular beliefs on humans, aggression and violence offers a stimulating cornucopia of ideas and counter-ideas, but it also reveals the level of ignorance with which one normally addresses these issues. Can we continue to afford such ignorance?

5.1.2 Human beings are congenitally violent

As indicated in Section 1.2.3, this pessimistic view of human nature dominates the academic literature, popular accounts on violence and the perception of lay persons. It also represents the underlying, albeit unspoken, philosophy of key social institutions such as the judiciary, law enforcement, corrective services and defence systems.

Expressions such as "That is just human nature" or "Human beings being what they are ..." are very frequent in both the popular and academic literature. They all derive from a fundamental belief that human beings are congenitally violent. Hence, a brief analysis of this statement is in order at this point.

What does one mean by the term *human beings*? The first mental picture generated after such a question is usually about oneself. When asked to consider more widely in space and time,

we may expand our mind and include other cultures and people living in the past, even in antiquity. Very few of us, however, go as far as visualising pre-historical humans. This is important, for if we restrict ourselves to the common myopic view of historical humans, then the statement in question is correct: humans have been actively involved in killing each other since history was recorded 7,000 BP. This may be the single most important explanation for the widespread acceptance of the notion of human congenital violence. The way history is taught at school — dates, kings and battles — does not help to see it otherwise.

However, such a restricted view of human beings does not account for about 90% of the time humans have lived on earth (Section 3.1). As there is no evidence of violence being perpetrated before 10,000 BP, pre-historical *Homo sapiens* were not human beings, according to the statement in question. Such a conclusion would be very difficult to defend in the light of modern biology and anthropology.

But, in the mind of the the lay person — but not of a scientist — negative evidence is weak evidence. Therefore, let us consider contemporary 'other cultures'. If human beings are congenitally violent, the many nonviolent cultures described in the literature that spans from Kropotkin (1905) to Bonta (1993) must be made of creatures that are not human beings. Thus a Kalahari desert Bushman is not a human being, a Semai Malay is not a human being, and an Amish in Pennsylvania is not a human being. Such a thesis would be very difficult to defend by any anthropological standard.

What does one understand by the term *congenitally*? The first answer that comes to mind is that it has something to do with the subconscious, spontaneity, instinct and the like; all concepts that have their own validity, but have little to do with the biological concept of congenital characteristics and/or with humans. As far as instincts are concerned, *Homo sapiens* represent an advanced stage of the evolutionary strategy of reducing instinctive behaviour in primates (Section 2.3.9). Moreover, social behaviour in particular cannot be defined by congenital information, let alone the genetic code for proteins (Section 2.4.8).

The existence of the subconscious as a causal component of our

behaviour was the single most important contribution — arguably the only one —of Sigmund Freud to psychology. But the subconscious owes its definition to infant or early childhood experiences, often mediated by nonverbal communication (Section 2.3.10), not to congenital information (embryonic and genetic programs). If violent behaviour is congenital, then soldiers are not human beings, because they have to undergo very intensive training in de-personalisation and assault techniques, in preparation for the battle field — or murdering women and children, whatever the orders may be. This thesis too would be very difficult to uphold by any anthropological standard.

What does one mean by the term *violence*? In light of the influence of the mass media, the first mental image retrieved by this question is direct physical violence, such as wounding and killing. As a matter of fact, physical assaults and murders occur systematically only within a complex cultural framework that directs how one should behave, promotes this behaviour and protects the actor — the concept of structural violence (Galtung, 1969). As acts of cooperation, sharing and helping others represent, instead, the bulk of our day-to-day behaviour — even within a structurally violent society — implies that most of us are not human beings. The reader will simply dismiss this idea as absurd, without relying on any particular anthropological concept.

5.1.3 Even children are violent

A very popular argument used to support the idea of congenital violence in humans is the one based on children's behaviour. One intuitively reasons that if children display a certain behavioural trait, this must be part of an ancestral, congenital characteristic of humans, not a cultural item imposed by education and peer pressure.

The origins of this interpretation of children's behaviour go back to the disgraced theory of atavism, which was popular at the time of Freud (Section 2.4.4). It is also based on a poor understanding of human developmental neurobiology. The outmoded view of the human brain as a stratified and hierarchical

system of functional regions has now been corrected with the modern idea of connectivism, i.e., functions are related to long pathways, not regions. Consequently, the human brain does not grow in layers like a cake put together at the bakery. According to this idea, the animal-like ancestral regions (the hypothalamus and circle of Papaz) would be laid down first; the semi-divine top layers (cerebral cortex) would follow to keep in check brutal instincts and irrational behaviour. This is the erroneous and outmoded view of the infant brain, not under control as yet, freely displaying ancient atavisms which will then lurk in the adult brain throughout life — the animal in us, ready to spring up when we are off our guard. No neurobiologist would subscribe to this view, but the public at large is left to believe so, while popular pseudo-science plays on these fantasies (Section 3.3.3).

It is true that an infant's brain is not fully developed, but the timetable of development does not recapitulate evolutionary situations of the past,[1] (cf. illustration p.59). Children easily break into aggressive behaviour for the same reason that they easily fall down: they are still in the process of acquiring skills. Jean Piaget explained that children go through a period of utilitarian individualism, before acquiring their cultural traits for socialisation (Sections 2.3.7). The skill of understanding other people's mind and developing nonviolent strategies to resolve conflicts of interest (win-win solutions) requires social experience. As teenagers, they will be initiated to the rules that make them women or men, they will then be exposed to discussions by elders engaged in negotiations (Section 3.2.3), and eventually become members of a nonviolent community, that is, sophisticated communicators rather than brutal winners or losers.

After filming Kalahari Bushman children pushing each other and playing practical jokes, Eibel Eibesfeldt concluded that aggression is congenital; with Piaget one can more correctly say that social behaviour was not developed as yet. Therefore, a child is not an unruly ancestral machine, but an incomplete human being. A child cannot be used to draw conclusions about biological determinism.

5.1.4 Violence is caused by a lack of resources

A very popular explanation for violence is that lack of essential resources contribute to aggression in humans, as in rats and chimpanzees. The answer that we are not rats (Section 2.4.3) may seem an easy way out, but it is not so. The degree of urgency makes a difference. For serious but non-life threatening situations, human societies have many strategies and institutions to cope with individuals lacking resources, such as charities and specific support groups. In cases of extreme urgency and situations of group panic, physical aggression and grave egoistic behaviour may occur, although it is not a rule. In these very rare instances, we are dealing with individual cases of low level of socialisation, more than a general trait of human nature.

But important anthropological issues are associated with lack of resources, which makes this question quite interesting. For example, !Kung bands are organised around water holes — very important resources in a desert. The use of water holes and conflicts of interest about water resources are regulated by complex traditions, rituals and negotiations, not by violent solutions (Section 3.2.3). The tradition of hospitality and sharing resources with a stranger has been with humanity from ancient history to contemporary societies (Kropotkin, 1914). Moreover, the strategy of hunter-gatherers when facing a severe lack of resources was dispersal, not fighting (Lee, 1979). The concepts of private property, individualism and egoism, well ingrained in structurally violent societies, render the popular association between lack of resources and violence an acceptable explanation.

5.1.5 Violence is caused by religion

In light of the nonviolent teachings of all mainstream religions (Section 4.3, note 10) this belief would seem theoretically unsound, but it is understandable in practice. As so many soldiers and civilians have died during wars fought to defend religious beliefs, religion can easily become in people's mind a causal factor of violence. In reality the idea of religion causing violence comes

from misunderstandings about both religion and the causation of violence.

A given religion is characterised by a particular code of beliefs mostly founded on a theistic view, which provides the philosophical and moral authority to *religare* (Latin 'to bind') people to God and devotees among themselves. It is this ethical and political (group identity) component that makes religion a powerful motivation for out-group aggression. Religion may be a strong motivational factor but not a cause; it can be exploited by the structurally violent institutions responsible for war, but it cannot be the initiating factor. Its interpretation as a causal component of violence comes from a confusion between religion and Church.

