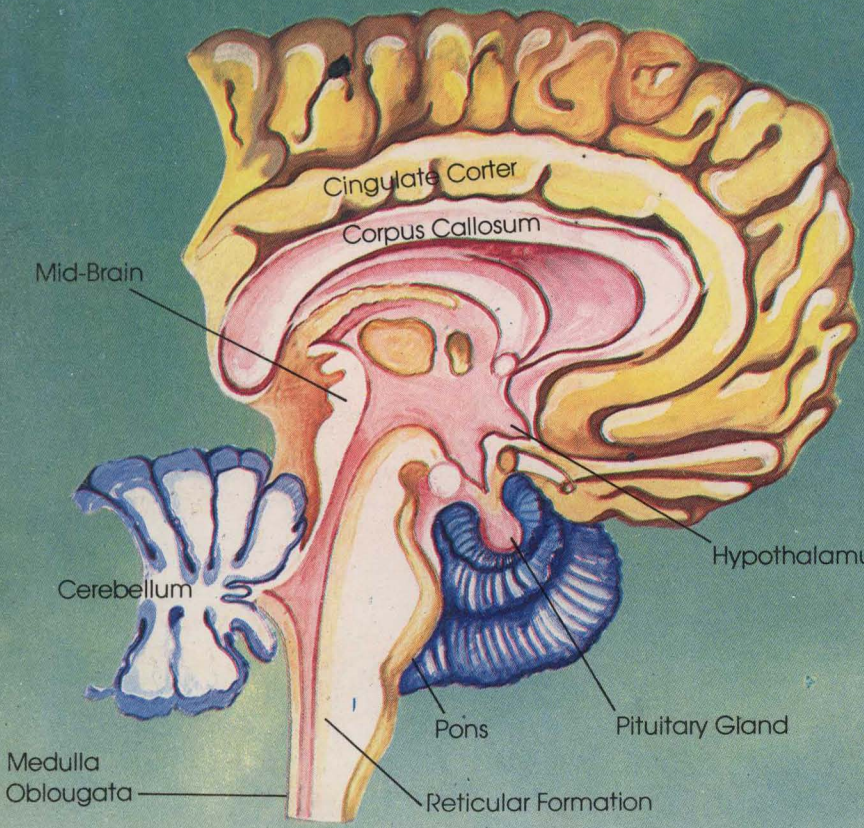
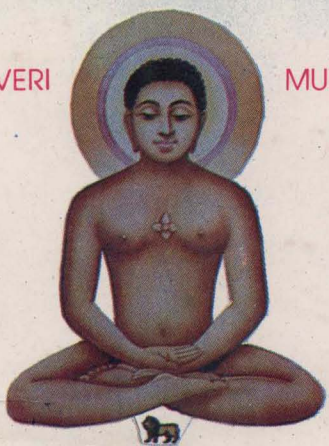


NEUROSCIENCE & KARMA

The Jain Doctrine of Psycho-Physical Force

LATE JETHA LAL S. ZAVERI

MUNI MAHENDRA KUMAR



About the Book

There is a timeless chasm existing between religion/philosophy and science. This has prevented each of them to be benefited by mutual interaction. The book is an humble attempt to bridge the chasm.

According to Jainism, one of the oldest living religions and philosophies, karma is a psychophysical force of cyclic nature, i.e., it is the fruition of the past karma which causes bondage of new karma.

Neuroscience explains how we go about in pursuit of our particular aims in life, the Jain Doctrine of karma explains why we do so. Thus the book is an endeavour to synthesize the ancient wisdom and modern scientific approach.

Some of the topics discussed are : Language of the Brain; Needing and Nourishing; Sleeping and Dreaming; Knowing, Learning and Intelligence; Perceiving, Loving and Attachment; Control of Aggression.

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About the Authors

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He was an Honourary Professor in the Department of 'Science of Living', in the Deemed University of Jain Vishva Bharati Institute, Ladnun. He was also awarded the honour of "Prekshā-pravaktā" i.e., an Exponent of Prekshā System of Meditation by Ganadhipati Shri Tulsi, the Anushasta of our deemed university. He was equally well-versed in both the modern neuroscience and the ancient science of karma. He had to his credit several books in the field of comparative study of Science and Philosophy/Spirituality. His works "Microcosmology : Atom in Jain Philosophy & Modern Science", "Human Body : Design & Function", "Prekshā Dhyana : Health Care" "Jain Biology" speak highly of his deep erudition and lucid style of simplifying the intricate theories.

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Neuroscience
&
Karma

(The Jain Doctrine of Psycho-physical Force)

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Editor : MUNI MAHENDRA KUMAR

Second Edition : 1994

Price : Rs. 100/-
($ 10)

Printed at : JAY KAY OFFSET PRINTERS, NANGLOI

CONTENTS

INTRODUCTION

The scope of the wisdom buried in the ancient literature produced by the Jain savants is unlimited. Without this literature, the treasure of India's unique heritage is bound to remain incomplete and truncated. Students of Jainology unanimously admit that many problems of human interest would remain unresolved in the absence of the study of this literature. It is, however, to be regretted that the interpretation, in modern scientific terms, of this vast treasure is only in its initial stage and is even now in a scrappy and haphazard form.

The chasm between *Religion/Philosophy* and *Science* is both deep and well-established. This is because the *scientific mind* does not accept anything that cannot be experimentally proved while the *religious mind* needs no proof for anything laid down in the sacred canonical books. The chasm has, unfortunately, prevented each of them to be benefited by a constructive study of the other side of the chasm. The present work is an humble attempt to build a small bridge to transcend the chasm. The inspiratioin for the attempt has come from the encouraging results of the *Yogakshem* year in developing an integrated personality.

Development of an Integrated Personality

On 21st February 1989, a unique festival — *Festival of Wisdom* — was started under the spiritual guidance of by Acharya Tulsi at Ladnun, a small township in the state of Rajasthan. The main purpose of the year-long program and celebrations, called *Prajñā Parva* — was development of an integrated personality.

In India, *science* has never been able to completely subjugate the religious sensitivities unlike in Western countries. *Mysticism and transcendence* remain as important as (sometimes even more) rationality, logic and sensible perceptions. Here, man's personality is not entirely denatured by the scientific objectivity nor has sacredness been taken away by its rationality. In fact, science, inspite of its spectacular achievements, has never been able to attract religious personalities and never had a chance to become a new religion here, as it did in the West.

On the other hand, dogmatic beliefs and the very definiteness of the answers given by religious scholars cause scientific-minded modern young men to view them with suspicion and skepticism if not with utter disbelief. It is essential to satisfy the skeptic by scientific methodology and convince them about the superiority of wisdom above superfluous knowledge.

Science will not, because it cannot, answer all the questions of great interest to human mind and for human welfare. But science has made tremendous progress during the last hundred years in the fields of *psychology, endocrinology* and *neuroscience.* Neuroscientists have carefully and precisely mapped out centres of pain and pleasure, besides identifying the *limbic system* in the brain which is the seat of our emotions. Discovery of the centres of anger and aggression by electric stimulation has clarified hitherto mysterious significance of self-generated anger in canonical literature. In short, science can show us methods and methodology for expanding and elucidating the secrets of much ancient wisdom contained in the sacred canons. In other words, the synthesis of the ancient wisdom and modern scientific knowledge can help us to integrate the *spiritual insight* with the scientific approach for creating a *spiritual-cum-scientific* personality. This is exactly what the festival of wisdom aimed at. This work is an humble effort to continue the task of development of an integrated personality which was started in *prajñā parva.*

Karmavāda — The Doctrine of *Karman*[1]

Karman and *rebirth* are the two most important presuppositions of almost all schools of Indian Philosophy. *Karmavāda* — the doctrine of *karman* — had to compete with a number of other doctrines — *Kālavāda* (the supremacy of time), *Niyativāda* (the supremacy of determinism) etc. about creation and events. The Jain philosophers accorded proper place to other doctrines while installing *Karmavāda* in the supreme position, as the ultimate determinant of the course of events. Even time *(kāla),*

1. See Prologue I.

nature *(svabhāva)* and *determinism (niyati)* are finally determined by *karman* and there is no such thing as fortuitism.

The common ground among the different systems is the belief in the *intrinsic purity* of the soul and its capacity to recover its pure nature, by following a course of philosophical enlightenment, austerities and moral discipline. Also, there is general agreement regarding the nature of fruition, that is, virtuous or moral actions will fructify into enjoyment, while sinful and immoral ones will fructify in suffering. A significant difference is in the necessity of an external agency, such as God. The Jain doctrine emphasizes that the impurity of the soul itself determines the nature, quantity, duration and intensity of the *karman* at the time of bondage and eliminates the necessity of an external agency. More significant differences are, however, in the nature and pathways of ultimate emancipation. However, here again, there is remarkable unity that all systems accept nescience *(avidyā)* or *(moha)* as the fundamental hindrance to emancipation. It deludes the soul and diverts its interests in the world process, leading to the cycle of rebirths. The *common aim* of all the Indian religions is to show the ways and means to *destroy nescience.*

Unorthodox view of *Karman*

At this point, we would like to clarify that the present work is neither a *religious* nor a *moral* treatise and it does not, therefore, aim to discuss the methods of *destroying* the *karman.* Its object is, rather, to view *karman* from a novel angle — not the transcendental angle but an *empirical angle* — and to explain the importance of the role of *karman* in producing our mental states and behavioural patterns in *scientific terms.* The orthodox view, generally, depicts the *karman* as a villain - an enemy. All our actions, good and bad, are attributed to *karman* but there is hardly any attempt to explain *how karman* makes us do what we do.

Now the doctrine of *karman* teaches us that pleasures and pain, urges and impulses, emotions and passions, our thoughts, speech and our actions are result of *karman.* At the same time, researches in neuroscience have established that there are reference standards in our

brain which not only regulate our breathing, nourishment and sleep but also influence our emotions, wants, desires, our satisfaction and revulsion, our longings and our fears. Thus there is an *indisputable connection* between the *modus operandi* of *karman* and *brain-function.*

Let us, for instance, see how anger is produced. Jain *āgamas*[1] (canonical texts) teach us that the passion-quartet — anger, arrogance, deceit and greed — are :

(i) self-generated

(ii) provoked by others

(iii) both self-generated and provoked by others

(iv) generated due to the fruition of a specific *karman* without any external cause.

Neuroscience has established that there are centres of anger as well as peace in our limbic system. Dr. Jose Delgado's experiments with E S B (electric stimulation of brain) has revealed that an animal (bull) can be made either fighting-mad or totally docile by stimulating (by remote control) different points of limbic system. Thus neuroscience not only explains but expands and clarifies what is rather vaguely stated in *āgamas.*

And so we think that it is appropriate to synchronize the presentations of modern *scientific facts* with *ancient philosophical wisdom.* "In the history of human thinking" says Werner Heisenberg, the physicist-philosopher, "new, interesting and the most fruitful developments frequently take place when two different lines of thought-lines, having their roots in quite different parts of human culture, in different times, or religious traditions — meet and mutually interact."[2] It is, however, a most difficult task. The writer may "either succeed in being intelligible by offering only superficial aspects of the problem and thus arousing in the reader the deceptive illusion of comprehension or give an account in

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1. *Thāṇaṁ,* 4/76-79
2. Physics and Philosophy, p. 161

such a fashion that the reader is unable to follow the exposition and becomes discouraged to follow any further".[1]

A brief resume of the *"Doctrine of Karman"* is given as Prologue I, to assist those readers who have little acquaintance with this subject. Those who are familiar with it may skip it altogether. Similarly salient features of the structure and function of brain is given as Prologue II, which we hope, will be appreciated by those readers who had no opportunity to gain knowledge in this direction. A glossary of scientific terms as well as technical philosophical words is given at the end.

We are not sure whether we have succeeded in making this presentation both *readable* and *intelligible*. The readers who honour us by reading our humble effort have to decide for themselves.

In compiling this book, we have derived much assistance from various treatises on Neuroscience and Jain Philosophy.

(1) Programs of the Brain by J.Z. Young, F.R.S.

(2) The Brain : Mystery of Matter and Mind by Jack Fincher.

(3) Studies in Jain Philosophy by Dr. Nath Mal Tatia, M.A., D. Litt.

(4) Illuminator of Jain Tenets *(Jain Siddhānt Dīpikā)* by Acharya Tulsi.

(5) Doctrine of *Karman* in Jain Philosophy by Helmuth Von Glassenhapp.

We are extremely grateful to Acharya Shri Tulsi and Yuvacharya Shri Mahaprajna who have been the main source of inspiration, and but for their blessings and encouragement, the present work would not have been accomplished.

J.S. Zaveri
Muni Mahendra Kumar

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1. Foreword to The Universe and Dr. Einstein.

PROLOGUE I

Doctrine of *Karman* in Jain Philosophy

Basic Principle

Rebirth is the most important presupposition and the *'Doctrine of Karman'* is the central dogma of almost all Indian philosophies/religions, consistent with their spiritual outlook. The gist of the doctrine is : every action of a living organism — thought, speech and bodily action — is the cause of a transcendental effect; it generates a certain potential psycho-physical force which manifests itself under appropriate conditions in the worldly life in the form of happiness or misery and suffering. Just as a promissory note (a bond or an IOU) does not lose its validity until and unless the amount is repaid, so also the effect of the force generated by an action continues to exist long after the disappearance of the cause itself. The effect, thus, does not confine itself to one life but continues for many lives beyond the present one. In other words, the entire gamut of the conditions and duration of the present life is the result of the actions in the preceding ones and those during the present life are the causes of the conditions and duration of the future existence. Since each life presupposes the actions of a preceding one, there is *no beginning;* and the migration of a soul continues without end, because actions which must be expiated in a future life are performed anew. However, the SOUL, pure in itself, has an innate ability to attain its pure state *(nirvāṇa)* by demolishing the power of *karman* and thus terminate the cycle of rebirths, after a course of moral discipline and spiritual enlightenment.

Metaphysical Basis

To properly understand the nature and function of *karman* it is necessary to briefly understand the metaphysical views of the Jains. According to Jains, the universe is neither created nor governed by a Supreme Being but is subject only to Universal Laws *(Lokasthiti)*. It is

eternal in its essential character, though its constituents undergo continuous change — change being as real as permanence. Jains find no contradiction between change and permanence as they do not believe in absolute permanence or total cessation. This is the doctrine of Non-absolutism *(Anekāntavāda)* which holds that truth/reality is free from absolutism. Six eternal/indestructible substances *(dravyas)* produce the infinite world-processes through their modifications and interactions. Each substance persists through its own modes. It *is* as well as *becomes*, as *being* and *becoming* are not mutually incompatible. In fact, becoming is not a derivative of being but is a necessary concomitant. These substances are :

1. *Ākāśāstikāya* — space, the container of all other substances, itself being self-contained.
2. *Dharmāstikāya* — a kind of ether; it is the medium of motion of all mobile constituents of the universe.
3. *Adharmāstikāya* — (counterpart of no. 2 above); it is the medium of rest, the concomitant cause of all resting constituents of the universe.
4. *Pudgalāstikāya* — physical order of existence — matter and energy.
5. *Jivāstikāya* — soul or psychical order of existence.
6. *Kāla* — time.

In this thesis, we are mainly concerned with two substances : nos. 4 & 5 and we shall describe these a little more elaborately.

Physical substance *(Pudgalāstikāya)* exists in two forms (i) indivisible ultimate atoms *(paramāṇu)* and (ii) aggregates *(skandha)* produced by the union of two or more *paramāṇus* governed by certain laws. The entire infinitely heterogeneous phenomena of the physical order of existence is produced by the infinite variety of aggregates of this substace. *Paramāṇu*, i.e. an ultimate atom is the basic material cause of the physical world.

There are several groups *(vargaṇās)* of this substance and some of them are purely *transcendental* while some are *empirically* useful to

living organisms. Bodies of all terrestrial organisms are made of *Audārika* group. *Śwasochvāsa, Bhāsā and Manaḥ* groups are used for the vital functions of breathing, speaking and thinking respectively. The subtle-most group is *karmana* group and the aggregates of this group are attracted and transformed by *jīva* and become *karman*, infecting and defiling the conscious substance — *jīva*.

JĪVA, the soul (or spirit) the only conscious substance out of the six, is distinct from all the above substances which are devoid of consciousness. Jains believe in the multiplicity of souls, each quite independent from anoher (and not a part and parcel of a super consciousness — *Brahman*). Each *jīva* possesses innumerable qualities. In its purest natural state each *jīva* is exactly like another and is endowed with eight qualities. :

1) *Kevalajñāna* (omniscience) — Pure and perfect knowledge — the faculty of instantly cognising, by direct experience, the content of the whole Universe which contains all reality and nothing but reality, without any contradiction or discrepancy.

2) *Kevaladarśana* — Pure and perfect intuition *(darśana)* — the faculty of instantly apprehending, by direct experience, the whole of real existence, without separation of contents, as a system with total internal consistency and structure but without reference to anything beyond.

3) *Ātmika Sukha* — Self-generated blissfulness which transcends pleasure/pain and joy/grief and which has no reference to anything outside the self.

4) *Ananta Vīrya* — Unfettered and unrestricted spiritual energy.

5) *Kṣāyaka Samyaktva* — Possession of Complete Truth.

6) *Aṭala-avagāhanā* — Eternal unchanging existence — freedom from migration.

7) *Amūrtatva* — Total formlessness.

8) *Agurulaghutva* — Total parity with other pure souls.

On the other hand, all living organisms, with their souls defiled by *karman*, have piecemeal and fragmented knowledge, intuition and energy; possess perverted faith and embodied existence; experience joy and grief and have a limited life-span and are therefore, subject to cycles of birth and death. *Karman*, the alien physical substance, infects and defiles all worldly organisms and veils, vitiates or obstructs the above mentioned eight qualitites *(gunas)* of a pure soul and keeps it away from its supreme state of existence.

Modus Operandi of *Karman*

Bondage (Bandha) — Here *karman* does not mean activity but the unification of a soul with material aggregates of *kārmaṇa vargaṇā* (group) as a result of the activities of the soul. Subtle-most matter of *kārmaṇa vargaṇā* fills the entire cosmos. The defiled mundane soul, under the influence of passions and emotions, is always engaged in some action. Any activity — mental, vocal or physical — produces vibrations in the soul and attracts these aggregates of matter which are then transformed into a transcendental psycho-physical force called *karman*. [1]

This union of jīva and *karman* is like that of milk and water. The resultant state is *bandha* (bondage). The *karman* may remain latent/supine for a time and then it rises (fructifies), manifests and gives its fruit — *karmaphala*. The duration and intensity of fruition depends upon the emotional state at the moment of bondage. Once the *karman* has delivered its fruit, it loses its potency and it ceases to be *karman* i.e. separates from the soul.

The Species of *Karman*

Since there are eight innate qualities of the soul, there are eight primary types *(mūla-prakṛti)* of *karman*.

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1. Even as a lamp by its temperature draws up the oil with its wick and, after drawing up, converts the oil into its body (viz., glow), exactly so does a soul-lamp, with the attributes of attachment and the like, attract the material aggregates by the wick of its activities and after arrtacting, transforms them into *karman*.

— *Tattvārthasūtra-Bhāṣya Ṭīkā*

1. *Knowledge-obscuring (Jñānavaraṇa) karman* obscures the pure and perfect knowledge.
2. *Intuition-obscuring (Darśanāvarṇa) karman* obscures the pure and perfect intuition.
3. *Feeling-producing (Vednīya) karman* holds up the self-generated bliss and produces pleasure and pain, joy and grief (in worldly life).
4. Deluding *(Mohanīya) karman* produces delusion — metaphysical and ethical — and :
   (a) prevents the innate ability of belief in truth,
   (b) destroys equanimity of conduct.
5. *Life-span-determining (Āyuṣya) karman* determines the biological species as well as the duration of life-span.
6. *Body-making (Nāma) karman* embodies the bodiless soul and determines the diversities and individual traits.
7. *Status-determining (Gotra) karman* determines the status and family conditions.
8. *Energy-obstructing (Antarāya) karman* obstructs/suppresses the spiritual energy.

Each of these primary species is divided into several sub-species which could be further subdivided into a large number. The total number of subspecies is 148. (See p. xiii)

Groups and Sub-species of *Karman*

It is obvious from the above that *karman* obscures, obstructs, cripples and distorts the innate characteristic qualities of the pure soul. But all the eight main species described above do not possess the same degree of potency of defilement. The eight species are thus divided into two groups : (a) Destroying *(Ghātin) karman* and (b) Non-destroying *(Aghātin) karman.* The former group cripples and distorts the innate qualities of the soul while the latter one, though unable to obscure any

fundamental quality of the soul, compels it to continue its wordly existence.

Four *ghātin karman* are :-

(i) Knowledge-obscuring
(ii) Intuition obscuring
(iii) Deluding
(iv) Energy-obstructing.

These are further sub-divided into (a) *Sarva-ghātin* — fully destroying and (b) *Desa-ghātin* — partially destroying.

(a) Sarva-ghātin : There are five categories of knowledge and hence there are five sub-types of knowledge-obscuring *karman* that veils them. Omniscience *(kevala-jñāna)* is an innate quality of pure soul which remains completely obscured by one of them. The remaining four sub-types are partially obscuring because they obscure only those categories of knowledge which are left uncovered by the fifth which covers the pure and perfect knowledge. Similarly the full intuition of the truth *(kevala-darśana)* remains obscured by one sub-type only of *darśanāvaraṇa karman*, while three sub-types partially cover the intuition. Five types of sleep-producing *karman* are also sub-species of this main type and they obscure the intuition fully.

The deluding *karman* is primarily divided into two types : (a) delusion of the truth and (b) delusion of conduct. Predilection for and faith in truth *(samyaktva)*, which is, like omniscience, the innate characteristic of the soul, is destroyed by the *sarva-ghātin* truth-deluding *karman (mithyātva)*.[1] Three strong types of passions (totaling twelve)[1] also fully cover their objects. Thus there are twenty

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1. Delusion of truth *(mithyātva)* lies at the root of evils, and the worldly state of existence of the soul and whatever misery there is in the career of a soul is ultimately due to it. It has no beginning in time and is there from all eternity. Its beginninglessness cannot be questioned because it is an ultimate fact. It is there. It is, also, the primary cause of the new bondage of *karman*. Until and unless its potency is destroyed or at least subsided sufficiently, the soul is unable to transcend the cycles of rebirths and continues its worldly state.

sub-types which are completely obscuring, that is, they obscure in full their respective objects. But this does not mean that there is absolute lack of predilection for truth or the capacity to cognise it. If that were the case, the soul would lose its soulness and become a non-soul. Even as the densest and darkest cloud cannot completely obfuscate the sun, exactly so the *karman* cannot obscure the total ability of knowledge and truth.

(b) Deśa-ghātin : Partially obscuring *(deśa-ghātin)* sub-species are twenty-five viz. the remaining four knowledge-covering, three sub-types of intuition-covering, mildest type of four passions, nine types of quasi-passion[2] and all the five sub-types of the obstructions *(antarāya) karman.*

Four *aghāti karman* are :

(i) Feeling-producing

(ii) Body-making

(iii) Status-determining

(iv) Life-span-determining.

They do not obscure any fundamental quality of the soul, but force the soul to continue its worly existence and prevent emancipation.

The feeling-producing *karman* has two sub-types (a) *Sātāvednīya* or pleasure-producing and (b) *Asātāvednīya* or pain-producing.

Nāma karman is concerned with body-making and causes the individual diversities. It has the largest number of sub-types (93) accounting for various forms of embodied existence. Thus, four *gati-nāma-karman* determine the species of the living organisms viz. (i) Sub-animal (such as plants) and animal world; (ii) human beings; (iii) celestial beings; and (iv) denizens of hell. In the same way various functions of organ-

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1. They are *anantānubandhin, apratyākhyānī* and *pratyākhyānī* types of anger, pride deceit and greed.
2. Nine quasi-passions are :
   (i) Joy/Laughter; (ii) Sorrow; (iii) Sensuous pleasure; (iv) Ennui in self-discipline; (v) Fear; (vi) Disgust; (vii) - (ix) Sexual desires of male, female and eunuch respectively.

building, joint-building, structure building commensurate with the species of the organism are allotted to other sub-types of this *karman.*

Gotra karman determines the diversities of racial, social and genealogical status and has two sub-types (a) high status and (b) low status.

Lastly, the *āyuṣya* (life-span) determining *karman* has four sub-types which are identical to *gati-nāma-karman* above viz. (i) sub-animal and animal life(ii) human life (iii) celestial life and (iv) hellish life.

Auspicious and Inauspiscious *Karman*

The four *aghātī karman* are also classified as (a) auspicious type *(puṇya)* and (b) inauspicious type *(pāpa)*. Those types whose fruition leads to enjoyment of pleasure and other blessings of worldly life are auspicious while those whose fruition leads to various types of suffering and misery are inauspicious. Whether a *karman* will be auspicious or inauspicious will depend upon the nature of the activities at the time of their bondage which may be moral/virtuous or immoral/sinful. It can be easily seen that *sātā vednīya karman* is type (a), while *asātā vednīya karman* is type (b). Similarly, high status, celetial and human life are auspicious while low status, hellish and sub-human life are inauspicious. Some of the subtypes of *nāma karman* are auspicious while some are inauspicious.

The number of sub-species are as follows :

(1)	*Jñānavaraṇa karman*	5
(2)	*Darśanāvarṇa karman*	9
(3)	*Vedanīya karman*	2
(4)	*Mohanīya karman*	28
(5)	*Nāma karman*	93
(6)	*Gotra karman*	2
(7)	*Āyuṣya karman*	4
(8)	*Antarāya karman*	5
	Total =	148

The States and Processes of *Karmar*

One of the most fundamental principles of the doctrine of *karman* is that every change in the soul synchronizes with a corresponding change in the state of *karman* and vice versa. Thus *kārmic* matter undergoes various processes due to the changes in the sates of the soul. We shall briefly describe some of the important processes here.

The first process is bondage *(bandha)* — attraction of *kārmic* matter from the space and its assimilation by the soul and its division into various types of *karman*. The *karman* does not yield fruit as soon as it is bound but remains inactive for some time, depending upon the duration of *karman (sthiti-bandha)*. This period of inactivity is called a *abādhākāla* and the *karman* is said to be in the state of *sattā*. After the period of non-production is over, the *karman* comes into rise *(udaya)* and begins to give it's fruit and this continues uninterrupted till the end of the duration *(sthiti-bandha)*.

Processes of Non-fruition

Premature fruition of *karman (Udīraṇā)* is a process in which *karman* is forced to yield its fruit prematurely by a strong effort of the soul, through a special kind of potency *(karaṇa)*. The forced premature fruition of deluding *(mohanīya) karman* produces a gap of non-fruition in the otherwise uninterrupted chain of fruition. This is called subsidence *(upaśama)*[1] or temporary non-fruition. Again, there is the process of destruction-cum-subsidence *(kṣayopaśama)* of *ghātin karman* wherein some portion of *karman* is subsided, some is destroyed while some is in the process of rise. It is this state of *kṣayopaśama* of the knowledge-covering *karman* that permits perceptual cognition *(matijñāna)*. The process of ultimate non-fruition is, of course, total demolition *(kṣaya)* which means final and total dissociation of the *kārmic* matter from the soul.

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1. The process of subsidence *(upaśama)* occupies a very important place in the soul's struggle for self-realization and emancipation. Out of the eight main species, the deluding *(mohanīya karman)* plays the most important role in perpatuating the worldly existence and even its short subsidence, therefore, gives the soul a glimpse of the truth of its own real nature and illumines its spiritual journey to the final goal.

Processes of Change in Fruition

By the application and manifestation of the process of a particular type of potency, the soul is able to change the nature *(prakṛti)*, duration *(sthiti)* intensity *(anubhāga)* and numerical strength *(pradeśa)* of the bonded *karman*. Transformation *(saṁkramaṇa)* is a process whereby one sub-type *(uttarprakṛti)* of a karman is transformed into another sub-type of the same main species. The process of increased realization *(udvartanā)* and decreased realization *(apavartanā)* are the transformations of the duration *(sthiti)* and intensity of fruition *(anubhāga)* respectively, of a *karman*. Finally there is a state of *karman* which is so irrefrangibly bound with the soul that it is not amenable to any of the above changes. This is the state of *nikācanā* in which all parameters are unalterably fixed and course of fruition is predetermined from the very time of bondage.

PROLOGUE II

The Brain

0. The Enchanted Loom

The *BRAIN'S* commanding presence orders sensation, movement, thought and a lifetime of memory. The central nervous system, a maze of nerve fibres, links all areas of the body to cells in the fabric of the brain, as in a loom.

Within that "enchanted loom" romanticized the Nobel prize winning physiologist Sir Charles Sherrington, "millions of flashing shuttles weave a dissolving pattern, always a meaningful pattern, though never an abiding one". Twenty-five centuries ago, Hippocrates, legendary father of medicine, declared "Not only our pleasure, our joy and our laughter but also our sorrow, pain, grief and tears arise from the brain; with it we think and understand, see and hear, and we discriminate between the ugly and the beautiful, between what is pleasant and what is unpleasant and between good and evil". In the sixth century B.C., Greek philosophers thought that the brain served as the organ of the mind and as the temple of the soul.

Object of mystery and superstition through most of history, human brain has revealed itself only in recent centuries. Modern technology enables neuroscientists to examine brain tissue for clues to nerve-regeneration and sprouting of neural fibres. Brain-surgeon Roger Sperry concludes that "the Brain's consciousness encompassed and transcended its physical workings; in the human head, there are forces within forces within forces, as in no other cubic half-foot of the universe that we know." Through the eyes of science, let us have a glimpse of the working of the enchanted loom.

BRAINSCAPE — THE PORTRAIT OF THE BRAIN

1. Divisions and Parts of the Brain

Through the centuries, surveyors of the brain charted every cerebral

hill and valley. They sprinkled Latin names across the brainscape — *amygdala, corpus callosum, hippocampus* etc. Some divided the brain into three sections — forebrain, midbrain and hindbrain. They determined that the skull housed not one brain but two - a matched pair - the two *hemispheres* which communicate through the *corpus callosum* deep within the cerebral divide. Though symmetrical, the hemispheres are not necessarily equal. In most persons, the left brain dominates the right side of the body, accounting for right-handedness.

