

ERADICATION OF *KARMA* AND GENETIC ENGINEERING

ERADICATION OF *KARMA*

If all the holes of a boat are plugged, no water enters. Similarly when one stops all the activities leading to *āśrava* like *mithyāttva* etc. he prevents the influx of *karmas*. The process of stopping the influx is the best device for a living being. *Asrava* is the problem and *Samvara* is the solution. *Āśrava* is the state of sleepiness and *saṁvara* is the state of alertness. *Āśrava* takes *jīva* to a lower level, and the *Samvara* takes the *jīva* to a higher level. *Samvara* is the right thing to do, it is the right path of spiritual progress.

Every worldly soul happens to be confined (not free). The imprisonment is due to the bondage of *karma* (*bañdha*). To be free *jīva* has to eradicate the *karmas* he is bound by. The process of eradicating the *karmas* is called *Nirjarā*. The world *nirjarā* means to fall off. It denotes dripping off, destruction, or removal of *karmas* from the soul. Inflow of *karma* is due to *āśrava*, the stoppage of the inflow is due to *saṁvara* and the eradication of *karma* is due to *Nirjarā*. *Jīva* can shed the *karmas* and purify his soul with the help of austerities.

Samvara

Literally, *Samvara* means blocking. *Samvara*, in theory of *karma*, means blockage or stoppage of the inflow of *karmas* to the soul. It is opposite of *Āśrava*, which means inflow of *karmas*. In the discussion of *āśrava* in previous chapter, we gave the example of boating, which also explains how *saṁvara* works. Let us pretend as if we went boating. We were having good time and suddenly noticed water rising on the floor of boat. We immediately felt that the boat had a hole and if the leak was not fixed the boat would sink. So, the first thing we did was to find the hole and seal it so that new water would stop coming in. **This stoppage of water coming in is called *saṁvara*.** A similar situation is that of our soul which is wandering in worldly affairs. We have so many holes (activities) through which *karmas*

are flowing in at all the times. We talked about these holes when discussing *āsrava*, such as *mithyātva* (wrong beliefs), *avirati* (vowlessness), *kaṣāya* (passions), *pramāda* (indolence) and yoga (activities). These activities allow *karmas* to become attached to the soul. Once we have realized the effects of such activities, we need to work towards overcoming them so that we can stop new *karmas* coming in before they further sink the soul. *Samvara* can be described in two types¹ :

1. Physical or objective.
2. Psychic or subjective.

The physical refers to the actual shutting of our activities which leads to stoppage of the inflow of *karmas*. The psychic means consciously striving to stop our passions.

Samvara is of 6 kinds :

- (i) *Samiti* (careful activity),
- (ii) *Gupti* (restraint of the activity),
- (iii) *Yati dharma* (dharma of monks),
- (iv) *Bhāvanās* (mental reflections),
- (v) *Parīśaha* (natural sufferings),
- (i) *Cāritra* (conduct).²

These 6 types of *Samvara* will be efficacious and real only if they are carried out with a firm faith in the commands of the Jina. Therefore, *samyaktva* is deeply and intimately connected with *samvara*. Through *samyaktva*, the *āsrava* called *mithyātava* i.e. wrong belief is completely blocked and stopped. By means of *samyakcāritra* and *yati-dharma*, the *āsrava* called *avirati* i.e. vowlessness is blocked. By means of *gupti*, *bhāvanās* and *yati-dharma* the *Āsrava* called *kaṣāya* i.e. passions is blocked. By means of *samiti*, *gupti*, *parīśaha* etc. *yoga* and *pramāda* are blocked. By means of *cāritra*, the *āsrava* called vowlessness, passions, activities together can be blocked.³

***Samiti* (careful activity)**

Samiti actually means *sam* + *iti* = *samiti* or the right use. Examples include having the right objective, spiritual awareness, the proper discipline,

and spiritual vigilance and caution. In this manner, there are 5 sub types of *samiti* :

(i) ***Iryā samiti (careful movements)***—This means to move cautiously and carefully, and looking closely on the ground so that no living being must be injured or killed. A monk observes this more carefully and that is why he does not walk around unnecessarily. He walks on the path, which most minimizes violence. Rather than walking on the grass or insects a monk would take an alternate route in order to minimize the violence caused by him, even if the alternate route was longer. A layman should also keep this in mind and should be careful while walking.

(ii) ***Bhāṣa Samīti (careful speech)***—One should limit or completely avoid speaking any thing which may provoke violence, flattery, condemnation, gossip etc. or use words that may cause harm to others. One should not inflict pain by using words which are filthy or abusive. One should also limit or deter uttering unpleasant and thoughtless ideas which are contrary to the principles taught by the Jina or scripture that can provoke wrong belief. One's words or speech must be kind and gentle. If anyone has confessed to a monk about his wrong activities or sins, then the monk must not speak about this to others. This *samiti* also reminds us that one must not frighten anyone, or preach a false doctrine.