A given Church represents the earthly administrative institution that oversees the correctness of beliefs and rituals, and protects a given religion from moral or political threats. The association between religious authority and civil authority was a physiological one when agricultural communities were first formed (Section 4.3). This association was confirmed throughout history, with bishops standing next to kings when flags and cannons were blessed.

In light of the above, religion as such should be absolved of being a primary cause of war. The primary cause of war is structural violence (Sections 4.4 & 4.5), not religion.

The minority that has a vested interest in conducting wars needs a theme for propaganda (Section 4.5, note 5). This minority uses religious feelings, like other group identity symbols, to move the population into a fighting spirit, because humans have no natural instinct to kill other humans (Sections 2.6.3). If they don't take up arms — the propaganda goes — the enemy will destroy our temple, rape our women, kill our children and take our cattle. The possible imposition of a different religion is always the most powerful, all-embracing threat to group identity — and the bishop agrees. People on the other side of the border are told exactly the same thing; a few raids in the countryside by thugs and militia will bring the message home. Should we really believe that religion caused the war in the first place?

5.1.6 Violence is caused by hormones

The relationship between levels of testosterone and aggression is well established in experimental psychology, because aggression increases when the hormone is administered to male rats.

Erroneous interpretation of causal relationships in science are well known, as in the description of the etiology of diseases, for example. The chain of cause and effect is generally complex in biomedical models; one can have an initial cause, which is enhanced by the effect of subsequent lesser contributing factors; all these effects act on different functional parameters, which can be mediated by neurotransmitters or enhanced by hormones. The final outcome (behaviour for example) is the result of a long chain of subsequent causes and effects. By tempering with one of these intermediate mediators one can alter results. But — and this is the main point — the mediator tempered with can only enhance, reduce or suppress specific behaviour, *not define* it in the first place and initiate a different one. For example, injecting a rat with testosterone will not produce aggression, unless a mouse (the initiating factor) is introduced into the cage. Hormones do not define behaviour; they are only modulators, not causes.

In humans in particular, post-natal learning about modalities of aggression defines violence and testosterone only enhances, not causes, aggression.

5.1.7 Violence is due to both genes and cultures

This is probably the most common position in the contemporary literature dealing with the causation of violence and war (for a review see Vogel, 1989 and Wrangham & Peterson, 1997). Super-specialised academics, faced with a complex set of interdisciplinary arguments and the tiresome nature/nurture debate, find refuge in this superficial compromise: human behaviour generally, and violence in particular, are due to both congenital (genetical, say some) and cultural factors. The discussion then revolves only around quantitative considerations about the evidence from twin studies (Martin et al., 1986). A

popular position is the 50:50 allocation (Baron & Richardson, 1994).

The intuition that congenital factors should play some role is correct, but the way it is formulated allows the perpetration of 19th century ideas of biological determinism — still of strong political appeal to conservative minds. The trouble with the 50:50 position is not so much in the naïvité of numbers, but in considering nature and nurture as being *qualitatively* the same, while they are not (Section 2.5.9).

Congenital factors in the development of the nervous system (*neurological imperatives*) only provide individuals with a predisposition, not specific behavioural traits (Sections 2.5.8 to 2.5.10). Any developmental biologist would admit that the genetic definition of proteins cannot, by itself, define behaviour; it provides molecular tools (when told to do so) within a stereo blueprint process that defines brain and behaviour (Sections 2.2.4 to 2.3.12). What ultimately defines specific human behaviour is the specific culture to which the child and the adolescent (and the adult) are exposed (Sections 2.2 to 2.4). This information system is so powerful in our species that it can generate the required behaviour in spite of unsuitable congenital predisposition (Section 2.5.12). The latter only contributes in terms of time of acquisition (the *time factor*) and level of performance (the *skill factor*); it does not generate specific behaviour. If a certain culture offered a genuine variety of behavioural options, congenital predisposition would then have the opportunity of playing a more significant role in defining behaviour; but this practically never happens.

In light of the above, the 50:50 position currently dominating the 'enlightened' literature on the origins of violence is naive (to be charitable) or, rather, ignorant about developmental neurobiology.

5.1.8 War is an evolutionary strategy

This position is popular among biomedical scientists, something that can be presented eloquently at tea time, the morning after watching the previous night's TV news on the horrendous scenes of militia slaughtering women and children. It relieves the anxiety

of sharing common humanity with both sides of the story (of the victim and perpetrator) and offers a safe scientific explanation.

The chain of reasoning being: humans are the result of an evolutionary process; population diversity and natural selection is the strategy used by evolution to adapt life forms to a changing environment; selection works by allowing the fittest to mate and pass on their more adaptive genes (so far these notions are compatible with modern biology, Section 2.4); when competition occurred, the strongest humans won; genes for aggression provided human ancestors with a winning edge; humans pay the price to nature for their successful existence by having outbreaks of violence, when law and order fails to suppress it; in the absence of a strong government, humans do kill each other. This is not a satirical *exposé*, but a summary of what this author has appreciated from distinguished colleagues.

This line of thought is historically interesting. The first half refers to well accepted modern biological concepts. In the second half, the mind gradually slips into outmoded themes, and these become more obsolete and antiquated as the reasoning reaches its conclusion. The idea of humans being selected on the basis of competition is from hard-core sociobiologists (Wilson, 1975), the gene for aggression acting in humans is from Lorenz (mid-20th century), humans paying a price to nature is from Huxley (end of 19th century) and the need for a strong government to prevent violence is Hobbes' contribution (17th century). A clear regression toward antiquity; only Plato is missing.

One wonders why learned scientists are able to apply their professional knowledge only to a certain point, where humans are concerned? They would go all the way with other species (Section 3.1.2), but they seem to want to avoid disturbing issues about humans — such as a nonviolent ancestry — and they slip into safe outmoded positions. The beginning of the reasoning provides scientific respectability, the end provides a soothing idea: we cannot change society, please don't even try (Section 5.3).

5.1.9 History proves that violence is a general human trait

This argument is much less 'scientific' than the preceding one (Section 5.1.8), but it goes in a similar direction. One could add TV news, with violence brought home from exotic distant places, and the argument of the universality (in time and space) of human violence would seem to be sealed.

The critique of a myopic view of *Homo sapiens* and of the generality of violence was mentioned above (Section 5.1.2): prehistorical humans were very probably nonviolent and much of human behaviour is cooperative and nonviolent. In this section we address the idea, often put forward in popular accounts, that wars waged in the past helped to control population growth and provided a winning edge for more successful cultures, thus civilisation marched on (literally).[2]

The very popular idea of war being evolution's answer to overpopulation (reviewed in Groebel & Hinde, 1989 pp. 10-22; in Haas, 1990 pp. 26-55; Barash, 1991 p.138-141) is not supported by historical evidence. In antiquity wars were fought with relatively small armies; casualties in those cases did not affect the total population of warring nations. In the Middle Ages armies were still relatively small and, more importantly, rarely led to the killing of a substantial proportion of combatants. The great noise generated by iron-clad knights was not matched by a proportionate number of cadavers on the ground.[3] The real killers were cholera and the plague, not wars. They effectively wiped out about one third of the European population. Moreover, the hundreds of thousands of French soldiers who died in the Russian campaign of Napoleon were mostly killed by General Winter, not in valiant battles designed to select the strongest.

It was only in the 19th century that the introduction of automatic weapons and raids on civilians began to cause substantial war casualties. But even the casualties of the first world war (about 10 million) were no match for the Chinese flu that killed about 20 million in 1918. The second world war did better (50 million) and the next one might do even better. But will the fittest soldiers survive? Is the battle field really selecting for

aggressiveness?

The idea that a battle field helps natural selection for aggressiveness also stands on no firm evidence. Compulsory military service is too recent (about one hundred years to date) to have an evolutionary impact of any sort. Before that, men enlisted in the army to escape the law, for adventure, for the pay, and in the hope of looting and raping; not a good selection of specimens with which to play natural selection for a valiant, soldiering humanity. Moreover, those who went voluntarily to war must have been the ones congenitally predisposed to aggression. The 'cowardly' ones might have been those who stayed home to pass their genes on to their children. Once on the battle field, the most aggressive ones must have run to the front line and contributed to more casualties than the less aggressive ones, who stayed behind, later raped the enemy's women and also went back home to pass on their lesser genes to their offspring. Hardly a good system for natural selection of aggressive genes.