At its base, juts the *brainstem* where nerve pathways shuttle life's impulses between brain and body. It contains the *medulla oblongata* with reflex-centres which control heart-beat, blood pressure and breathing, and flash signals to swallow, sneeze and laugh. It is the most vital part of the entire brain, the evolutionary core, the primitive site for survival.

Guarding the rear of the medulla is the *reticular formation*, the brain's alarm apparatus, monitoring the sensory signals that pass through it, and alerting the decision-making cortex to take action. From the medulla and adjacent areas radiate the twelve pairs of cranial nerves which serve the sensory and motor needs of head, neck, chest and abdomen.

The bridge — *the pons* — serves as a neuronal link between *cerebral cortex* and *cerebellum*, the fore and the hind-brains; nearby is the control centre that regulates breathing rhythm. Wedged between stem and cerebral hemispheres, the *cerebellum* governs a human's every movement. Apparently initiating nothing itself, the cerebellum monitors impulses from motor centres in the brain and from nerve endings in muscles. Modifying and coordinating commands, it smoothes a dancer's footwork or lets a hand glide a glass to lips without sloshing the contents. There is evidence that it may also play a role in a person's emotional development modulating sensations of pleasure and anger.

Filling the ventricular lakes and their tributaries, the brain's precious *cerebro-spinal fluid* measures less than half a pint and is renewed about three times a day. It supplies nutrients to and carries away metabolic wastes from the brain.

Wondrous alchemy is produced in the *hypothalamus* which lies just beyond the midbrain-end. It synthesizes hormones to control growth, raise and lower temperature, regulate the body's water-balance and activate sexual behaviour. The hormones funnel into the *pituitary gland* below, where they are stored or released into the blood-stream. Nearby is the *pineal gland* — the vestige of a primitive third eye — in fact, a light activated biological clock that regulates sex-gland activity.

The *thalamus*, at the top of the brainstem helps to regulate consciousness. Information from nearly every area of the body is relayed by it to the *cerebrum* above. The *limbic system*, composed of various parts, is the emotional brain.

Above spreads the vaulted *cerebrum*, the two-thirds of the brain where human thought and creativity originate. Hundreds of millions of microscopic threads of white matter form an array of connections between the cortex's nerve centres and distant parts of the brain. The *corpus callosum* knits together the two hemispheres and unites the special powers of both hemispheres, one specializing in analytical and verbal skills, the other adept in space and pattern perception. The left one which dealt in the abstract symbols of language and numbers, was logical and sequential in processing information. The right one generated mental images, grasped things as a whole, was holistic and simultaneous in its thinking. Recent studies have established that the brain divided (by cutting the corpus callosum) can function as ably as the brain intact.

Less than a 1/4 inch thick, the *cerebral cortex*[1] forms a fissured mold snug against the skull. It is composed of six layers of cells meshed in some ten thousand miles of connecting fibres per cubic inch. Each hemisphere is further divided into four lobes : (1) *Frontal lobe* (2) *Parietal* lobe (3) *Occipital* lobe and (4) *Temporal* lobe. Every voluntary movement from hand-shake to the wink of an eye is controlled by *motor cortex* in the frontal lobe. Sensory cells that respond to touch, heat, cold, pain and body-position cluster the parietal lobe. *Visual cortex*

1. The cortex measures about 2½ square feet and is about ¼ inch thick.

occupies an area in occipital lobe at the back o each hemisphere. *Hearing* is processed in temporal lobe. In spanning parts of all lobes dwell the mysteries of *thought, language* and *memory*. Language control areas in left hemisphere, direct the smooth transfer of thought and expression into speech. But linguistic functions may be assumed by other areas including those in the right hemisphere, dormant until compelling need awakens lazy neurons. *Prefrontal cortex* (rather vaguely charted) is the realm of *planning* and *foresight.*

2. Important Parts and Functions

After this brief survey of the brainscape, let us have a closer look at some more important parts and functions of the brain.

A. Reflex Action

Some sensory messages require such a rapid response that they never even reach the brain. Touching a hot iron, for example, can trigger a protective circuit known as a *reflex arc.* When the hand touches the iron, receptor cells in the skin pick up the message and transmit it to sensory neurons which relay it *directly* to a motor neuron in the spinal cord. The motor nerve speeds a message back to the muscles of the arm and hand which yank the fingers away. The finger has already left the iron by the time the burn is felt. In due course, the brain, overriding lesser sensations, will trigger the muscular responses of frown and cry of pain.

B. Reticular Activating System

Roughly the size of a little finger, the *reticular formation* lies in the central core of the brainstem. It runs from the top of the spinal cord into the middle of the brain.

The ability to concentrate at a most critical moment, say at the match-point, in a tennis match, lies in the *reticular formation.* It operates continuously in all humans during periods of alert wakefulness.

Every second, 100 million messages bombard the brain carrying information from the body's senses. A few hundred, at most, are permitted through to brain regions above the brainstem. Of these, the conscious mind heeds a few. While a person may be partially aware of

many sounds, smells or movements around him, concentration is limited to one sensation at a time. Without the reticular formation's alerting action, the cortex could not sort the significant messages from the trivial ones. The reticular formation continuously sifts and selects, forwarding only the essential, the unusual, the dangerous to the conscious mind.

Messages are sent as nerve impulses from sensory receptors in all parts of the body to the cortex through pathways that run up the spinal cord to the reticular formation. From there they are relayed to other brain regions. These pathways and the reticular formation are collectively called the *reticular activating system* — "RAS" for short. When stimulation of the reticular formation slackens, we sleep. Injury causes a coma, a prolonged state of unconsciousness. Reticular formation is, in essence, the physical basis of consciousness. Without this alarm apparatus, a person would be "reduced *to a helpless, senseless paralyzed blob of protoplasm*".[1]

C. The Feeling Brain — Limbic System

Our passions and our drives are as much the brain's creations as are intellect and reason. The forces of fear, elation, grief, anger and lust arise from the most primitive region of the brain known as the *limbic system.*

The limbic system works with both the cerebrum above and the brainstem below. While connections of the limbic system with the cerebrum permit an interplay between reason and emotion, those with the brainstem help in maintaining a state of emotional balance and alertness. Generally, both of them work in harmony, but the balance can be easily upset. A highly activated limbic system can overwhelm rational thought, making a person speechless with fury or joy. Through conscious control, a person can resist the urge to eat or drink, fight back tears or suppress sexual desire.

Various parts of the limbic system encircle the brainstem, and nerve pathways, interwoven through these parts, send a continuous flow of electrochemical impulses that direct human drives and emotions. The

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1. John D. French, neuro-physiologist.

hippocampus constantly checks information relayed to the brain by the senses and compares it to experience; the *thalamus* analyses and passes information from sensory and motor nerves to the brain. From *hypothalamus* arise feelings of pain, pleasure, punishment and rage. Above the hypothalamus is the *amygdala,* thought to be related to feelings of rage and aggression. The *septum* appears to contain yet another limbic pleasure centre.

D. The Hypothalamus

Only the size of a thumb-tip, a cluster of nerve cells, called the hypothalamus, receives one of the richest blood supply in the entire body. It nestles between the thalamus above and the brainstem below. Through its connection with the brainstem, hypothalamus maintains *homeostasis,* the body's internal equilibrium. It keeps body temperature constant at roughly 98.6 degrees F. *Hunger and thirst-centres* in it serve as the body's appestat. Hypothalamic disorders may cause compulsive eating or loss of interest in food, with this sophisticated sensing system, the body constantly balances and replenishes itself. The hypothalamus controls growth and sexual behaviour through the pea-sized *pituitary gland.* When sensors detect a drop in hormones in the blood stream it commands the pituitary to step up production and the latter responds by organizing the endocrine glands' release into the blood. It is a delicate system of reciprocity. So crucial is it that injury to certain hypothalamic regions can kill the sex urge entirely.

The hypothalamus also coordinates the *"fight or flight"* reaction in times of emergency. It organizes a chain reaction of defenses with a single aim: to put the body in top physical condition to cope with the emergency. Under the command of the pituitary gland, *adrenals* spew out *adrenalin* and *noradrenalin,* the heart beats faster, blood pressure and blood sugar rises to supply maximum energy and the breathing becomes faster.

E. Centres of Pain and Pleasure — E S B

Much of our knowledge stems from *electric stimulation of the brain* or *ESB.* It was discovered that stimulation of different parts of limbic

system provoked reactions ranging from anger and anxiety to euphoria, sexual interest and states of deep relaxation. For instance, while stimulation of a certain part of *amygdala*, above the hypothalamus, can incite fury, current applied only three millimeters away produced extreme relaxation and detachment. Cancer victims have received instant pain relief from *septal* stimulation.

Nobel Prize-winning Swiss physiologist, Walter Hess devised a method for penetrating deep brain structures. He stimulated thousands of brain-sites, most of them in the hypothalamus. Depending on the part stimulated, the cat, under observation, would eat, drink, curl up and sleep or become sexually aroused. He firmly believed that the *true emotion* could be electrically induced. Other scientists have confirmed his theory.

Reward- or pleasure-centres situated in the hypothalamus were accidentally discovered by psychologist James Olds and were later confirmed by further studies.

Transistorized radio receivers, activating cranial electrodes allowed stimulation by remote control which freed test animals from cables that had restricted their natural movements in experiments. Yale University physiologist Jose' Delgado transformed a charging bull into a docile animal by pressing a transmitter button sending radio signals through the electrodes implanted in two different parts of the limbic system.

F. Wonderful Chemistry of the Brain

In recent years, researchers have discovered nearly thirty chemicals that act as neuro-transmitters, each designed to convey a different type of information. But the most exciting discoveries have led scientists to believe that the brain possesses a special chemical control system to cope with pain and stress by producing natural pain killers similar to morphine. They are called *enkephalin* meaning "in the head" and *endorphine* meaning the "morphine inside".

Enkephalins may also regulate mood. These chemicals, when heavily concentrated in the limbic system, act as the body's own 'natural high' and counteract disappointment, prevent depression, and produce euphoria.

Scientists, believe that further research into the body's natural opiates may lead to the development of non-addictive pain-killers and ultimately, to a total understanding of the complex chemistry of pain.

3. Brain and Consciousness

The desire to experience transcendence from ordinary consciousness is probably innate. Altered states of consciousness can be achieved (i) by taking perception-distorting (psychedelic) drugs and (ii) through various techniques of meditation.

Practice of Meditation

All techniques of meditation share certain features : In quiet surroundings, the meditator concentrates on a single point of focus — a word, shape, idea, question or, perhaps, his own breathing. Such concentrated attention compels the mind to shift from its customary active state to one of passive receptiveness. As the mind's activity is stilled, the meditator becomes detached from thought. Some practitioners seek relaxation and a sense of well-being. Others, particularly those who practice a religion in which meditation plays a central role, aspire to mystical states.

Scientific findings showed reductions in blood pressure, heart-rate and oxygen-consumption, intensified alpha brain-waves and other signs of deep relaxation. The meditators produce a unique consciousness, a state of deep, though wakeful, relaxation. This "relaxation response", is the reverse of the 'fight-or-flight' reaction that causes blood pressure, hearth rate and oxygen consumption to soar during stress.

Similar feats of mind over body have been credited to the hypnotic trance. Hypnotic suggestions can bring about changes in heart-rate, stop bleeding, increase muscular strength, or lower one's sensitivity to pain. Hypnosis has cured phobias and caused warts to disappear spontaneously. Researches suggest that self-hypnosis or auto-suggestion allows practitioner to gain control over heartbeat, breathing, digestion and glandular activity — involuntary processes not normally subject to conscious control. Like meditation, it couples physical relaxation with mental concentration.

Self-hypnosis has been used as a psychoanalytic device to delve into the unconscious. Medical and psychiatric associations have approved its practice, and dental and medical schools now teach it.

A newer technique for consciously regulating physical processes is biofeedback. Sophisticated electronic equipment monitors a persons' brain-waves, blood pressure and other involuntary activities, displaying information, or feedback, about them. The biofeedback subject learns to control these activities through passive concentration, a relaxed mental state allowing the mind to respond to the audiovisual display and modify the particular physical process. It seems relaxation, rather than conscious effort, is the key to successful biofeedback.

4. Brain in Health and Disease

A. Advances in Neuroscience / CAT Scanner

In research in diagnosis and treatment, the neurosciences are advancing with unprecedented speed. Before the advent of the brain scanner, in the early 1970's, many brain-disorders were difficult or impossible to detect by conventional X-ray techniques because these could not distinguish between a tumor and a healthy tissue, both being nearly the same density. The development of computerized axial tomography or CAT scanner has revolutionized the diagnosis of brain disorders. Doctors can now see into the deepest recesses and layer after layer of their patients' brains. The scanner's high speed computer projects a sharply focused, highly detailed tomogram, or cross section, of the patient's brain on to a television screen. A suspected tumor, blood clot or hemorrhage can be diagnosed quickly and accurately. The CAT scanner not only finds and determines the size of the tumor but a series of scans can distinguish a spreading from a non-spreading tumor and between old and new strokes.

B. Beyond CAT — NMR or MRI

A new method of scanning promises to take the place of CAT in the near future. *Nuclear magnetic resonance imaging,* shortened to NMR or MRI, is the technique in question. The single proton in the atomic nuclei of hydrogen-1 has an intrinsic magnetism which makes it, in essence, a

bar magnet and most MRI (magnetic resonance imaging) has been generated using hydrogen-1 resonance. By the mid 1980s, MRI of hydrogen-1 nuclei was being used to locate tumors, strokes, multiple sclerosis, scars and other lesions. The clinical usefulness of MRI is that no X-radiation is delivered to the body. This means that MRI can be used safely in infants, children and pregnant women. MRI will probably replace CAT and other forms of X-ray imaging in diagnostic radiology.

C. PETT

New computer imaging techniques have made possible a sophisticated version of radioisotope scanning called PETT, or *positron emission transaxial tomography.* An injected radioactive isotope moving through the body emits positrons which collide with electrons in body cells resulting in mutual annihilation and release of *gamma rays.* A computer turns the information into a coloured map of the body's metabolism. The PETT scan could eventually become a routine part of psychiatric diagnosis of more than one kind of mental illnesses.[1]

D. Evoked Potential Testing

Measuring the electrical activity of the brain is another way of finding disorders and exploring brain function. Minute changes (evoked potential) in electrical voltage, are the brain's response to sensory stimuli and the computer can identify the specific brain-waves created by the stimulus. *Evoked-potential* testing is ideal for detecting vision and hearing defects in newborn infants and can prevent life-long impairment. It can also be used to determine the cause of a child's poor scholastic performance, to assess brain damage, to diagnose brain tumors and multiple sclerosis.

E. Neurosurgery / microsurgery

Important progress in the treatment of brain disorders has also been achieved through drug research and advances in neuro-surgical

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1. A PETT scanner machine costs several million dollars and requires thirty people to produce one diagnostic scan.

techniques have kept stride with drug research. Development of ara - A, a drug used to combat the deadly virus herpes encephalitis marks a medical milestone. Similarly, microsurgery is saving the lives of many potential victims of stroke, the most common brain injury. Using fine tools and a microscope, surgeons divert an artery from scalp to brain in hopes of increasing blood supply and preventing stroke. It has also boosted the success rate for operations to remove weaknesses in the walls of brain arteries.

The most radical form of neurosurgery, the brain transplant, has already been performed with surprising success on Rhesus monkeys. Less awesome than the total brain transplant is the grafting of selected areas of the brain. Researchers believe brain grafts might relieve Parkinson's disease and other human neurological disorders as well.

F. Psycho-Neuro-Immunology

The mind itself may play a role in curing disease. It is now well established that negative emotions can upset body chemistry and bring on disease. Positive emotions have the opposite effect. A recent new research discipline, *psycho-neuro-immunology* shows that systematic pursuit of salutary emotions and technique of auto-suggestion alleviates chronic pain and retard degenerative diseases.

As scientists penetrate the substance of the brain with grafts and transplants, pacemaker machines and drugs for controlling brain functions, a fundamental question arises : To what extent can we manipulate the brain — precious sustainer of life, physical basis of mind — before the very essence of life itself is transformed ?

The challenge of unfolding the brain's mysteries is a compelling one — can man discover the mechanism of thinking, and whether, by so doing, can he achieve new orders of understanding the dimensions of his own nature ?

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PRECAUTIONARY NOTE
Difficulties of Language regarding Terminology

In the chapters which follow, we have tried to discuss human attitude and behaviour from two different lines of thought. Since we are obliged to use the same language for expressing both lines of thought, it is prudent to explain the concepts of a few fundamental terms in each line of thought to avoid serious difficulties in specifying the use of these words in the text.

1. Consciousness and Soul

(A) The term 'Consciousness' is considered a misleading term and is very much disliked by some Metaphysicians. They consider "self-consciousness" as a psychological impossibility and strongly object to the use of the expression.[1]

Neuroscientists also use the term consciousness in a very limited sense to specify the state of a person in which the activating programs of brain allow experiencing and thinking, that is, the state which is diametrically opposite to unconsciousness. In saying that one is conscious, we mean that one is awake and aware and open to receive and give out information and the capacity to do this depends upon the operation of a system in the head, called brain. Thus conscious experience is entirely dependent on the activity of the brain. Sleep, drugs and brain-damage alter the condition of consciousness. Consciousness, therefore, is the name that is applied to the condition that is experienced. Unfortunately, our language is capable of describing our knowledge and our experience, but we get into serious difficulties when we try to use the language to describe the *knower*. And the difficulty becomes unsurmountable because the 'knower' is not accepted by neuroscience as an eternal non-physical entity.

(B) According to the doctrine of *karman*, the soul — the eternal, non-physical conscious substance — is the ultimate *'knower'*. Knowing and

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1. "..... We ought to banish the very expression 'consciousness' or 'state of consciousness' from our language . . ."
— Elements of Metaphysics by A. E. Taylor, 7th Edition, footnote on p. 79.

experiencing are inherent in the soul. Knowledge can be born or rather emerge with or without the help of sense-organs and mind which are, however, only external instruments, the different states of the soul being their spiritual counterparts. The soul could never be bereft of consciousness. Even one-sensed organisms, such as plants, do possess the feeling of touch and can experience pain. These organisms are *asaṁjñī* i.e., they do not possess a brain or mind. But by suitable electronic apparatus, not only the pain but their awareness and expression of the pain can be recorded and studied.[1]

2. Soul and Mind

Many psychologists, metaphysicians and others use the terms 'mind' and 'soul' as virtually interchangeable names of the object studied by psychologists. So far as there is any definite distinction of meaning between the terms as currently used by English writers, 'soul' seems to carry with it more of the implication of substantiality and relative independence than *'mind'*. Some writers prefer to use the term 'spirit' for soul in the sense here suggested.

Those who do not believe in the ultimately real dualism i.e., separate existence of the two systems — the (mechanical) physical system i.e. the *body* and psychical entity or system i.e. the soul — cannot find the connection which subsists, as an actual fact, between body and soul but are forced to invent a connection in keeping with the general scheme of physical and psychological hypotheses.[2]

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1. Secret Life of Plants by Peter Tompkins.

2. Compare the following striking passage from Avenarius, *menschliche weltbegriff*, p.75 : "Let an individual M denote a definite whole of 'perceived things' (trunk, arms and hands, legs and feet, speech, movements, etc.) and of 'presented thoughts' as I, ... then when M says 'I have a brain', this means that a brain belongs as part to the whole of perceived things and presented thoughts denoted as I. And when M says 'I have thoughts' this means that the thoughts themselves belong as a part to the whole of perceived things and presented thoughts denoted as I. But though thorough analysis of the denotation of I thus leads to the result that we have a brain and thought, it never leads to the result that the brain has the thoughts. The thought is no doubt, a thought of 'my ego' but not a thought of 'my brain' any more than my brain is the brain of 'my thought'. i.e., the brain is no habitatioin, seat, generator, instrument or organ, no support or substratum of thought. Thought is no indweller or commander, no other half or side, and also no product, indeed not even a physiological function or so much as a state of a brain."

3. Mind and Brain

(A) Neuroscientists (and others) commonly refer to mind as an entity comprising the operations of the brain during the periods of awareness. No one has any direct perception of this as an entity and, in some senses, we know even less about it than about the brain. It clearly has no physical attributes and one cannot see or hear or touch it. It, however, is useful as a description of the general mode of operation of the brain and is sometimes described as the functional organization of the brain. But the brain performs many functions of which we are not aware and, therefore, the mind is perhaps that part of the brain's functional organization of which we are conscious. But even at best, it is really a vague concept.

(B) In Jain philosophy, mental activity is differentiated from physical or muscular entity (which includes vocal activity or speech). All the three are controlled by the non-physical entity '*citta*' which is the psychic component of the soul animating the physical body including brain. The term *manaḥ* is the closest translation of the term mind and is commonly used to distinguish it from the body *(śarīra)*. *Manaḥ* has two functioins — conceiving and perceiving. It is associated with sense-organs in the process of perception and is associated with memory and planning etc. in the process of conception. Thus, in reality, *manaḥ* is activated only when it functions and becomes *amanaḥ (non-mind)* during the periods of non-functioning. Thus it is to be regarded as an external instrument of mental functions, while *citta* is its activator and psychic master.

1. KARMA AND NEUROSCIENCE

Introductory :

Anyone who ventures to fathom and interpret the profound wisdom of the ancient Jain Philosophy, particularly in modern scientific terminology and methodology, must first humbly apologize, for his temerity to (i) those who really know because he may irritate them and (ii) those who do not know because he may mislead them. What then is the excuse for such a venture ? It is our firm belief that what follows in this book will be found useful to (i) those inquisitive scientists who are impressed by the wisdom of the ancient seers and sages in the East and are anxious to augment the vistas of their knowledge and (ii) those inquisitive philosophers who believe that the facts proved by science may be able to pave the way for discovering more truths and knowledge.

A conservative/die-hard philosopher may at this point, question the *locus standi* of science to pronounce opinions on such subjects and thereby trespass into the field reserved, for philosophers and theologians. It may be held that those who study 'mere matter' should not dabble in the study of fundamentals but leave it to those who are concerned primarily with man and humanities. We humbly beg to differ from this view as it involves a false dichotomy of knowledge.

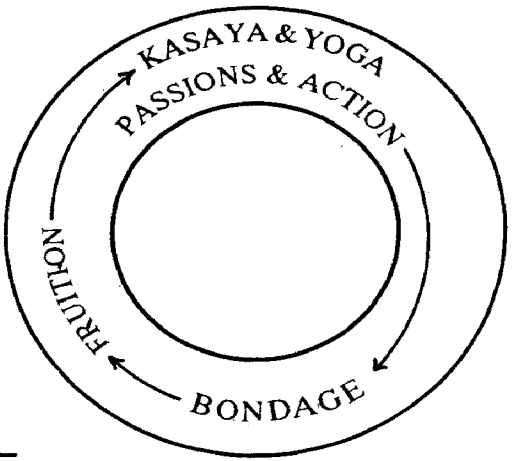
Knowledge is obtained in many ways and knowledge about human mind is in many ways different from knowledge about any other subject. But to reject scientific facts impoverishes the effort to research into the truth. We believe that scientific facts, properly interpreted, can help towards better understanding of some of the great questions such as the relation of 'body and soul' or the 'meaning of our existence'.

Modern advances in Biological Sciences such as endocrinology, physiology, neuropsychology and genetics explain *how* living organisms go about in pursuit of their particular aims. Doctrine of *karman* show *why* they do so. We believe that all that is necessary is that ancient knowledge and the interpretation of the ancient wisdom be expanded, translated and re-stated in terms that encompass discoveries of modern science.

We further believe that simultaneous discussion of the *facts of science* and *wisdom of philosophy* will help all of us to better understand both of them. While science, by itself may not be able to add fresh knowledge on the subject of *karman*, we are confident that scientific facts, if properly and systematically correlated with philosophy, are sure to enhance our understanding of the latter.

1. Cyclic Nature of Karman

The fundamental essence of the Jain doctrine of *karman* is based on the self-sufficiency and cyclic nature of the system; that is, the effect of the existing *karman (karmaphala)* becomes the cause of the new *karman (karmabandha)* and the vicious circle continues *ad infinitum* until one achieves emancipation. (see figure). As stated in "Doctrine of *karman*", the soul, pure in itself, has an innate ability to regain its pure state (*Nirvāṇa*[1] i.e. emancipation) by demolishing the power of *karman* and



1. The analogy of sea-water defiled and polluted by various impurities and pure water obtained from it is useful to understand the nature and process of *Nirvāṇa* in many respects. It is well-known that totally pure water, in large quantities, is produced by the process of distillation. Rain is also a natural process of distillation.

   Basically it is possible to purify water because even in the polluted state of sea-water, it never surrenders its waterhood (i.e. atomic structure H_2O). Similarly the soul never loses its fundamental soulhood when defiled by another substance — *kārmic* matter. It would be noted that processes such as filteration can remove undissolved impurities but distillation is necessary for removing dissolved pollutants. Similarly *'Nirvāṇa'* can be achieved only by a prescribed process of spiritual discipline.

thus terminate the cycles of rebirth. An important facet of *karmaphala* (fruition of *karman*) is the bondage of new *karman*. The chief causative factors of the bondage are *Kaṣāya*[1] (which includes *Nokaṣāya*[2] and *Yoga*[3] and both factors are the result or effect of the fruition of the existing *karman*. While 'attitude and behavior' are the ultimate effects of the past, it is also the cause of the new bondage. Behavior is constituted by threefold activities — mental, vocal and muscular or thought, speech and bodily action. However, both speech and bodily actions are themselves regulated by thought (at least so far as humans are concerned). The speech is always preceded by thought and it is the human brain that produces language, love and aggression, pleasure and pain, happiness and grief, and much more positively come *through* the brain though not *from* it. We can thus study both the cause and the effect of *karman* by a critical study of (analyzing) how the brain works and controls the attitude and behavior of a person and regulates his life.

2. Neuroscience

Today several disciplines are involved in the study and research of Brain and its functions. Some of the prominent ones are :

- *Anatomists* who study pathways in the brain
- *Physiologists* who record and study its electrical responses
- *Biochemists* who investigate its endless chemical activities
- *Clinical neurologists* and *neurosurgeons* who tell us much about its health and disease
- *Psychologists* of various sorts who assess the performances, attitude and behavior of men and animals under different conditions.
- *Psychiatrists* who treat mental illnesses.

And the list is by no means complete. To organize the great mass of information that is being collected from experiments and observations by all these and other disciplines, the scientists agreed to give a name, a general label to the entire study and called it *'Neuroscience'*.

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1. *Kaṣāya* : Passions — anger, arrogance, deciet and greed.
2. *Nokaṣāya* : Quasi-passions — joy, etc. (see Prologue I).
3. *Yoga* : Threefold action — thought, speech and physical activity.

Tremendous advances have been made in neuroscience in recent years and this new knowledge is used to make valuable statements about puzzling aspects of human behavior. Not only can it give new views of the problems raised by our habits, our work and play and our emotions and passions but also help with the study of philosophy (epistemology in particular), aesthetic appreciation, ethics and religion.

3. Brain Contains Knowledge

The basic fact about brain is that it contains knowledge and information written in its own language. Information in a living system is a feature of the arrangement of its parts which constitute a 'code' or language. To understand the language of the brain, we must learn to interpret the elements characters of the script in which it is written. Neuroscience is beginning to do this and in this book, we *hope* to show how the organization of the brain can be considered as the written script of the programs of our lives. So, the most important feature of the brain is not the material that it is made of but the information that it carries.

The neuroscience can translate the language of the brain into ordinary language and such knowledge of the brain enables us to expand our understanding of fundamental problems such as : why do people indulge in violence though they know that it is wrong to do so ? Thus, we hope to show that study of the brain reveals patterns of information and action whose significance we can still perceive only dimly.

2. PROGRAMS OF THE BRAIN

0. A. Classification of Living Organisms according to the Doctrine of Karman

The Jains classify living organisms from several aspects. One of them being *jāti* i.e. classification based on the number of sense-organs possessed by the organism as follows :

(i) ***Ekendriya*** — One-sensed organisms possessed of sense of touch, e.g. plants.

(ii) ***Dvīndryiya*** — Two-sensed organisms possessed of senses of touch and taste, e.g. worms.

(iii) ***Trīndriya*** — Three-sensed organisms with touch, taste and smell, e.g. ants.

(iv) ***Caturindriya*** — Four-sensed organisms with touch, taste, smell and sight, e.g. house-flies.

All these four categories do not possess a brain (i.e. they are *asaṁjñī*).

(v) ***Pancendriya*** — Five-sensed organisms with all the five senses including sense of hearing. They are of two types : (a) without brain *(asaṁjñī)* (b) with brain *(saṁjñī)*. The latter are further subdivided into:

(i) ***Deva*** — celestial beings.

(ii) ***Nāraka*** — denizens of hell.

(iii) ***Manuṣya*** — humans.

(iv) ***Tiryañca*** — sub-human organisms.

The last are further sub-divided into

(i) ***Jalacara*** — aquatic animals e.g. fish.

(ii) ***Sthalacara*** — animals living on land (including amphibians) e.g. cattle; lizards.

(iii) ***Nabhacara*** — birds.

0. B. Classification according to Biology

In biology, the psychic order of existence on this earth is first divided into two kingdoms — the animal kingdom and the plant kingdom. This, therefore, is the highest category and all animals are included in the animal kingdom and all plants in the plant kingdom. The biological classifications consist of a descending sequence of seven categories : (i) kingdom, (ii) phylum, (iii) class, (iv) order, (v) family, (vi) genus and (vii) species.

Species : In the ascending sequence, species is the basic unit and the lowest category. A species is defined as a group of individuals which are genetically distinct, reproductively isolated and similar in morphological characteristics. *Panthera leo*, the lion and *panthera tiqris*, the tiger are species of the genus *panthera*.

Genus (Pl. Genera) : A genus is an assemblage of related species and it is implied that all the species under one genus have evolved from a common ancestor. Thus *panthera* is the generic name for the species lion, leopard and tiger. They have many features in common and they are, therefore, included in one genus. The genus panthera is differentiated from the related genus *felis* which includes other wild cats such as the golden cat, the jungle cat, etc.

Family : This catagory includes related genera and is separated from other related families by important and characteristic differences. All types of cats belonging to different genera are included under the family *felidae*. This family is distinctly separated from *canidae* which includes dogs and foxes.