(iii) ***Eṣaṇā Samiti (carefulness about taking food)***—Caution must also be paid about all matters relating to food. A monk should go for alms to various houses and should take a small portion of allowable food from each place so that the layman, from whom the food is taken, does not have to be cooked again. Also monk should not take any raw vegetable, raw seeds or any food which has been in contact with living beings, including those taken from a burning stove, oven or even a refrigerator. A monk should not go for alms if it is raining and should not accept any food brought for him. There are forty two faults which monk must avoid while accepting alms. A layman should also refrain from committing a sin in the offering of food to

monks. All intoxicated and forbidden food are not to be taken by either monk or laymen.

(iv) *Ādāna nikṣepa samiti* (carefulness about putting clothes and other things on)—A monk should take the utmost care, before using clothes, to make sure that there are no insects in the folds which may be crushed, hurt or killed. Care must be taken before taking and putting away vessels, books, or sitting down etc. Similar precautions should also be taken by layman.

(v) *Pariṣthāpana Samiti* (carefulness about disposal of excreta)—One should be very careful about how, and where one disposes of trash, refuse or excretions so that no harm is done to even the minute insects or bugs. A monk must never keep either food or water overnight, but must rather dispose of them carefully as mentioned above.

***Gupti* (restraint of activity)⁴**

Gupti means restraint. Samiti helps us to regulate our activities, while Gupti helps us to further restrain or curb activities of mind, speech and body. There are 3 types of gupti :

(a) *Mano Gupti* (restraint of the activities of mind)—One must restrain extreme grief, anger, joy and anxiety (*Asarkalpanāviyogī*). One must restrain oneself from the effects of the love and hate, and pain and pleasure (*samatābhāvinī*). One must be restrained and think steadily, not of external things, but of one's own soul.

(b) *Vacana Gupti* (restraint of speech)—One must restrain speech by observing a vow of silence (*maunavalabhī*) for a certain number of days or by speaking as little as possible and only when absolutely necessary (*vāknīyamī*).

(c) ***Kaya Gupti* (restrain of physical activities)**—One must be careful and should restrain one's physical activities as per rules laid down in the scriptures (*Yathasūtra Cestāniyami*).

***Yati dharma* (dharma of monk)**

Ten duties of monks :

Monks observe the following great duties to the fullest extent. While householders follow them from a lesser degree to fullest extent.

- (i) *Kṣamā* (forgiveness)
- (ii) *Mārdava* (politeness) and *Laghava* (meekness)
- (iii) *Ārjava* (simplicity)
- (iv) *Mukti* (absence of avarice)
- (v) *Tapa* (internal and external austerities)
- (ii) *Samyama* (controlling senses)
- (iii) *Satya* (avoiding condemnable speech)
- (iv) *Śauca* (mental purity)
- (v) *Aparigraha* (non-possesiveness)
- (vi) *Brahamcarya* (celibacy).⁵

***Bhāvanās* (mental reflections)**

Bhāvanās means contemplation, through which you motivate your soul to carry out lofty reflections. There are twelve types of *Bhāvanās* :

(i) ***Anitya Bhāvanā***—All external substances including the body are transitory (*anitya*). They are perishable and therefore, we should not have attachment for them.

(ii) ***Aśaraṇa Bhāvanā***—Human beings are experiencing tremendous agitation. When death occurs and the soul has to leave the body there is no one who can save a *jīva* who is helpless. Wealth, family, etc. have to be given up at such a time. No worldly things can provide refuge so why should we depend upon them.

(iii) *Samsāra Bhāvanā*—In the cycle of *samsāra*, mother can become wife, wife can become mother and an enemy can become friend etc. how futile is *samsāra*? We should not have attachment for it.

(iv) *Ekatva Bhāvanā*—"I am alone, I was born alone, I will die alone, I am sick alone, I have to suffer alone, I have to experience the *karmas*, which I have earned alone". Therefore one should be cautious and keep away from the attachment and hatred.

(v) *Anyatva Bhāvanā*—"This body is transitory and it is different from me. I am the soul which is not perishable. While body is perishable. Even wealth, family etc. are not mine. They are different from me, therefore, I discard attachment for all these things."

(vi) *Aśuci Bhāvanā*—"This body is made up of impure substances. It is being nourished by impure substances. I will discard my attachments for this body and engage myself in self-discipline, renunciation and spiritual endeavours."

(vii) *Āśrava Bhāvanā*—Thinking on inflow of *karmas*. All causes that create the inflow of *karmas* should be discarded.

(viii) *Samvara Bhāvanā*—*Samvara* means blocking of the inflow of *karmas*. One must contemplate on Samiti, Gupti, Yati-dharma etc. One must carry out these activities and try to reduce or stop the new bondage of *karma*.