Besides war, in-group violence against political opponents does not support the idea of adaptive natural selection. Whistle blowers, trouble makers, outspoken opponents of authority are likely, if anything, to have a congenital predisposition toward aggressive behaviour. Throughout history they have been marginalised, tortured, imprisoned and killed. Obedient public servants, obliging persons who turned a deaf ear at the right moment, shy operators who worried about consequences for their family, were all rewarded with good careers and passed on their lesser genes to their children. Hardly a good system for natural selection of aggressive genes.

5.1.10 More pop beliefs about violence

A popular theme is that the media is the cause of violence in society. Concern for violent news on TV and newspapers, violent films on TV and in cinemas, and violent information on the Internet spring up every time serial murderers and child-murderers are forced upon people's minds. Then it falls into oblivion, as violence pays a lot to a minority who does not intend

giving up profits. The mistake in causality one makes in blaming the media for violence is not different to that of blaming hormones (Section 5.1.6). Moreover, blaming the media is also hypocritical, because we support tabloids and TV with our money, while we do not order testosterone over the counter (unless we are competitive sportsmen).

The idea that capitalism promotes violence comes from romantic socialism. It is technically correct, but it is affected by the same mistake in causality related to hormones and the media discussed above, and fails to recognise the primary role of structural violence. Unfortunately, historical communist regimes are the only practical experiments we had in theoretical socialism; they demonstrated that capitalism has no exclusivity for violence.

The idea that violence is caused by the State comes from traditional anarchic philosophy. It actually represents a tautology: neolithic hierarchical cultures, where the minority controlled the majority — the embryo of the State — appeared in parallel with structural violence (Section 4.3, note 1).

5.1.11 Ignorance about the origins of violence survives well

The education of the public proceeds in a patchy way. As soon as the computer industry introduces new technology, an obliging public is willing to be trained in complicated matters such as modem, pentium, ports, and various compatibilities. Resources for training are abundant and people are prepared to instruct each other with enthusiasm over a beer or at the bus stop. Obviously, somebody has a vested interest in keeping the public interested and educated.

The opposite happens with some important issues such as nutrition, the environment, and, of course, human nature. In these cases medieval ignorance about rather simple concepts happily survives side by side with modern advanced knowledge about technology. No urgency to inform is evident, the need to reach a consensus on those issues is not felt; the opposite may be true. Incorrect information is tolerated in the name of freedom of

speech, and ignorance is respected in the name of freedom of opinion.

One may wonder how one can account for this continuation of folk beliefs on the causation of aggression and the origins of violence. One general explanation could be put forward. The idea that we are not congenitally violent — and perhaps even predisposed to nonviolent solutions — has such far-reaching implications for social institutions (Section 5.3) that it may retrieve subconscious fears of radical changes.

So much for the wider public. University students have access to those revealing simple concepts in their first-year textbooks of neurobiology and anthropology. What keeps them from exploring this topic? An answer could be found in recent educational trends. Students are now trained for very specialised tasks, not educated any more; so the social implications of science are lost in a web of technical rituals. A degree is needed to fill a precise skill required by the community (Section 1.3.2), not to question or promote a better humanity (Section 4.1, note 1). Moreover, social ideals are not fashionable any more and students tend to play down issues of social responsibility in the name of 'realism'.

What about academics? The realisation that we are not congenitally violent may raise the frightening prospect of the ethical obligation of doing something about it. This author felt this urge ten years ago, when he moved from the safe bench work of experimental biology, to the scary world on the border between science and the humanities. Getting committed in interdisciplinary studies is tiring and unrewarding, while digging your disciplinary trench even deeper is rewarding and cozy — less work too. Becoming a world expert in a microproblem tends to make one quite ignorant in the process, but it provides one with a clear label; one has a home. The academic no-man land of interdisciplinarity is uncomfortable, but one can fly high and have fun. One can also also fall harder (Section 5.2.9).

NOTES

[1] The theory of recapitulation was proposed by Ernst Haeckel in the late 19th century. He observed that embryos of different species look like each other at early stages, while at later stages one begins to discern the primordia of features typical of different species. He also observed that at early developmental stages embryos display features that are reminiscent of early life forms, but later these are replaced by more complex organ systems typical of their own phylogenetic level. Haeckel therefore concluded that development recapitulates evolution or, in other words, ontogenesy recapitulates phylogenesis. Nowadays the theory of recapitulation is considered an over-simplification and is not enunciated in the same terms.

[2] This was the pet argument of colonial powers in the 18-19th centuries. The same powers subsequently discovered that one does not need to use an army to conquer others. It is safer and cheaper to invade their markets — hence the de-colonisation in the 20th century.

[3] So many times German emperors descended into Italy to find local City-States massing armies larger than his, and he gave up on war.

5.2 Implications for Peace Studies

5.2.1 Introduction

As indicated in the Preface, this work is for students and academics in the field of sociology and political science. The style of presentation is interdisciplinary (Section 1.1.1). The aim is to gain a holistic understanding of human beings, their behaviour, and the origins of all forms of violence.

We believe that peace and conflict resolution studies are about people, and all aspects of modern knowledge about them should be used by scholars of this discipline. Here we consider the implications of Parts 2, 3 & 4 for Peace Studies.

5.2.2 Peace Studies is about human nature

A common view of the aim of Peace Studies is the reduction of violence and war. But this is a restrictive view. An important field of research is actually concerned with more fundamental aspects: the establishment of positive peace (Barash, 1991)
Research on *positive peace* goes beyond the temporary reduction or absence of violence, to explore ideas about the establishment of human conditions that would promote the full development of personal potentialities and cooperation among members of a community. The design of positive peace necessarily involves proposals to change some traditions, values and attitudes; it deals with prevention (Section 4.1.3), a gradual nonviolent revolution (Section 5.2.7) and new social models (Section 5.4).

In order to pursue such research, one needs to understand human beings and the possible constraints (*neurological imperatives*) when embarking on cultural changes . As discussed earlier (Section 1.2.2), a serious long-term political project is based, implicitly or explicitly, on a particular idea of human nature. Hence the discussion offered in this work about congenital characteristics (Sections 2.2) and cultural flexibility (Sections 2.3) of *Homo sapiens*.

5.2.3 Freud's malaise revisited

The public at large, as well as some sociobiologists, find it difficult to distinguish biological evolution from cultural evolution, because of the similarities between them (Section 2.4.6). The very effective cultural transfer of violence from one generation to the next which occurred since historical times (about 5,000 years of documented injustice and blood shed) would seem to justify a pessimistic view of human nature (Section 1.2.3). In *Civilisation and its discontent* Freud stated that:

"It is clearly not easy for men to give up the satisfaction of this inclination to aggressiveness. They do not feel comfortable without it." (Freud, 1961 p. 61).

His explanation for why humans do not feel comfortable, the malaise of a civilised society, is interesting. According to Freud, humans would find themselves locked between Eros and Death, in a vicious circle of eroticism and aggressiveness that needs to be controlled by an educated consciousness able to suppress the wild subconscious. The suppression of these natural instincts by civilised society would cause a general malaise in the community, and even neuroses in severe individual cases. Freud thought he could explore the subconscious of his neurotic patients, the recalcitrant wild animal that resisted the taming of civilised society. To be fair, *Civilisation and its discontent* was written by the aging Freud at the outbreak of the second world war and under the trauma of bone cancer. But this idea was in agreement with the ambiguity of the role of biological determinism which pervaded the whole of his work.