Order : This category includes related families. Therefore, both the above families are placed under the order *carnivora*.

Class : This category includes the organisms of related orders, e.g., the order *primates* which includes man, monkey, gorilla, etc., and the order *carnivora* which includes the lion, the cat, the bear, the dog, etc., are included in the class *mammalia*. There are also a number of other orders in the class *mammalia*.

Phylum (Pl. Phyla) : Classes of different organisms having some features in common are included in a phylum. The phylum *chordata* includes a number of classes such as *amphibia*, *reptilia* and *mammalia*. In the case of the plants, several classes constitute a *division* which is equivalent to the phylum of the animal kingdom.

Example : Phylum Arthropoda is divided into four classes — Crustacea, Myriapoda, Insecta and Arachnida.

Class Crustacea — crab, prawn.

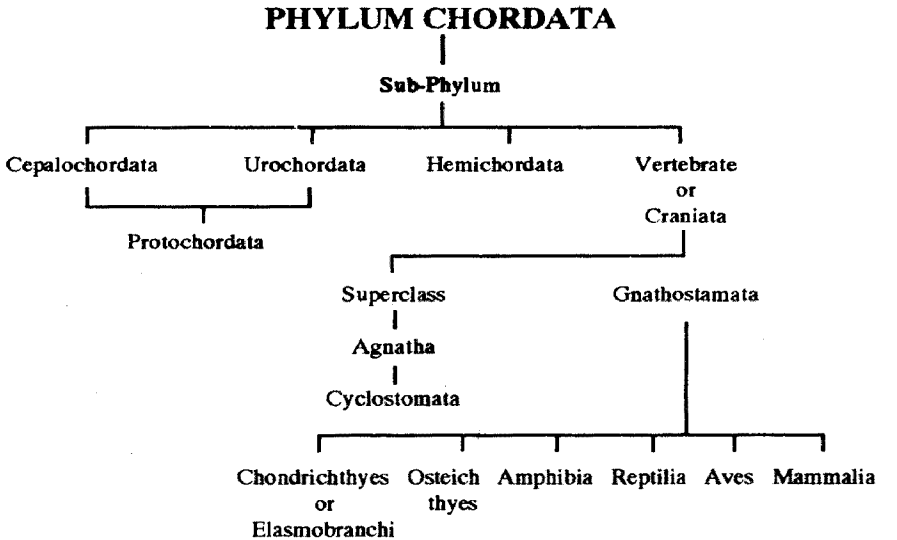
Class Myriapoda — centipedes and millipedes.

Class Insecta — butterfly, cockroach, bed-bug, mosquito, fly.

Class Arachnida — scorpion, spider.

Genus Musca — flies.

Species Musca Domestica — housefly.



1. Structure of the Brain

Let us begin our discussion with some questions : What is a brain ? How does it operate ? How does it know and think ? How does one learn, remember and forget ? How do all these processes go on in the brain

while we lead our daily life ? Even the most able physiologist (or neurologist) has no real answer to a single question. If the essential feature of the brain is that it contains knowledge and information, our task is to learn to translate the language it uses. However, physiologists and other neuroscientists would rather try to "understand the brain" only in the common scientific terms of Physics and Chemistry. Biochemistry and Biophysics have indeed shown an immense amount of detail about the messages that pass along nerves and the chemicals that they secrete. But it is inconceivable to describe and explain how the brain operates by giving details of these processes.

There are at least fifty thousand million (50,000,000,000) neurons in a human brain and each of these has many parts. This figure becomes even more astounding when it is realized that each neuron can interact with other neurons in not just one, but many ways — it has been recently estimated that the number of inter-connections may be as many as 10 with 800 noughts (zeros) following it. The brain has thus been aptly compared with "ten thousand million bureaucrats telephoning each other about the plans and instructions for keeping a country's affairs going".[1]

2. Programs of Life

The advent of computers and artificial intelligence with their theories and programs has given us an efficient analogy — the analogy of a program[2] which enables us to describe the functions of brain in an understandable language. Thus it can be said that our lives (and those of other animals) are controlled by sets of programs written in their *genes* and *brains*. Some of these programs ensure that we breathe, eat and sleep; some others control our growth, adulthood, senescence and death; others govern our speech and other forms of communication; still others regulate our emotions — our love and hate.

There are some long-term programs which ensure the continuity of our race. Even the most important programs used for mental activities

1. J. Z. Young, F.R.S., in his Reith Lectures of 1950.
2. The term 'program' is used here in the modern use of word in 'computer program' and not as in programme of a meeting or function. Program means "a system (a plan of procedure) under which action is taken".

such as thinking, planning, believing and worshipping are also there, since all our actions and thoughts come *through* the brain although it is difficult to say whether they come *from* it. In short, the brain operates in definite organized ways, called programs and results of these programs constitute the entity that we call 'personality'. To avoid too much complication, we shall ignore, as far as possible, the ultimate (transcendental) separateness of the body and soul and treat a living organism as an entity.

3. Selection of Programs

We can then say that a set of programs would mean a plan of action or activities which would be undertaken by an organism during its life-span. It would be composed (written) beforehand by *karman* and would, obviously, be selected from an innumerable possibilities *to confirm to* the particular group or class to which the organism belongs.

The selection of program will depend upon the past carrier of the individual and would be composed mainly by two out of the eight main categories of *karman* (See Prologue I) viz., (i) Life-span-determining *(āyuṣya) karman* and (ii) Body-making *(nāma) karman*.. Thus the programs of a human organism would be the combined work of the three selective agencies : (a) *Manuṣya-āyuṣya-karman* (b) *Manuṣya-gati-nāma-karman* and (c) *Manuṣya-anupūrvī-nāma-karman.*

Indeed, other selective agencies would also be concerned e.g. the culture, family etc. of the organism would be determined by the "Status-determining *(gotra) karman*". In the case of humans, it would also be the major determinant of his religion, legal, social and political status and language. Various other contributions to the programs of and organism would have to be made by several other selective agencies from the other major categories of *karman*. In fact, every division and subdivision of all the eight categories would have some influence, even if faint, in determining the brain organization and programs of what an individual would be and can do in a life-span — to love or to hate, to command or to obey and what to believe and whom to worship.

4. Translation and Transmission of Programs

Organization is the essence of a living organism. An organism continuously acts to maintain its organization because it receives from its past lives the plan or program to survive. Primarily determined by *āyuṣya karman.* Programs for other activities such as religion, beliefs, learning, cultural behavior etc. would be influenced and determined by other major *karman.* All those programs are embodied in the subtle micro-body —*kārmaṇa śarīra* —of the organism. The language of the program must be such that it can be translated and transmitted to produce the right actions by the gross physical body for the self-maintenance of the living system, and must be interpreted by some in-built mechanism which acts as a translator and transmitter.

Programs of vertebrate organisms *(saṁjñī pancendriya)* are translated on two levels :

1. The basic level is inherited, written in the triplets of bases of the DNA code which is transcribed and translated during development and throughout life, enabling the organism to react appropriately with the environment.

2. The second level is embodied in the structure of the brain. Its units are various groups of nerve cells which deal with breathing, eating, sleeping as well as perceiving, thinking and communicating.

Two more levels are added to these in the case of human organisms *(saṁjñī manuṣya pancendriya)* :

3. Speech, culture and mathematics represent the third level of the human life program largely embodied in the verbal spoken expression i.e. spoken and written language.

4. Reasoning mind is the fourth level of the human life.

3. INTERNAL FORCES OF LIFE

0. Characteristics of Living Organism (Jain View)

It is clear from the preceding chapter that a living organism depends upon an 'organization' that regulates all its actions. What exactly, then is 'living' ? In other words, what is the difference between 'animate' and 'inanimate' ? According to Jain Philosophy, animation (life) is caused by the unity of a non-physical (or non-material) entity called SOUL or spirit with a material body. That is, there is a subtle spiritual self associated with the gross physical body during the life; death is the separation of the two. Until emancipated, the soul is always enveloped by *karman* (as *karma-śarīra*). Thus, on death, what is separated from the physical body is soul-cum-*karma-śarīra*. It is the *karman* that is responsible for the 'organization' of the physical body. The role of the non-material soul is somewhat akin to a catalyst. An organism 'lives' for the duration of the life-span which is determined by one of the eight main categories of *karman* viz. *āyuṣya karman.*

Body and Soul

Birth of an individual organism in a particular species at a particular time and in a particular place is neither arbitrary nor accidental but the very precise result of the individual's *karman* which again is the result of its actions in the past life or lives. The determination of the species, the life-span, the social status, feeling of pain and pleasure and such other fundamental factors of the individual's 'life' are the combined result of four *aghātin* main categories, viz., (i) *nāma-karman* (ii) *gotra karman* (iii) *vedanīya-karman* and (iv) *āyuṣya karman* and their relevant sub-categories.

The Soul

No one has yet been able to synthesize a *living cell* in the laboratory, although we know now, in some detail, what the various material substances involved are in the making of a cell, because life is not merely a composition of *material substances.* A *non-material* soul-substance *(jīvāstikāya)* is also essential to create a live cell. Soul is a substance but

not a physical one. And this non-material/non-physical substance is eternal; it can neither be created nor destroyed. A soul animates a particular organism and manifests itself in various vital functions of a living organism. They can be classified into ten groups, called *prāṇa* [vital force or bio-energy].

(1) Āyuṣya prāṇa — ability to keep alive for a predetermined life-span which maintains the unity of the body and soul; when it terminates, death occurs.

(2) Swāsocchvāsa prāṇa — ability to breathe — an essentially vital function for continuing life.

(3) Śarīra bala — vigour of the physical body as a whole.

(4) Vacana bala or bhāṣā bala — ability of vocal expression, both articulate and inarticulate.

(5) Manaḥ bala — ability to think.

(6) to (10) Indriya prāṇa — ability of utilising the perceptive power of each of the five sense-organs.

Now it is not difficult to see that any of these psychic faculties *(prāṇa)* is of no empirical use without its physical counterpart called *paryāpti*[1] (bio-potential). This means that only a *saṁjñī pancendriya* organism (five-sensed organism with brain) is possessed of all the ten *prāṇas*, while the lower ones will be possessed of less. Thus, in a one-sensed organism, such as a plant, only four *prāṇas*, which is the bare minimum, could be active and manifested, viz. *āyuṣya prāṇa*, *swāsochhvāsa prāṇa*, *śarīra bala* and only one *indriya prāṇa*, that of touch. All the rest would be dormant. It should be remembered that faculty of communication (*bhāṣā bala*) is possessed by two-sensed and higher organisms.

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1. This is the process of *paryāpti* (bio-potential) which is completed in six stages : (1) The first is *āhāra paryāpti* — the in-take of the fertilized ovum by the soul. (2) The second is *śarīra paryāpti* — adoption of the ovum as the physical body. Then follow (3) *indriya paryāpti*, (4) *śwāsocchvāsa paryāpti* (5) *bhāṣā paryāpti* and (6) *manaḥ paryāpti* — the sequence of the consummation of the potential faculties of sense organs, respiration, speech and thought respectively.

There is much evidence that bodies of *all* living organisms on earth from plants, bacetria, jellyfish (the simplest of animals that has a nervous system) to apes and humans, all use the same DNA Code and similar amino-acids. And yet, no two organisms are totally identical. True, that all members of a particular species and sub-species would possess the same genetic code but the genes, themselves, would vary from member to member. This is because, the genes are not only hereditary but are also significantly influenced by the *karman* of the individual member. Thus, while the general behaviour of all the members of a species would be the characteristic one of the species, it would infinitely vary from member to member. This is because, though humans alone appear to have consciousness or minds distinct from their bodies, each and every living organism, also, has a non-material soul associated with a material body. The existence of the soul distinct from the body is not merely a concept but a metaphysical reality.

1. Basic Biological Principles

According to biology, living organism is qualitatively distinct from the non-living matter. Functioning of the former is governed by some unique biological laws. The essence of living organism is the set of principles determining the transmission of genetic information from one generation to the next.

Living organisms are composed of the same constituents as the rest of the earth, but it possesses, besides free will, which is the characteristic of life, all of the following attributes : organization, excitability, conductivity, contractility, metabolism, growth and reproduction. One or more of these, but not all, may be possessed also by non-living matter.

Vitality and Homeostasis

In its composition, a living organism contains no special element but is mainly made up of some 16 of the 92 elements that occur naturally on the earth. Not only are these elements a very special set but they are combined together to make molecules more complicated than any others known in the universe. Biologists do not accept that living depends upon

a non-physical soul or spirit but they agree that a *vital force* is produced by these unique large molecules, i.e. they are organized into living organisms which are not closed systems in equilibrium, but in a steady state of interchange with the external environment maintained by continual intake of fuel and expenditure of energy. Thus, *carbon* which is the most common constituent of foodstuffs, goes through the stomach and intestines into the blood and from there to a muscle where it is burnt to give energy when the muscle contracts. In a couple of hours after eating, it will be breathed out of the lungs as *carbon dioxide*. This process of self-maintenance is called homeostasis. It is not a static condition but a dynamic equilibrium. In most parts of the body, there is a rapid turn over in many tissues and even the cells themselves are continually replaced by new ones. And yet, as all these interchanges go on, the integrity of the whole organism is preserved. Thus the process of homeostasis, which consists, as it were, of a continual *death and rebirth, is the essential property of life. A vital force or vitality* is the principle at work, which prevents the dissolution of the body inspite of continual expending of energy. End of vitality results in death.

2. Survival/*Saṁjñās*

Living involves using information to make choices between alternatives, with the aim of achieving the goal of continuation of life. Every organism carries in its DNA, the instructions for doing this by dealing with various eventualities that may arise. Life continues because organisms make repeated choices among previously established sets of possible alternative actions. The very essence of living is the presence of varied possibilities of actions allowing selection of those that ensure survival.

Thus, one of the fundamental characteristics common to all living beings without exceptioin is the *aim of survival.* Every organism achieves it with efficiency rarely approached in man-made machines. The apparatus which *is* perfectly adapted for this purpose is supplied by *nāma karman* and *āyusya karman* which provide suitable reference standards or *saṁjñās* (unlearned instincts) for every category of

organism. In humans, the pattern of nerve cells of the *hypothalamus* of the brain are the physical embodiments of fundamental standards. The patterns of human actions are set originally during embryonic development under the control of DNA which in itself is partly inherited and partly *kārmic*. These reference standards are the primal drives or the unlearned instincts. Throughout life, they generate wants and desires, influence hunger and satiety, longings and satisfactions, love and hate, revulsions and fears. Of course, these are not the only or even the main influences and one does not follow only the hypothalamus. In human life, the standards include many further subleties derived from learning and culture. In all cultures, from the most primitive to the most sophisticated, people are continually faced with situations where they must choose what to do, what to say, what to ask for, what to buy, what to give and so on, of course their choices depend upon all sorts of individuals needs, preferences and cultural influences. Thousands of other equally powerful influences, not necessarily instinctual but learned, interact with the primal drives. They may reinforce or countermand a primal drive.[1] But all of these are subordinate to a fundamental method of acting that is embodied in the programs of the brain.

3. Reference Standards

Every living organism acts in a directed way, each moment of its life, this is because the highly stable DNA molecules give instructions and information providing standards indicating what to do. For humans, instructions of the genes provide, during embryonic development, the system of reference standards at which to aim, e.g., the cells of the hypothalamus ensure (as we shall see in a subsequent chapter) that the right amount of food and drink are taken and the right amount is incorporated to allow the body to grow to its proper size. Throughout life, the genes continue giving instructions to the cells as to how to select the right chemical action to fare the eventualities that are likely to cause

1. For example a non-vegetarian would be delighted when served with, say, a well-cooked lobster dinner. On the other hand, a born vegetarian would find the very sight so repulsive that he may throw up. In neither case is the lobster responsible for the result but learned emotional feelings.

the body to disintegrate. The information is embodied in an enormous long string that we describe as *genetic code*, provided by the sequences of three nucleotide bases. The reference standards in our brains influence our wants and desires, our satisfaction and revulsions, our longings and our fears. The causes of actions of a given man will include not only all the above variables but also his free will.

4. BIRTH; GROWTH; AGING; DEATH

0. Programed Sequence

What determines the life-span of a living organism ? According to the doctrine of *karman, āyuṣya karman* is the chief determinant and the decision is made in the previous life, that is, an organism is born with a predetermined life-span. It may run the full course or die a premature death, depending upon whether it meets with an *upakrama* (cause of untimely death e.g. fire, drowning, accident) or not, when the bondage of *āyuṣya karman* is *sopakrama* — subject to *upkrama*. Death, however is inevitable and no organism can live a single instant more than its determined life-span *(āyuṣya)*. The time duration or length of the life-span is characteristic of the species of the organism which is determined by the *nāma karman*[1] which is, thus, the auxiliary determinant of the life-span. The *death* is usually preceded by *aging* and *senescence*.

Biologically, the life of a human, from conception to death, may be viewed as a series of events that follow one another in a programed sequence.[2] The sequence of human development, early helplessness,

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1. The bondage *(bandha)* of *āyuṣya karman* takes place only once in every life. It, not only, determines the span but simultaneously determines six vitally significant parameters for the next life. These parameters are :
(i) *Jāti* i.e. one of the five types of *jāti*—one-sensed organism, two-sensed organism, etc. (Also see classification in Chapter II). (ii) *Gati* i.e. one of the four types of existence — celestial, hellish, human and subhuman. (iii) *Avgāhnā* i.e. one of the two types of body, either *audārika* or *vaikriya*. All these parameters are determined by *nāma karman*. (iv) *Sthiti* i.e. life-span or duration in time. (v) *Pradeśa* : quantity of *kārmic* atoms. (vi) *Anubhāva* : intensity of fruition. — (*Ṭhāṇam*, 6/116)
2. Ancient Jain Philosophers divide life into ten stages :
(1) *Bālā* — Infancy — experience of pleasure and pain is subdued. (2) *Kriḍā* — Childhood — tendency for playing (games, sports) is strong; sexual desire is absent. (3) *Mandā* — Adolescence — capacity for sexual activities is developed; tendency of exhibiting virility is subdued. (4) *Balā* — Adulthood — sexual ability fully developed; strong tendency for exhibiting virility. (5) *Prajñā* — Adulthood continued; engrossment in family, wealth, status etc. (6) *Hāyaṇī* — Middle age — sexual desire begins to degenerate. (7) *Prapuñcā* — Post-middle age, beginning of senescence; commencement of degeneration of respiratory organs. (8) *Prāgbhārā* — Senescence progresses; skin is wrinkled; other signs of aging are obvious. (9) *Mṛṇamukhī* — Senescence is far advanced; zest of life (keen interest) vanishes. (10) *Shāyaṇī* — Pathetic signs of againg; miserable existence; bed-ridden.
[Explanation — Quoted from Haribhadra Suri's *Daśavaikālika* Commentary, pp. 8-9) (*Ṭhāṇam*, 10/154).

long childhood, late and short adolescence and long adult life is designed to allow the brain to develop and to acquire and use a set of programs of an essentially social life.

1. Reproduction

Living organisms perpetuate their species from one generation to another through *reproduction.* It is a precise duplication and transmission of characteristics from parent to offspring. In lower organisms, reproduction is often a simple matter of division of cells. In human and higher organisms, sex comes into operation; reproduction requires two parents : a male and a female. Reproductive cells, called *gametes,* which are produced in the reproductive organs of both sexes, are a special variant of cell. The female gamete is called *ovum* or egg and the male gamete is called *sperm.* Meiosis is a special process of cell-division and takes place in the reproductive organs. It is a sequence of two divisions. In the first division, each daughter cell receives only *one* of each pair of homologous chromosomes. Thus, in meiosis, daughter cells differ in their sets of genetic information both from each other and from the original cell.

A. Conception

The incredible sequence of events that occur before birth, resulting in the formation of a perfect human being, is one of the most amazing parts of the human story. *Fertilization* is union of the ovum with the sperm which takes place in the mother's womb. In humans, a mature viable ovum is surrounded by a barrier (tough membrane). An estimated 35 million sperms are needed to break a large enough hole in the barrier for a single sperm to enter the ovum. As soon as this is accomplished, the ovum fuses with the sperm and prevents the entry of additional sperms. Now the male pronucleus with 23 chromosomes unites with its counterpart — the female pronucleus — and the full complement of 46 chromosomes align themselves in 23 pairs in the *fertilized ovum.* The single cell is now ready to receive a *soul.*

Precisely at this instant, a transmigrating soul, which is conscious substance enveloped in microbody—*kārmaṇa śarīra* — arrives in the womb (from its previous life) and animates the fertilized ovum which

becomes its physical body through a stage-by-stage biological process.[1] A new human being has been conceived. The new human is thus, endowed with (i) the genetic code contained in the 23 chromosomes from the mother (ii) the genetic code contained in the 23 chronosomes from the father and (iii) the code contained in the *kārmaṇa śarīra* appended to his soul from his previous life/lives. All these begin and continue to interact and integrate into various programs which would control the life of the new human. Its existence and development is totally dependent on *kārmic* and hereditary programmed instructions. Those for remaining alive come from DNA and *āyuṣya karman.*

B. Prenatal Development

Now the single cell with a full set of 46 chromosomes, (23 from the mother and 23 from the father) divides into two duplicates of itself. This is the first in a series of divisions and the cells divide again and again in a long process of development in which many changes occur in a precise sequence. The nucleus of the fertilized and animated cell contains full instructions needed to make all the different proteins of all the different types of cells in the body (a liver cell, a nerve cell and so on). Using these instructions, the *embryo* produces all the different organs in a precise sequence following a harmoniously regulated time-schedule and spelled out in DNA blue-prints contained in the nuclei of the fertilized ovum. The growing embryo is attached, first by a stalk and then by a rope-like *umbilical cord,* to the placenta. It receives nourishment from the placenta via its umbilical life-line.

When a human baby is born, it is already about nine months old. It has spent these nine months of life, since conception, living as a parasite within the body of its mother. During this period it increases from a microscopic single cell to 3 to 4 kg. mass of protoplasm composed of nearly 10 trillion cells, integrated into various functional systems.

C. Birth

Birth inevitably, brings a certain amount of trauma for the infant. For nine months it has rested in gently supporting fluids. The sheltering

1. See,p. 13 of this book.

environment is suddenly replaced by air. The oxygen supply from the mother is cut off. With a convulsive gasp the newborn draws in air and fills its lungs for the first time.[1] A baby's existence and growth is partly dependent on hereditary programmed instructions 'contained in his DNA and partly on the instructions from the fruition of the body-making (*nāma*) *karman*. Organ building, joint building, structure building and such other functions of remaining alive and growth would be the outcome of the joint action of the DNA and various sub-species of the body making (*nāma*) *karman*.

2. Childhood

After birth, the *child* begins to learn by virtue of the neural equipment provided by heredity. But this equipment is not a static machine; it is not complete and in final form at birth. The full number of nerve-cells is already laid down at the time of birth but they are far from their final form either in structure or in function. Each of them has the capacity to develop and mature with a wide margin of possibilities by suitable experience. The nervous system continues to change and matures for many years after birth, with the help of suitable inputs, at appropriate time. Simultaneously, the body grows in size and weight. Cell-division — increasing the total number of cells — is the main process of growth.

Development of Skills

A child is born with an ability to perform well some actions including those that it needs to maintain its life such as sucking, swallowing and breathing. This implies that programs for such actions are 'hard wired'[2] and cannot be varied. Within the first two years, it acquires other skills — feeding, attending, perceiving, manipulating and inter-acting with others. Each of these has a background of species — types genetic instructions — but are also capable of adaptational changes. They form the very center and core of all subsequent behavior and personality, that is, form the center of brain-program of actions. Thus, these skills become generative and can be combined and recombined and lead on to the use of tools and language.

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1. See, p.31 of this book.
2. See, glossary.

As the child brain develops further, the skills that are acquired include language and the capacity to understand conservation of quantity, cause and effect and much else. These later developments are accompanied by physical changes in the brain. For example, if a child, up to at least 10 years old, unfortunately loses the usually dominant left cerebral hemisphere, it will, none the less be able to acquire language in the right *hemisphere*, which would normally not possess this facility. So evidently the use to which the brain is put fundamentally influences its later development.

In the pre-operational age (2-7 years), the child's thinking is like a slow motion film representing one static frame after another but lacking a simultaneous encompassing view of all the frames.

Later, however, there is unification of previously distinct processes, either by the overall interaction of the parts or by a dominating superior control. At this time, the child is becoming more socialized and less egocentric. The interaction with others may be a requirement for the maturation. The child begins to pass from personal forms of representations to socialized forms with more general meaning.

Emotional Development

It is obvious from the crying of a child's first day that (i) he is a communicating creature, and that (ii) he experiences something that can be called emotion or feeling, viz. *discomfort* or *pain*. The expressions of emotion do not all appear from the beginning but gradually, following a hereditary program. One of the earliest is *smile*. At first, the baby smiles mainly when he is drowsy but later on it becomes an important part of the communicating system. *Laughter* seems to develop gradually, later, in response to tickling and much later in social situations. *Anger* develops later than smiling but full *temper tantrums* come much later. Surely a child cannot have learned to throw tantrums from his elders. The capacity to do so was inborn and then developed and matured. It involves specific actions of the brain and we shall see later that it comes from the limbic system. *Blushing* develops later still and more readily in girls. All these obvious facts show us that humans are born with certain capacities for communication of emotional and even moral attitudes.

The human pattern of a long childhood is genetically determined. Other mammals become mature, immediately they have stopped growing. Only in man and apes is there a long period of immaturity followed by rapid pre-adolescent growth spurt. It seems likely that extension of the period of childhood is related to the acquisition of social skills, which will be only learned if the child is obedient to his elders. During childhood the child is mostly concerned with its own life in the immediate present. His own homeostasis is his primary interest in these early years and for long after and meeting his own emotional and physical needs may be a requirement for maturation. Here *cognition* and *emotion* are never wholly separate, because of the interaction of brain processes.

3. The Programs for Adolescence

To emphasize the place that emotion plays in the unfolding of the programs, consider what happens at adolescence. An internal biological clock, that has been ticking, begins to send signals to the pineal gland which had been producing a hormone, ***melatonin***, which inhibited the maturity of the *sex glands*. Now the pineal begins to remove the inhibition and allows maturation to start. Simultaneously, the *hypothalamus* sends chemical signals to the *pituitary* to release *gonadotropic* hormones. We have no control over the clock and there is ample evidence that factors such as climate or food have little effect also. Sex hormones, now released from the *ovary* or *testis*, produce a dramatic change in her or his physical and emotional condition. A sudden growth spurt is sparked adding as much as 15 to 18 cms in a year. The brain also continues to develop some of the human characteristics with appropriate inputs at series of critical or sensitive periods. Learning consists both by selection among the many possible pathways in the brain as well as *instruction*. It may well be that the emergence of new potentialities, requiring new stimuli, continues far on into the adult life. Growth in height stops entirely by the age of 18 to 21 in boys and 16 to 18 in girls.

4. Aging and Death

During the long adult life, active growth ceases; cells that wear out or are destroyed by accident or disease are replaced and a dynamic equilibrium is maintained. But ultimately, the repair processes become less efficient and cannot adequately replace the day-to-day losses.

Various body-functions gradually begin to deteriorate and *senescence* (aging) sets in and ultimately results in *death*.

The end of the life is by a definite process of senescence, which should be distinguished from disease (even though some of its manifestations lead to disease). It has been recently shown that cells from older men are capable of fewer divisions than those from younger ones. This proves that senescence itself is a programmed terminus and death is a part of the program of life. Actually, death occurs at each moment throughout life — thousands of blood cells and cells of the intestine die every second, but they are replaced and repaired by programmed mechanisms that allow the attainment of the predetermined age. There are enzymatic mechanisms by which even DNA can be repaired. If a piece of one of the double chains of DNA dysfunctions, it is removed and a new stretch of DNA is synthesized. Specific enzymes — the *ligases* — then join the new pieces into the old chain and more and more such repairs have to be made in older organisms. The problem is that repair mechanisms themselves need repairing and the regress of what repairs the repairer and the repairer of the repairer cannot be indefinitely avoided. Thus, there is a limit on the possible length of survival of any individual homeostatic device. This fact is, sometimes, expressed in a different way in terms of cell-division. There is an upper maximum limit to the number of divisions of a cell called *'Hayflick limit'* after which they cease dividing and die. In a life time of 100 years, the number of divisions is about 50. Thus senescence or aging is a complex process with many contributing factors not necessarily exclusive. "Hayflick limit" of cell division agrees with the concept of an inherently programmed finite life-span of about 110 or 120 years. This does not mean that there is no possibility of improving repair processes. Though the actual life-span could never be exceeded, and the idea of much longer life is not altogether pleasing, particularly to those of us who are already very old, knowledge of some of the factors, would not only *reduce* the possibility of dying in younger age, but also some of the miseries of old age.

5. LANGUAGE OF THE BRAIN

0. The Brain and *Citta*

According to the Jain philosophy, a living organism is an organic composite of two entities—a physical body and a non-physical/non-material soul. The physical body, which includes the physical brain, is an inanimate material thing by itself. Its animation is derived by the virtue of being intimately associated with the soul whose characteristic attribute is consciousness. In the worldly life, the non-physical soul must have a physical body to function and perform in. And a physical body must be activated/animated by the soul. The part of the soul which animates the body and the brain is called *citta*. Thus *citta* is integral with soul and is, therefore, non-physical. The threefold activities of life—mental, vocal and bodily—are all activated by *citta*. It is true that "without a brain there is no thought" but it is equally true that "Only a *live* brain can think". And a brain is live because it is animated by *citta*.

1. The Neural Code

All organisms are active systems, choosing to do what may keep them alive. In higher animals and humans, the most significant selections are made by the *brain*.

Brain regulates the whole life of an individual by selecting the possible course of action every moment of the life. The nervous system (of which brain is a part) is, thus, much more than a system of communication which is, indeed one of its important functions. The brain contains the *reference standards* and controls our actions in the light of coming information. Thus programes of the brain can be, in a way, considered as a responding device whose work is determined by the past. But the total human behaviour is determined not only by past but also by plans for the future and the brain is the remarkable apparatus which creates models for the future.