(ix) *Nirjarā Bhāvanā*—*Nirjara* means to shed whatever *karmas* we have, one must think of the benefits that accrue from each of the 12 kinds of *Tapas* or the austerities which cause *nirjarā*. One must contemplate on these austerities in order to destroy sins.

(x) *Lokasvabhāva Bāvanā*—*Lokasvabhāva* means one contemplate on the three lokas, i.e. three parts of the universe namely :

- (i) The upper world.
 - (ii) The middle world.
 - (iii) The lower world.
- and also the whole universe filled with souls and pudgals.

(xi) *Bodhidurlabah Bhāvanās*—Under it one must contemplate on how difficult it is for the souls that are wandering aimlessly in four stages of existence in the *samsara* without attaining the *Jina dharma*. There should not be even the slightest negligence in observing the religion propagated by the Jina.

(xii) *Dharma Bhāvanā*—"Oh : Arihant Bhagwan, the omniscient, has expounded and excellent *sruta dharma* and *cāritra dharma*. I will engage myself in this dharma." One should carry out this contemplation again and again.⁶

***Pariṣaha*⁷ (natural sufferings)**

The 22 *Pariṣahas* pertain to enduring of hardship and while doing so remaining in a state of serenity and equanimity so that all *karmas* may be destroyed. These are more prominently followed by monk and nuns. The 22 types are :

- (i) **Hunger**—A monk must not accept food which is blemished and prepared with any one of forty-two faults, even if he has to remain hungry.
- (ii) **Thirst**—A monk must not take unboiled water, even if he has to remain thirsty.
- (iii) **Cold**—Even when it is cold a monk should not wish for heat.
- (iv) **Heat**—Even when it is hot a monk should not wish for cold.
- (v) **Insect bites**—If a monk is bitten by insect while he is meditating he should not brush it away or become irritated, but should tolerate it calmly.
- (vi) **Clothes**—A monk must accept whatever clothes he may receive.
- (vii) A monk must tolerate evil words told to him.

- (viii) A monk must tolerate kicking and beating.
- (ix) A monk must tolerate diseases.
- (x) A monk must sleep on a wooden flat bed or coarse grass.
- (xi) A monk must not take a bath.
- (xii) A monk must wear torn clothes but should not ask for new clothes.
- (xiii) A monk should not experience shame or helplessness while going for alms from door to door.
- (xiv) If a monk does not get alms, then he should not become worried and on contrary, should think pleasure having got a chance to perform austerity.
- (xv) A monk should not be attracted towards the beauty of woman.
- (xvi) A monk should not become disturbed by hardship while meditating in a cemetery.
- (xvii) A monk should not become agitated even when there is suffering or grief.
- (xviii) A monk should not become proud while being honoured.
- (xix) A monk should not become irritated when getting pricked by thorns, etc.
- (xx) A monk should not feel sorry for not attaining knowledge even after good efforts.
- (xxi) If a monk is ignorant and cannot read, he should not become depressed. He must think of *karmodaya* and must keep his pursuit of knowledge alive.
- (xxii) A monk must try to understand the message of Jina and should never doubt about it.⁸

***Cāritra* (conduct)**

Implicit faith in the truth, which is born either with the help of the preceptor or fostered by a spontaneous intuition of the truth, is the starting point of the path of self-realization. There are various processes of leading oneself from the stage of implicit faith in the truth to the stage of final

realization of truth. The processes have a common term for them and that term is yoga. **In Jainism the term *cāritra* (conduct) is the exact equivalent of the general term yoga.**

The term yoga has a chequered history. The word yoga occurs in the earliest sacred literature of Hindus in *R̥gveda* (about 1500 B.C.) with the meaning of effecting a connection. Later on in about 700 to 800 B.C. the same word is used in the sense of yoking a horse. In still later literature (about 500 or 600 B.C.) it is found with the meaning of controlling the senses, and the senses themselves are compared with untrolled spirited horses. The word probably represents a very old original of the *Āryan* stock, which can be traced also in the German *joch*, OE, *geoc*, Latin *jugum*, Greek *zugon*.⁹ In Pāṇini's time the word yoga had attained its technical meaning, and he distinguished the root *yuj samādhau* (*yuj* in the sense of concentration) from "*yujir yoge*" (*yujir* in the sense of connecting).¹⁰ Only Ācārya Haribhadra (8-9 A.D.) who defined for the first time in the history of Jaina thought, the term yoga in the sense of what leads ones to emancipation.¹¹ This meaning of term is unanimously accepted in the post-Haribhadra Jaina literature. Of course, the term 'yoga' was used in general sense of subduing the senses and the mind and the processes of concentration and ecstasy even in the earlier stages of the Jaina thought as well as in the early Buddhist thought. But the term *jhāna* (*dhyāna*) and *samādhi* were more in vogue than the term yoga. It is only in the *Yogasūtra* of *Pātañjali* that we find the proper meaning of *dhyana* in the whole process called yoga for the first time.