This view of violent atavic brain regions that must be controlled by the 'human' cerebral cortex and the ethical codes of 'civilised' society, was further promoted by early anthropologists (Dart, 1953), animal ethologists (Lorenz , 1966) and popular writers such as Ardrey (1970), Sagan (1977 pp. 149-151) and Hart (1991 p. 153).[1]

We would like to suggest that the cause of the malaise of civilisation is more likely to be *the opposite of that suggested by Freud*: we feel uncomfortable in a violent society. A congenital

predisposition toward living in a nonviolent community is still there in contemporary *Homo sapiens* (Section 3.2.6), but the appropriate social systems that co-evolved with it — small and egalitarian communities — changed relatively recently (5-10,000 BP) into large hierarchical agricultural societies through a rapid process of cultural evolution (Section 2.4.5). Freud had a good intuition about a possible mismatch between human neurological imperatives and the new social environment, but he did not have the necessary information to translate that intuition into the correct, in our view, theoretical formulation.[2]

The malaise of a hunter-gatherer brain being forced to operate in a structurally violent society can arguably be recognised in the high incidence of mental disorders, the frequency of depression and the high rate of suicide. If humans were designed to live in the midst of daily competition, hostility and aggression, we would happily ravel in 'our element' (competition and violence), without getting depressed about it. Humans did cope for thousands of years and gained a wealth of knowledge and technology through it (Section 4.3.8). Now the price of that strategy for progress is becoming too high and violence does not pay any more.

5.2.4 Just don't train them

This author has sat in many tutorials and discussions, where concerned educators (mostly women) explored ways of reducing aggression in children and youth. This laudable attempt at remedial education is not necessarily based on an optimistic view of human nature. It is mostly based on the same principle of medicine: finding a cure for a disease (Section 4.1.3). But a more effective long-term aim would be to identify the ontogenetic origins of aggression (Section 2.5) and prevent the disease, rather than attempting an almost impossible cure. This is positive peace (Section 5.2.2). It is also a radical approach. Should we give up a search for intelligent solutions only because they may disturb the existing social order, or disorder as it may well be?

Ironically, the radical suggestion of preventing aggression, rather than correcting it, is technically simpler. Instead of devising

complex remedial programs, just do not train young minds in the art of violence. Moreover, not doing something at all is cheaper than doing something on the top of something else. For example, producing cartoons and films is expensive; kids could run in the fresh air chasing balls or collecting insects, while the producers of *Ninja Turtles*, *Pokemon* or *Street Fighter* could make money creating educational resources for schools; money on police, jails and pensions for widows and orphans would be saved.

5.2.5 Rousseau's jokes revisited

In 1750 Jean Jacque Rousseau earned his first recognition as a philosopher and writer with a short essay entitled "*Si le rétablissement des sciences et des arts a contribué à épurer les moeurs*"(Rousseau, 1952, pp. 119-142). His thesis was that the arts and the sciences added nothing to our real happiness and great thinkers had themselves no teacher. Thus, studying only corrupts children. He then stormed European intellectual *salotti* of the Age of Revolutions with *Emilie - On education*.

Rousseau is a disturbing presence in Peace Studies. His literary production comes through as a satirical, misleading distortion of ideas put forward in the literature on positive peace. His idea of the 'noble savage' (Section 1.2, note 7) may have made an impression on enlightened 18th century ladies sipping hot chocolate, but it comes out as a joke when confronted with the modern research traditions of neuroscience and anthropology (Section 1.2.5).[3] But contemporary sociology still refers to Hobbes, Locke, Kant, Hume and Rousseau when discussing issues relating to human nature, not to contemporary research anthropologists such as Montagu and Lee.[4]

So the idea of nonviolent neurological imperatives can be easily mocked as Rousseaunian romanticism. His suggestion of not educating children also comes out as a joke, when confronted with modern developmental neuroscience and sociology. So the idea of removing structural violence from a child's educational and social environment can be also be scoffed at as Rousseaunian romanticism. Perhaps the young Jean Jacque should have found a

job as a music teacher, instead of becoming a professional story teller for romantic revolutionaries.[5] Telling stories (Gould, 1978) can make one popular with the conservative Western media that likes biological determinism or with revolutionary French intellectuals who liked the noble savage, but it remains pseudoscience in both cases. However, it is not necessary to resort to a conspiracy theory to explain the popularity of a violent human nature, as it relieves responsibility from the audience.

5.2.6 The conservative/progressive character of positive peace

There is a curious contradiction of terms in the politics of nature conservation. Progressive ideas promote the conservation of nature, while conservative ideas appeal to progress to destroy nature. It would be helpful if a similar play on words was possible with regard to positive peace, where progressive ideas promote the conservation of human nature; unfortunately, conservative ideas too promote the conservation of human nature, but of a different type. The disagreement is about the nature of human nature.

Contemporary trends would like academics to promote an understanding of how the present-day society works, be 'realistic' and simply generate technical improvements. Interestingly, the current conservative climate is not the result of an ideological confrontation or political struggle between Capitalism and Communism, as generally believed, but rather the outcome of an ideological vacuum created by the fall of the Berlin Wall in 1989. The vacuum was rapidly filled by a social ethic of individualism and instant gratification. This new ethics of Mr Market limits political plans to short-term, crisis-management solutions. Readers entrenched in this philosophy may not be interested in the following sections, if they have not already stopped reading this book. But those who see themselves as members of a community, rather than just individuals, may find here a justification for having read thus far.

5.2.7 Nonviolent revolution

The human neurological imperative of cooperating in an egalitarian community (Section 3.3.4) finds its expression in historical popular rebellions against social injustice and structural violence, from ancient slave revolts, to the French and Russian Revolutions. The recent overturning of the centralised bureaucracies in eastern Europe was also inspired by the idea of liberty. But Mr Market was quick to fill the political vacuum.[6] Unfortunately the only tools available for radical changes have so far been violent,[7] that is, with rapid political changes, and no parallel cultural changes.

As long as radical social changes are attempted through rapid and violent revolutions, they are doomed to fail. In fact, in the absence of a nonviolent cultural alternative, they always reverted to a structurally violent system, that is, different minorities began to oppress the majority.[8]

A transition from structural violence to positive peace would necessarily occur slowly and democratically (Section 5.4).

5.2.8 Summary

This final discussion on the origins of violence should end with a synopsis of ideas presented so far and already summarised in Sections 2.6.3, 3.3.4 and 4.3.7:

Evidence available from neuroscience, evolutionary biology and anthropology:

- The human nervous system is designed in such a way that it needs post-natal information for the definition of behaviour.
- Both direct and structural violence take the form of behaviour.
- Thus violence cannot be a congenital characteristic of human.
- There is no evidence that pre-historical humans used violence against each other.
- Our distant ancestry is more likely to be nonviolent.
- Humans have not been in a position to undergo substantial biological changes since their nonviolent adaptation.

Main points of the hypothesis on the origins of violence:

- Domestication of plants and animals generated a food surplus and large human settlements.
- Food surplus led to specialisation of tasks.
- Job specialisation led to social stratification.
- Astronomy became the dominant profession.
- Religious concerns provided astronomers with additional power.
- Direct violence became necessary to maintain social stratification.
- Conflicts of interest with neighbouring hunter-gatherers led to wars of defence.
- Taxation and enforced trading led to wars of conquest.

5.2.9 Possible objections to the hypothesis

In Parts 2 & 3 of this work currently accepted ideas were critically assessed on the basis of evidence available in the literature, while in Part 4 new ideas were proposed in the form of educated guesses or hypotheses. These represent two quite different approaches, both open to criticism.

One could criticise Parts 2 & 3 by suggesting that evidence in the literature was biased. This can hardly be the case for neurobiology, as we used generally accepted concepts with which even undergraduate students are supposed to be familiar. The anthropological literature enjoys less consensus about the nonviolence of palaeolithic humans and hunter-gatherers in general. We have dealt with this aspect in Section 3.2.4, although much more discussion between neuroscientists and anthropologists is needed.

Criticising the new hypotheses presented in Part 4 is easier. But this is not a problem, as the purpose of this part of the work is exactly that of exposing these ideas to criticism. Here we list a number of difficulties to which attention should be drawn.

1) Just as we have no evidence that palaeolithic humans were violent, we also have no evidence of the opposite. However, the meaning of the adjective *nonviolent* was discussed previously

(Section 3.2.5); it remains a negation, with or without a hyphen. So a neutral position on congenital predisposition to violence is within the bounds of the present hypothesis on the origins of structural violence. While the hypothesis accepts a human predisposition toward aggression; it also stresses that it evolved bioculturally for the purpose of hunting animals and defence from animals, not for intra-specific violence — hence the usefulness of the term *violence* as distinct from aggression.