A convenient method to understand the working of the nervous system is to study artefacts, such as computers, that imitate us. It is true

that the most sophisticated computer provides a very inadequate model of the human brain. But an understanding of the principles — 'transfer of information' and the 'software' or system of programmes — can give us much insight of the brain's working. The conceptions of code and language are particularly important.

The units of the neural code are : *brain, sense-organs,* and *nerve - cells.* The brain is the controller, issuing orders for actions, after it has decoded (understood) the signals it receives from the sense- organ via the nerves. Nerve-cells are units of brain which initiate most of our actions. We sleep or work, go walking or eating or reading because our brains contain active cells that operate when we choose to do these things. Discussion of whether the cells of the brain do these things or allow some other agent — the mind — to work through them will come much later. Suffice it to say here that mind always influences not only our reflex actions but also *emotional ones.* (e.g. tears roll down at a touching scene in a film). The brain is, therefore, subject to information from outside and influences from within.

2. Simplified Version of Brain Action

How is the brain able to produce all the complex actions of a human life ? The essence of this power lies in the great number and variety of nerve-cells, their connections and their activities. Each one of the several thousands million nerve-cells in the human cortex corresponds to one of the following :-

1. A small part of one particular feature of change going on in the environment.
2. Some small parts of a memory-record of past external change

   or
3. Some small part of the instruction for an action that can be done by the body.

This is indeed an over-simplification of the action of our cells from moment to moment. Thus nerve-cells are the *letters* of the cerebral *alphabet.* Combinations of them compose the words, sentences,

paragraphs, chapters and books that constitute the programs that produce our patterns of behaviour. To understand the language of the brain, it is necessary to know how the nerve cells combine, like letters, to produce units that have meaning like words. Just as language, spoken or written, is used to attain a purpose and grammar is the system that regulates the proper use of language, the brain operates a sort of metalanguage with a metagrammar, which regulates the proper conduct of life, (including speech). We shall now explain briefly how the three sorts of nerve-cells mentioned above function.

3. Physiology of Nerve-cells

The miraculous functions that brains perform depend on the power of nerve cells to produce certain electrical and chemical changes. The nerve fibres are very extended strands of *protoplasm* stretching away from a central nerve - cell - body. This contains the nucleus, whose *DNA* is reponsible for making it ready to perform its particular function of sending appropriate messages which take the form of signals passing along the nerve-fibres. There is an electrical potential difference of nearly one-tenth of a volt between the inside and outside of the fibre. Similar voltages across the surfaces of all of our millions of nerve-cells provide the means by which messages are sent and decisions made in the nervous system. Each nerve-fibre is a charged system; it has a source of energy available to allow the propagation of messages. If the fibre is suitably stimulated, a sort of electrical explosion spreads all the way along its whole length. This is the *nerve-impulse* which is the signal that travels along nerve-fibres. After the signal has passed, there is a *'refractory period'* before the next impulse can pass. Each action potential is thus complete, and they are all identical. It is as if there was a train of gunpowder, where each explosion sets off the next. The size of the 'impulse' depends upon the charge at each point. The signal comes out as strong at the end as at the beginning.

The nerve-impulses are thus the basic units of the language, comparable to letters. They do not themselves convey meaning. The meaningful units or words of the brain language are the individual nerve-cells. Differences of quality, such as different tones or visual contours, are

encoded in the nervous system by having a different nerve-cell and nerve-fibre for each quality. That is why we have such a vast number of nerve-cells. The brain is essentially a multichannel system. Its method of coding is to make up messages by putting each item of information into a separate channel.

4. The Synapses and Neuro-transmitters

Each cell of the brain or spinal cord called *neuron* has a number of receptive branches, the *dendrites*, and a single outgoing fibre, the *axon*. The dendrites are spread through a limited volume around the cell body and they serve to initiate activity in the cell so that it sends signals along its axon, reaching to a greater or lesser distance. Each fibre entering the nervous system from a sense-organ branches many times and makes connections with many cells in the spinal cord or brain. Conversely, each central cell receives the endings of many incoming fibres and of the fibres arising from cells elsewhere within the brain. The points where the endings of the axon of one cell meet the dendrites of another are known as *synapses*. At the synapse, the membranes of the two nerve-cells are pressed against each other, but the contents of the fibres are not continuous. There is, therefore, a barrier between the inside of incoming (pre-synaptic) fibre and that of the post-synaptic cells. This barrier makes it impossible (usually) for the electrical nerve-impulse to spread from one to the other. The transmission is effected by the release from the pre-synaptic fibre of a *chemical*, such as *acetylcholine*, to which the post-synptic surface is especially sensitive. The response to the chemical serves to amplify the effect of impulses arriving, so that they influence the post-synaptic cell.

These *chemical transmitters* have become well-known only in recent years. They are found in the knobs (known as *boutons*) at the ends of the pre-synptic fibres. There may be up to 50,000 of these little knobs attached to the surface of single cell of the cerebral cortex. They will include branches of several different incoming nerve-fibres. The currents produced under the different boutons will summate. If they are sufficiently close together in space and in time, then they will set up an action potential, travelling away down the axon of the post-synaptic cell

to its ending in contact with yet another nerve-cell, or with a muscle or gland. This process of summation of the effects of the boutons is thus the means by which decisions are reached in the nervous system.

5. Decoding

The signals arriving in various combinations along the sensory nerve-fibres will activate particular nerve-cells. The first stage of what may be called the decoding of the signals in a set of nerve-fibres is by the activation of certain particular cells of the brain by the synapses.

The basic outlines of the patterns of connection are laid down by heredity. These are our pre-program, such as that for breathing. Nearly all of our activities include a part that is *hereditary* and can be referred to as *instinctive*. Much more interesting is the question of how these basic patterns come to be combined with other patterns of action of the nerve-cells by the process of learning. This is how we acquire language and the socially transmitted programs that dominate so much of our lives. Even more interesting is the question of how new programs can arise within us, as they certainly do, if we are even minimally creative. These are some of the problems that we hope to face later. However, decoding does not mean that there is some final stage where the message is understood. The decoding is completed only by action or preparation for action.

It should not however be concluded that we are activated only by external stimuli. In fact, many of the nerve-cells go through continual cycles of activity or changes in sensitivity. The effect of incoming impulses is then to alter their frequency of discharge. Whole sections of the nervous system never cease their activities. To take the simplest example, the cells of the respiratory centres send out nerve-impulses regularly every few seconds to the muscles of the chest, from our first breath to our last. Some of these rhythms are due to inherent properties of the membranes of the cells. Others are the result of cyclical chains of nerve-cells, so arranged that they continually re-excite each other. Our behaviour, thus, comes from the combined operations of this vast set of internal rhythms with the inflow of information from the sense-organs.

Our task would then be to try to understand how all these millions of cells, acting together, produce the programs of human action.

Our endeavour is to see whether by study of the brain we can also connect its functioning with that of the *karman* and thereby can improve upon it as an environment for philosophical understanding of the doctrine of *karman.*

6. RHYTHMIC LIVING AND LIVING CLOCKS

0. Fruition and Bondage of *Karman*

Cycle of the fruition of the old *karman* and bondage of the new *karman* is continuous and without break. As we have seen, fruition produces instincts which not only generate feelings but also command appropriate actions that satisfy the need. Animals just act out instinctive rituals of survival and reproduction by eating, mating and fighting. Man also does feel angry, hungry sexually aroused but he can, because he has the reasoning mind, control his responses to the insistence of the instinctive drives and modify his action. He could, for example, channel an erotic mood on to another creative track, or reject fatty food after a look at his bulging waist line. Both — instinctive actions of the animal and modified ones of man — result in the bondage of new *karman*. All actions come *through* the brain. The simple nerve network that is the brain of a jellyfish, the simplest of animals, has a few simple programs that keep it afloat and seeking for food. Higher mammals such as ourselves have many more complex programs. We shall try to get further insight into them in the following paragraphs.

1. Hierarchy of Controls

We may gain further insight into brain programs by looking first at some rhythmic actions that are generated within nervous systems. The conduct of a complex life like ours involves an elaborate *hierarchy of controls*, many of which operate rhythmically. These internal rhythmical processes as well as external activities continue all the time producing our behavioural patterns.

An analogy, perhaps will be useful to understand the correspondence between the structural and functional characteristics of the nervous system and the life that it regulates. Computers are, in a sense, artificial brains and in a most general sense the analogy of computer programs can be helpful. More useful may be the concept of a hierarchy of controls. E.g., in a complicated organization such as an army, it is

essential to separate functions at different levels. Each level can thus operate with a minimum of information and memory whether it be the *general* in command or a humble *corporal* of a section.

Computers and brains use the hierarchical system extensively. E.g., on the motor side, general indication of courses of action are produced at the highest level and passes to lower ones such as the *spinal cord* where details of execution are organized. At the lowest level, more nerve-cells regulate the detailed movements of, say, limbs In the human brain, the *cerebral cortex* exercises a great deal of overriding control and we can identify many lower levels. The spinal cord cointains the basic reflex mechanisms for the control of movements of the body and limbs. The *cerebellum,* among other functions, ensure that the movements are steady and properly timed. The *reticular system* at the center of the brain has a central function in activating all the rest, for instance, by the control of sleep and wakefulness. The *hypothalamus* and neighbouring regions contain the system of reference standards, which ensure that the whole brain takes the actions that are needed for continued life. The *cerebral cortex,* the largest part of the brain, is concerned with analysis of incoming information and deciding what to do in the light of memory-records stored from the past. Although the arrangement is hierarchical, yet the cortex exerts much detailed control, for instance, on the movement of individual muscles. This emphasizes the extent to which the operations of the human brain constitute one whole, more fully integrated than in other species. This very fact that there is so little 'delegation' of control may be reflected in the *unity* of the individual mind, being the program of a *unified brain.*

Animals and men live out patterns of activity, following programs of instructions partly inherited and partly learned. These programs are written or initiated in the hierarchical structure and activities of the nervous system. An essential feature is that the patterned activity is generated from within. The programs unfold themselves, without waiting for stimuli, although the former often need the latter for their fulfilment.

2. Rhythms of Life

Some programs are performed with basic rhythms that are intrinsic to a cell group in the brain. From our first breath to our last gasp, the nerve-cells of the respiratory centers go through rhythmical changes that provide us with oxygen by breathing. These are nerve-cells that *never* come to rest, incidentally showing that repose and sleep, whatever they are for, are not essential for basic nervous functions. Also there are sensors in the lungs and in certain sites along the arteries that measure the amounts of oxygen and carbon dioxide in the blood and send messages to the respiratory centers, producing an increase or decrease in the rate of breathing.

Many other programs seem much more exciting than respiration, say the program for speaking or for loving. But let us not despise breathing, after all it is essential and has provided us with a simple example of understanding the brain.

Nearly all the more important programs are compounds of rhythms with periodicities initiated within the organism and stimuli provided from outside. When we eat, drink, we use programs that involve internal rhythms. They are initiated by learned or unlearned instincts which command appropriate action to meet the need and produce the satisfaction of consummation or fulfillment. Both the internal changes and external stimuli are essential for the satisfactory action. It may be recalled that the programs are written by the various sub-species of body-making (*nāma*) *karman* as well as life-span-determining *(āyuṣya) karman* in the features of bodily and nervous anatomical and physiological organization that ensures the performance of these actions.

3. Interaction of Feeling and Behavior

Nerve-cells and their connections are organized into higher assemblies of neurons that operate reflex actions such as blinking or drawing away the hand from a hot plate. But the behaviour even of simple animals, cannot be described as the consequence only of reflexes, as if they were puppets performing a series of movements dictated by the environment. In man, as indeed in all animals, much of the impetus to

act comes from *within*. Our behaviour involves an elaborate interaction of *nervous system* (of which the brain is the main constituent) and *endocrine system*. Philosophers, as well as scientists — including neuroscientists — agree that *hormones secreted by endocrines have profound influence* on our mental states and behaviourial patterns.

The coordinating effects of the nervous system, as we have seen, are transmitted, nearly instantaneously by electro-chemical impulses. The endocrines secrete chemical messengers (hormones) which are carried through the body by the blood stream. The action of the latter is more slowly established but longer lasting than that of the former. While nerve-action is measured in milli-seconds, some hormones need several days to get started and then last for weeks, months or even years. Nerve-impulses control the function only of muscles while hormones may act on all the cells of the body. Lately, it has been realized that nervous and endocrine systems, both functioning to integrate the organism, are not as divergent as was formerly supposed. Many endocrine glands act on the nervous system through their hormones; on the other hand, endocrines are stimulated or inhibited by products of the nervous system.

Within the central nervous system, there are groups of nerve-cells, which are capable of functioning as glands. The chemical messengers released by these *neuro-secretory cells* are called *neurohormones*. These cells serve as links between the central nervous system and the endocrine system. With the help of these dual cells acting as go-between, the central nervous system can control the functional activity of many endocrine glands, and adjust their activity in accordance with the requirements of varying internal and external environments. Equally or more important is the reverse relationship by which the endocrine system can influence the central nervous system. This concept of the *reciprocal inter-relation* of the two systems is now generally accepted. For instance, pituitary which is described as the conductor of the endocrine orchestra is itself controlled by the overlying hypothalamus which is a very important part of the brain. The pituitary gland produces some dozen different hormones, which control many medium-and long-term

functions such as sex, reproduction and location, growth, metabolism and thyroid activity.[1] Thus inter-connection of pituitary and hypothalamus is a typical instance of the interlocking of the two systems.

Recent studies on neuro-secretions leave no doubt that the nervous system has its own endocrine specialization for the release of hormones. The functional interlocking is so remarkable that nervous and endocrine elements are coming to be regarded as constituting a single integrated system called *neuro-endocrine system.* As research deepens our knowledge of coordinator systems, it becomes increasingly apparent that their products participate not only in every bodily function, but have profound influence upon the mental states and behaviour of individuals.

The neuro-endocrine system is the seat of feelings, emotions and passions of man. Impulses and urges which are the forerunners of emotions and passions,[2] not only generate feelings but also command appropriate action that satisfy the need. To understand the behaviour and its determinants, it is not enough to know about nerve-cells and their connections. We have to appreciate all the manifold influences that determine what we may call our moods and all the facts of human behaviour.

Love, hate and fear are endocrine expressions. It is the primitive

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1. The intimate reciprocal relationship between the two systems can be illustrated as under : The visual stimulus of the beauty of a pretty girl causes electric nerve impulses to activate the anterior pituitary of a young male with the hypothalamus as an intermediary. The pituitary, in turn, produces and delivers the gonadotrophin hormone to sex glands. The nerve and hormone signals make his heart beat faster, increase blood-pressure, tense muscles and cause sexual arousal.
2. The words emotion, passion, feeling, desire etc. refer to subjective states of mind with slight difference in meaning, depending on the context. It is difficult to translate ordinary language into a more scientific one. Psychologists and neurologists have found it difficult to produce an exact language with which they can talk precisely about needs and desires, loves and fears, beliefs and morals, and so on, as was possible in the case of physics, chemistry and mathematics. Moreover, common speech is not at all the same in different languages. While the word 'emotion', for instance, is the most general, and is used to mean all states of mind, the word 'desire' refers to feeling of wanting or needing. 'Feeling' is more informal and refers to both weak and intense states. On the other hand, the words 'urge', 'drive', 'impulse', and 'instinct' refer to impulsive forces which produce the above mental states, and are, therefore, forerunners of emotions.

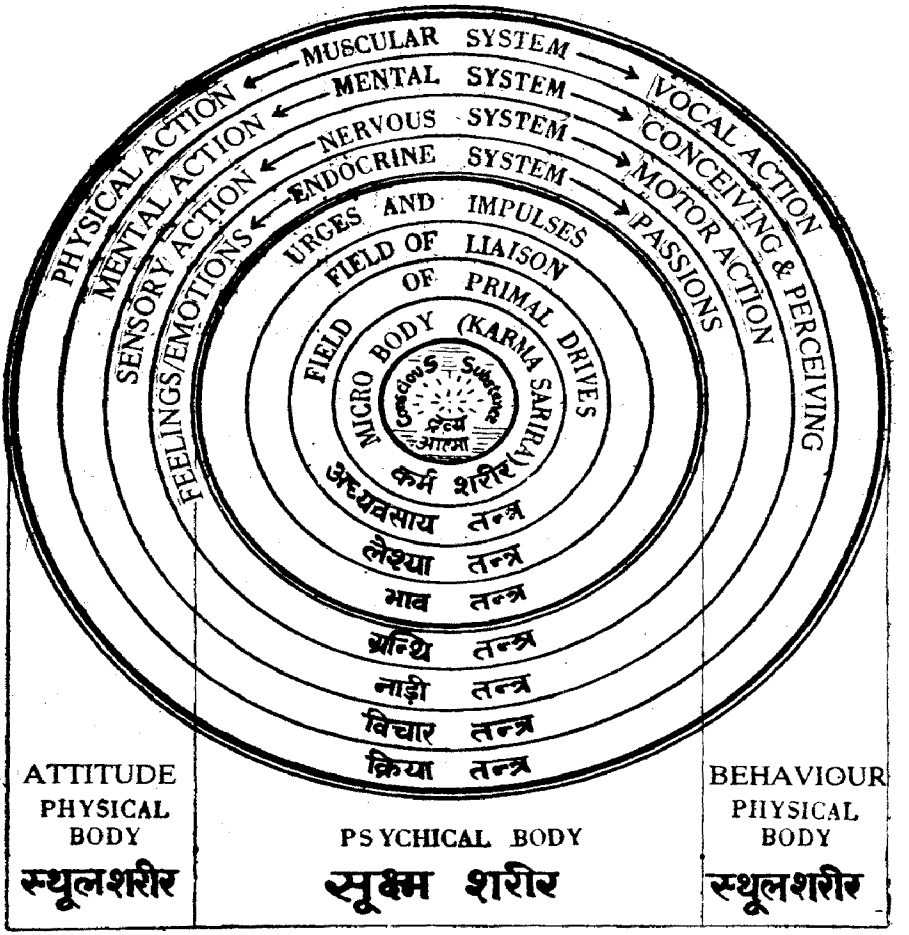
urge of aggression from the endocrine, that will start war and not the brain, because no reasoning mind will ever wish to kill or injure. All the passions, emotions and impelling forces are the actions of the endocrine expressions. The reasoning mind itself has no emotions but many a time the powerful impulses from the endocrine can overwhelm and continue to tinge the supposed reasoning. Urges and impulses, the precursors of the emotions, are not produced either by brain or by endocrine. In fact, these are forces more subtle than those found in the physical body. They are produced in the microbody *(kārmaṇa śarīra)* as a result of the rise of the bonded *karman (karmaphala).* Thus *kārmaṇa śarīra* is the origin of all impulsive forces and the mundane soul is *always enveloped by karmana śarīra.* The radiations of psychic energy have to pass through this enveloping field and their interaction (called *adhyavasāya*) proceeds further towards the gross physical body. At the border of the subtle body, they are transformed into urges and impulses which will later produce fellings and emotions in the physical body (see diagram).

4. Living Clocks/Hormonal Rhythms

"Many features of our life operate with periodicities of from seconds and minutes to months and years."[1] The brain and (endocrine) glands, between them, generate these rhythmic programs and there has been a great advance in understanding of how they do it.

Basic rhythms are a very fundamental feature of human programs and several of them arise by cells in the hypothalamus acting as clocks and controlling the *pituitary gland.* The operations of the pituitary are themselves controlled by the overlying hypothalamus, as stated earlier. The hypothalamus, besides carrying electrical nerve signals, also control the pituitary by the production of special active chemical substance, the process known as *neurosecretion.* The hormones of the *cortex* of the *adrenal gland have fundamentally important influence on every cell* of the body. These adrenal secretions are produced in man, mainly just before dawn, as if to be ready for their job of toning us up throughout the

1. Halberg F., Implications of Biological Rhythms, (1977).



day. These rhythms are produced partly by changes in the amount of the *adrenocorticotropic* hormone (ACTH) released by the pituitary, and partly by an intrinsic periodicity in the cells of the adrenal gland itself. This example reminds us that there are complicated interacting feedback systems, even in these rather slow-going parts of the program. In the brain, the hypothalamus sends an ACTH-releasing factor from its nerve-cells to the pituitary. These nerve-cells are no doubt influenced by all sorts of cerebral activities. There is, indeed, evidence that alteration of these circadian rhythms may have very profound effects on metabolism,

perhaps including influences on the length of life.

The *pineal body*, another gland located within the brain, is believed to be the *biological clock* which controls the period of maturation (puberty). During the first few years of life, its chief duty is to give the child (both male & female) to grow properly. It secretes a hormone called *melatonin* which inhibits the gonads (sex glands) and holds the sexual activity in abeyance, in childhood. This mechanism is, thus, the basis of our own most fundamental programs, the lengthening of childhood and delayed onset of puberty. Probably a genetic mechanism that keeps the pineal gland active for a period (14 years for boys - 12 years for girls), is responsible for one of the most fundamental features of our whole life system. It is significant that in adults, there is little or no *melatonin* in the blood, because it is no longer needed for its original purpose. Human reproduction is not cyclic like that of some animals.

Finally, the sleeping - waking rhythm is controlled by the neurons of the Raphe[1] near the mid-ventral line, which produce *serotonin (5-HT)*. Injection of a drug that prevents 5-HT synthesis produces insomnia. In antagonism, substances such as adrenaline produce awakening. Probably they have effects upon different parts of the reticular system.

The rhythmic brain programs show that men (and animals) are provided by their genes with clocks and also with the equipment needed to maintain these rhythms throughout the length of the day. This is what we are calling, for convenience, *a program*. It is a physical system of nerve cells whose organization constitutes a coded store of instructions, compounded of heredity, *karman*, and learning. It is obvious that such programs regulate many of our more routine actions throughout our lives, making us wake and sleep, eat and play, grow and age. In other chapters we shall have to see whether we can identify similar information-stores as the basis for the more complicated things that we do, including loving and hating, knowing and thinking, and even believing and worshipping. We do these things only in part rhythmically, but they are actions coming

1. See Glossary.

from within the system. All living action comes essentially from within, as a result of the operation of the programs, in part inherited, in part acquired. These programs co-operate with the signals coming from the sense-organs, but even these are not simply imposed on us. What we see and hear is largely the result of our own programs for searching, some of which follow habitual rhythms.

7. SLEEPING

0. *Darśanāvāraṇa Karman*

In the state of perfection, the soul has infiniteness of knowledge *(jnana)* and intuition *(darśana)*. The types of *karman* that obscure knowledge and intuition are respectively called knowledge-covering *(jñānānavaraṇa)* and intuition-covering *(darśanāvaraṇa)*. There are nine sub-types of intuition-covering *karman* which include five types of *sleep*. The effects of these five intuition-covering *karman* are felt in

(i) sleep with easy awakening *(nidrā)*

(ii) sleep with difficult awakening *(nidrā-nidrā)*

(iii) sleep while seated or standing *(pracalā)*,

(iv) sleep while walking *(pracalā-pracalā)* and

(v) sleep accompanied by superhuman deeds (somnambulism) (*styāna-gṛddhi* or *styānardhi*).

The object of the *karman* is to deprive the soul of using its faculty of intuiting truth.

It is not difficult to see that the state of sleeping is equivalent to absence of cognition *(pratibodha)*. Conversely, wakeful state is active cognition or intuition.

1. Program for Sleeping

At least once a day, we cease to be conscious — the mind does not operate and only the brain remains partly active as the guardian of our personality and the guarantee of its continuance. When we wake up, we are still the same person as before. At intervals, the program wakes us up for a period of conscious mental activity. There is, therefore, a wonderful opportunity to study the parallel changes in brain and mind as we fall asleep each night and in the morning wake again. By following electrical changes and reports of consciousness, we can see how the activities that we call those of the brain and those of the mind are related, providing

together the entity that we call a person, sometimes conscious, sometimes not. Finally, by study of this conscious entity, we shall show how both brain and mind can actually be divided by the surgeon's knife, and also how consciousness is altered by brain-injury.

Knowledge about sleep is therefore important for the study of programs of the brain for several reasons. First, sleep is certainly a state both of the brain and of consciousness. Secondly, no one will question that it occurs following a rhythmic program. Thirdly, it involves a simultaneous change of activity of the whole brain and of the condition of consciousness.

2. Process of Sleeping and Dreaming

Understanding of sleep has been revolutionized by the discovery that electrical activities in the brain indicate that there are two main types of sleep : REM (Rapid Eye Movement) and NREM (non-Rapid Eye Movement) also called *active sleep (AS)* and *quiet sleep (QS)*.

As a person drifts out of wakeful awareness, his muscles relax; heartbeat and breathing slacken, this is drowiness and if his brain waves were recorded on an EEG, they would show a steady alpha rhythm of relaxation. He may think he is awake, but he is in the embrace of sleep's first stage. The slightest noise could break this fragile slumber.

A few minutes later, the sleeper descends to Stage 2. Brain waves take on the appearance of wire spindles, tracing a dramatic design of peaks and valleys across the EEG paper. The eyes begin rolling slowly from side to side. Although Stage 2 sleep is deeper than Stage 1, it would still take only a slight noise to awaken someone.

Soon a few of the large, slow delta rhythms appear in the brain's wave pattern. This heralds the onset of State 3. The body becomes even more relaxed. Blood-pressure, heart-rate and body-temperature decline. Only a loud noise would awaken the sleeper.

Roughly twenty minutes have elapsed since the onset of sleep. The fourth stage begins. It would be extremely difficult to wake the sleeper

from this deepest phase of sleep. Bed-wetting, sleep-talking and sleep-walking occur only in this stage.

Forty minutes have passed. For the next half hour or so, this sleep-cycle will run backwards. From stage 4 back to stage 1. The first dream of the night is about to begin, the sleeper has entered the REM period. In REM, the vital signs change suddenly and dramatically. Breathing, heart-beat and blood-pressure become irregular. Under closed lids, the eyes dance back and forth as though the sleeper were watching a movie. In theory, this is exactly what happens during REM. According to the "Scaning theory", the eyes move around as they follow the action of a dream. During REM, the brain sends a signal to the arms, legs and other large muscles to stop moving. This sleep-paralysis prevents the body from acting out movements occurring in dreams.

The first REM period lasts nearly ten minutes. When it ends, the whole cycle repeats itself, usually four or five times each night. Each cycle lasts an average of ninety minutes. As the night wears on, REM periods lengthen, while NREM periods grow shorter. The final REM period of the night may last as long as one hour, or one-half to two-thirds of the total REM sleep each night.

If a person is woken up during active sleep he will often report that he had been dreaming, whereas this is less common when someone is woken out of quiet sleep. Even a few minutes after a period of active sleep he will not remember that he had dreamt. Here then we have a means of discovering something about the relations between the electrical activity of the brain and the dreaming mind, for surely we regard dreaming as a mental activity. These two types of sleep have been found in nearly all mammals and birds, but not apparently in reptiles or other lower vertebrates or in invertebrates, though many of these show periods of inactivity.

3. Quiet sleep

The program of sleep that is written in the brain thus involves a much more complicated score than would be needed for a mere alternation of sleeping and waking.

Two regions particularly involved in sleep are called the *raphe nucleus* and *locus coeruleus*, near to each other in the *medulla oblongata* at the hind end of the brain. The cells of the raphe nucleus produce the *amine serotonin* (6-hydroxytryptamine, 5-HT) and deliver it along their axons to nuclei further forward. It is probably released in the thalamus (the gateway to the cortex) and acts upon the cells there to produce the synchronized activities of the cells of the cortex that give the slow waves of quiet sleep.

Studies are beginning to show how two sets of cells interact to produce the rhythm of waking and sleep and the detailed pattern of quiet sleep and active sleep throughout each night. A suggestion is that neurons producing serotonin induce the quiet sleep and then the catecholamines set in action a series of dream-producing neurons.

4. The Programs for Dreaming or Active Sleep

The effect of stimulating the geniculate cells — the dream-producing neurons — is to produce activity in the occipital and other parts of the cortex, which we experience as dreaming during active sleep.

In this, only actual movements are at most a few jerks. So the great cortical activity is accompanied by an inhibition of the motor centers or *sleep-paralysis* as stated above. It has been found that this inhibition is initiated from a special hinder part of the locus coeruleus. Failure of inhibition of movement occurs in sleep-walking.[1]

So, the programs for sleeping and for dreaming are quite complicated, and seem to involve periods of activation of the brain but inhibition of the movements that would be expected from their activity. The actions of these various cells of the core brain thus constitute the physical basis or 'script' of the program of sleeping and waking.

5. Functions of Sleep

If there is a program for sleeping, what is its aim and are there

1. Sleep-walking or somnambulism is, according to the 'Doctrine of *karman*', extreme rise of intution-obscuring *(darśanāvaraṇa) karman*, called *"styāna-gṛddhi nidrā"*, in which the sleeper may even go to the extent of performing such extra-ordinary feats, as are impossible during wakeful states, remaining totally unaware of them.

feedback mechanisms to ensure that the aim is achieved ? Are there some minimum necessary amounts of sleep and of dreaming, and if these are not allowed, is there full compensation by more sleep and dreaming later on ? It seems at first obvious that sleep is for rest and recuperation — but why should the brain alone need to recuperate rather than other tissues ? The heart for instance never rests.

Perhaps it is a mistake to look at sleep only or mainly as a rest for the brain. It is reasonable to think that many bodily activities require periodical recuperation and that providing for this is the reason for the physiological changes that accompany the various sorts of sleep. The best known are the changes in adreno-corticotropic hormone (ACTH), which controls the secretion of cortisol by the adrenals, so that it is three times higher on waking in the morning than at midday. Since the adrenal cortex is responsible for promoting many activities that are responses to 'stress', we have here real evidence of the filling of a sort of 'reservoir' during sleep.

Similarly, production of growth hormone *(somatotropin)* is at a maximum during the first hours of sleep, that is during a period mainly of quiet sleep. After a day of heavy bodily exercise, there is increased quiet sleep.

6. Sleep Requirement

Infants sleep nearly sixteen hours throughout day; children need ten or eleven hours. Most adults average seven or eight hours each night. Middle-aged people require slightly less sleep. In old age, naps become frequent.

The need for sleep increases during pregnancy and illness. Anxiety, depression and physical or mental exertion also lengthen sleep. Researchers theorize that additional REM time — the result of longer sleep — restores the brain and helps it to integrate new experiences. In less stressful periods, demands on the brain are reduced, decreasing REM time. REM deprivation actually benefits some people. In a 1975 experiment at the Georgia Mental Health Institute, patients hospitalized for depression improved when they were deprived of REM sleep.