NIRJARĀ

The word *Nirjarā* is made up of two words i.e. "Nir" and "Jarā". Nir is prefix while *Jarā* means to fall off. Hence, in the Jaina Philosophy *Nirjarā* means falling of, destruction, or removal of *karmas* from the soul. In the chapter of *āsrava* and *saṁvara*, we gave the illustration of boating. Let us go again to that example which also explains how *nirjarā* works. Let us suppose, as if we went for boating. We were having a good time and suddenly noticed the water rising on the floor of boat. We immediately felt

that the boat had a hole and if leak was not sealed the boat would sink. So the first thing we did was to find a hole and then sealed it so that more water stoped coming in. Then, we started pouring out the collected water so that the boat would be dry again. This removal of water is called *Nirjarā*, *karmas* are accumulated in the soul through *āsrava*. These *karmas* cover the attributes of our soul, and the removal or destruction of these *karmas* is called *Nirjarā*.

The more effective the *nirjarā*, the faster the attributes of the soul will shine. Once all the *karmas* are shed, the soul will get salvation and then, it will be able to exhibit all its attributes in full capacity. In fact, as we are constantly accumulating and stopping *karmas*, we are also to some extent shedding *karmas* too. In respect to quantitative shedding, *nirjara* is grouped into two kinds :

- (1) *Deś* (limited) *Nirjarā*,
- (2) *Sarva* (total) *Nirjarā*.

In *Deś Nirjarā* there is limited shedding of *karmas*, this is experienced by all while suffering from adversity or performing austerities, or prayers etc. This shedding is done during all the stages of *guṇasthānakas*.

Sarva Nirjarā is the total shedding of *karmas* and occurs right before the soul is liberated. Whenever the soul becomes a *Kevalī*, it has shed off all *ghāti karmas* forever, but still has to shed *aghāti karmas*. The rest of the *aghāti karmas* are shed off forever right before the soul is liberated and achieves salvation. These souls are called *siddhas*.

When *karmas* mature they give rise to their results and once these results and experienced completely the *karmas* are considered shed off. *Nirjarā* can also be divided into two kinds by the process of shedding *karmas*. They are :

- (1) *Akāma Nirjarā*.
- (2) *Sakāma Nirjarā*.¹²

When *karmas* mature automatically at their due time they cause suffering accordingly. Thus we have no control on the timing of such

suffering and we have not put any special effort or shown special desire or intention to suffer on our side. Once the supposed suffering is over then those *karmas* which caused this suffering are considered shed off. This natural process of maturity and shed off the *karmas* is called *Akāma Nirjarā*. Example as follow : When someone suffers from hunger not voluntarily or willingly but due to unavailability of the food then those *karmas* which caused these suffering will be shed off passively.

On the other-side when *karmas* are brought to maturity ahead of their due time by special efforts voluntarily or willingly to give their results then those *karmas* will be shed off sooner then expected. Thus we have a control on this process and this active process to shed off the *karmas* prematurely is called *Sakāma Nirjarā*. Example as follow : When we perform fasting (not eating) voluntarily and willingly even though the food was in abundance then we brought out suffering actively ahead of the time, which in turn will shed off the *karmas* prematurely.

Therefore in *akāma Nirjara*, condition for shedding off *karmas* are ripe, and *karmas* exhaust themselves after producing their results. When *karmas* lose their bondage in this way, it is called *swataḥ*, (self destruction). In *sakāma nirjarā*, the destruction of *karmas* occurring ahead of their natural time by special efforts, by means of *tapas* (austerity), is called *Upāyanirjarā*, initiated destruction.

Our life is a live drama consisting of accumulating *karmas* and shedding of *karmas*. This drama never stops until we reach salvation. Depending upon what kind and with what intensity we commit sinful activities (*pāpa*), *nirjarā* may be easier or harder. In order to simulate the process of *nirjarā*, different examples are given to show how hard it would be to remove dust or a stain from an article of clothing.

(i) The easiest one is compared with how easily dust, which becomes stuck to dry clothes can be removed.

(ii) It becomes a bit harder to remove the dust if the dust is stick to clothes, which are wet.

(iii) It becomes still harder to remove the dust if the dust is stuck to clothes, which are oily.

(iv) It would be ever more harder to remove a stain from the clothes of those who work at a gas station.

(v) It would be almost impossible to remove a stain when it is from coal-tar.

(vi) There are times when you cannot remove a stain and just have to throw the clothes away.