2) One could suggest that the definition of *violence* and its use as a rationale for this work is such that the statement 'humans are congenitally nonviolent' becomes a *tautology*. In other words, if one defines violence in cultural terms, then it becomes a tautology to state that violence has cultural origins only. This interesting objection[9] can be dispelled simply with a reiteration that the definition of violence as a cultural trait is the same as describing it as a purely cultural evolution in humans. It is a repetition, not a logical vicious circle or tautology. But one needs neurobiological (Part 2) and anthropological (Part 3) evidence to support the purely cultural essence of violence.

3) The hypotheses presented in Part 4 were specifically tailored to the case of sedentary agriculture. They cannot be applied as such to the appearance of structural violence in nomadic pastoral cultures. Moreover, the two modalities of food production sometimes developed jointly. Some populations even switched from one economic solution to another with changes of environmental conditions. The generality of the hypotheses cannot be stated at this early stage.

4) Likewise, the hypotheses were specifically tailored to the case of tropical hunter-gatherers becoming sedentary, while some palaeolithic hunter-gathering cultures adapted to rather cold climates, as a consequence of glaciations. These nordic cultures switched from gathering (principally) and hunting to virtually just hunting. One should investigate these cases better, as the role of aggressiveness may need a modification.

5) This author is not fully satisfied with the explanation offered for how women became subordinate to men in the process of adopting agricultural sedentism (Sections 3.3 note 2, 4.3.3 & 4.3.4). This aspect of the hypothesis becomes even weaker in the case of nordic hunting cultures mentioned above.

6) The role of theistic religions in Peace Studies is important. Bonta (1993) has listed several religious cultures in his list of 45 'peaceful people'. This aspect goes beyond the discussion of the present work, but it carries interesting implications. The essentially nonviolent teaching of most theistic religions (Section 3.2, note 14; Section 4.3, note 10) has important anthropological implications. Most theistic religions appeared during or soon after the neolithic period (Section 4.3). Why should the prophets of God translate the simple cultural rule of hunter-gatherers into a spiritual message? Why should, for example, Jesus exhort us to love each other, while 'naturalistic' religions do not? It could be that the very loss of nonviolent spirituality caused the spiritual need for nonviolent ethics, a form of remedial education for the new violent humans (cf. front cover and Sections 4.1.4 & 4.4, note 4).

NOTES

1 The literary genre of *la bete sauvage* inside us, the sign of Cain, the heritage of Neanderthal, the inevitability of war, sells well with a bored and guilty public.

2 But Kropotkin (1914) would have been available for the diligent reader.

3 The first reports of the scientist-explorers of the Age of Enlightenment had provided Rousseau with romantic accounts of happy savages dancing under coconut trees. As a matter of fact most of these newly discovered societies had horticultural and fishing cultures with structural violence and a past tradition of war (the 'nondestructive-aggressive' system B of Fromm, 1973 p.

195) which was not expressed in everyday life due to the favourable environmental conditions of the times. The important distinction between 'primitive' and hunter-gatherer cultures was the product of later anthropological research. Interestingly Robert Ardrey dedicated his own "Social Contract" to Jean Jacques Rousseau, in spite of his belief in congenital human violence. Perhaps the empathy came from a similar romantic and uninformed use of science: in the case of Ardrey it concerned human genetics (Ardrey, 1970 pp. 28-65).

[4] Lorenz (1966), not a supporter of an optimistic view of human nature, criticised Rousseau (1952 p. 363) for framing the question of human nature in misleading ethical terms (goodness and badness).

[5] Rousseau's ideas may have inspired the social philosophy and anti-intellectual attitude of recent dictators (Russell, 1961 p. 660).

[6] After playing guinea-pig for historical Communism, these countries had to do the same for a pure free market system as well — a new experiment — which turned out to be very damaging — this second 'lesson' is not recognised as yet in Western democracies, where one tends to confuse 'democracy' with 'free market'. It is also not recognised that Western democracies have a mixed economy, not a free market system, which arguably only manifested itself in the Federation of Russian Republics in the 1990s.

[7] Exceptions may be the overthrow of dictator Franco in Spain and recent changes of government in Portugal.

[8] It is of interest that most dictators embraced populist ideals at the beginning of their careers: Julius Caesar was the leader of the *Populares* but he introduced totalitarian ruling in Rome; Napoleon Bonaparte was an artillery officer serving the French Revolution, but he became an Emperor; Benito Mussolini and Adolph Hitler were young socialists, but they became oppressors of people; Joseph Stalin eliminated Nicholas II of Russia, only to became a

'tzar' that killed millions of political opponents; Boris Yeltsin has become a popular hero for opposing Stalinism, but then he sought totalitarian powers for himself. Nonviolence was successfully used by Mahatma Gandhi as a new strategy for the struggle against colonialism (Barash, 1991 pp. 557-565), but the lack of appropriate cultural changes prevented nonviolence from becoming a new social strategy even in India.

[9] A similar objection was put forward, and then retracted, by Karl Popper concerning the theory of evolution.

5.3 The role of neotopias

5.3.1 Introduction

Two very different approaches were adopted in this work: currently accepted ideas were critically assessed on the basis of evidence available in the literature (Parts 2 & 3), and new ideas were proposed in the form of educated guesses or hypotheses (Part 4). Exploring new ideas is not a popular approach in the current academic environment which tends to discourage creativity (Sections 1.3.2 & 5.1.11). This last section — essentially an appendix — goes even further, and it explores the disgraced world of utopia, with the aim, of course, of rehabilitating it.

5.3.2 New ideas are to solve problems

New ideas are useful only in so far as they can be tested through research (Section 4.1) and, if the evidence supports them, they can be applied to solve problems.

How can the idea of a nonviolent human nature be applied? The rationale for such an application is the following: if humans are not compelled to violence by unavoidable intrinsic forces, they are free to use their unique neurological flexibility and recently acquired democratic institutions to conceive and implement nonviolent social contracts. This would be compatible with the principle of biocultural evolution (Section 2.4.7) and in harmony with their neurological imperatives (Section 3.2.5). It would represent a process of re-humanisation, i.e., re-establishing harmony between nature and nurture, e.g. between congenital predisposition and social environment.

The process of re-humanising ourselves can only be envisaged if we have some understanding of how humans became culturally violent in the first place, in order to set conditions which may prevent such an occurrence again. Hence the need to formulate hypotheses about the origins of violence and testing them.

The problem to be solved is, of course, the fact that structural

violence does not pay any more and that this recent unnatural diversion from *Homo sapiens* must be disposed of.

New theoretical models will stimulate research on the identification, reduction and possibly elimination of cultural and structural violence. The currently prevailing pessimistic view of human nature is very unlikely to promote research and subsequent progressive changes. This pessimism explains why authorities confront violence with violent corrective measures and attacks on privacy. This approach only enhances structural violence without improving the quality of life of violent and 'corrected' citizens (Section 4.1, note4). On the other hand, the Rousseaunian suggestion of establishing an egalitarian society with no private property and limited needs would be anti-intellectual and repressive.

Having identified the problem — alienation of humanity due to unnatural violence — and the tools at our disposal — brain plasticity of children and the tradition of democracy, or rather liberal socialism — a valid exercise would be to formulate modern utopias, or rather neotopias.

5.3.3 Utopia is not popular

Utopia (from the Greek word *ou* for 'not' and *topos* 'place', i.e., a non-existing place) was Thomas More's imaginary island with perfect (according to him) laws, politics and economy. Ever since Plato's *Republic*, utopian writers have offered ideal models of how human society should be or will be (Davis, 1981). An analysis of the utopian models reveals the authors' assumptions on human nature. For example, Plato, More and Campanella were convinced that humans are incapable of self-management and should be led by appropriate wise men. So they described hierarchical societies with philosophers, humanists and priests, respectively, at the helm — the hypothetical leaders were clones of the three authors.