Antidepresent drugs may be effective partly because they supress REM sleep.

Some scientists believe that personality accounts for basic differences in sleep requirements. One study found that long sleepers, those who sleep nine or more hours, are more anxious, introverted and less confident than short sleepers, who get six or less hours of sleep. Long sleepers, the researchers found, often use sleep as an escape from problems. Short sleepers are generally energetic, cheerful and self-confident and are also less inactive than long sleepers.

7. Sleep Deprivation

The program for sleeping is so insistent that it is very difficult to deprive people of sleep. In spite of the demand for sleep, the effects of deprivation are sometimes not so marked as one might expect. After very long deprivation, people suffer from *hallucinations* and *paranoia*, thinking they are being persecuted. This perhaps confirms the idea that some sort of reprogramming goes on in the brain while we sleep.

Whatever it is about sleep, that is important, partly relates to active sleep. After deprivation in this way for a night, people show more active-sleep-periods the next night and so on. On the other hand, volunteers deprived of all sleep for three nights have mostly quiet sleep on the fourth, but more than usual active sleep on the fifth. So it seems that both sorts are necessary.

8. Dreaming — Why is it necessary ?

The fact that we need active sleep and that it is associated with dreaming has been considered to support the idea that the benefits of sleep come from dreams. Dreams could be regarded as providing for b tter building of the memory model by continued operation of the mechanism for memorizing during the night, even when no further information from external sources is available.

A dream is a sort of extension and fantasy of life, often expressing

urges that are suppressed or disguised during the day. We live out our fears in dreams too, and perhaps we get over them in this way. People who have lived through battles or other terrifying experiences certainly re-live them in dreams for long afterwards, but it is not clear whether this somehow relieves their pain. The theory that dreams are wish-fulfilments is not borne out by hungry or thirsty people, they do not have obviously relevant dreams.

9. Rest and Relaxation

It may be that in looking for complicated explanations for the significance of sleep in ourselves, we are missing its most obvious biological feature which is stillness. We should not exclude the possibility that there is no unique physiological benefit to be derived from sleep, beyond keeping the animal or person inactive/motionless. Many human beings have learned to do with far less sleep than a simple circadian rhythm suggests. There are reports of regular sleepers for whom an hour or even 15 minutes each night is enough.

So it may be that there is no basic physiological need to spend so much of our lives in an unconscious state.

It is found that systematic relaxation achieved by proper technique can replace sleep much more efficiently. Half an hour of total relaxation practised with proved technique can be better than three hours of sleep as far as the rest is concerned.

8. NEEDING AND NOURISHING

0. Hunger Drive *(Āhāra Saṁjñā)*

We have seen that all living beings from one-sensed organisms to humans are possessed of several primordial drives *(saṁjñas)* as essential aids for survival. The first of these is the *hunger-drive (āhāra saṁjñā)* which urges the organism to go in search for food and prompts it to take nourishment.

The primal drives are subtle impulsive forces which originate in the micro-body *(kārmaṇa śarīra)*. *Āhāra saṁjñā* seems to be produced by the combined fruition of several sub-species of three *aghāti karman* viz. feeling-producing *(vedanīya)*, body-making *(nāma)* and life-span-determining *(āyuṣya) karman*. The hunger-drive is transmitted to and transformed in the gross physical body as desire (need) for food. We shall see how this desire affects the brain and stimulates it to take action that satisfies the need. Each human activity starts from a definite intention, directed at a definite goal and is regulated by a definite program, which requires that constant cortical tone is maintained. Study of the programs that regulate such primitive needs of the body as eating and drinking provide a basis for examining the higher ones. Let us, therefore, begin by examining the systems that ensure the genesis of the basic needs whose fulfillment ensures the continued existence of the body.

1. Nourishment

The intake of food and drink is at the very centre of all activities for survival and the amount that we eat and drink is very precisely regulated. During a lifetime, each of us consumes several tons of food and thousands of liters of liquid, yet, once adult, we remain of about the same size and weight within limits of a few kgs. Where is the reference standards by which the intake is regulated to produce this remarkable result ?

Ordinary individual eats and drinks what he needs, with a rhythm of regular times and if his habits are interrupted, he feels hungry or thirsty. The empty stomach gives waves of contraction and we all vaguely feel

hunger in our stomachs. Even more definitely the throat is dry when we are thirsty. But these simple visceral feelings are not the only sources of the nerve signals that set us off eating and drinking. It is the function of nerve-cells in certain regions of the brain, in the *hypothalamus*, which are programmed to send signals either in a regular pattern of habits or when the composition of the blood indicated that there is a need for food or water. The operations of these parts of the brain, together with those of the stomach, are accompanied by feelings of hunger or thirst.

During an experiment on the control of drinking, Dr. Andersson had previously inserted, under anesthetic, a fine tube into the hypothalamus of the brain of a goat. Whenever a tiny drop of strong salt solution was sent down the tube the goat dipped its head into a bowl of water in front of it and began to drink. If a dilute solution was sent down to the brain the drinking stopped at once. The minute injections were imitating the condition in which when the blood becomes more concentrated, the goat is thirsty, and the blood then becomes diluted when the animal drinks. These nerve-cells also regulate the amount of water in the body.

Besides controlling the intake of water, it controls the amount of water that is let out, by increasing or decreasing the amount of a hormone — ADH (anti-diuretic-hormone) — sent from the pituitary gland to the kidney, which stops secretion of the urine. The hypothalamus thus controls both the intake and output of water.

2. Central Regulator

Thus particular nerve-cells in the hypothalamus serve as the *central regulator* of the amount of water in the body. They do this by actually swelling or shrinking when the salt-concentration of the blood changes. The setting of this *"homeostat"* has been made by heredity and is modified by the subsequent physiological experience of the individuals. The amount of food intake is also regulated from the same region. The lateral areas provide the drive to start eating and the medial ones to stop it.

The stimulus that normally sets these cells into action is partly the composition of the blood. Some of the nerve-cells here take up sugar from the blood and they send out signals when there is not enough of it

there. These cells provide the homeostat's reference standard for sugar. Probably other cells are sensitive to other substances, but many details of the system are still not known. Most of our eating and drinking follows acquired rhythmic programs and control of them is a complicated business, influenced by many higher levels of the brain. One of these centers lying just above the hypothalamus is known as the *amygdala*, from its shape like a nut.

The influence of the cerebral cortex on hunger are still more complicated. We all form habits as to when to eat, and also how much. People can change their habits according to personal and social demands. We cannot pretend that we fully understand even the simpler controllers of the needs for food. Nevertheless in the hypothalamus there are those lateral centers that become operative. When we are hungry, they give us appetite. The medial centers send messages when appetite has been assuaged and we are satisfied. The two areas are interconnected and inhibit each other, corresponding, we may suppose, with the mutual interplay of appetite and consummation.

3. Artificial Stimulation of the Brain

Feelings of satisfaction can also be produced by artificial stimulation of some of these very areas, injury to which causes error of eating, drinking, and sexual and other behavior. With the electrodes in some positions, the shocks have rewarding effects and are sought for as if they were satisfying.

Similar observations have been made during stimulation of the brain in therapeutic procedures designed to alleviate the pains of dying patients. Stimulation by electrodes in some regions was reported to give great reduction in pains and sometimes pleasurable feelings, including those of sexual satisfaction.

Experiments by electrical stimulation show that there are some areas of the brain whose activity produces drives to action, others that indicate satiation. Areas where stimulation produces very active responses may be quite close to others that produce the opposite effects. These are intricate networks of millions of distinct nerve-cells, with many different properties and connections. We are able to reproduce the

normal actions of the brain very crudely. Thus, the operations of the whole system determine not only how actions are normally related to bodily needs but also, in man, how the rewards are influenced by the activities of certain brain-areas and the chemical substances contained by them. These areas are responsible for the quality of affection, pleasure, satisfaction or the reverse.

These reward - centers are influenced by signals coming both from outside the body and within it, including, for example, those from the nose and from the taste-buds of the tongue. A specially interesting pathway begins in the cells of the locus coeruleus, lying near the taste-centers of the **medulla oblongata** showing some relationship between the sensation of taste and the drive to search for food.

4. Selection by Instinct

In ancient times, both men and animal had the instinct to guide them to find whatever they needed to keep them healthy and to detect and reject the poisonous and unhealthy. They made special efforts to meet particular deficiencies. Children, for example, deficient in calcium, will eat plaster. Some of these capacities for selection of taking what is needed and rejecting what is harmful are certainly innate while others are learned. Unfortunately, while the animals have retained the capacity, humans, with progress of civilization, gradually lost the instinct to a great extent.

9. KNOWING, LEARNING, MEMORY, INTELLIGENCE

0. Jain Epistemology I

A. Consciousness is Knowledge

The Jain theory of knowledge, in its basic form, is closely related to and presupposed by the Jain doctrine of *karman* which forms the very basis of Jain ethies. Consciousness is the characteristic attribute of all living organisms because each of them is a composite product of a body and a soul. As we have already seen, physical body, by itself, is an inanimate object, its animation is derived by the virtue of being intimately associated with the soul through *citta*.[1] The soul is inherently capable of knowing all things with all their attributes — past, present and future. But this capacity is obscured in its worldly state of existence by knowledge-obscuring *(jñānāvarṇīya) karman*, and will depend upon the nature and extent of the removal/subsidence of this *karman*. Persistent endeavour in the form of repeated reciting etc. is believed to be one of the techniques for destruction-cum-subsidence of the this *karman*, thus leading to intellectual development.

B. *Jñānāvarṇa Karman*

The knowledge is inherent in the soul. In the pure and perfect state, the soul has infiniteness of knowledge *(kevala jñāna)*. It does not shine fully because there is *kārmic* matter to veil it. The knowledge is perfect when this veil is totally destroyed. It is imperfect when there is only partial removal and subsidence of *kārmic* matter. Absence of knowledge is unnatural to soul even as darkness is foreign to the sun. It is the clouds of the *kārmic* matter that obfuscate the innate knowledge of the soul.

There are five categories of knowledge and hence there are five sub-types of the knowledge-obscuring *karman* that veils them. Of the five types of knowledge,

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1. See chapter 5, for explanation of *citta*.

(1) *Mati-jñāna* (perceptual) and

(2) *Śruta-jñāna* (verbal/scriptual)

are born with the help of sense-organs, brain and mind.

(3) *Avdhi-jñāna* (clairvoyance),

(4) *Manaḥparyāya -jñāna* (cognition of mental modes) and

(5) *Kevala-jñāna* (pure and perfect knowledge)

are independent of all physical assistance.

In this book, we are mainly concerned with the first two types. It should be remembered that the sense-organs are only external instruments, the different states of the soul being the internal i.e. the spiritual counterparts of them.

C. *Mati-jñāna* (Perceptual Cognition)

This is developed in four stages, viz. (i) *avagraha* (perception), (ii) *ihā* (enquiry), (iii) *avāya* (perceptual judgement) and (iv) *dhāraṇā* (retention).

Avagraha, itself, is two stepped — *arthāvgraha* followed by *vyañjanāvgraha.* The former is the contact of the sense-data with the sense-organs, while the latter is indeterminate cognition of the object.[1] It is indeterminate because the distinctive characteristics are not yet cognized. *Enquiry (ihā)* which follows the *avagraha* strives or inquires for some particular characteristics and having found them results in a *determinate cognition.* For instance, in the first stage, a person simply cognizies the general existence of a sound, while in the second, he cognizies the nature of the sound also. *Avāya* (or *apāya*) is ascertainment of the right and exclusion of the wrong and ends with a *determinate judgement.* In the case of a sound, one determines that the sound must be that of telephone-bell and not that of the door-bell. The last stage is *dhāraṇa* which means *retention* of the perceptual judgement. It is threefold : (i) final determination of the object which includes the condition of non-oblivion in future (ii) resultant emergence of mental trace and (iii) the recollection of it again in future (memory).

1. See the footnote on page 69

D. *Śruta-jñāna* (Verbal/Scriptural Knowledge)

Śruta which originally meant 'scripture' gradually came to mean any symbol, written or spoken, and finally was even identified with inarticulate knowledge. Both *mati* and *śruta* are the results of partial removal and subsidence of *kārmic* matter veiling the innate faculty of the soul. A soul could never be bereft of *mati* and *śruta*. Even the one-sensed organisms, e.g. plants (vegetable kingdom) are held to be possessed of both these categories. To be bereft of these is to lose the nature of soul and become a non-soul. It is admitted that one-sensed organisms have neither the tongue to speak nor the ear to listen nor have they any symbol of their own. But, nevertheless they are capable of potential verbal knowledge.

Mati and *śruta* are thus very much interdependent and it is difficult to separate them. In brief, we can say that perceptual knowledge that is due to the activity of sense-organ(s) is *mati* and when it is capable of expressing to others, in some manner, it becomes *śruta*. The versatile knowledge of the objects of perception whose versatility is in proportion to the learnedness of the cognizer is *śruta-jñāna*.

It is not difficult to see that Jains recognize the *words* as well as other *symbols* such as physical gestures as *śruta*. Thus there is *akṣarśruta* which comprises the shape of the letter (script), the sound of the letter (spoken letter) and its conventional meaning. On the other hand, there is *anakṣarśruta* comprised of physical gestures.

As stated above, *mati* and *śruta* are dependent upon the help of various external organs. The other three categories, which are completely free from the dependence upon external instruments, are direct apprehension of truth and reality by the soul. Distance, spatial or temporal, is not a hindrance on the capacity of the soul to know. The question of physical contact or limited distance or size comes in only when the inherent capacity is limited. And the delimitation, even, is not ultimately due to some extraneous condition. It is due to the soul itself which has acquired the *kārmic* veil by its own activity. It has also the ability to remove the *kārmic* veil which can be *partly* or *totally* removed.

Scientific Epistemology

1. Knowledge in the Brain

Can the brain be said to *contain* knowledge ? Do we know a given fact all the time or only when asked about it ? The concept of memory-records in the brain helps us to reconcile diverse uses of the concept of 'knowing', such as — 'knowing that' and 'knowing how'. Just as knowledge can be recorded in books or in computers, so knowledge of different sorts is *encoded* in the brain all the time. We shall now try to find out how it is written there and how the record is consulted when we think.

(a) Thinking

Is thinking only a form of problem-solving ? Actually it covers all forms of consciousness, awareness, with and without perception. Without perception, it is an internal questioning process i.e. testing hypotheses. If the store of information that we call *knowledge* is in the brain, then thinking involves the process by which some items are temporarily called from the store and used to solve a problem, perhaps only the simple one of identifying what is being heard — a telephone bell or an alarm clock ?

(b) Daily Run of Thoughts

Throughout the day, we think a series of thoughts, one at a time. They may be aroused by stimulation from outside or by the internal operations of the brain. The thoughts that are thus called up may be visual or auditory or perhaps of a smell, taste or touch. They need not be verbal, though often they are. So a succession of thoughts follow a program, that is recorded in our brain as a combined product of heredity, *karman*, the custom of our tribe and our individual experience. Thus, all the thinking depends upon the organization and activity of materials stored in the brain. Without a brain, there is no thought. It is easy to conclude that the natural programs for thinking are those that run every day to promote one's life in his culture. He will, of course, use the methods, verbal and otherwise, that have been learned by virtue of inheritance of human capabilities and the environment. As stated earlier, the versatility of such

program stored in his brain will be proportionate to his learnedness.

2. Learning and Remembering

(a) Learning

Learning is one of the processes by which programs are written in the brain. We learn because we are provided by heredity with programs that enable us to do so. These inborn mechanisms are not infinitely powerful, i.e. we cannot learn any thing or every thing. The power to learn will obviously vary between individuals and there may be limits, determined by everybody's *karman*, to what it is possible for any person to learn. We can say that a brain is not a general-purpose computer into which any information can be placed. It is more like one that already has a system of programs within it. The information at each point of a computer-memory is determined wholly by the programmer (though some computers include programs for search of the environment). Information can be added to the store and it can be *totally erased and replaced* by quite different information. Obviously, brains are *not like this.* Can you imagine total erasure of all the information in your head and its replacement ? The memory of a person or animal is something that is constructed and grows as a result of a unique series of experiences and actions from conception onwards. It can be *added to*, but never *wholly remade.* Indeed, its very existence is only possible as part of that program of events that we call a lifetime.

(b) Remembering — What is memory ?

Memory is man's record of experience. The ability to remember is essential to human personality uniting his past and present and creating a continuing sense of identity. And by drawing on the past, he prepares for the future. Thus memories are action systems that allow for the setting up of programs of action effective for survival. In human memory, there are two interrelated components, parts or systems known as *short-term* and *long-term memory.*

Before an event can be stored in the memory, it must be experienced. Short-term memory retains information long enough for the mind to grasp it and it stores an average of seven items (the length of a telephone

number) at a time and erases older items as new ones are added. If one wants to retain an item for a longer time, he must rehearse it and transfer it to long-term memory. Are they two independent systems of memory or are they some how interconnected ? We shall see this in the next section.

3. Engrams — Stable Memory Records

Long-term memory records must, surely, involve some physical change, for records of single events can remain for up to 100 years in man. Cyclic activity could not last for even a fraction of this time without becoming distotred. Moreover, procedures such as shock or anaesthesia do not disrupt such records. Nature of this change remains a matter or speculation and many theories have been advanced including the following three which are worth examining :

(1) a change of standing pattern of activity

(2) a change of some specific chemical molecules such as those of RNA

(3) a change in the pathways, themsleves, between neurons within the nervous system.

(1) In Canadian psychologist Donald Hebb's view, short-term memory is an active or dynamic memory : Sight or sound sets off a pattern of nerve-impulses in the brain. They circle a closed loop of connected neurons, just long enough for the brain to perecive it. This will, them, fade away unless, by some process of consolidation, more permanent structural trace is made. This structural trace, called *Engram,* would correspond to long-term memory. If the nerve impulses circle their selected pathways long enough, they could leave behind an indelible memory-record and thus convert the short-term into long-term memories.

(2) The hypothesis that memory has a chemical base is popular with biochemists. According to this theory, memory is coded in proteins or chains of molecules. A new protein called scotophobin was found in laboratory animals by Georges Ungar in 1970. But there have been no convincing experiment to prove that specific chemical molecules are involved in memory.

(3) The most influential theory and main basis for stable memory-records, again by Hebb, is that memories are fixed in the nerve pathways themselves. Everything known about the nervous system suggests that its coding depends upon the use of quite numerous distinct channels, each carrying a slightly different feature of the information. New behavior is, therefore, likely to be the result of new connections, not of the formation of specific molecules. Majority of neuroscientists believe that *selection of pathways* is the basis for the memory mechanism. Hebb suggested self-re-exciting chains, that is, the continuous flow of nerve-impulses along a pathway or loop alters the synaptic connections in some way. When the activity dies down, the new connections remain, creating a nerve network that stores a specific memory. Activating one or two neurons in the chain will tend to trigger the others and thereby bring the memory back to mind. Yet there is really no single piece of hard evidence for this belief. Electron-microscopy has brought the possibility of visualizing changed synapses, and hence of changed connections but has revealed that there are so many synapses on each cell that looking for those changed by learning is worse than trying to find the needle in a haystack. The concept of a distinction between short-and-long-term memory has been used extensively by neurologists and psychologists. Its validity is strongly indicated by the results of surgical removal of tissue of the temporal lobes and hippocampus of the brain for the relief of epilepsy. After removal of the hippocampus on both sides there has been found to be a very severe impairment of the capacity to set up long-lasting information stores, short-term memory remaining normal.

4. Categories of Memory

Two categories of memory are : *memory for skills* and *memory for events*. A study of the course of acquiring a skill, say to type or to play a musical instrument, reveals that at first, there is little progress. Then there is advance by jumps to new plateau of achievement and finally achievement of apparently unbelievable feats.

All animal memories can be considered as stored information for the performance of skills. Humans also have the facility to recall single events that occurred both recently and long ago. Capacity to do this may

be one of our unique features. In order to find out what the memory system of the brain is like, it is probably wiser to begin by studying the memory for skills rather than events. This, of course, does not mean that the two sorts of memory are unrelated.

5. Strategies of Memorizing

Before we can find out how long-lasting memories are built up, we must discover how they are related to the basic programs for activity-strategies that have been growing in the brain since childhood. There is probably no discontinuity between acquisition of the earliest social skills and the memorizing of information by an adult. The mature memorizer transforms the information to give it meaning.

Re-coding for Memory

Psychologists are actively engaged in trying to discover the systems that are used to register information. One suggestion is that each unit to be remembered is accompanied by some ancillary information that acts as a retrieval cue. An example of such cues would be 'time tags' or 'place tags' - 'when did I hear that name ?' or 'where did I hear it ?'. It has been realized that storage depends greatly on meaning and on relating new information. The model may be formed by removal of unwanted material, leaving relevant connections.

All these may illustrate the richness, difficulty, and importance of work on the human memory system. The long-term store can perhaps at present best be described as 'a single semantic abstract memory system which contains both linguistic and pictorial information and which can be accessed equally well by words or pictures'. One might add 'or by any sounds, smells or tastes, or by touches or pains'. Blind and deaf people still have memories. Whatever system is involved must have a large component of association, whether between sights or sounds or meaning or emotional feelings.

6. Forgetting

If learning involves the formation of new connections, how does it come about that we forget ? The easiest answer is that we don't. Perhaps once something has passed into long-term memory, at least part of its

effect may be there for ever. Early influences in childhood remain with us, at least to some extent and psycho-analysts will say that there are many buried 'unconscious' memories that can yet be recalled. It is quite likely that what we call 'forgetting' is, in fact, the interference of subsequent learning. It is assumed that 'memory traces' show some exponential decay with time, perhaps due to quasi-random neural activity, but there is little physiological basis for this.

The value of forgetting might not seem as important as that of remembering, but "if we remember everything, we should be as ill as if we remembered nothing" said William James. Aside from rare cases, forgetting is commonplace. Without this ability, our mind would be cluttered with useless trivial matter.

7. Prodigies of Memory

There are great variations between individuals in capacity to remember, and a few people have memories that seem quite fantastic. People with 'iconic memories' can study a page for a few moments and then recite everything written there. These people seem to have a literally photographic memory. This faculty is somewhat disturbing to our scheme for understanding the brain model as a semantically organized system.

Other memorizers report that they do, in fact, use programs that involve meaning. In his study, *The Mind of a Mnemonist,* Soviet psychologist A. R. Luria (1968) records that his subject memorized strings of items, even of nonsense, by placing each of them in some spot on a walk he would conduct in his head around a familiar place. As he walked, he would distribute the items around landmarks. He might place a pencil near a fence, a banner on a building, a shoe in a window. He could then recall them several years later. He evidently had some special freak of brain structure or activity that gave him the capacity to use place codes in far greater detail than is normal.

What we do in memorizing is to add to our set of programs of suitable actions. When we say that something becomes a symbol, we mean that it has acquired significance. Human beings have the power to continue

to learn the symbolic significance of external signals, even when they are adult.

***Avadhāna Vidyā* (The Art of Memory Miracles)**

In India, the faculty of memorising was very highly developed in pre-writing era. All the treasures of scriptural and scholarly knowledge had to be preserved only in memory, handed down from generation to generation. This necessitated the development of a technique called *"Avadhāna Vidyā"* for achieving long lasting memory and faithful recollection whenever needed. The technique consisted of mainly associating the perceived object or word with another similar but more familiar and easily memorised object or thought. Concentration of mind, versatility of imagination and stability of intellect are three essential constituents of this technique.

An important facet of *Avadhāna Vidyā* is the use of the power of memory for instant mathemetical calculations, such as, higher roots of very large numbers. Demonstration of *Avadhāna Vidyā*[1] almost appeared to be a miraculous feat.

8. Intelligence

Intelligence is possessed by all humans to one degree or another. Both 'intelligence' and 'electricity' lack complete explanations that appeal to our common sense. Yet we do recognize the undeniable fact of their existence. Intelligence is something exhibiting all the abilities — to think rationally, to act purposefully and to deal effectively with (the) environment — that make mankind the highest order of mammal. This force is both deliberate, logical and predictable or disordered, intuitive and spontaneous.

Testing Intelligence

There is little relationship between perceptual abilities and intellectual achievement. French phychologist Alfred Binet, the father of modern intelligence-testing, argued that reasoning, judgement, comprehension and the capacity for self-criticism, rather than keenness

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1. Muni Mahendra Kumar, Co-author of this book, is himself a famous *"Śatāvadhāni"* (i.e., mnemonist of 100 items at a time.)

of the senses, were the essential activities of intelligence. He found that brighter children performed at a *mental age* more advanced than their *chronological age*. An intelligence quotient, or *IQ* could be computed by dividing a child's mental age by his/her chronological age and multiplying that number by 100. The Stanford-Binet Intelligence Scale, an IQ test, is still used today.

The Spectrum of Intellect

The attempt to define intelligence as a single general ability has been complicated by the discovery that the brain's left hemisphere appears to be *analytical, linear and verbal* while the right one ie *synthetic, holistic* and *imagistic*. Right and left hemisphere faculties could make for quite a spectrum of human intellect - from the mechanical or artistic geniuses on the one hand, who can hardly express themselves in writing or speech, to the highly articulate individuals at the other extreme, who think almost entirely in verbal terms.

What then do intelligence tests test ? The Stanford-Binet Intelligence Scale, Scholastic Aptitude Test (SAT) and Weschler Adult Intelligence Scale (WAIS) measure our aptitude for convergent thinking or the ability to logically deduce *correct answers*. Divergent thinking, the ability to discover *new answers* considered crucial to creativity, is not measured by intelligence tests. Ability to get along with people, musical and artistic aptitudes and the mental gymnastics needed to play intricate games like chess, also, cannot by measured by intelligence test.

The fact that individual intellectual capabilities differ is as undeniable as the existence of the genius and the retarded. But the question is what are the causes of the difference ? Heredity, environment or something else such as *karman* ? The range of a person's potential intellectual development is determined by heredity as well as *karman*[1] while the environment determines the extent of development within that range.

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1. The relevent *karman* is *jñānāvaraṇa;* the degree of removal/subsidence of *mati-jñānāvaraṇa* and *śruta-jñānāvaraṇa* is the main determinant of the person's intellectual development.

Creative Intellect

Creativity is man's most precious ability. Creative insights require seemingly opposite ways of thinking — intuition and logic, fantasy and craftsmanship, inspiration and perspiration. For outstanding scientific discoveries, gift of fantasy has greater significance than rational, analytic thinking. On the other hand, artists must also be rational, besides having inspiration and fantasy, for transforming banal into the sublime.

According to one theory, *creativity* has four stages; (i) preparation (ii) incubation (iii) illumination and (iv) verification. The creative act, however, does not always happen in such neat sequence of steps.

Regardless of the sequence of stages, the preparation and verification stages tap the logical, verbal strengths of the left hemisphere while the other two — the heart of the creative process — use the gifts of the intuitive right hemisphere. In the division of labour between the two hemispheres, one-half of the personality emotes and dictates, while the other half listens and notates. Free from the shackles of verbal thought, the right hemisphere's ability to think in visual and auditory images, is crucial to artistic creativity. Nor is it less important for scientific creativity. In fact, combinatory play seems to be the essential feature in all productive thoughts.

Beyond a certain level of tested intelligence, there seems to be little relationship between IQ and creativity. At once self-centred and self-critical, creative people are as contradictory as their creative acts. They are intensely observant but thrive on complexity and confusion. In the words of a researcher[1], they are both "crazier and saner than the average person". While Socrates believed that "No one without a touch of the muse's madness will enter into the temple of art", today creativity is regarded as a sign of mental health. The integration of left and right hemispheres' thinking in creative activity produces a sense of psychological wholeness.

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1. Frank Barron.

10. PERECIVING — TOUCHING/ PAIN, SEEING AND HEARING

0. Jain Epistemology II

Sense-organs *(Indriya)*

In the preceding chapter, we had seen that perceptive cognition *(mati-jñāna)*, which is one of the five types of knowledge, is born with the help of sense-organs. In other words, sense-organs are essential instruments of perception. One way of classification of living organisms, according to Jain philosophy, is based on the number of sense-organs possessed by the organism. Thus, there are five classes : One-sensed organism, two-sensed organisms and so on. Now the worldly existence of any organism in a particular class is the precise result of the combination of fruitions of various sub-species of *karman* but they belong mainly to two species — body-making *(nāma) karman* and life-span-determining *(āyuṣya) karman*. The entire vegetable kingdom belongs to the class of one-sensed organisms i.e. they possess only one sense-organ — that of touch.

Jains divide each sense-organ *(indriya)* into (i) *(bhāvendriya)* sense-organ qua psychical i.e. the ablity of the soul to have various sensuous experiences and (ii) sense-organ qua physical *(dravyendriya)*, i.e. the physical sense-organ. Thus, when it is said that a one-sensed organism possesses only the sense of touch, it is meant that the *body* of these organisms are equipped only with the instrument of *touch perception* (one *dravyendriya*). On the other hand, *pancendriya* i.e. five-sensed organisms would have all the five physical sense-organs. It should be remembered that the capabilities of the soul *(bhāvenriya)* is empirically useful only when its counterpart *dravyendriya* is available.

We have also seen in the preceding chapter that all the five classes. Even the one-sensed organisms are not bereft of *mati-jñāna*. This means that one-sensed organisms (e.g. plants) have the sense-organ of touch and so are possessed of *mati-jñāna* — perceptual cognition — through this.

Since the sense-organ of touch is also the instrument of experiencing/pain, all one-sensed organisms must experience pain also. Pain and pleasure are the results of the *vedniya* or feeling-producing *karman* which has two sub-species (a) pleasure-producing and (b) pain or suffering-producing. These feelings are experienced by all organisms from one-sensed to five-sensed. We shall discuss the mechanism and programs of touching, seeing, hearing as well as experiencing pain in this chapter.