From these examples, you can imagine how simple process or how complicated a process *nirjarā* can be. In some instances, one would have no choice but to bear the results of one's *karmas*. This last kind of *karmas* are called *nikācita karmas*. **At this time, it would be wide to remind us that *nirjara* is done most effectively by humans only, because other destinies have their own limitation. But for humans, the limitations are set by humans only.**

The special efforts to destroy *karma* is done through *Tapas* or austerities. Austerity means restrain, which is done willingly by giving away some of the bodily comforts to discipline our mind from passions and pleasures. Austerities are performed at various occasions uniqueness. Austerities may be performed at two levels :

- (a) Physical manner,
- (b) Psychic manner.

(a) Physical Manner : In the physical manner the person performs the austerity, but does not have the inner desires to change his or her life and therefore, it is just a physical act.

(b) Psychic Manner : While in the psychic austerity the person controls his or her inner desires along with performing a physical act. Unless the austerities are performed in psychic manner, they don't produce the much needed results. **After all, the whole purpose of austerities is not just to simply make the body suffer, but to change our desires.** Once that happens the person will be on the path to spiritual uplift. Austerity is part of right conduct.

Austerities are categorized into two groups¹³ :

- (i) External Austerity.
- (ii) Internal Austerity.

(i) External Austerity—External austerities are noticed by others because they have a greater component of physical than psychic manner. This austerity is further divided in six types as follow :

- (i) Fasting completely (*anaśana*)
- (ii) Partial fasting (*uṇodarī*)
- (iii) Limiting the number of items of food (*vṛti sañkṣepa*)
- (iv) Limiting desired tasty food (*rasa parityāga*)
- (v) Bodily endurance (*kāyakaleśa*)
- (vi) Controlling of the senses (*pratisaṅlīnatā*).

(ii) Internal Austerity—Internal austerities are not noticed by others because they have a greater component of psychic than physical manner. Internal austerity is further divided in six types :

- (i) Atonement (*prayāścita*)
- (ii) Politeness (*vinaya*)
- (iii) Serving others (*vaiyāvacca*)
- (iv) Giving away (*Vyutsarga*)¹⁴
- (v) Spiritual study (*swādhyāya*)
- (vi) Meditation (*dhyāna*).¹⁵

External Austerity

(i) Fasting Completely (*Anaśana*)—*Anaśana* means fasting, renouncing food and water etc. for a day, for many days or throughout one's life. One day of total fasting is called *upavāsa*. Fasting completely until death is done, when life is close to an end. Such fasting is considered very auspicious and is called physical *Anaśana*. *Bhāva Anaśana* refers to the total control of our *inner desires* for a short or long time. If this austerity is cultivated then only one becomes able to strive for spiritual upliftment.

(ii) **Partial fasting (*Unodarī*)**—*Unodarī* means eating less than what one's hunger is. The Jaina dharma prescribes thirty-two handfuls of food per day and in order to perform this austerity, one may eat a few handfuls less than the prescribed limit. *Bhāva Uṇodarī* means to **limit our desires** to some extent. It may be more difficult to do this than to control them totally. But with the regular practice one can limit his inner desires.

(iii) **Limiting the number of items of the food (*Vṛti Saṅkṣepa*)**—In *Vṛti Saṅkṣepa*, we put a limit on the number of items we eat during a single sitting or throughout the day. *Bhāva Vṛti Saṅkṣepa* means to **limit of desires** for some part of a day or a whole day. This austerity will help us to control our desires so that our mind will keep off from wandering.

(iv) **Limiting desired tasty food (*Rasa parityāga*)**—*Rasa parityāga* means to renounce tasty foods which one likes very much. It can be done partially or in total for a short time or prolonged period of time. *Bhāva rasaparityāga* is more difficult to perform than the other austerities because in this most **desired thoughts** are limited. An austerity of this nature will help us to control our passions even in the most tempting situations.

(v) **Bodily Endurance (*Kāya kleśa*)**—*Kāyakleśa* means to stand or sit in a particular posture for a long time. This austerity may cause pain, but one should ignore the pain. In *Bhāva Kāyakleśa* one stands firm in **controlling passions even if temptations are great**.

(vi) **Controlling of senses (*Pratisaṅlīnatā*)**—In *pratisaṅlīnatā* one controls all types of senses in order to prevent pleasant and unpleasant temptations. In order to perform this austerity, one may stay in isolation for one or more nights. In *bhāva pratisaṅlīnatā*, one controls oneself from telling distorted truth, or from participating in sensual activities. Thus this austerity helps to **control passions like anger, pride, deception and greed**.

Internal Austerity

(a) **Atonement (*Prāyaścita*)**—In *Prāyaścita* one asks for forgiveness for the various errors of commission and omission, the faults and sins committed knowingly or unknowingly. This austerity may be performed in the presence of a monk or nun or can be done alone. *Prāyaścita* helps us to reflect upon ourselves in a way that leads to self-correction. Even for a small fault we begin to say *Micchāmi dukkaḍḍaṃ*.