Nineteenth century utopian writers, instead, "... believed in human progress and the perfectibility of human nature and saw history as a continuous ascent towards an ideal social order. Twentieth-century authors, disillusioned by war ... see humans as

savages and incapable of erecting a progressive social system. Their dystopias are visions of tyranny and decay." Afnan (1989 p.1) was referring to utopias such as *News from nowhere* (William Morris, 1890) and dystopias such as *Nineteen eighty-four* (George Orwell, 1961).

Interestingly, romantic utopias never resulted in success, when well-meaning settlers tried to reconstruct the Garden of Eden on this earth, while Orwell's prediction did not eventuate anywhere on this earth in 1984, although Mr Market is a good surrogate of Big Brother. It is no wonder that the concept of utopia is in disgrace as an intellectual pursuit and that the very word is now used to refer to a romantic, unrealistic idea.

As the term *utopia* carries negative connotations in its extended colloquial meaning, it may be convenient to use the term *neotopia* to refer to future proposals for nonviolent societies.

5.3.4 Neotopic models

Contrary to popular belief, utopias are not idle dreams of poetic inspiration, but explicit or implicit political models. Whenever a political party launches an election campaign, utopia is actually presented to the voters,[1] with its implicit assumptions about structural violence and human needs,[2] and explicit propositions about solutions for current social problems.[3]

Of course, if utopias are based on romantic, uninformed ideas about humans, as in the case of 19th century socialist utopias, they really remain 'utopic' projects (Section 5.3.3). But if one reconsiders critically the essence of human nature, *neotopic projects* for a future nonviolent society become feasible.

A proper discussion on this topic is beyond the scope of this work, but a few general criteria for neotopic projects, within the optics of positive peace, could be mentioned.

In this author's opinion, a transformation of a structurally violent society into one in which children can fulfil their personal potential within a cooperative, nonviolent community would be feasible if:

- changes occur gradually (in about two-three generations);

- local nonviolent cultural traits are kept into account (religion, art, relationship with nature);
- the tasks of government are decentralised and local communities are allowed to self-manage;
- education is given a high priority, with the aim of personal growth, not just professional training;
- political education of children is provided, so that they become informed, critical and articulate citizens; [4]
- pluralism of ideas is maintained.

Past utopian writers conceived totalitarian and universal models supposedly appropriate for all humanity. The modern approach would be to conceive several *pluralistic, democratic and evolving neotopias*, each compatible with the physical characteristics of a given region and the particular nonviolent cultural traits of the people who inhabit it.

Theoretically, Australia would be an interesting playground to conceive neotopic models, because it is a relatively new nation, with a rich multicultural composition and limited internal and external tensions (Willmot, 1987).

NOTES

[1] In this case the term 'utopia' lives up to its popular meaning, as promises are rarely maintained.

[2] Citizens are assumed to be egotistic individuals, incapable of managing local community affairs and in need of strong governance; not a great deal of progress from Thomas Moore.

[3] These propositions mostly deal with economic models that favour the traditional constituency of that party and short-term solutions to minor social problems. Long-term solutions of major social problems (violence, social justice, environment, education) are not dealt with.

[4] The terms *political* and *education* need qualification. Education is not ideological indoctrination: by teaching the history and

philosophy of all ideas one provides students with the conceptual tools necessary to appreciate the plurality of current trends and to make personal choices. Political (from the Greek *politikos* = pertaining to the citizen) education would provide future citizens with the knowledge necessary to participate in the administration of the *res publica* in an informed and articulate way. Public participation is the rhetoric - not applied through withdrawal of political education - of contemporary ritualistic democracies (Giorgi, 1995).

References

Adams, D. (1989) "The Seville statement on violence - A progress report" *Journal of Peace Research* , vol. 26, pp. 113-121.

Afnan, E. (1989) 'The good of the world and the happiness of the nations - A study of modern utopian and dystopian literature', *The Journal of Baha'i Studies* , vol. 1, no. 4, pp. 1-20.

Aggledon, J. P. (1993) "The contribution of the amygdala to normal and abnormal emotional states" *Trends in Neurosciences*, vol. 16, pp. 328-333.

Alberts, B. et al. (1994) *Molecular biology of the cell*. Garland, New York.

Ardrey, R. (1970) *The social contract*. Atheneum, New York.

Ash, R. (1990) *Information theory*. Dover Publications, New York.

Barash, D. P. (1978) Barash, D. P. (1978) *Sociobiology and behaviour*. Heinemann, London.

Barash, D. P. (1991) *Introduction to Peace Studies*. Wadsworth, Belmont (California).

Barnett, S.A. (1988) *Biology and Freedom - An essay on the implications of human ethology* . Cambridge: Cambridge University Press.

Baron, R. A. & Richardson, D. R. (1994) *Human aggression*. Plenum Press, New York.

Barr, M.L. & Kiernan, J.A. 1993. *The human nervous system*. J.B. Lippincott, Philadelphia.

Bobbio, N. (1993) *Thomas Hobbes and the natural law tradition.* The University of Chicago Press, Chicago.

Bodley, J. H. (1997) *Cultural anthropology - Tribes, States, and the global system*. Mayfield, Mountain View (California).

Bonta, B. (1993) *Peaceful people – An Annotated bibliography*. The Scarecrow Press, Metuchen (New Jersey)

Bronowski, J. (1973) *The ascent of man*. British Broadcasting Corporation. London.

Burger, J. (1990) *First people* (The Gaia Atlas). Anchor Books, New York.

Candland, D. K. (1993) *Feral children and clever animals - Reflections on human nature*. Oxford University Press, Oxford.

Cavalli-Sforza, L. L. (1991) "Genes, peoples and languages" *Scientific American*, November, pp. 72-78.

Cavalli-Sforza, L. L., Menozzi, P. & Piazza, A. (1994) *History and geography of human genes*. Princeton University Press, Princeton.

Chagnon, N. A. (1977) *Yanomamo - The fierce people*. Holt, Rinehart and Winston, New York.

Changeaux, J-P. (1985) *Neuronal man*. Pantheon, New York.

Cherfas, J. (1979) "Learning to chirp" *New Scientists*, 17 May, pp. 535-539; "Singing in the brain" 24 May, pp. 649-651; "I sing therefore I am" 31 May, pp. 716-718.

Chesler, P. (1973) "Maternal influence in learning by observation in kitten", pp. 389-392 in T. E. McGill (ed.) *Readings in animal behaviour*, pp. 389-392. Holt, Rinehart & Winston, New York..

Childe, V. G. (1936) *Man makes himself.* Watts, London.

Childe, V. G. (1952) *New light on the most ancient East*. Routledge & Kegan Paul, London.

Craig, I. (1994) "Misbehaving monoamine oxidase gene" *Current Biology*, vol. 4, pp. 175-177.
Crook, D. P. (1989) "Peter Chalmers Mitchell and anti-war evolutionism in Britain during the great war" *Journal of the History of Biology*, vol. 22, pp. 325-356.

Cummings, J. L. (1995) "Anatomic and behavioural aspects of frontal-subcortical circuits" in J. Grafman et al. (eds) *Structure and functions of the human prefrontal cortex*, pp. 1-12. Annals of the New York Academy of Sciences, vol. 769.

Danesh, H. (1979) *The violence-free society - A gift for our children*. Baha'i Studies, vol. 6. Canadian Association for Studies on the Baha'i Faith, Ottawa.

Dart, R. A. (1953) "The predatory transition from ape to man" *International Anthropological and Linguistic Review* , vol. 1, n.4.

Davis, J.C. (1981) *Utopia and the ideal society*. Cambridge University Press, Cambridge.

Diamond, M. C. (1988) *Enriching heredity*. The Free Press, New York.

Diamond, J. (1991) *The rise and fall of the third chimpanzee*. Radius, London.

Eibl-Eibesfeldt, I. (1975) *Ethology - The biology of behavior*. Holt, Rinehart and Winston, New York.

Eibl-Eibesfeldt, I. (1979) *The biology of peace and war*. Viking Press, New York.

Eibl-Eibesfeldt, I. (1989) *Human ethology* . Aldine de Gruyter, New York.