1. Programs for Perceiving

Without a continual flow of information from specialized sense receptors, the brain would be cut off, not only from the external environment but also from an awareness of the body's internal states. Out of the traditional 'five senses', sense of touch, which includes pain, is a 'near sense' while seeing and hearing are 'distance senses' equipped with distance receptors. Though thousands of sensory messages are received by the brain every second, only those which are important are 'perceived' while the rest are ignored. Thus, there is a remarkable distinction between sensation and perception. The messages or signals may come from events far away as in seeing, or at the surface of the body as by touching, or actually within it as when feeling pain.

2. The Cerebral Cortex and Perception

The cerebral cortex is an immense folded sheet of layers of nerve-cells arranged in columns. The nerve-fibres bringing signals from the sense-organs, via the thalamus, enter the sheet from the inside. They are arranged in a regular pattern or map, which exactly reproduces every point of the receptive surface of the body, in the correct relations with its neighbors. Thus there are cortical maps for vision, for hearing, and for touch. It is interesting that there are no such detailed maps for smell or taste, which do not have the same power to detect 'shape', at least in man. It is the cortex that asks meaningful questions and so dictates the whole perceptual process through its connections with the mid-brain. But more interesting problem is to find out how the cortex uses the messages it gets from the sense-organs to answer its questions and ask more questions. This is the serial process that we call perception.

3. Touching and Pain

A. The Skin

The skin contains several different sense-organs, which between them serve the various senses that we call touch, pressure, temperature, and pain. Some of these sensory cells are large and conduct signals rapidly. Others are smaller and slower and still others are free nerve-endings, very thin nerve-fibres not attached to any definite receptor-structure in the skin. Each different sort of nerve-ending provides signals for a different sensation. During ordinary life, sense-organs are part of the system of exploratory programs which an animal or man continually employs to satisfy its needs. The senses of touch, and of pressure, mostly come into action when we do things with our hands and feet. Each of these types of receptor is activated by a somewhat different sort of pressure or deformation of the skin. The various types of sense-organ in the skin do not work independently, and the sensations we feel there, such as degrees of smoothness or roughness, pressure, tingling, tickling, or movement are the result of collaboration at both the spinal and cortical levels between the various signals.

B. Cortical Areas for Touch

There are three well-known tracts leading from the skin to the brain. A large area of the cerebral cortex receives the signals from these pathways, all laid out in a regular map, corresponding to the topography of the body surface, but with greater areas for the more functionally important parts. These *'somatotopic'* maps are a fundamental feature of the cerebral computer, as they are also for vision. A difference between touch and pain, is that there are active programs for gaining information by touch. We learn to recognize the feel and shape of things, whereas pain is basically inflicted upon us and is formless. Correspondingly, pain has no cortical representation. The symbolic significance of signals of touch are determined by much more complicated systems of reference, after they have passed through thalamus to the cerebral cortex.

C. Programs for Avoiding Damage

Every animal must have programs to ensure withdrawal from

harmful situation and no viable organism can be without it. Such programs have obvious advantages for survival. Pain is a warning to avoid further damage. The complex pains that we suffer, are devices necessary for survival. Even the highest organisms have some simple withdrawal response. A child does not have to learn to draw away its hand from a hot object. The flex or reflex ensures that it pulls it away even before it feels the pain and howls. But the child soon learns not to do it again.

All sensations are subjective. What is so special about pain and pleasure ? Experiences of pain are sensations, like the associated experiences of the material events that accompany them. The difference is that pains and pleasures are intimate and personal to oneself. They cannot strictly be shared because they are signals that carry warning or reward to that particular individual alone.

D. Pain and Suffering

Suffering of pain varies a great deal between individuals. The same sensation signals from a toothache, for example, affects each person differently. The process by which the brain converts raw sensations into suffering is complicated. While the *sensation is equal to the power of stimuli, suffering varies by many factors*, some within the body and the others without, some examples show that the expression of pain depends upon past experience and culture which means that past experience has a great influence on what we feel and suffer, as it obviously does upon what we know.

Many investigators have sought for a special set of nerve-fibres carrying signals of pain, but no one has ever been able to prove that there is any particular type of nerve-ending in the skin that generates 'pain', as the rods and cones generate 'vision', the organs of the ear 'hearing', or those of the nose 'smell',. Those are all 'distance receptors', and the signals that they send serve to symbolize events far away. Pain, however, is essentially *in* or *on* the body, and it indicates that there is derangement of some sort in the bodily activities. In order to find the nature of this derangement,what we should look for is not specific pain-sense-organs,

but the disordered activity of other sense-organs. To a large extent this is what in fact has been found by recent studies of the physiology of pain.

E. Internal Pains

Though there is no known cortical centre for pain, it must, in some way, become connected with the cortical analysers, otherwise we should never be able to learn to avoid external events that are likely to be painful. What is the physiological basis of pain ? Pain, probably, results from disordered nerve discharges, especially if they involve impulses in certain of the thin nerve-fibres called free nerve-endings. These are the simplest of all sensory nerve-terminals and they occur not only in the skin but also in some internal organs, especially in the walls of arteries and in the heart. This raises the question of how we feel internal pains. The answer is paradoxically that to a large extent we don't. For instance, cutting or pricking the stomach or intestine does not give pain. What does hurt is dragging or pressing them. The pains that we feel as headaches are probably in the blood vessels of the brain.

F. Regulation of Pain — Reticular Formation

If pain is not felt in the cortex, is there any other part of the brain in which it can be said to be located ? From the spinal cord, three main pathways lead upwards to the brain. One of these three pathways consists not of long straight-through fibres but of a series of little neurons with axons that are small and short and therefore called 'reticular' or 'net-like'. This reticular system is a very complicated set of cells. These can send signals to many different areas. The reticular system is thus not only central in position but also in the fact that it communicates information very widely. It is also central in its functions in the sense that it regulates the whole state of activity of the brain, for example, in sleeping and waking.[1] The nerve-cells of the reticular formation can produce the substance *enkephalin*, injection of which kills pain in the same way as does morphia. Enkephalin is probably the neurotransmitter involved in synaptic transmission in these reticular brain centres. Morphine thus acts

1. See chapter 7.

by imitating the action of enkephalin in stimulating the nerve-cells that switch off the responses to traumatic stimuli, including the subjective phenomena of pain. This is the brain's program for reducing pain. However, in extreme cases, where the brain is not able to reduce or regulate pain, it just gives up and resorts to withdraw itself, resulting in "unconsciousness" or fainting. Once again we see how actively the brain regulates everything that is allowed to enter it, even pain.

G. Pleasure and Pain

Some of these central regions are not concerned with pain but are pleasure centres. We do not yet know enough to be able to say whether the pain-inhibiting sets of cells are identical with these that produce pleasure. Is pleasure to be regarded as the absence of pain, or possibly vice versa ? Do our programs seek to maximize pleasure or minimize pain, or both ? The important point is that there are here what we might call the reference systems that set the course of the whole living control system. Their operation largely determines the ends or aims of the animal or man. These brain regions and the programs they produce are determined by *vedniya karman*, heredity, and, no doubt, modified by experience. These controls are there to provide the objectives that we seek for in life. It is not too much to say that these systems largely determine what human beings do. But human life is not simple. Other types of program intervene, as it were, on top of these fundamental ones of pleasure and pain that are produced by the actions of the reticular and reward centres. So evidently there are activities in this part of the brain that regulate what we commonly call emotional feelings.

H. Surgical Relief of Pain

Discoveries about the central grey matter have been used in the relief of human pain. Intractable pains are said to be relieved by lesions in the medial part of the thalamus, or by cutting the cingulum bundle, which connects the frontal cortex to the hippocampus. It is clear in any case that there is no one single 'centre for pain' in the brain. The cerebral system does have distinct parts, but many of them interact for the performance of each program of action. Pain is the result of a disordered operation of a program for exploring the world in the immediate neighborhood of the

skin, or of the operations of some internal organ(s) of the body. The disordered signals serve to symbolize that something is wrong and this sets off the programs that may put it right, which in man may be very complex. Pain may initiate the brushing away of a wasp, or be the stimulus for the foundation of a research institute for the treatment of cancer.

4. Seeing

A. Structure of the EYE

Although seeing is not like photography, we shall begin by saying that the eye is, in some ways, very much like a camera. It has a lens and a diaphragm (the iris) and a focusing device. What is more, the first step in the process of vision is a photochemical change somewhat like that in a photographic plate. The retina contains a mosaic of more than one hundred million separate receiving elements of two sorts, the rods and cones, each of which detects a tiny part of the image that is thrown on it by the lens, producing a minute electrical or chemical change. Only the cones are sensitive to colors and most of them are concentrated near the centre of the eye. Here there is a small area, the *fovea*, containing only about 30,000 receptive cones. These perform nearly all the detailed work of seeing, except in dim light. In order to see things, we have, therefore, continually to explore them by minute movements of the eyes around them, examining the part we want to see by the fovea. This is of fundamental importance for our system for thinking about vision because the program that control these eye-movements, largely determines what we see.

B. VISION

Vision is not like taking a series of photos but is part of a whole life-system. Thus vision is a dynamic process, using a series of scans, but these are not rigidly determined as in a television raster. They are varied according to the nature of the scene itself and the previous experience of the individual. Moreover the scanning does not work by converting the information in the spatial scene into a single channel, but puts it into many parallel channels, which maintain the spatial relations, so in a sense

the original picture is reproduced on the cortex, but modified and much expanded. We can regard all vision as a continual search for the answers to questions posed by the brain. The signals sent from the retina constitute 'messages' conveying these answers.[1] The brain then uses this information to construct a suitable hypothesis about what is there and a program of action to meet the situation. The sequence of processes involved in the act of seeing do not therefore really begin in the retina, but involve the brain. Nevertheless it is convenient to ask just how the retina composes its messages. The rods and cones are the light-sensitive elements. They contain special pigments, which change when the intensity of light falling on them varies. This change alters the electrical potentials of the cells, so that the pattern of light thrown by the lens produces a corresponding pattern of electrical and chemical change in the various neurons which make up the retina. These impulses in the optic nerve-fibres at each moment of scanning a scene are the answers, in code, to the 'questions' that had been asked at the previous moment. Of course, if something quite unexpected happens, it is seen even though it had not been anticipated. The point is that what goes on in the retina is not merely the recording of a 'picture', but the detection of a series of items, which are reported to the brain. If the eyes are prevented from moving, the signals fade within a second and no picture can be seen.

C. Physiology of Vision

Human photoreception is a complicated process. We are able to encode all sorts of aspects of the world and to decode the signals and act accordingly. Our eyes have lenses and we examine the pictures or patterns thrown upon the retina. The task therefore is to understand how the brain is able to decide appropriate responses to many different

1. This is equivalent to indeterminate cognition (*anākāra upayoga* or *darśana*), which precedes every determinate cognition (*sākāra upayoga* or *jñāna*). In Jain Epistemology, *anākāra upayoga* consists of four classes of *darsna* viz. (i) *caksuḥ-darśana* (eye-cognition or vision); (ii) *acakṣu-darśana* (cognition by the mind as well as the sense-organs, other than the eye; (iii) *avadhi-darśana* and (iv) *kevala-darśana*. The last two are cases of direct cognition by the soul, without the help of any external instrument.

Subsequent use of this information by the brain to construct a suitable hypothesis is determinate *upayoga* or perceptual knowledge — *mati-jñāna*, which becomes the basis for a program of action.

patterns. Perception is an active search for meaningful clues and the brain builds programs that guide the search. These programs may possibly be something like those that artificial intelligence workers devise for pattern recognition with computers. Perception involves making structural descriptions from the data and testing interferences as to what these data mean for us. The brain presumably has programs for examining features such as brightness, corners, edges and so on, in order to find, first points, then lines, regions, surfaces, bodies, and eventually objects that have meaning or use. The brain reads the letters, words, sentences, and paragraphs of the visual code. The optic nerves carry the information to at least three parts of the brain, the midbrain, cerebellum, and through the thalamus to the cortex. All these parts are interconnected and concerned in any act of vision, but the first two deal mainly with detailed control of the eye movements. Deeper in the centre of the midbrain are motor nerve-cells, each of which has its own 'movement area' so that it sends signals when there is movement in a particular part of the visual field. So, in a general way, we can say that the projection from the eye to the mid-brain is concerned with 'where' to look, while the cerebral cortex determines 'what' to look at.

The primary visual cortex is in the occipital region at the back of the head. Here the pattern of the retina is enormously enlarged, with 5000 cortical cells for each cell of the thalamus.

As signals from the retina pass through the various visual areas they are recombined in different ways. This is the process by which the words of the brain are joined in 'grammatical' ways to give meanings. No doubt, there are *hereditary* and *kārmic* elements in the development of the grammar and it is also greatly influenced by experience.

In the later stages of decoding, each part of the system — retina, cells of the thalamus, the primary visual cortex — progressively extracts more and more abstract or general features of the visual information. The process does not continue uninterruptedly for vision, or any other sense. The whole set of brain actions goes on in discrete packages, each of perhaps one-fifth of a second. Our own awareness of the stream of consciousness suggests that there is some central processor receiving

information at about this rate, which is also the order of frequency of the electroencephalogram.

At present, there is no adequate theory as to how the information from all sense-organs collected in the various cortical areas interacts to produce actions by us. It is likely that the 'putting together' of all the information is a property of groups of neurons. Anyhow it is a mistake to try to discover some 'final' stage of synthesis. Each part of the brain continually moves on from one action to another, just as the whole person does in real life.

D. Development of the Programs of Seeing

A three year old child shows few eye movements. There is very marked improvement upto 11 years as the scanning procedure becomes more systematic. As the speed and efficiency improves, movements are enough to allow the appropriate response. One can see this very well in the process of learning to read. At first, each letter must be examined separately, then words, phrases, sentences, whole paragraphs or perhaps pages or even whole books, can be in a sense 'comprehended' at a glance by a reader. The program for seeing probably consists of a routine that dictates a series of operations, guided by subroutines as expectations are examined.

E. Recovery of Sight

The most instructive of all the clinical studies of vision are those of patients who are born blind but have later recovered their sight after surgical operation. On recovery of vision, such patients are able to recognize only some of the objects that they already know by touch. They have, no program for seeing. With patience and time, they may learn to see, but it is a slow and painful process, unlike the normal acquisition of programs for seeing at the appropriate time of the developmental sequence of a child. This is an excellent example of one of the sensitive critical periods, when the brain is especially ready to develop some particular capacity. We have therefore a moderately clear idea of what we mean by programs for seeing. We shall discuss the programs of hearing in the next chapter together with those of speaking and writing.

11. HEARING, SPEAKING AND WRITING

1. Sense of Hearing

All living organisms do not possess the sense of hearing. Only the five-sensed *(pancendriya)* organims - humans and subhumans - posses it. The human ear consists of three main parts. Sound waves directed by the *external ear* strike the ear-drum (tympanic membrane) in the *middle ear* and cause it to vibrate. The vibrations are transmitted and set up waves of motion in the fluid in the labyrinth of the *internal ear*. The motion of the fluid excites sensory cells in the labyrinth which transmit impulses to the acoustic centre in the brain. The receptors for hearing are more than 20,000 stiff hair-like fibres which can vibrate like reeds of a harmonica and relay their impulses along the auditory nerve to the brain. Like the messages of the other sense-organs, the sounds detected by the ears are not meaningful untill they are analysed and interpreted in the brain.

The basic arrangement of the auditory pathways in our brain is similar to that for vision. Information from the ear is relayed through various lower stages and then to the cortex through a set of cells in the thalamus. The primary cortical receiving area for hearing is along the upper border of the temporal lobe. The receptors for sound in the cochlear organ of the ear are tuned to respond to particular frequencies. Sounds that do not seem significant enough to merit attention by the higher brain are filtered out. For instance, a parent may wake instantly to the sound of a baby's crying, yet sleep soundly through the rumble of trucks and their sounds. Relevant features include constant frequency, amplitude-modulation, frequency-modulation and noise-bursts. All human beings are born with some sets of feature detectors suitable for language. The capacity to recognize the variants of speech-sounds is altered in the course of learning of a language. The English vowel sounds that are so easily distinguished in 'red' and 'raid' cannot be separated by many Indian speakers. Conversely Indians require six different 't' sounds, which are mostly indistinguishable to English speakers.

2. Speech

The production of speech is finely organised. The main parts of the mechanism for the production of speech are the *larynx (sound-box)* and the supralaryngeal apparatus — *the pharynx, tongue, palate* and *lips*. The energy for speech transmission comes from the puffs of air expelled from the lungs. Air we breathe is converted by the valve action of the larynx into the sound-waves of speech. Vocal cords, that vibrate break the air into minute oscillating puffs having a regular pitch. They flow through vocal track of nose and mouth. Brain-controlled muscles alter the shape of the tract walls, cause the soft palate to lift, shutting off air to nose, prompt tongue to change shape and position; lips to purse or spread, channeling the air to crash against, roar over or hiss between the teeth. The frequency (pitch) of the sound is varied by the speaker (between about 60-350 Hz) by changing the pressure of the air and varying the tension on the vocal cords by muscles in the larynx. Variations in this frequency are an important agent in many languages. Nearly all the detailed information is encoded by the supralaryngeal tract.This acts as an acoustic filter and by varying its shape, the speaker alters the sound produced, just as do the length and openings of an organ pipe. The actual contractions that alter the shape of the vocal tract are due to about 15 muscles. Speaking involves selecting those movements of the muscles that produce the conventional sounds of a language in certain conventional patterns of words and phrases.

3. Brain and Speech

No one can doubt that the brain is involved in the act of speaking, that is, it is a result of the activities of the brain. Speech is essentially the product of a person and the concept of a person must include his brain. For, the continuity of the personality depends upon the store of programs' records in the brain. If the dictionary is not in the brain, where is it ? And with the dictionary must surely also be the grammar, and the system that uses both to produce meaningful speech. One of the areas specialized for speech, called *Wernicke's area,* is in the left temporal lobe. It enables us to comprehend speech. Another area, known as *Brocas area* in the folds of the frontal lobe, lies next to the area that coordinates movement of the

tongue, lips, palate and vocal cords. It controls the flows of words from brain to mouth. Every minute, two hundred syllables are exquisitely synchronised — "the most brilliant technical achievement of the human brain".

When words are heard, the sounds pass to the auditory area of the cortex in neurological codes to the adjacent Wernicke's area, where they are unscrambled to understandable patterns of words. If the words are repeated, they shift forward to Broca's area. Once there, they rouse the nearby *motor area*, controlling the movement of speech-muscles. A third area, the *angular gyrus* bridges the gaps between the speech we hear and the language we read and write. It transforms speech-sounds into the visual messages needed to write what we hear and converts visual messages from reading into the sound-patterns required to recite poetry.

The process of understanding/decoding speech largely depends upon a set of anticipations and expectancies. The analysis of the process of speech-decoding has allowed the production of blueprints for machines that could recognize speech. Recognizing speech, like seeing and other perceptual acts is an active process of reconstruction, not a mere passive reception. There may be some expectancies that are common to all mankind, especially if we include gesture as a part of speech. We all recognize the meaning of loud aggressive speech or the soft words and smiles of love. However, most of the decoding of speech depends on the store of *a priori* knowledge about the language. Every speaker or listener carries in his cortex a vast store of information about any language he uses. This includes the complete inventory of phonemes and words, the rules for forming syllables from phonemes and sentences from words.

4. Language — Definition and Structure

We might define language as "a species' specific system of intentional communication between individuals". It involves encoding of some desired message by selecting appropriate items from a mutually known set of signs, transmission of these, as by sound gesture or scent, and decoding by the recipient as evidenced by some response. The transmitter, intends either to produce some action by the listener or to

have some effect upon him by provision of information. To do this, he uses the equipment with which he is provided, whether he is a baby crying or a professor lecturing. Even when a person is 'thinking to himself', he still has at least some trace of intention, either to solve a problem or to fulfil some desire in his day-dreaming.

This definition of language is broad enough to cover all species. Human language differs from all other systems of communication in that it allows the recombination of symbols to provide for effective transmission of a range of message so large that many call it infinite. We can talk about (almost) anything. All our means of communications, from crying onwards, probably follow certain rules of structure. By these principles and rules, the brain selects one sound and rejects another for transmission, or recognizes the intended meaning when it hears them.

Why should the organism recognize certain objects or communicate about them ? The answer is : we recognize and speak about those situations that are relevant to ourselves. The brain operations that do this must be those that compute the appropriate relationships. The clue to the operations may be that the information from the senses is laid out on the surface of the brain as a series of maps. Brain activity is a process with an aim. The relations, that the brain computes and the rules by which it does this, are likely to have a large inherited component and there is strong evidence that human beings are genetically programmed for speech.

Where do sentences come from ? Neuroscientists believe vocabularly is stored in many parts of the brain. Each connected to the language centre, because wherever there is brain-damage, there is usually a naming disorder. When the connection between *Broca's* and *Wernicke's* areas are damaged, the patient may understand other people and produce meaningful thoughts. But the thoughts are expressed in meaningless language. If the *angular gyrus* is damaged, a person may be able to repeat the words he hears but not those he reads.

Neuroscientists think that children under the age of ten, or until puberty, have a capacity to develop language in both hemispheres of the brain. If language-centres in the left hemispheres are injured, the right hemisphere takes over compensating for the loss.

5. Language Universals

Psycholinguists theorize that very deep and restrictive principles that determine the nature of human language are rooted in the human mind. These principles account for the creative aspect of language enabling human beings to continually compose new sentences instead of repeating a fixed number of phrases. The human brain is genetically programmed for language development. Thus learning a language means that maturing parts of the brain enable children to recognize basic regularities in the speech they hear around them. These regularities are language universals. But expecting a child to learn a language without the experience of talking to others is like trying to start a car without switching on the ignition.

The most important universal feature of all is the creativity or productivity of language. The fact that we can construct and understand an indefinitely large number of messages is the basis of the freedom of the individual to be different from others. This freedom is in turn the basis of the great adaptability of humans and of their cultures.

6. The Origin of Language

If there are universal features in human language, it seems likely that it arose once only, within a single population, or at least that one system has outlived all the others. Some people suggest that human language first became possible as a result of adopting the upright posture, perhaps as much as 10 million years ago.

Since it is now shown that part of the basis of human speech is inherited in the DNA, there must have been evolution of it by gradual natural selection.

12. LOVING AND ATTACHMENT

0. *Maithuna Saṁjñā* and *Veda*

The primordial drives are not only essential aids for the survival of the individual organism but also for the reproduction of the species. Next to the hunger drive, *(āhāra saṁjñā)* discussed in 8th chapter, is the *maithuna saṁjñā,* that is, the primal drive for sex and reproduction. Just as the former is the impetus for taking nourishment, the latter produces the drive mechanism for mating and reproduction and no living being is without it. In higher animals and humans, reproduction and sexual activity is also associated with attachment, loving and caring for the partners and progeny. Thus our discussion of sexuality includes loving, caring and attachment.

While the physical aspects of sexuality are determined by three *aghātī karman* — body-making *(nāma)*, life-span-determining *(āyuṣya)* and feeling-producing *(vedanīya)* — the psychological aspects are determined by one of the *ghātī karman* — the deluding *(mohnīya) karman,* through its three subspecies called *'veda'* (urge for sexual behavior). These are —

(i) *Puruṣa veda* or desire for female.

(ii) *Strī veda* or desire for male.

(iii) *Napuṁsaka veda* or desire for both male and female.

It is this *deluding karman* which is again responsible for the production of attachments also. The powerful possessive instinct *(parigraha saṁjñā)* is intimately associated with *maithuna saṁjñā* and both are determined largely by the deluding *karman.* Transcendentally, each soul has to transmigrate through innumerable cycles of life and death and in each life it forms attachments with organisms of its species in that life. The attachment in the present life is, therefore, purely *empirical* and has no ultimate significance whatsoever. Its duration is only for one life-span. Thus, the *ultimate* truth is the *solitariness of the soul.* But the life-long attachments are important empirical facts of the

worldly life. Stronger the intensity of fruition of the deluding ***karman***, deeper is the attachment and vice versa.

1. Loving and Reproduction

The word *love* is used in many senses. In fact, the Oxford English Dictionary has no less than 24 columns of meanings for 'love'. Basically all love involves an element of self-love and we can safely emphasize that our actions are a curious confusion of selfishness and altruism. When we love someone, we feel happiness in their company and sadness in separation. Pleasure and happiness are internal signs that our programs of action are working successfully. We have, however, to search for the connection between happiness of loving others and our inherent selfishness and this is not quite as easy as we might hope.

We have seen that sensations of pleasure are possible only with proper functioning of certain centres and circuits including the frontal cortex and hypothalamus. People in whom these regions are not working adequately are difficult to please. Indeed they may be full of displeasure and even apt to terminate their life altogether. It is, therefore, no surprise that the activities that we characterize as loving, are also regulated by the actions of the hypothalamus. Electrical stimulation of these centers in conscious human subjects may produce feelings of general well-being and pleasure.

The hypothalamus insists upon the performance of self-preserving activities and makes sure that we eat and drink the right amounts and defend ourselves if attacked. Homeostasis conserves the whole program for a way of life, which is written in the genes and passed on by reproduction. The hypothalamus contains programs devoted to long-term conservation. It ensures that, in due course the individual comes to sexual maturity. In humans, sexual attracations, mating behavior and care of the young occupy a major part of our lives and energies. It is proper for the conservation of our kind that such activities should be pleasurable and rewarding, and these are the pleasures of love.

The hypothalamus, thus, has a central part in directing behavior towards the goals both of self-preservation of the individual and the

reproduction of his genetic program. But we can see now that this love is only a special part of the larger program for the conservation of life. Our self-preservative 'selfish' desires are as much a part of this as our altruistic wishes for others. Being directed by the same parts of the brain, the two sorts have naturally much in common. The very activities of sex, which may lead us to all the responsibilities of parenthood, are themselves perhaps the most rewarding of all experiences for the individual.

2. Programs for Attachment

We have seen earlier, how we learn physical and develop and intellectual skills, and now we are concerned with our emotional development. The child is born with programs that ensure that he receives attention, for example, crying, and the mother is also programmed to respond to them. Her brain and her hormones normally make sure that she responds to its cries just as they also ensure that she has the milk to feed it. There is an inherited program that promotes attachment to the mother which is most essential, at least, in the first year of life. This is preprogrammed response which shows the presence of neural mechanism ready to respond to certain stimuli by attachment. At the same time, mother is programmed to become emotionally attached and to remain attached to the child. Her face and her voice are prominent in the list of characteristics which elicit responses from the child. The evidence from childhood shows that humans are born with a propensity to pay special attention to the sights and sounds of each other[1].

Is love, then nothing else but attachment ? There is nothing altruistic about the child's devotion (to its mother); it is purely selfish and for long remains so. The little tyrant develops various skills — attractive devices — to fascinate, capture and control her, sometimes by crying and at other times by smiling. Throughout the long period of childhood, he is learning to get on with people by building the model set which must serve him in all his later human relations.

Adult attachment is very much different from the reaction of the

1. This may perhaps be the basis of anthropomorphism i.e. our tendency for a scribing human characteristics to physical events, animals or gods.

child to his mother but it may be the same *neural mechanism* that is responsible for some characteristic features of adult life. Outside the family, adults, very often, become attached to groups or institutions as well as to stars of stage, sports stars and religious leaders. Indeed, it seems to have a common basis in all mankind, for most humans respond to leaders.

We have to search for the steps by which selfishness is transformed into mutual pleasure and self-sacrifice for others.

3. Development of Sexuality

With the development of sexuality come new needs. There is much conflict in the evidence about the conditions conducive to sexual developnent in humans. Certainly the conditions differ greatly with culture. The basic impetus to sex comes from deluding *karman*, heredity and hormones, but its manifestations are profoundly influenced by experience. Very often, grown men and women may enter into matrimony without the slightest idea of how to go abaout sexual intercourse and proper sexual behaviour is developed after a period of experiment and learning. Inspite of a spate of publicity about sex, it remains a very private phenomenon among humans and this very privacy leads to much anxiety and ignorance and to quite unfounded fears of being abnormal.

The conditions of permanent attachment and marriage of course also differ enormously between different societies and cultures. The whole question of sexual attractions between permanent partners seems still to need study. Western theory that we become attached to each other by a biological bond seems to be as likely to be right as any other.

In a primative society, where death was much prevalent, full reproductive power was essential and the satisfactions to produce children had to be strong. But, today population dilemma has made the question of sexual relations very peculiar. Although we, no longer, need to produce so many, the programs remain with us and sexual desires grow more powerful, aided by cinema, TV and literature.

Though individual sexual attachments are related in some way to those formed in childhood, we are still without certain knowledge of the foundations of adult sexuality because we still lack adequate studies of the development of brain. The overlaps between attachment behavior, parental behavior and sexual behavior are commonplace and quite often one treats a sexual partner as a parent and the reverse.

4. The Gonads (Sex Glands) and Sex Hormones

To appreicate the basis for sexual urges, it is useful to have knowledge of the genetic and hormonal factors that influence it. The genetic difference between the sexes lies in the chromosomes. Out of the 46 Chromosomes, only two are responsible for determining the sex. Thus, while a male will have X and Y, the female will have X and X. This difference will result in anatomical distinction between their respective reproductive systems.

The term gonads literally means 'seed' and the male and the female sex organs (the gonads) produce the 'seed' of the new generation. The gonads of the female are the ovaries and in the male they are testes. Their principal function is to produce germ cells, ova and sperm, respectively that can fuse together to produce a new life. They also double as potent endocrine glands, secreting hormones that condition the functional state and influence the psychic biological phenomena involved in the sexual act.

The major female hormones estrogen and progesterone are produced by the ovaries. Similarly the main male hormone testosterone is produced by the testes. However, adrenal glands produce both male and female hormones and both are present in every individual but in different amounts. Thus the difference between the sexes are quantitative rather than absolute. Every individual is a human first and a male or female as it was, only secondarily. Thus, if the resultant sex is a balance of maleness and femaleness, though it will be tipped more or less strongly in different individuals, it is natural for every one to show some characteristics of the opposite sex, both physically and emotionally. This is why the woman may like to be dominated but also want sometimes to dominate and the man can find that he also wants it this way.

The relationship between the hormonal factors and the programs of so called higher parts of the brain is still very obscure. There is no doubt that it is a two-way relationship. Hormones influence thinking and vice versa.