(b) **Humility (*Vinaya*)**—One must cultivate humbleness towards everyone. This austerity leads to tolerance and sympathy towards others and helps us to overcome ego and anger.

(i) ***Jñāna Vinaya***—One should be humble and respectful to those who are superior in knowledge and wisdom.

(ii) ***Darśana Vinaya***—One should be humble and respectful to those who have acquired the true insight of religious principles.

(iii) ***Cāritra Vinaya***—One should be humble and respectful to those who have good morals and follow religious principles.

(iv) ***Māna Vinaya***—One should pay respect and be humble to all saints who help others in their spiritual upliftment.

(c) **Serving others (*Vaiyāvacca*)**—*Vaiyāvacca* means serving religious teachers, ascetics, virtuous people, monks, colleagues, and companions devotion. One should especially render services to the sick and weak. Though this austerity seems to be external activity it makes a person humble and serves the purpose of overcoming ego and hatred.

(d) **Giving away (*Vyutsarga*)**—In *Vyutsarga*, not only one gives away sinful physical activities but also gives away sixteen different inner passions.

(e) Spiritual study (*Svādhyāya*)—*Svādhyāya* means to study scriptures or can also mean to understand the self. Through study we try to answer the questions : Who am I? Who should I be? Through *Svādhyāya* we realize that a soul is pure thing. This will lead us to contemplate on the question : What am I doing in this body? Thus, study will lead us to be a pure soul. This study is divided into five levels :

(i) When one starts reading the scriptures it is called *Vacana*.

(ii) While reading some doubts may arise and trying to resolve them is called *Prachanā*.

(iii) After understanding what is right and contemplating on it is called *Anuprekṣā*.

(iv) After realizing what is right, one should contemplate on it again and again so one can stay in focus. This repetition is called *Amnāya*.

(v) After learning what self is one should teach others the same. This is known as *Dharmopadeśa*.

All five of above are external *svādhyāya*, but these will lead us to internal *svādhyāya* about the self. **Thus one will acquire right perception and right knowledge, which will lead to right conduct and will open up the path of ultimate liberation.**

(f) Meditation (*Dhyāna*)—*Dhyāna* means concentration of thoughts. This concentration could arise from intense passions like attachment, lust or animosity or from the search for the truth and from the absolute detachment towards worldly affairs.

Dhyāna is divided in four categories :

(i) *Ārtadhyāna*

(ii) *Raudradhyāna*

(iii) *Dharmadhyāna*

(iv) *Śukladhyāna*.

(i) In *Ārtadhyāna* a person reflects on the :

(a) loss of dear ones (*Iṣṭa viyoga*).

(b) development of a new relationship with an undesirable.

- (c) Physical illness (*Roga cintā*)
- (d) Future planning (*Agrasoca* or *Nidānartha*)

(ii) In *Roudradhyāna* one is absorbed in taking revenge for the damage or loss caused by others. There are four types :

- (i) *Hiñsānubandhi*
- (ii) *Mr̥ṣānubandhi*
- (iii) *Steyānubandhi*
- (iv) *Samrakṣānubandhi*.

Both *Arta* and *Roudradhyāna* lead to accumulation of bad *karmas* and therefore *Arta* and *Roudradhyāna* should be avoided.

Dharmadhyāna means reflecting on the ways and means towards realization of self.

Śukladhyāna means reflecting on the purity of the soul. *Dharmadhyāna* and *Śukladhyāna* lead to removal of *karmas*. Therefore for the purpose of *nirjarā* we shall contemplate on *dharmadhyāna* and *śukladhyāna*. If contemplation on *dharmadhyāna* is at the highest level then by achieving *śukladhyāna* one can completely destroy *mohnīya karma*, *Jñānāvarnīya*, *Darśnāvarnīya* and *Antrāya karmas* and one can become *kevalī*.

Other Austerities

There are some other common external austerities. They are :

(i) *Navakārsī*—In *Navakārsī* one has to take food and water forty eight minutes after sunrise. Even the brushing of teeth and rinsing of mouth is done after sunrise in *Navkārasī*.

(ii) *Porsī*—*Porsī* means taking food and water three hours after sunrise.

(iii) *Sādh-porsī*—*Sādh-porsī* means taking food and water four hours and thirty minutes after sun rise.

(iv) **Purimuddha**—*Purimuddha* means taking food and water six hours after sun rise.

(v) **Avadhdha**—*Avadhdha* means taking food and water eight hours after sun rise.

(vi) **Biyasaṇa**—It means taking food twice in a day sitting at one place.

(vii) **Ekāsaṇa**—It means taking food only once in a day.

(viii) **Āyāmbila**—It means taking food only once in one a day. The food should not have any taste and spices and should be boiled or cooked. Also one shall not take milk, curd, ghee, oil and green or raw vegetables.