Eccles, (1991) *Evolution of the brain - Creation of the self.* Routledge, London.

Edelman, G. M. (1988) *Topobiology – An introduction to molecular embryology*. Basic Books, New York.

Edmund, G. & D.C. Kendrick,1980. *The measurement of human aggressiveness* . London: Ellis Horwood.

Eldredge, N. (1995) *Reinventing Darwin - The great debate at the high table of evolutionary theory*. John Wiley, New York.

Eron, L.D., Huesmann, L. R. & Lefkowitz, M.M. (1974) "How learning conditions in early childhood, including mass media, relate to aggression in adolescence" *American Journal of Orthopsychiatry* , vol. 44, pp. 412-423.

Facchini, Fiorenzo, 1985. *Il cammino dell'evoluzione umana*. Jaca Books, Milano.

Flavel, J. H. (1966) *The developmental psychology of Jean Piaget*. D. Van Nostrand, Princeton.

Freeman, D. (1964) "Human aggression in anthropological perspective', pp. 109-119 in J.D. Carthy & F.J. Ebling (eds.) *Natural history of aggression*, pp. 109-119. Academic Press, New York.

Freud, S. (1961) *Civilisation and its discontent* (English translation by James Strachey). W.W. Norton, New York.

Fromm, E. (1973) *The anatomy of human destruction*. Greenwich: Fawcett Crest, Greenwich.

Fung, Y-C. (1952) *A history of Chinese philosophy*. Princeton University Press, Princeton.

Futuyma, D. (1986) *Evolutionary biology* . Sinauer, Sunderland (Mass).

Galbraith, John K. (1969) *The affluent society.* Houghton Mifflin, Boston..
Gallagher, J. J.& Craig T. R. (1987) *The malleability of children*. Paul H. Brooks, Baltimore.

Galtung, J. (1969) "Violence, peace and peace research" *Journal of Peace Research* , vol. 6, pp. 167-191.

Galtung, J. (1975-1976) *Essays in Peace Research - Vol. 1 Peace: research, education, action ,Vol. 2 Peace, war and defence*. Ejlers, Copen.
Galtung, J. (1990) "Cultural violence" *Journal of Peace Research*, vol. 27, pp. 291-305.

Gibson, K. R. & Anne Petersen, A. (1991) *Brain maturation and cognitive development*. Aldine de Gruyter, New York.

Gilles, F.H., Leviton, A. & E.C. Dooling, E. C. (1983) *The developing human brain*. John Wright, Boston.

Giorgi, P. P. (1989) "What's wrong with marsupials?" in Capone, G. (ed.) *Australia and Italy - Contributions to intellectual life*. Longo Editore, Ravenna.

Giorgi, P. P. (1995) "Editorial" *Convivio*, vol. 1, pp. 87-92.

Giorgi, P. P. (2000) *Functional neuroanatomy - Lecture notes*. Minerva E & S, Brisbane.

Gould, S. J. (1978) "Sociobiology - The art of storytelling" *New Scientist*, November 16, pp. 530-533.

Gould, S. J. (1981) *The mismeasure of man.* Penguin Books, London.

Gould, S. J. (1987a) *The flamingo smile*. Penguin Books, London.

Gould, S. J. (1987b) *An urchin in the storm* . Penguin Books, London.

Gould, S. J. (1991) *Bully the brontosaurus* . Penguin Books, London.

Gould, S. J. & Eldredge, N. (1993) "Punctuated equilibrium comes of age" *Nature*, vol. 366, pp. 223-227.

Grieve, N. & Patricia Grimshaw, P. (eds) (1981) *Australian women*. Oxford University Press, Melbourne.

Groebel, J. & Robert A. Hinde, R. A. (eds.) (1989) *Aggression and war - The biological and social bases*. Cambridge University Press, Cambridge.

Gross, D.R. (1992) *Discovering anthropolgy*. Mayfield, London.

Haas, J. (ed.) (1990) *The anthropology of war*. Cambridge University Press, Cambridge.

Hall, B. K. (1992) *Evolutionary developmental biology*. Chapman & Hall, London.

Halliday, T.R. & P.J.B. Slater, P. J. B. (1983) *Genes, development and learning*. Blackwell, Oxford.

Hamblin, D. J. (1975) *The first cities.* Time-Life Books, Amsterdam.

Harth, E. (1991) *Dawn of a millennium.* Penguin Books, London.

Haviland, W. A. (1987) *Cultural Anthropology*. Holt, Rinehart and Winston, New York.

Herman, R. (1993) "Genes make worms behave" *Nature*, vol. 364, pp. 282-283.

Herman, E. S. & Chomsky, N. (1988) *Manufacturing consent*. Grawth-Hill, New York.

Hinde, R. (1974) *Biological basis of human social behaviour*. Mc Grawth-Hill, New York.

Homer-Dixon, T. F., Boutwell, J. H. & George W. Rathjens, G. W. (1993) "Environmental change and violent conflict" *Scientific American*, February, 16-23.

Hobbes, T. (1958) *Leviathan.* The Liberal Arts Press, New York.
Ingold, T., Riches, D. & Woodburn,J. (eds.) (1988) *Hunters and gatherers - vol. 1, History, evolution and social changes* . Berg, New York.

Jablonski, N. G. & Aiello, L. C. (1998) *The origin and diversification of language*. University of California Press, Los Angeles.

Jean, G. (1986) *L'écriture, mémoires des hommes*. Gallimard, Paris.

Jolly, C. J. & Plog, F. (1987) *Physical anthropology and archaeology*. Alfred A. Knopf, New York.

Jurmain, R., Nelson, H. & William, A. Turnbaugh, W. A. (1987) *Understanding physical anthropology and archaeology*. West Publishing Company, St. Paul (Minnesota).

Kandel, E. (1999) "Cerebral cortex and plasticity" in Schwartz, J. H., Kandel, E. & Jessell, T. M. (eds.) *Principles of neural science*, pp. 1024-1027. McGraw-Hill, New York.

Kandel, E. & Jessell, T. M. (1999) "Development of the visual system" in Schwartz, J. H., Kandel, E. & Jessell, T. M. (eds.) *Principles of neural science*, chapter 60. McGraw-Hill, New York.

Kiernan, V. (1993) "Panel hears conflicting views on biology of violence" *New Scientist* , 12 June, p. 7.

Kitcher, P. (1985) *Vaulting ambition - sociobiology and the quest for human nature*. MIT Press, Cambridge (Mass).

Kolb, B. & Whishaw, I. (1990) *Fundamentals of human neuropsychology*. W. H. Freeman, New York.

Kropotkin, P. (1914) *Mutual aid - A factor of evolution*. Reprinted edition. Porter Sargent Publishers, Boston

Kupferman, S. (1999) "Instincts" in Schwartz, J. H., Kandel, E. & Jessell, T. M. *Principles of neural science*, chapter 58. McGraw-Hill, New York.

Lane, H. (1977) *The wild boy of Aveyron*. Granada, London.

Leacock, E. & Lee, R. B. (eds.) (1982) *Politis and history in band societies*. Cambridge University Press, Cambridge.

Leakey, R. (1981) *The making of mankind*. Michael Joseph, London.

Leakey, R. E. & Lewin R. (1978) *Origins*. Macdonald & Jane's, London.

Leakey, R. E. & Lewin R. (1993) *Origins reconsidered* . Abacus, London.

Lee, R. B. (1979) *The !Kung San: men, women and work in a foraging society*. Cambridge University Press, Cambridge (Mass.).

Lee, R. B. (1988) "Reflections on primitive communism" in T. Ingold; D. Riches & J. Woodburn (eds) *Hunters and gatherers* , vol. 1, pp. 252-268. Berg, New York.

Leroi-Gourhan, A. (1967) *Treasures of prehistoric art*. Harry N. Abrams, New York.

LeVay, S. (1993) *The sexual brain*. MIT Press, Boston.

Lewis-Williams, J. D. (1981) *Believing and seeing - Symbolic meaning in southern San rock painting*. Academic Press, London.

Linden, E. (1992) "Bonobos – Chimpanzees with a difference" *National Geographic*, March, pp. 46-53.