13. ART, ARCHITECTURE AND AESTHETICS

0. Art and Spiritualism

India is the land of spiritual outlook and nothing that is bereft of spiritual value could satisfy the Indian mind. Philosophy, Logic, Art and Science all possible branches of thought were inspired by spiritual outlook. Thus, for Indian Philosphers, logic is nothing but an instrument for the interpretation of the spiritual intuition. To get rid of spiritual darkness and enlighten the path of self-realization is the end of all *science.* An *art* is not an art, if it does not give glimpse into the beauty of truth. The common end of all arts - music, painting, architecture, poetry etc. — is to remind us of the supreme state which is beyond this wordly existence. And that is why amongst the most renowned poets are Kabir, Surdas, Tulsidas and Mira and the supreme objects of architectural beauty are the temples, (and cathedrals), the abodes of God.

1. Essence of Living

So far we have been studying the programs for simple biological homeostatic functions such as breathing, eating, mating (reproduction) etc. which we, humans, share with sub-human animals and millions of other species. In this and the succeeding chapters, we shall study the two most trully characteristic human activities, viz. *Art* and *Religion.* In doing this, we shall have special opportunities to test whether our study of the programs of the brain can really help us to understand ourselves.

Religious beliefs and aesthetic pleasure derived from art (music, painting, poetry, drama etc.) are very precious and are most important of all the functional features which distinguish human attitude and behaviour from that of animals. In fact, they are the *essence* of human life. And we believe that proper and adequate knowledge about the brain can enlarge our capacities for creativity, imagination and perception, for appreciation of nature's beauty, for understanding the significance of our lives, and for deepening our religious beliefs. Belief and creative art are

not mere peripheral luxury activities. They are literally the most important of all the functional features that ensure human homeostasis.

In this chapter, we shall try to show that aesthetic creation (and enjoyment) are fundamental features of human life. They are activities in which the brain is operating in the same way as it does in daily life but at a higher level, as it were. In the next chapter, we shall examine some of the ways in which *beliefs* operate and will discuss why they are so important.

2. The Necessity of Art and Aesthetics

Human perception is a form of creative activity. We appreciate the products of artists (painters, musicians, poets etc.) because they express and amplify our creative aptitude and stimulate our reward-centres. Our daily lives and perceptual activities continue satisfactorily because of the rewards that come from these centres. They continually influence our thoughts, words and actions, urging us, as it were, to do things that are satisfactory.

The search for satisfaction goes on continuously. Pleasure and indeed all enjoyments involve search for the meaning and significance of satisfying situations or objects. The significance may be intellectual or emotional or both. Works of art are the symbols which show that the process of living is proceeding satisfactorily. They reassure us that things are ordered as we supposed. The activities that go to the creation and enjoyment of works of art are thus quintessentially those by which the brain, working every day as a creative agent, synthesizes inputs from the world to make a satisfactory life. The creations and satisfactions of art include and symbolize both our individual acts of perception and the expression to others of what we perceive. These are the very brain actions that give us the powers of communication by which we obtain all the rest — food, shelter, sex, social life and recreation.

Art in general and painting in particular, ensures that life is worth while for its own sake, irrespective of any ideology. We are, all, aware of the relationship between artistic creation and the daily programs of the brain, but it is difficult to express its depth. Even the most philistine

person or the poorest, has feelings for design, for instance clothes, cartoons or in advertisement. Thus the work of the artist is at the very centre of human activities. He gives us new ways of seeing or hearing or thinking. The bringing together of the two realities, universe and the psyche goes on every minute of the day in each of us. The artist cannot solve the mystery any better than the rest of us but he brings it to our attention and gives us some satisfaction by showing and sharing this puzzle of what is 'real'.

3. Art and Brain

The signs on canvas or in words arouse interest in us on account of their connection with our life-pattern or program, which is guided by our emotional needs. In short, we make each moment of perception, part of the structure of our thinking and feeling.

Man is both a symbol-using creature and also a fabricator, both of words and objects. The things that he makes inevitably reflect the operations of the needs of the symbolising system within. Those, whose brains are full of concern for sex or of violence introduce symbols of them in their paintings or poems or films, or perhaps by graffiti on the lavatory walls. A child makes a hobby horse out of a stick for use, as it comes to be an image of features of a horse. Indeed all it needs at the absolute minimum is the capacity to be made to go. It can be effective even if it is exceedingly abstract, provided that its symbolism stimulates the necessary imagination and action.

4. Principles of Aesthetics

Much of the appeal of a picture, poem, or song may be related to inborn emotions and the attitudes that express them, for instance of sorrow or of joy. It may be that a lot of our responses to shapes and colours and sounds depend basically on inborn capacities, but of course immensely modified by cultural influences. If the primary aim of art is to please, it also has an endless series of secondary uses. 'Pragmatical' functions of art are more prevalent today then ever. We need only think of the immense numbers of people who still worship, or at least give respect to, visual images, such as those of god Ganesh, goddness Kali, the

Virgin or the Crucifixion. Advertisers are continually searching for new ways to attract us to their products, and how well they understand that the human brain program is especially attracted by human features, especially those of pretty girls.

5. Poetry and Music — Language of Emotion.

Almost all humans are pleasantly affected by patterns of tunes and rhythm. To enjoy and be moved by them is a characteristic trait of our species. The patterns that are preferred vary with culture, but some features are universal and they help us to understand the fundamental structuring of human brain process. A child indeed responds to music and poetry without being taught. Although the more sophisticated patterns of music can be appreciated only after much experience, yet music (of a sort) is played in almost every public place.

Poetry and Music have been called the language of emotion. Any emotional response is a combination of sensation and the response to it. For example, certain stimuli arouse fear or sadness, religious fervour and devotion, and in each case the particular emotion is accompanied by physical changes such as increased heart-beats and weeping, relaxation and tranquillity. Music produces a partial or symbolic emotional response. When we hear it, we do not necessarily recognize or identify the emotion. We may feel a sort of faint sadness without weeping, or joy without laughter, or bliss without euphoria. Music has its own language which illustrates the abstract qualities of human experience, rather than particular facts. These qualities are fundamental features of the whole cerebral organization; therefore inevitably, when, say, sadness or joy are suggested, whole complexes of associated details may follow. The cerebral organization operates as one single whole. Neuroscience have made some progress towards understanding the parts of the brain that are involved in musical appreciation. The capacity to appreciate music is lost after injuries to some cortical areas. The areas especially concerned with music lie around those in the temporal lobe that are responsible for hearing. Recent work has shown that the areas for musical appreciation are mainly in the right cerebral cortex, whereas those for speech are in the left. Thus the left ear (connected to the right cortex) is the better

receptor for melodies; and injury to the right temporal lobe has the greater effect on musical appreciation.

The temporal lobes of the cortex lie close to the hippocampus and other basal parts of the cerebral hemispheres that are connected with reward-systems and emotional responses.

6. Architecture

We hope to have convinced the reader that pursuit of the fine arts is, indeed, close to the core of the structure of culture, perhaps in all ages and all communities. For architects and planners, the message is clear. *Humans need buildings and objects around them that suit the structures of their brain-program. Of course, we must add at once that the structure* of what they see will greatly influence their brains.

The architect can imagine, search and discover significant symbols for us all, like any other artist. Indeed, many architects realize this and do great things for us and often succeed in breaking old conventions and teaching us to enjoy new ones. Indeed, people with aesthetic sense travel thousands of miles just to see wonderful architecture of Taj Mahal or the temples of Delwara and Ranakpur.

7. Drama and Playing

All art forms, whether visual, poetical or musical, try to introduce us to fresh and novel ways of perceiving and feeling. This question of the search for novelty may lead us to the relations of art to play. Playing is *pleasant, interesting, and creative. Yet, it is also partly innate and* conventional. Drama and Play also involve experiments in socialization. It is successful in so far as it is pleasurable, and this makes it effective as an introduction to social life. In laughter, we have a pre-programmed sign to use in order to show that life is proceeding well.

Both activities are in a sense 'non-serious' and 'non-functional' but are not therefore unimportant. Both are self-rewarding, but are often enjoyed with others. Both express a need for surprise and for change and is especially important, if we are looking for the emotional basis for originality. They are, in fact, important components of the homeostatic system. Finally they are symbolic of life, and what could be more important than that ?

8. Art, Science and Discovery

Perhaps we shall never know how art began, but we are surely lucky to have brain systems that urge us on to continue to look and listen, to play, to experiment, to enquire, to imagine and construct, and to find satisfaction in what we have made or discovered. These are the activities that have made man what he is, and they have been especially evident in both art and science in recent times. We can rejoice that man has made new discoveries, not only of new ways of making things, but also of new ways of thinking, of seeing, and of hearing. Of course, the discovery of new ways of understanding the world is not the exclusive privilege of either the exact method of the scientist or the imagination of the artist. Although scientific discoveries are mostly thought to be the result of rational and analytical thinking, it appears that the physician, chemist and mathematician must be no less intuitive than the poet, composer or painter.

The rationality must be complemented by the intuition that gives scientist new insights and makes them creative. Such insights tend to come when relaxing during a walk in the woods or a beach. In such periods of relaxation the intuitive mind seems to take over and the resulting clarifying insights give so much joy and delight to scientific research. This is illustrated by the discovery of the theory of relativity in the beginning of this century. Einstein himself, observed "- - - the gift of fantasy has meant more to me than any talent for absorbing positve knowledge."

14. RELIGION : BELIEVING AND WORSHIPPING

0. Right Belief

Indian philosophers in general and Jains in particular emphasize that perfection and self-realization is integral in soul and yet it has been hindered from achieving its infinite glory from eternity. The soul has been oblivious of its own real nature and has been wandering in wilderness.

The principle which acts as hindrance against self-realization is called *avidyā* or *mithyātva* (nescience) or *moha* (delusion), because it deludes the soul by producing perverse belief or faith. The soul is lured in the wrong direction and it clings to the worldly life as the source of happiness which leads to the endless cycles of re-births. The common aim of all the Indian Systems is to show the way out of this vicious circle and the very first step in this direction is the destruction of nescience or perverse belief.

According to the doctrine of *karman* in Jain philosophy, the most vicious bondage is that of belief-deluding *(darśana mohanīya) karman.* Its function is to delude the soul and produce nescience — perversity of faith/belief *(mithyādarśana).*

In order to destroy the perversity, the first thing that is necessary is possession of right belief of spiritual conviction *(samyagdarśana).* Once this happens, the soul turns back and treads upon the *right path.* Thus right belief is the foundation of Jain religion; it *(samyagdarśana)* is the sine qua non — forerunner / precursor — of right knowledge *(samyag-jñāna)* and right conduct *(samyakcāritra).*

1. Knowledge Depends on Believing

The very word belief implies conviction and trust and the essential feature of all our beliefs is that we believe in them, they are the props and stays of our brain programs. Without belief we could not have trust in

either analytic propositions, such as "2 + 2 = 4" or synthetic ones such as that "the sun will rise in the morning." Thus *beliefs* are essential to all *reasoning* but they are not *achieved* by *reason.* They are, quite simply, the result of the trusting capacity of the human brain, which allows the individual to build up programs that use such beliefs. Of course, it is hard to know just how much of any particular belief is due to training and how much to heredity. But the basic capacity to believe is essential to the functioning of every individual, and, like the capacity to speak, it must have a fundamental inherited background.

The capacity to believe includes much more than religious belief. Belief is necessary to accept the fundamental concepts upon which all logical discourse depends. Acquisition of knowledge in the human's rational way depends on the capacity to recognize certain logical truths. For example, we know what is meant by asking a question and giving an answer. Then we must agree about the nature of truth and falsehood, equality and difference, the meaning of `more' and 'less', `before' and `after', and many more such relationships. In fact, we have to have faith in the intelligibility of discourse, capacity to learn. The capacity for believing is a mode of operating that is not learned by experience. Of course, this does not mean that a baby is born with any particular system of logic or of religious belief, but that its brain will develop a power to operate with complete reliance on certain concepts. Without the capacity to believe, it could not function at all. The development and construction of the whole human brain-model depends upon this capacity to accept or have faith in certain fundamental methods of operating. Animals do not believe either in logic or in God. As Bertrand Russell said, 'believing seems the most "mental" thing we do'.

We all need belief where knowledge fails us. But it is degrading to continue to use detailed beliefs that have become inconsistent with knowledge.

2. The Function of Belief

To fulfill their tasks, beliefs have to assist the individual through all the difficult phases of life. The individual has to face a very wide

range of eventualities and anxieties, and his own detailed knowledge and information is usually supplemented by a set of categorical beliefs, whether scientific, political, or religious. We all need beliefs. A characteristic of our method of brain modeling is that we require what we call 'explanations' for all the occurrences around us. We expect them to fit into one coherent scheme. Yet all of us, however wise, reach, in the end, points where our knowledge and understanding fail and some form of hypotheses, or guess, or faith, or religion becomes the only possible way to provide the explanation. This is, therefore, the mode of brain-activity that relates a man to ultimates that he cannot know about logically. Many people believe that they can do this by cultivating modes of mystical experience, which they enshrine in beliefs about some spirit or god. Others may find that a logical belief in the unity of nature is sufficiently satisfying. Neither of them can prove that they are right.

The capacity to accept faith in religious beliefs is determined by the strength or intensity of deluding *(mohanīya) karman* and has inherited background. Man has an innate tendency to believe in God. But the actual form of his faith varies very much with his culture. He needs repeated reassurances in the face of his fears of the unknown and is comforted by belief when he is faced with the uncertainly of his future. Our brain-programs are so highly organized around concepts of persons that gods are nearly always personified. To form a concept of god in non-personal terms may be a rational aim but people prefer to believe in the operation of agents who are receptive to human communications. Thus, Jesus and the Virgin are in a sense more important than the Father or Holy spirit who is remote and inaccessible. An important feature of the gods and goddesses in many religions is that they are accessible and receptive to human appeals and also have greater powers.

3. Religion — Social vs. Personal

The dual character of religion (transcendental and empirical) explains the paradox that it is both a personal/private and a social/public phenomenon. Many people feel that a man's religion is his own affair and we come across such pronouncements as "My mind is my church" or "I am a sect myself". Strictly speaking a church or a sect is not *'religion'*

but is only an assembly of like-minded people holding identical beliefs. But such an assembly is fundamental to the social nature of man and has been rightly or wrongly identified with 'religion' in all ages and all cultures. Perhaps for social-minded men the satisfactory conduct of his life require a degree of shared belief and some participation in collaborative ritual. The tendency to meet together in large or small gatherings is even more widespread than specific religions, and survives even when religion itself is discarded. People who never go to church or temple are often ready for a party to be held in the church. The very fact of assembly gives reassurance that we are part of larger whole and the individual's life is strengthened thereby.

4. Rituals are Social Obligations, not True Religion

This interpretation in the preceding paragraph emphasizes that ritual is more important than true religion. In a traditional society, there is no sharp distinction between two different activities practised *together*; for example sowing seeds and the prayers that accompany it. They are deemed to be of the same value, and one simply does them together. Religious rituals should be regarded as a special sort of *social language*, serving to symbolize society. Ritual often serves more for showing and saying than for actually producing some particular effect. The purpose of participation in a rite is to show one's respect for the social order. Also one's own upbringing and method of brain-working insist that one must do it. Even some superstitious acts and beliefs are supposed to reduce *tension* and *anxiety*. The individual does not participate because he believes in them, but because it is the correct thing to do in the circumstances. To say, 'I don't believe in Religion' is more 'bad manners' than 'bad metaphysics'. Religious experience and moral conscience take many forms and undoubtedly help many people by rites, whether in communal gathering and worship or individual meditation. Human brains are, as we have often emphasized, especially programmed to be indoctrinated. We make much use of simple rituals, for instance, of *eating together*, from the banquet to the family breakfast or supper. Each has its proper procedure. Communal acts, including worship, sanctify endeavours into acceptable and necessary conventions.

Religious rites serve as signs of passage from one state to another, from child to adult, from single to married, and from alive to dead. They may be said to map the life-program of the individual.

5. True Religion is Personal

To emphasize the social function of religion is not to minimize the genuine importance of its personal content. Studies of the sociology of religion give us plenty of insight into its function in society but what does this leave of religious truth for the individual ? We can, no longer, *believe* in the literal truths of traditions nor is it easy to *accept* the rejection of the scientific truths which has been characteristic of many religions. In the orthodox past, we have been taught, almost wholly, by exhortations and traditions with their attendant superstitions and dogmas. Whatever the meaning of *God* or of the *universe* may be, we should use all our knowledge including facts proved by science to understand them as clearly as we can. This is indeed what men have been doing through the centuries by expanding their sense of awareness and wisdom. Science cannot negate eternal truth nor can religion negate a proven fact. And, hence, it is wrong to believe that scientific discoveries can negate the truths of philosophy. Wisdom of philosophy and discoveries of science can, together, pave the way for more truths and knowledge which may be woven into a higher wisdom and used for the benefit of mankind. Both good and evil are present to some degree in human nature. True religion stimulates the good traits and inhibits the bad ones. Control of inherently evil traits can only be achieved from within by suitable modification of programs which have been inherited or learnt. The effect of these programs produce an urge which is stronger than the force of theoretical knowledge. Subjugating of the urge can be achieved by developing power that lies deeper in the sub-conscious. Such power is also innate in all humans. It is the function of the religion to develop that power by right techniques.

It is our spiritual duty to countermand and overcome the evil urges and we have the innate capacity to do so. All that is needed is to develop this potential into a reality. This is the work of the true religion.

6. Worshipping

Throughout this analysis/discussion our idea has been that *believing* is a characteristic feature of the human brain. The same is also true of *worshipping*. It is not something that is done with ritual solemnity only in church or temple. It is the product of a need in every human being and most of us have programs that provide satisfaction of the need to worship. We can, positively, identify worshipping as a very real program of the brain. As we feel the effects of worshipping, we allow our reward systems to pour their gladness over the whole range of cortical programs and there are literally streams of nerve-impulses releasing floods of the chemical messengers that open useful pathways *to* the cortlex and *within* it. Study of belief and worship emphasizes again that the brain program is one undivided whole.

15. FEARING AND FIGHTING

0. Aid for Survival

Bhaya saṁjñā, instinct of fear, is one of the four primordial (unlearned) instincts[1] possessed by every living organism. Preparations for defense are essential for all animals, in a sense, for all life. Every living organism is continually in danger of destruction. Life is a precarious steady state maintained only by continual activity and preparedness to meet and counter adverse conditions. Instinct of fear is an aid for survival available to all life. In humans, all psychological distortions — cruelty, vindictiveness, hate etc. are produced by the deluding *(mohanīya) karman.* They are called quasi-passions *(nokaṣāya).*

1. Programs for Defense

Brain provides higher animals and men with special programs that alert them to threats to their security and enable them to deal with them. Readiness to meet danger is ensured partly by inborn programs and partly by others that are learned. These are the programs that give them fear and anxiety. Stimulation of certain regions in the brain of an animal produces arching of the back, bristling of the hairs, baring of the teeth and all the signs of aggression. Conversely after removal of some other regions, monkeys no longer display the appropriate reaction of fear to a sudden disturbance, and they will pick up and examine dangerous objects such as snakes. Evidence that there are similar centers in the human brain comes from the results of injuries and tumors, which may turn a mild person into an aggressive one or the reverse.

The physiological responses to clues to danger, whether inborn or learned, prepare the individual to give an appropriately strong response of fight or flight, and suitable responses are as necessary in social life as in physical conflict. The right response may vary from a fight to the death

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1. The four primal/unlearned instincts are : hunger, fear, sex and possessiveness.

to submission to a superior in the hierarchy of business or any part of social life. In either case, the individual must be prepared.

2. Mechanism for Fight or Flight — Origin of Aggression

It has been known for a long time that secretion of adrenaline by adrenal glands prepares the body for fight or flight. Quite recently several systems of aminergic[1] nerve-cells and fibers in the brain have also been found to be involved in aggressive and defensive actions by men and animals. We begin to see the connections between the programs of fear and anxiety that prepare us for trouble, and those of defense and attack with which we deal with it.

Anxiety, fear and aggression are necessary parts of life, vital to the continued existence of the individual and of the species. We characterize them as evil and wish they could be abolished, but they are the inevitable corollaries of the precarious and unstable nature of life. We cannot avoid meeting destructive conditions and we may need aggressive forces to protect ourselves from some of them. Certainly we can make every effort to minimize conflicts within our species. To do that, we shall need to consider what human attitudes and controls are required to regulate our reactions to each other in a growing population with limited resources. The programs for defense, if appropriately controlled, may yet be exceedingly useful. No one should deceive oneself into thinking that all groups of men are going to live contentedly without constraints. There are too many inequalities among us already and those who are deprived will seek for better conditions, which the privileged will deny them. There are certain to be conflicts. But proper and adequate development of man's innate capacity for peace and non-violence may, at least, help to limit and to contain them.

3. Criminal Aggression

There is evidence that some criminal psychopaths have a definite chromosome abnormality, with an extra Y chromosome (XYY). But the

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1. Aminergic synapses are those at which the transmitter is a monoamine such as noradrenaline.

liability to be violent, no doubt, lies both in the genetic background and family upbringing. E.g. a failure of attachment when young, can make one cold, irreverent of human life, aloof, and emotionally distant. A greater inner emptiness and sadness is the basis of these persons' need to be powerful, strong and aggressive. It is always easier for them to be *mad* than *sad.*

Thus the programs that lead to excessive violence are probably a compound of hereditary brain defects such as errors of monoamine systems, and failure to achieve adequate personal and social attachments. The latter may in turn be a compound of genetic inadequacy and oppressive social conditions. We cannot deal with the genetics easily, if at all, and we are only beginning to understand the 'amines', but we can improve at least some social conditions. Obviously the causes of aggression are very complicated and it is not limited to those who are 'socially deprived or backward'.

These various pathological manifestations of anxiety, fear, and depression are obviously the result of distortion and overactivity of programs that are useful to alert the organisms to possible dangers. Like all other brain programs these have a genetic background but are elicited and reinforced by environment. The pathological overaction may be hereditary or due to past or present stimuli.

4. Control of Aggression

The control of aggression is very complicated. It involves many different brain regions and is influenced by many chemical substances. There are three areas in the basal parts of the brain whose effect is to increase the tendency of violence and no less than six parts that reduce it, the latter lying further forward in the brain. The *Neocortex*[1] has greater influence and in man it could dominate these basal zones. There is continual interplay between the tendencies to violent actions that spring from the lower centers and the restraints imposed by the learned

1. Neocortex — the most recently evolved part of the brain essential for many of the special human programs, such as those for speaking, thinking and conceptual planning.

responses of the cortex. In man, the orbital zone of the frontal cortex is an especially important inhibitor *of the tendencies produced by* the lower regions.

The actions of the lower parts of the brain are greatly influenced by the higher parts. Experience and learning are such dominant factors that in man the lower centers are largely controlled by cultural or individual influences. It is characteristic of humans that they can be educated. We may have innate capabilities for aggression and violence, but it does not follow that we need to use them.

5. The Chemistry of Aggression/Violence

Three Chemical transmitters, characteristic of some of these areas, have been identified and their amounts can be altered by several deliberate mental procedures. These are (1) *noradrenaline* (NA) and (2) *dopamine* (DA). Increase in the levels of a third amine (3) *serotonin* is found to depress aggressive behavior. A proper ratio between these amines is important in control of aggression.

The discovery that these substances are active in the brain has been made only recently, but for many years it has been known that adrenaline produced by the adrenal gland is involved in reactions of alarm and stress. In the brain, amines are 'transmitters' used by one nerve-fibre to activate another at synoptic junctions. It is very interesting that the central part of the adrenal gland (the medulla) is devoted to producing similar substances and sending them in the blood all round the body. The 'alarm reaction' that they cause was one of the first examples of emotional processes to be studied by physiologists. Stimulation of the nerves to the adrenal gland releases adrenaline, which has the effect of preparing the body for action. The heart speeds up, digestion stops, blood is diverted from the viscera to the muscles and sugar is mobilized as fuel from the liver. It is indeed strange that this and the similar substance, noradrenaline, are at the same time at work in the intricate networks of the core brain, making the animal or man alert, attentive, and ready to respond.

Both in the brain and body, these amines produce rather general effects. These are not the programs that tell the animal or person exactly what to do, only that he should be aroused and ready.

6. Aggression (Violence) — not a Biological Necessity

As stated in the beginning, an aggressive response is ready to be used in every normal adult human by virtue of his possessing primordial unlearned instincts. But anger does not spring up spontaneously; at least in normal people, it has to be 'aroused'. It is triggered (and grows), for instance, by infringement of 'rights' to territory or possessions, frustration and attack on children etc. These responses are part of the mechanisms of 'fight' or flight' and come from the ancient core brain (including the hypothalamus) as much as from adrenal.

The question is — Do people have a biological need for the 'discharge' of aggression (like orgasm in sex) ? There is some evidence which lends plausibility to the theory that they do. For instance, readiness with which people respond to calls for aggressive war, universal prevalence of sports with contents of combat and violence (e.g. bull-fight), popularity of art and theatre in war, from sagas (like *Mahābhārata*) to horror films.

Nevertheless, it is incorrect to say that every individual feels that he has a **need** for aggression, though most do become angry when provoked. The tendency to defend one's rights or one's children does not mean that one has to be violent and it should not be equated with aggression.

Thus, aggression is neither a biological necessity nor it is universal. There are many historical instances of non-violent communities where violence was controlled voluntarily without any special laws or police.[1] There is no dearth of instances of non-violent response even to the most aggressive provocations in the history of mankind.

7. Militarism and Warfare

Whatever might have been the origins of warfare, it is obviously a

1. Studies on Anti-violent and Abormal Communities by Paddock J., (1975).

major continuing danger to all individual human beings and to mankind. Wars continue to be as prevalent as ever and military leaders are at helm of affairs in many nations.

Can we find an explanation for the marked tendency of humans to form groups that fight each other? Is warfare the result of aggressiveness of individuals ? "War" wrote Rousseau "is not a relation between *man and man* but between *state and state.* Each state can have for enemies only other states ad not men". It is difficult to imagine that heterogeneous groups can possibly remain in perfect equilibrium without antagonism. The question, before us, is — how conflict could be made limited and contained ? We have ample information to help us to control the dangerous capacities for violence. Protective and defensive mechanisms possessed by us are to be seen as having the positive survival values and not identified with aggression and attack. Surely such a view is more sensible.

The Chemistry of aggression/violence gives us a very important clue for controlling aggressive behavior in general and violence in particular. We know that *serotonin* is secreted within the brain, possibly by *pineal body* and through a proper technique of meditation, people may be trained to increase its proportion in blood circulation. The secretion of adrenalin and noradrenalin by the adrenal gland can be increased or inhibited by changes in the amount of ACTH released by pituitary under the influence of ACTH-releasing factors from hypothalamus. Both pituitary and pineal are found to be amenable to the conditions produced by meditational practices.

16. SOCIETY AND CULTURE

0. Status-determining *Karman*

Biological characteristics concerned with social systems are mainly the domain of status-determining *(gotra) karman.*

Thus, we would expect our genetic system to have various inbuilt features and characteristics determined by the *gotra karman* and not a blank sheet for individual cultural development, but a sheet, at least, inscribed with certain tentative outlines of social and cultural behavior.

It should be remembered that the status-determining *(gotra) karman* is very intimately related with its counter-part — the body-making *(nāma) karman* and to a little less extent to life-span-determining *(āyuṣya) karman.* And, therefore, the inscription on the sheet will be the result of all these *aghāti karman.*

1. Cooperation and Altruism

Questions about our relations to each other, such as, freedom and equality, rights and duties are matters of intense concern to everyone. From the fables of Aesop to the fables of Orwell, men have tried to learn and to teach by using animal analogues of social organization. But human cultural organizations depend upon a fluent language, which animals do not have. Our societies are regulated by custom, which are altered from time to time. Cultural evolution, however, cannot be totally independent of its biological substratum and our social systems are possible only because we have certain biological characteristics. In other words, no human societies could exist without the special features of our brains, bodies and endocrine glands. Also, we are all influenced by our long childhood. (See chapter 4).

The virtues of cooperation and altruism, are common features in both human as well as social animals who have a genetically controlled system of ethics that regulates their responses to each other. *Altruism* broadly means to refrain from being selfish or endangering one's own life for the benefit of the society. It is at a maximum among the social insects

where all the members of each colony are descended from one queen and, therefore, closely related. They help each other and may even die in defence of the colony. Cultural practices involve the relations of human beings to each other and are symbolized in many ways including kinship. Kinship is certainly the dominant structure in the culture of many people, but it often has little or nothing to do with blood relationships.

Economic, religious and other relationships may be much more powerful than kinship. We can neither discard nor prove the possibility that some customs have survived because they promoted the spread of genes for altruism. It is doubtful how far human loving and caring (as we ordinarily understand them) are the products of specific hereditary influences providing the capacity to learn from experience. The question is whether the human behavior is mainly the result of social and cultural influences and whether these can be changed.

Altruistic behavior from parents increases chance of survival of the child. But the parent-offspring conflict (weaning conflict) would be inevitable because of the parent's ability to produce other offspring. Help of elder children in rearing of sibs will also be determined by their own genes, but the situation will vary according to the attitude of the culture to marriage. Thus the interconnections of cultural and genetic influences are indeed complicated.

It is clear that the advantages of altruism over selfishness depend upon many circumstances. Genetics and its determinant *karman*, plural especially *gotra karman*, thus provide some suggestions about possible basis for social behavior. Many species of animals and plants achieve success by cooperation. Rational human beings can save themselves by promoting the lives of not only fellow-humans but also animals and plants, by the doctrine of reverence for life and proclaiming that all *men are 'brothers'*. Geneticists may laugh at this but neuroscientists, who study actual human interactions, will know that we do have programs to ensure our own security by recruiting the assistance of others (see chapter 12, "Loving and Attachment") that is our natural selfishness is best served by altruism. There is no justification for the attitude that

regards 'culture' as an intrusion separate from 'nature'. Study of kinship-systems of primates show elements of human kinship system as well as great complexity and variety. Finally, it is necessary to remember that patterns of culture are regulated by far more complex and immediate concerns than the proper distribution of genes.

2. Ethics

The capacity to learn ethical concepts develops during the long period of childhood when an individual is bound to be subservient to elders if only because one is genetically programmed to obey. It is during this period that the capacity to learn ethical concepts develop. Our capacity to learn the proper order of society is equivalent to learn the order of words in a sentence. Obedience is the 'dispositional cement' that binds society and it probably has a hereditary background. Heredity gives us the capacity of learning what is right or wrong in our relations with others as well as powers to be happy or angry. What they do not give us is our particular conceptions of morals, rights and duties.