(ix) **Upavāsa**—In *Upavāsa* one does not take food for whole day i.e. twenty-four hours starting from sunrise to sunrise the next day.

(a) **Tivihāra Upavāsa** : One drinks only boiled water during *upavāsa*.

(b) **Covihāra Upavāsa** : One does not even drink water during *upavāsa*.

(x) **Tivihāra**—In *Tivihāra* after sunset no food or juice is to be taken, but one can take only water until sunrise the next day.

(xi) **Covihāra**—In it after sunset no food or water is taken until sunrise the next day.

(xii) **Telā**—It means *Upavās* for three consecutive days.

(xiii) **Atthā**—It means *Upavās* for eight consecutive days.

(xiv) **Māsakhamāṇa**—It means consecutive *Upavāsa* for one month.

(xv) *Navapada olī*—During every year for 9 days starting from the 6/7th day in the bright fortnight until the full moon day in *Āświna* and *Caitra* months, one does *Āyambila*. This is repeated for the next four and half years. These *āyambilas* can also be restricted to only one kind of food grain per day.

(xvi) **Other austerities are**—*Varṣītapa*, *varadhamāna* and *Visasthānakatapa* etc.

In *Ekāsana*, *Biyāsana*, *Āyambila* or *Upavāsa* one takes only boiled water and that too only between sunrise and sunset. It is better if one can do *Covihāra* or *Tivihāra* day before starting these austerities. If any of the austerities allow food, one shall not take raw vegetables, underground roots and raw grains while performing such austerities.

CāRITRA¹⁶

To achieve *mokṣha* we need the right knowledge, right faith and right conduct known as three jewels in Jainism. Regarding right conduct, we must achieve control over our inner desires and reach a stage where there is no attachment or hatred. It is not a easy as it sounds, for this one has to form new habits and discard old habits. In order to change our habits, we take vows which help us to restrict what we do and eventually live naturally restrained. Although different people take different vows and despite the outer differences in the observance of these vows, the goal of all is to attain right conduct. As we find in the scriptures there are different vows for monks and nuns and for male and female house holders.

When one makes a resolution to restrain willfully from something with full understanding and faith then that resolution becomes a vow. The scriptures have divided these vows into two main groups :

- (i) *Mahāvratas* (Major vows or absolute vows),
- (ii) *Anuvratas* (Minor vows or relative vows).

Mahavratas¹⁷

In these vows, non-violence, truthfulness, non-stealing, celibacy and non-possessiveness are observed mentally, verbally and physically in total.

Each of these three aspects are further observed in three ways : not committing oneself, not asking anyone else to do so, and not encouraging anyone to do so. Those who wish to observe these vows renounce their worldly lives and become monks and nuns or *Aṇagārī*.

(i) *Savvāo Pāṇivāyāo Virmaṇa Vrata* (Absolute Non-violence vow)—In this vow, non violence is observed mentally, verbally and physically in total including for daily needs.

(ii) *Savvāo Muṣāvāyāo Virmaṇa Vrata* (Absolute Truthfulness vow)—In this vow, lying is given up mentally, verbally and physically in total. Only the truth is spoken.

(iii) *Savvāo Ādinnādānāo Virmaṇa Vrata* (Absolute Non-stealing vow)—In this vow, stealing is given up mentally, verbally and physically in total. Nothing is taken unless it is offered by the owner and meets the restrictions of the monkhood life.

(iv) *Savvāo Mehuṇāo Virmana Vrata* (Absolute Celibacy vow)—Celibacy is observed mentally, verbally and physically in total. Upon taking this vow, one cannot even touch or think about a member of the opposite sex.

(v) *Savvāo Pariggahāo Virmaṇa Vrata* (Absolute Non-possessiveness vow)—Greed and material possessions are given up mentally, verbally and physically in total. Only items, which are needed to meet out daily requirement are kept.¹⁸

Anuvrats¹⁹

It is difficult for house holders to fully practice the above vows, and so, the vows that house holders take have some limitations and are called minor vows. These vows are not as stringent as *Mahavrats* and people who take these vows are called *Srāvakas Srāvikas* or *Āgārī*.

(i) ***Sthūla Pañivāyāo Virmaṇa Vrata (limited Non-violence vow)***—Being a house holder, one has to carry out house hold and community activities. Thus, it is not possible to totally avoid violence, especially against one sensed living beings. However, one should take the utmost care to observe non-violence.

(ii) ***Sthūla Musāvāyāo Virmaṇa Vrata (limited Truthfulness vow)***—One should take the utmost care in not telling lies. Another words one should only speak the truth.

(iii) ***Sthūla Ādinnādānāo Virmaṇa Vrata (limited Non-stealing vow)***—One should take the utmost care not to steal or borrow the belonging of others without their permission.