Lopreato, J. (1984) *Human nature and biocultural evolution*. Allen & Urwin, London.

Lorenz, K. (1966) *On aggression*. Methuen, London.

Lumsden, C.J. & E.O. Wilson, 1981. *Genes, mind and culture* . Cambridge (Mass): Harvard University Press.

Maclean, C. (1977) *The wolf children* Penguin Books, London.

Maier, H. W. (1969) *Three theories of child development*. Harper & Row, New York.

Malson, L. (1972) *Wolf children*. Transl. E. Fawcett, P. Ayrton & J. White. NLB, London.

Martin, G. & Pear, J. (1992) *Behavior modification: what it is and how to do it*. Prentice Hall, Englewood Cliff (N.J.).

Martin, N. et al. (1986) "Transmission of social attitudes" *Proceedings of the National Academy of Sciences*, vol. 83, pp. 4364-4369.

Maybury-Lewis, D. (1992) *Millennium - Tribal wisdom and the modern world*. Viking (Penguin), London.

Melotti, U. (1984) "The origin of human aggression - A new evolutionary view" *The Mankind Quarterly*, vol. 24, pp. 379-391.

Melotti, U. (1985) "Competition and cooperation in human evolution" *The Mankind Quarterly* , vol. 25, pp. 323-352.

Melotti, U. (1990) War and peace in primitive human societies - A sociobiological view" in Van der Dennen, J. M. G. & Vincent S.E.

Falger, V. S. E. (eds) (1990) *Sociobiology and conflict*, 241-266. Chapman & Hall, London.

Midgley, M. (1978) *Beast and man - The roots of human nature*. Methuen, London.

Montagu, A. (1957) *Anthropology and human nature*. McGraw-Hill, New York.

Montagu, A. (1968) *Man and aggression*. Oxford University Press, London.

Morell, V. (1993) "Evidence found for a possible aggression gene" *Science*, vol. 260, pp. 1722-1723.

Morris, W. (1980) *News from Nowhere and selected writings and designs*. Penguin Books, London.

Munson, R. (1981) "Why medicine cannot be a science?" *Journal of Medicine and Philosophy*, vol. 5, pp. 183-208.

Norton-Leonard, J. (1977) *The first farmer*. Time-Life Books, Amsterdam.

Noss, J. B. (1974) *Man's religions*. Macmillan, New York.

Orwell, G. (1961) *Nineteen eighty-four*. New American Library, New York.

Pain, S. (1993) "Modern hunter-gatherers no guide to Stone Age past" *New Scientist*, 20 February, p. 8.

Pei, M. (1968) *The story of language*. George Allen & Unwin, London.

Piaget, J. (1977) *The development of thought - Equilibration of cognitive structures*. Viking Press, New York.

Plomin, R. (1990) "The role of inheritance in behavior" *Science* , vol. 248, pp. 183-188.

Popper, K. R. (1959) *The logic of scientific discovery*. Hutchinson, London.

Popper, K. R. & Eccles, J. C. (1977) *The self and its brain - An argument for interactionism*. Editiones Roche, Basel.

Pujol, J., Vendrell, P., Junquè, C., Marti-Vilalta, J. L. & Antoni Capdevila, A. (1993) "When does human brain development end? Evidence of corpus callosum growth up to adulthood" *Annals of Neurology*, vol. 34, pp. 71-75.

Reed, E. (1978) *Sexism and science*. Pathfinder Press, New York.

Renfrew, J. M., (1973) *Paleoethnobotany - The prehistoric food plants of the Near East and Europe*. Methuen, London.

Reynolds, H. (1999) *Why weren't we told? – A personal search for the truth about our history*. Viking, Ringwood (Victoria).

Rigsby (1998) "A survey of property theory and tenure types" in N. Peterson & B. Rigsby (eds.) *Customary marine tenure in Australia*, pp. 22-46 (especially note 1, p. 35). Oceania Monographs, University of Sydney, Sydney.

Rose, Steven; Leon J. Kamin & R.C. Lewontin, 1985. *Not in our genes - Biology, Ideology and human nature*. Penguin Books, London.

Rousseau, J. J. (1952) *On the origin of equality - On political economy - The social contract* . Translated by G. D. H. Cole. William Benton (Encyclopaedia Britannica, The Great Books), Chicago.

Ruffié, J. (1983) *De la biologie à la culture.* Flammarion, Paris.

Ruse, M. (1985) *Sociobiology- Sense or nonsense?* Reidel, Boston.

Russell, B. (1961) *History of western philosophy*. George Allen & Unwin, London.

Sagan, C. (1977) *The dragons of Eden*. Hodder and Stoughton, London.

Salla, M., Tonetto, W. & Martinez, E. (1995) *Essays on peace*. Central University Press, Rockhampton. The text of the Seville Statement is at p. 67. It was also published in *Social Alternatives*, vol. 12, n.2 (1987) pp. 271-274.

Summy, R. (1994) "Nonviolence and the case of the extremely ruthless opponent" *Pacifica Review*, vol. 6, pp. 1-29.

Summy, R. & Saunders, M. (1995) "Why peace history?" *Peace and Change*, vol. 20, n.1, pp. 7-38.

Spatz-Widom, C. (1989) "The cycle of violence" *Science*, vol. 244, pp. 160-166.

Sponsel, L. E. (1994) "The mutual relevance of anthropology and Peace Studies" in Sponsel, L. E. & Gregor, T. (eds)*The anthropology of peace and nonviolence*, pp. 1-36. Lynne Rienner, London.

Sponsel, L. E. & Gregor, T. (1994) *The anthropology of peace and nonviolence*. Lynne Rienner, London.

Stanford, C. B. & Allen, J. S. (1991) "On strategic storytelling - Current models of human behavioural evolution" *Current Anthropology* , vol. 32, pp. 58-61.

Stevenson, L. (1987) *Seven theories of human nature*. Oxford University Press, Oxford.

Swartz, K. B. & Rosenblum, L. (1981) "The social context of parental behaviour - A perspective on primate socialisation", pp. 431-432 in D.J. Gubernick & P.H. Klopfer, eds, *Parental care in mammals*. Plenum Press, New York.

Tattersall, I. (1999) *The last Neanderthal*. Westview Press, London.

Thorwald, J. (1962) *Science and secrets of early medicine*. Thames & Hudson, London.

Trivers, R. L., (1985) *Social evolution*. Benjamin/Cummings, Menlo Park.

Turner, A. & Paterson, H. E. H. (1991) "Species and speciation - Evolutionary tempo and more in the fossil record reconsidered" *Geobios* , vol. 24, pp. 761-769.

Van der Dennen, J. M. G. & Vincent S.E. Falger, V. S. E. (eds) (1990) *Sociobiology and conflict*. Chapman & Hall, London.

Vogel, C. (1989)*Von Töten zum Mord*. Carl Hanser, München.

Willmot, E. (1987) *Australia, the last experiment (1986 Boyer Lectures)*. Australian Broadcasting Corporation, Sydney.

Walsh, J. E. (1996) *Unravelling Piltdown*. Random House, New York.

Wiemann, J. M. & Harrison, R. P. (1983) *Nonverbal interaction*. Sage, Beverly Hills.

Wilmsen, E. N. & Denbow, J. R. (1990) "Paradigmatic history of San-speaking peoples and current attempts at revision" *Current Anthropology* , vol. 31, n. 15, pp. 489-507. Critical comments: vol. 31, n. 15, pp. 507-524; vol. 32, n. 1, pp. 55-57.

Wilson, O. E. (1975) *Sociobiology - The new synthesis* . The Belknap Press of Harvard University Press, Cambridge (Mass).

Wilson, O. E. (1978) *On human nature*. Harvard University Press, Cambridge (Mass).

Wrangham, R. & Peterson, D. (1997) *Demonic males – Apes and the origins of human violence*. Bloomsbury, London.

Wright, Q. (1965) *A study of war.* University of Chicago Press, Chicago.

Yellen, J. E. (1990) "The transformation of the Kalahari !Kung" *Scientific American*, April 1990, pp. 72-79.

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