The child, early, learns that his first selfish attitude must be modified. The demands for self-sacrifice will seem, at first, to conflict with its needs for comfort etc. and may leave traumatic scars in some cases. Ultimately and in most cases, it realizes that altruism helps him to fulfill his needs within society.

The existence of moral rules is quite common in human cultures and behavior and the capacity to respond to them is probably genetically inherited. So, the capacity to learn during the long period of childhood appears once again a central human feature. Culture is transmitted by virtue of this genetically determined pattern of growth and development of brain. The factors that ensure the development of an ethical sense are both external and internal. It certainly does not mature as do the ability for walking (or talking). The respect felt by the subordinate for the superior plays an essential part and it is this respect which develops to ultimately become 'conscience' and the basis for moral behavior. This building of the personality is at the very center of the system of hypotheses and actions that constitutes the model in the brain, which we

are holding to be organized around the attributes of a person. The concepts of good and evil as well as tendencies to aggression and guilt are built up by a series of steps beginning with the child's mental capacity to establish people (first his parents) within his own mind. The basis of conscience is the self-condemnation for aggressiveness. These concepts (like all other sorts of knowledge) must depend upon the nerve-cells in the brain which are the physical basis[1] of conscientious action.

3. Leadership and Power

The particular patterns learned in youth of appreciation of rights and duties, submission and dominance remain to a large extent throughout life and all cultures are built upon them. One of the basic concepts is that of power which pervades perhaps all cultures. There may be some egalitarian societies but exercise of power and leadership are also conspicuous features of human relations. Power has been defined as the ability of a person to influence the behavior of others. The attitude that power and leadership are essential implies that disagreement[2] is typical of human organizations.

Recently, however, these attitudes tend to modify to reduce conflict. The acceptability of the personality and the attraction of the leader are reduced by coercive power, in these days. On the other hand, sharing of responsibility can give certain advantages. For the leader, himself, acceptance by individuals or groups is now considered more satisfying than monetary rewards.

4. No Justification for Division in Classes

Notions about rights and duties, freedom and equality vary with cultural patterns and are not determined mainly by genetic inheritance. Genetic differences do affect such notions, but it is impossible to say

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1. The psychical basis, counterpart of the physical basis — for the knowledge of the concepts of good and evil and tendencies to be aggressive and guilty, is the individual's *karman* in general and body-making *(nāma)* and status-determining *(gotra) karman* in particular.
2. This is very aptly reflected in the common proverb — "*munḍe munḍe matir bhinnā*" which means "every brain thinks differently."

whether election of particular capabilities influence the direction of cultural growth. We have to remember the fundamental unity of the human race, and surely, there is no genetic basis for division into classes (or *varnas*) as is prevalent in orthodox Indian culture. Classes have different rights, duties and rewards in society. When all men are brothers, it is extremely difficult to justify gross injustice on the basis of the functions that people in different classes perform. Ironically, we take them for granted as entrenched in the order of society and are not shocked by such differences. But ethics and biology both tell us that it is not right to do so which vindicates the Jain view.[1]

Variety, whether inherited or acquired is a valuable feature for the polymorphic[2] human species, genetically and culturally. But there is no genetical foundation for the classes which are rewarded so drastically unequally.

5. The Right to Live

All individuals have equal right to live and they have the responsibility and capacity to make some use of life for the benefit of both self and society. We all have duties and obligations to our society. These are usually defined by custom, as also is the extent of the individual's right to be sustained by social facilities. Anyone who accepts the benefits of society has obviously some duties towards it. No society is perfect or eternal and all are liable to change and evolve. Privileged classes will resist change but violence is never justified even to promote aims of equality and freedom which is never absolute.

1. The Jain Philosophy does not believe in the arbitrary class-division sponsored by the Vedic tradition. Bhagawān Mahāvīra declared that the worth of man should be evaluated not by the status of his birth, but by that of his action.
2. Polymorphism — the persistent presence of genes producing different types of individuals in a population. Man is a polymorphic species.

GLOSSARY

A. Terms related with Brain

Amygdala : An almond shaped basal part of brain situated at the front of the limbic system, affecting rage and aggressiveness and other emotional behavior.

Axon : Part of a neuron (the nerve-cell); a long fibre that carries nerve-signals away from a nerve-cell-body, often for a long distance to neighboring neurons. (see, *neuron*)

Brain : A highly organized constituent of nervous system, composed of millions of nerve-cells, providing the programs of action by detecting events and comparing them to a set of standards and to its memory record.

Brainstem : The range of bulges that forms the central core of the brain, running from the top of the spinal cord into the middle of the brain.

Cerebellum : The twin-lobed, oval structure at the back of the brain, responsible for coordinating movements, having close inter-relation with the cerebral cortex.

Cerebral cortex : Thin, convoluted, outer layer of the brain composed of gray matter in the cerebrum; birthplace of man's higher mental functions. It receives signals via the thalamus from all sense-organs and sends signals to the lower parts. Each neuron of its *receptive areas* represents some external feature and those of its motor areas represent movements of muscles.

Cerebrum : Main part of the brain; about seven - eighths of the total weight of the brain, it fills the upper part of the skull. It is a mixture of gray and white matter. It is divided into two identical hemispheres and each one of them is further divided into four regions called lobes.

Cingulate cortex : The middle part of the cortex (where the two sides lie against each other). It is concerned largely with emotional programs, but is little understood.

Corpus callosum : the bridge of nerve-fibres connecting the left and right cerebral hemispheres; it permits the exchange of information between them.

Core brain : The central part running the whole length including the reticular system; regularising sleeping and waking and emotional responses.

Dendrites : Short receptive branches of a neuron, extending from the nerve-cell-body receiving impulses from nearby neurons.

EEG : Electroencephalogram; the waves of change of electrical potential recorded by electrodes attached to the scalp recording the amplitude and frequency of brain-waves.

EEG Machine : A machine used to get the EEG record.

ESB : Electrical stimulation of the brain through electrodes, implanted in the brain, used to map brain-functions and study behavior.

Frontal cortex/Frontal lobe : One of the four regions of the cerebral cortex. The anterior part, important for its general inhibitory actions, especially repressing inappropriate programs. Lies directly behind the forehead. It's hindmost part contains the motor cortex.

Hippocampus : A part of the brain (shaped like a sea-horse) lying close to the cerebral cortex. It is a part of the limbic system; thought to play an important part in learning and short term memory.

Hypothalamus : A very important part of the brain; region at the base of the forebrain essential in coordinating central nervous system functions, including the regulation of body-temperature, sex-drive, thirst and hunger. It contains reference systems or standards of the programs for ensuring homeostasis. Through pituitary gland, it regulates endocrine activity and plays important role in emotions of pain and pleasure.

Limbic System : An integrated network which includes thalamus, hypothalamus, hippocampus, amygdala and parts of the reticular formation as well as limbic region of cerebral cortex; is involved in emotions and behavior.

Medulla oblongata : The hindmost part of the brain that provide the programs regulating essential activities such as breathing and blood-circulation.

Memory : Act of summoning up the past or that of fixing of present data for future reference; the set of brain programs that allows addition of *information* to the programs already available for self-maintenance.

Microneurons : Small nerve-cells that have no long axon carrying signals away to a distance. e.g. cells of retina in the eye.

Mid-brain : The region behind the thalamus. It is concerned with programs for visual and auditory search.

Neocortex : The most recently evolved part of the brain, essential for much of the special human programs such as those for seeing, thinking, speaking and planning.

Nerve-cell-body : The main portion of a neuron, containing the nucleus.

Nerve-impulse : The signal that passes without decrement along a nerve fibre, also called an 'action potential.'

Neuroendocrine system : The integrated actions of nervous and endocrine systems, usually controlling slow processes such as growth.

Neuron : A nerve-cell; the basic conducting unit of nervous system. It includes a cell-body with nucleus, receptive dendrites and an axon carrying nerve-impulses away.

Occipital lobe : The lower portion of the cerebral cortex, containing the visual area.

Parietal lobe : The side of the cerebral cortex. It is concerned with touch and with programs involving several senses, such as language and information about spatial orientation.

Pleasure centers/reward centers : nerve-circuits within the hypothalamus and other limbic system sites where pleasurable feelings are believed to originate.

Pons : The band of tissue bridging the left and right halves of the cerebellum, containing many important groups of nerve-cells.

Prefrontal cortex : The most anterior part of the cortex; may be related to the ability to plan and to make choices.

Purpose : The aim or objective of a living system (or artifact).

Raphe : The region where the two halves of the medulla oblongata are joined. The name literally means 'a seam'.

Reflex (action) : An inherited program for performing a single action in response to an external stimulus.

Reticular formation and RAS : A dense network of neurons in the brainstem that regulates consciousness and channels the brain's attention. It and its pathways running from the spinal cord to the cortex are known as the 'reticular activating system' (RAS).

Reticular System : A network of short neurons running up and down near the center of the brain and responsible for the programs of arousal to action and sleep.

Somatosensory cortex : The part of brain that deals with signals sent from the skin; e.g. for touch.

Spinal Cord : It constitutes the central nervous system together with brain. It is body's main nerve circuit, carrying out reflex actions and sending nerve impulses to and from the brain through its nerve tracts; it extends from the base of the brain-stem to the second lumbar vertebra and is enclosed by the spinal column.

Standard : Goal, set-point, reference-point. Hereditary standards are basically defined by the genetic program.

Synapse : The microscopic gap between two adjacent nerve-cells. The terminal knob (bouton) by which the end of a presynaptic axon comes into contact with the dendrite of a post-synaptic nerve-cell; the joint effect of many of these knobs activates the post-synapatic cell, usually by releasing a chemical transmitter.

Temporal lobe : A part of the side of the brain containing the temporal cortex on the outside (largely concerned with hearing) and certain basal lobes within that are concerned with emotion, located near the temples of the skull.

Thalamus : A twin-lobed part of the brain consisting of cells at the center of the brain, which sends signals from various sensory systems to the cortex. Also has other functions. The name literally means 'a chamber'.

Transmitter (Neurotransmitter) : A chemical substance — one of approximately thirty — at synaptic nerve-endings released either to excite or inhibit the post-synaptic cell. Stored in axon terminals, this chemical substance is released into the synaptic gap when a neuron fires, and locks on to a receiving cells dendrites, e.g. acetylcholine or noradrenaline.

B. Terms Related with Cell and Gene

Cell : Basic structural and functional unit of a living organism, typically consisting of Cytoplasm, Nucleus and an outer wall. These tiny structures, ranging from less than one-hundreth to a one-fourth of a millimeter in diameter, contain protein-factories among numerous specialized departments and thread-like structures called *Chromosomes.*

Nucleus : The center of every cell, containing the chromosomes and the DNA, separated by a membrane from the rest of the cell, the cytoplasm.

Chromosomes : Thread-like bodies in the Nucleus of a cell. Number of chromosomes is usually constant for any one species and is 23 matching pairs in humans. They carry information which determines characters of both cell and organism. They contain molecules of DNA with a complete set of hereditary information.

DNA : Deoxyribonucleic acid. The hereditary material of life contained in chromosomes. The DNA molecule is able to duplicate itself to give two similar daughter molecules. This ability is the basis for formation of hereditary material for next generation. It is the blueprint for producing

all the organs, proteins and chemicals necessary for carrying out the innumerable functions crucial for life.

Gene : The functional unit factor of inheritance. It is a portion of DNA which is a part of a chromosome within a cell nucleus. They occur in pairs, one from each parent, either the same (homozygotic) or different (heterozygotic); one may be dominant and prevent the manifestation of the other, recessive. Genes, jointly and severally, influence development of a particular character or a group of characters. They contain the instructions for making proteins (usually enzymes) and/or expression of a specific trait. A defective gene may produce a serious disease. They are subject to change by mutation.

Genetic Code : The language of the *genes.* It is composed of an alphabet of four letters *(Nucleotides)* arranged in sequences of triplets each ensuring the attachment of a particular amino acid as a protein grows. The information in the code thus controls the properties of the enzymes whose actions ensure living.

Genetic Program : The set of genes in an organism determining its development and provide the standards and actions that enable it to learn how to survive.

Genotype : The inherited program of instructions that controls the development and life of an individual.

Nucleic Acids : Very long molecules containing four sorts of units, the nucleotides, arranged in series to constitute the genetic code that organize the programs of development.

Nucleotides : Units of nucleic acids. Each contains : (1) one of four bases (e.g. adenoid); (2) a sugar (ribose in RNA, deoxyribose in DNA); (3) a phosphoric acid. Thousands of nucleotides are strung together by union of sugars with the acids. Each (different) sequence of these bases determines the attachment of a particular amino acid to a growing protein chain.

Enzyme : A protein acting as a catalyst by virtue of its folded structure, which brings essential reactants close together by squeezing them and

forces them to react — combine (chemically) at low temperatures. Thus they are the miracle workers forcing chemical changes that a chemist can only do at high temperatures. For instance, they oxidize sugar to give up energy at body-temperature as they would do only if heated. They may break molecules down or build them up to make proteins, carbohydrates or fats.

Protein : Complex organic substances abundant, widely distributed, and essential for living organisms. They are macromolecules (very large and complicated) composed of a sequence of hundreds or thousands of amino acid units.

Enzymes are proteins but all proteins are not enzymes. There are at least 1,00,000 varieties of proteins in human body. Two types of proteins are : (1) functional, (2) structural.

Amino Acid : A simple organic molecule (containing nitrogen) able to act both as an acid and a base and so to join with others to make the long chains of proteins. The same 20 amino acids occur in all animals as well as plants.

Mitochondria : Power-house of the cells found in almost all cells for generating energy;

(In Genetics)

Transcription : The process by which the information in a section of the DNA of a chromosome is copied into a different nucleotide, messenger RNA, which is carried from the nucleus to the cytoplasm and there translated to make a protein.

Translation : The process by which the information carried from the nucleus by messenger RNA is made to produce a particular protein by enzymes associated with special granules — the ribosomes.

C. Terms Related with Computer and Program

Computer : An artificial device for processing information. In a digital computer, a code is used to represent the information in such a form that

the machine can perform the operations indicated by the program supplied by its user. Using a binary code, the program (algorithm) operates by making decisions between 0 and 1 at the rate of 1 billion per second.

Algorithm : A program by which a complicated calculation is reduced to a long series of simple ones that a digital computer can perform.

Artificial Intelligence : The making of computer programs in machines that imitate human intelligence. (Robots can recognize and select parts and assemble them).

Binary Code : Expressing numbers using 0s and 1s only. Thus 1 = 1, 2 = 10, 3 = 11, 9 = 1001. This allows mechanical devices to calculate very quickly.

Bit : Short for 'binary digit', the unit that represents a single yes/no decision, hence the basic unit of information.

Code : A set of visible signs, sounds or other physical events adopted to form a system of communication of messages.

Computer Memory : Information is stored by altering the states of a large set of mechanical or electrical devices usually by on/off switching. The 'meaning' of the information at the address of each point thus depends on the program arranged by the operator.

Computer Program : A list of signs in some language which causes the computer to carry out a logical sequence of calculation to answer a question relating to the real world, which the program represents by means of algorithm.

Communication : The interaction between systems or parts of a system using a prearranged code.

Concept : The learned program for the use of word or set of words i.e. its meaning.

Digital : A system of coding, using only a few clearly defined signs, usually only two - indicating presence or absence, 0 and 1.

Hardware : The actual material of a computer. See, *Software.*

Hard-wired : Programs incorporated into the structure of a computer and therefore not variable by the software program. In the body, reflexes are hard-wired and so are other connections formed by heredity and not subject to modification by learning.

Program : A set of code-signs that indicates the actions to be performed by a living system or artifact (e.g. computer) in order to achieve its purpose.

Software : The programs devised to make the hardware of a computer solve the problems set by the user.

D. Terms Related with Endocrine Glands/ Hormones

Endocrine System : One of the two control-systems of the body. Endocrine glands secrete chemical regulators called hormones, directly into the blood-stream or the lymphatic fluid. They regulate metabolism, growth, and reproduction. Working intimately with the nervous system, they integrate the responses of diverse organs and tissues of the body to internal and external stimuli.

Hormones : Chemical substances secreted into the bloodstream by endocrine glands (pituitary, thyroid etc.) and providing signals to the target-organs sensitive to it. Hormones have profound influence on the mental states and behavioral patterns of an individual.

Adrenal : An endocrine gland situated above the Kidney. Its outer part (**cortex**) produces steroid hormones such as cortisone, which influence many bodily activities and are essential for survival. The inner part (**medulla**) produces adrenaline, which prepares the body for attack or defence.

Adrenaline : A catecholamine, secreted as a hormone by the adrenal medulla, acts as a transmitter at many synapses. Noradrenaline is a modified derivative.

Corticosteroid : One of the hormones produced by the cortex of the adrenal gland.

Gonads : Sex-glands; ovaries in females; testes in males.

Gonadotropic Hormones : Secretions of the pituitary gland serving as signals that activate gonads, e.g. follicle stimulating (FSH) and lutenizing hormone (LH).

Melatonin : An amine secreted by the *pineal* gland.

Noradrenaline : Secreted by *adrenal* as well as some special nerves and used as a transmitter; related to adrenalin.

Pineal : A small cone-shaped endocrine gland in the brain; produces melatonin that inhibits sexual development and so may be responsible for the long period of childhood in humans.

Pituitary (Hypophysis) : The body's "master gland". It lies close to the *hypothalamus* by which it is controlled. It produces tropic hormones which activate or inhibit the activities of the other glands. Hence, it is called, the conductor of the endocrine orchestra. It regulates numerous metabolic processes such as growth and reproduction.

Serotonin : An indoleamine used as a transmitter by some synapses involved in the program of sleeping, etc.; can also inhabit aggression.

Sex hormones : They are produced by the gonads under the influence of the *pituitary*. They control the physical as well as behavioural characters of the sexes. The male hormones are androgens, the female estrogens and progesterone, but both sexes produce all sorts, in different proportions.

Testosterone : The male sex hormone, produced by the testis and causing the development of masculine characters.

E. Miscellaneous Terms

Aim (objective) : The target to which actions are directed, as specified by the operations of a program.

Altruism : The performance of actions for the benefit of others rather than for oneself.

Amines : Substances derived from Ammonia e.g. adrenaline, acetylcholine, serotonin.

Awareness : See *experience.*

Circadian : Occuring rhythmically about once a day.

Consciousness : The state of a person in which the programs of the brain allow experiencing and thinking; opposite of unconsciousness.

Culture : The particular system of symbols, ideas, values and artifacts used by a group of people.

Drive : Strong impulsive force producing feelings to act in a certain way; primal drives are primordial unlearned instincts e.g. hunger, sex.

Elan vitale : The life-force, or vitality postulated by some to explain the continuation of life as an alternate to soul.

Emotion : Mental condition of a person produced by impulsive forces through the interaction of hormones and cerebral action. They generally compel the person to take physical action to satisfy the need.

Empirical : What is concerned with worldly life; it is based on experience or reason; opposite of transcendental.

Epistemology : Theory of Knowledge; study of the programs by which we acquire knowledge and the capacity to use them.

Evolution : The change of the genetic programs of populations. It has resulted over the ages, in the addition of information (knowledge), giving organisms the ability to survive in conditions detrimental to life.

Experience(ing) : The condition of a person when he is sensing, thinking or dreaming; state of awareness.

Feedback : The use of part of the output of a regulated system to compare with the standard set for its program and produce appropriate change of input.

Free Will : The choice between alternative programs of action, which is performed by the human brain using all the information it has about the probable course of events in the world.

Grammar : The set of brain programs by which sentences are generated. Words are joined according to grammatical rules to make discourse.

Homeostasis : The ability or disposition of living organisms to maintain a steady state inspite of changing conditions in external environment.

Matter : A general term for objects of the universe, of which physical science has made detailed study. Physical order of existence, different from psychical order.

Meta-language : A code used for speaking or studying another language.

Molecule : The smallest unit of a substance that can enter into a chemical reaction. They are made up of atoms, from two to many thousands as in macromolecules, such as proteins or very few as in water.

Senescence : The decrease with time of the physical powers and increasing probability of death; probably, this is part of the inherited program for life.

Transcendental Questions : Questions about ultimates, which can be posed but not answered by human cerebral programs, e.g. what is God ? Opposite of *'Empirical'*.

Vitalism : The scientific theory that life is maintained by some special force that cannot be explained by the principles of physics and chemistry.

GLOSSARY OF *SANSKRT/PRAKRTA* WORDS (Terms Related with Jain Philosophy)

Abādhākāla : Period of inactivity during which *karman* remains inactive after bondage. (See, *sattā*)

Adharmāstikāya : One of the six eternal substances; medium of rest. (see *dharmāstikāya*).

Aghātin karman : Types of *karman* that do not obscure any fundamental quality of the soul.

Akāśāstikāya : Space; one of six eternal substances that contains all other substances.

Anantānubandhin (Kaṣāya) : Most virulent type of passion-quartet which are sub-species of deluding *(mohanīya) karman*, that leads to endless worldly existence by destroying the right faith.

Antārāya karman : Energy-obstructing *karman* — one of the eight main species of *karman* that obstructs the spiritual energy.

Anubhāga (bandha) : Intensity of fruition of *karman* determined at the instant of bondage but amenable to change by particular potency of soul.

Apratyākhyānin (Kaṣāya) : Type of passion-quartet that is less virulent than the most virulent type; inhibits the aptitude even for partial renunciation; sub-species of deluding *(mohanīya) karman.*

Apavartanā : Attenuation of the duration *(sthiti)* and intensity of fruition *(anubhāga)* of *karman* after the bondage; also see *udvartanā; sankramaṇa.*

Aśātā Vedanīya Karman : One of the two sub-species of feeling-producing *(vedanīya) karman* that produces feeling of misery and suffering.

Audārika (Śarira) : One of the five types of bodies of the living organisms. The gross or physical body.

Āyuṣya karman : Life-span-determining *karman*; one of the eight main species of *karman* that determines the life-span of the organism.

Bandha : Bondage; the process of intimate association of the soul with *karma-pudgala*; the soul under the influence of passions attracts *kārmic* matter *(karma-pudgala)* which is then inseparably mixed up with it; the resultant state is bondage.

Bhāṣā : Speech; a vital function of some organisms; one of their three activities *(yoga)* which are also the cause of *bondage.* Also see *manaḥ; śwāsocchvāsa.*

Bhāṣā Vargaṇā : A group of material aggregates used for producing speech.

Brahman : Absolute; the Ultimate Solitary Reality — single conscious element which pervades the entire universe according to the Vedānta philosophy.

Darśana : Intuition or indeterminate cognition; one of the two inalienable characteristics of the soul; the faculty of cognising reality without separation of contents; counterpart of knowledge, also see *jnāna.*

Darśanāvarṇa Karman : Intuition-obscuring *karman*—one of the eight main species of **karman** that obscures *'darśana'* which is one of the eight innate qualities of soul. Also see *darśana, kevala darśana.*

Dharmāstikāya : One of the six eternal substances; medium of motion, also see adharmastikaya.

Dravya : Substance. Six eternal/indestructible substances *(dravyas)* produce the infinite world processes through their modifications and interactions.

Ghatin karman : Types of *karman* that obscure fundamental qualities of soul.

Sarva-ghātin : Those which are completely obscuring.

Deśaghātin : Those which are partially obscuring. Also see *aghātin karman.*

Gotra karman : Status-determining *karman* — one of the eight main species of *karman* that determines the status and family conditions.

Guṇa : Quality or inalienable attribute of a substance.

Jīvāstikāya/Jīva : One of the six eternal substances; only one that possesses consciousness; soul; individual self; the conscious constituent of a living organism.

Jñāna : Knowledge or determinate cognition; the faculty of cognising reality with separation of its contents; counterpart of intuition; also see *darśana.*

Jñānāvarna karman : Knowledge-obscuring *karman* — one of the eight main species of *karman* that obsecures *jnana* which is one of the eight innate qualities of soul.

Kāla : Time; one of the six eternal substances.

Karman : (1) Threefold action or activity of a living organism viz., (i) mental, (ii) vocal and (iii) physical or bodily action.

(2) Imperceptible transcendental effect resulting from thought, speech and bodily action; a potential psycho-physical force which is the cause of the worldly existence of soul; it obsures, vitiates and obstructs the eight inmate qualities of the soul through its eight main species.

Karma-phala : Fruition of *karman*; *karman* rises from its hitherto supine state and manifests itself and gives its fruit (fructifies).

Kārmaṇa Vargaṇa : Group of material aggregates capable of being attracted and transformed into *karman* by living organisms.

Kevala darśana, Kevala Jñāna : The basic innate qualities of a soul in its purest natural state; pure and perfect intuition and knowledge; direct experience of the total reality without any contradiction or discrepancy; also see *darśana, jñāna.*

Kaṣāya : Passions; the principal armament of the psycho-physical force of *karman* for perpetuating its existence; it is the main cause of the bondage of new *karman* and continuation of the worldly existence of the soul, its four bold manifestation viz. angery arrogance, deceit and greed are the sub-species of the deluding *(mohanīya) karman.*

Kṣaya : (Total) Destruction of *karman;* one of the three states of non-fruition of *karman.*

Manuṣya āyuṣya, Manusya Gati, Manusya Anupurvī : These three sub-species of *karman* are the joint determinants which bestow the human state to the soul.

Kṣayopaśama : Destruction-cum-subsidence of *karman;* one of the three states of non-fruition of *karman*, applicable to four *ghatin karman;*

permits partial manifestation of the innate qualities of soul; see also *ksaya, upaśama.*

Manaḥ-vargaṇā : Group of material aggregates specifically used by living organisms for the process of thinking; also see *bhāṣā.*

Mithyātva : Nescience; perverted or false faith/attitude; predilection for untruth; opposite of *samyakatva.*

Mohnīya karman : Deluding *karman;* one of the eight main species of *karman;* produces delusion — metaphysical and ethical;

(i) *darśana mohanīya* — prevents the innate ability of belief in truth and (ii) *cāritra mohaniya* — destroys equanimity of conduct.

Nāma karman : Body-making *karman* — one of the eight main species of *karman.* It has a large number of sub-species, accounting for various forms of embodied existence of soul.

Paramāṇu : Ultimate indivisible unit of *pudgalāstikāya* i.e. physical order of existence. It is the ultimate cause of the physical existence; also see *pudagalāstikāya;* skandha

Prakṛti : Nature, type, or species of *karman* after bondage with soul.

Mūla Prakṛti : There are eight main species *(mūla prakṛti)*

Uttara Prakrti : *Mūla Prakṛtis* are divided into many sub-types *(uttara prakṛti).*

Prakṛti Bandha : Type-bondage; one of the four categories of bondage determining the type or species of the *karman,* at the time of bondage.

Pratyākhyānī (kaṣāya) : One of the four types of passion-quartet. It is less virulent than *apratyākhyānī* and inhibits the aptitude for complete renunciation (ascetic life) but allows partial renunciation.

Pudgalāstikāya : The physical order of existence. One of the six eternal substances that possesses senuous qualities and thus can be cognised by sense-organs.

Puṇya and Pāpa : Auspicious or virtuous and inauspicious or sinful *karman* respectively. Fruition of the former results in physical pleasure

and that of the latter, in suffering, physical as well as spiritual.

Samyaktva : Right faith : predilection for truth; it is the innate characteristic of the soul, but it remains obscured by perversity *(mithyātva)*. from eternity.

Saṁkramaṇa : Process of transformation of one sub-type into another sub-type of the same main species of *karman* by an effort of the soul.

Sātā Vedn̄iya : One of the two sub-species of *vedn̄iya karman* that produces feeling of pleasure; also see *asātā vedn̄iya*.

Sattā : Existence; inactive state of *karman* after bondage prior to the state of rise *(udaya)*. (see, *abādhākāla*)

Skandha : Aggregate or composite body. In the case of *pudgala* — the physical substance — ultimate atoms *(paramāṇus)* combine together to make *skandhas*. All visible perceptible objects are *skandhas*.

Sthiti Bandha : Bondage of *karman* with respect to duration; one of the four categories of bondage determining duration of association of *karman;* it is determined at the instant of bondage but amendable to change by special potency of soul.

Sukha and Dukkha : Physical Happiness and misery; normally, results of *punya* and *papa* respectively, by the fruition of feeling-producing *(vedn̄iya) karman*. *Ātmika sukha* (self-generated spiritual bliss) is, however, an innate quality of pure soul and is independent of anything external.

Śwāsochchvāsa : Breathing; a vital function which needs the help of a specific group of matter — *śwasochchvāsa vargaṇā*.

Udaya : Fruition or rise of *karman*; the state of maturity and fructification of *karman*.

Udīraṇā : Premature fruition of *karman* forced by a strong effort of soul; precursor of the state of *upśamana* in the case of deluding *(mohanīya) karman*.

Udvartanā : Enhancement of the duration *(sthiti)* and augmentation of

the intensity of fruition *(anubhāga)* of *karman* after the bondage; also see *apavartanā, saṁkramaṇa.*

Upaśamana : Subsidence of *karman* for a period less than 48 minutes *(muhūrta).* One of the three states of non-fruition of *karman,* applicable only to deluding *(mohanīya) karman.* It holds an important place in the soul's struggle for self-realization. see also *kṣaya, kṣayopaśama.*

Varganā : Group or category, generally of different types of pudgala (physical substance). There are innumerable groups but a few ones are empirically useful to living organisms e.g. bodies are made from *audārika* group. Other groups are, *bhāṣā, śwasochhwāsa, manaḥ,* etc., useful for vital functions of the organism.

Vednīya karman : Fearing producing *karman;* one of the eight main species of *karman* that is feeling-producing, it obstructs the natural bliss of the pure soul and produces earthly pleasures and pain/suffering.

Vīrya : Psychical energy; it is necessary for the demolition of *karman.* **(Ananta Vīrya) :** The infinite energy which is inherent in the soul; it is obstructed by *antarāya karman.*

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Born as a Jain devotee and educated in Science and Technology, and being a Professional Electric Engineer and an active exponent of Preksha Meditation, he had developed a rare skill of dealing science and philosophy with equal authenticity.

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