(iv) ***Sthūla Mehuṇāo Virmaṇa Vrata (limited Celibacy vow)***—One should be satisfied with his spouse only and should avoid sexual contact with others.

(v) ***Sthūla Pariggahāo Virmaṇa Vrata (limited Non-possessiveness vow)***—One's earning for material possessions and greed for collection should be as limited as possible.

Guṇavratas (supporting vows)²⁰—The following vows support the above five vows so that they can be carried out more effectively.

(vi) ***Diśā Parimaṇa Vrata (Geographic limitation vow)***—Since it is necessary to move to fulfill one's needs, one should limit his desire to perform activities with in a needed radius of area. Therefore, one should set limits with in the scope of travel or business etc.²¹

(vii) ***Bhogopabhoga Virmaṇa Vrata (consumption and occupation limited vow)***—One should set limits on the consumption of various items

despite whether they are used once or repeatedly to avoid incoming sins. Also one should limit oneself to the kind of occupation he selects because some occupations have more exposure to sins than others.

(viii) *Anarthadañdavirati Vrata* (purposeless Violence limitation law)—We sometimes carry out activities for fun or to tease our friends and foes. However, we should realize that all such activities attract *karmas*. This vow reminds us not to build unnecessary *karmas*.

***Śīksā vrata* (training vows)²²**—The above eight vows tell us how we can limit our actions (mental, verbal and physical activities) in order to reduce the inflow of *karmas*. The next four vows train us to stop *karma* from coming in, and to get rid of existing *karmas*.

(ix) *Sāmāyika Vrata* (self control and equanimity vow)—Since we live a social life, it may not be possible to spend much time in shedding *karmas*, but we should spend at least forty-eight minutes a day in such efforts. During these forty-eight minutes, we give up all familial, social, economical and cultural responsibilities and we control ourselves mentally, verbally, and physically. During this time we should concentrate on religious readings or meditation, **which will help in preventing new *karma* come in as well as help to get rid of old *karma***. This 48 minutes will also give us a glimpse as to how easy or difficult it may be to control ourselves. Once we become accustomed to doing this. We may extend the self-control time to a period of more than 48 minutes.

(x) *Deśāvakāśika Vrata* (day to day additional limitation vow)—At the time of waking up, we take this vow in order to put limits on our activities for that day, and thus, **limit our exposure to accumulating *karma***. In this way we learn to live a more controlled life.

(xi) *Poṣadha Vrata* (Monkshood exposure vow)—This vow teaches us how to live like a monk, or a nun, for a day. By taking this vow, we give up all our household, social, economical and cultural responsibilities for a

day. We should practice this vow as often as possible. By practicing this vow, the inflow of new *karma* is slowed down and existing *karmas* are eradicated. If this vow is easy to observe it may eventually lead to monkshood.

(xii) Atithi Samvibhāga Vrata (selfless offerings to unexpected guests vow)—This vow teaches us to share. Sharing is more worth while when an unexpected, needy person comes to your door and you offer with an open heart. Monks and nuns are the best receptors for this type of sharing. However, while giving you should not have any regret or expectations in your mind. By sharing, you are developing a sense of detachment with the feeling that nothing is mine. Observing this vow will lead to liberation from worldly life.²³

Our thoughts while talking these vows are also very important. They should be positive and meant to destroy *karmas*.

There are three common obstacles to our vows :

- (i) Māyā (Deception)
- (ii) Nidāna (Expectations)
- (iii) Mithyātva (Wrong beliefs)

(i) Māyā (Deception)—When you take a vow, it should be for the betterment of your soul. Vows should not be taken to show-off or receive praise. Also those should not be taken to deceive otherwise these will produce inferior results.

(ii) Nidāna (Expectations)—Many of us take vows in order to gain something materialistic in return. Such is not good because not only do we use up what we achieve, but **we lose the main purpose of performing vows to destroy *karmas*.**

(iii) Mithyātva (Wrong beliefs)—This occurs when one, without belief in liberation, takes the vow that the ultimate pleasure of the body is the prime purpose in this life. We should not forget that austerities are performed to liberate the wandering soul from worldly engrossment. We

must understand the values of vows mentally, verbally as well as physically otherwise these will not bear the proper results.

TRIPLE JEWELS—THE PATHWAY TO EMANCIPATION

The triple Jewels—right attitude, right knowledge and right conduct constitute, according to Jainas, the pathway to final emancipation.²⁴ Right attitude or *samyagdarśana* is the predilection or love for truth. Every soul has such predilection in some measure. But unless and until it develops into a self-conscious pursuit of truth, it does not help in spiritual progress. It is only at the stage of self-conscious effort for spiritual advancement that this love of truth is called *samyag-darśana*. The soul is conceived as groping in darkness before it acquires this love of truth in an appreciable measure. And it has to undergo a number of processes before the acquisition of this characteristic. There are souls who do never acquire this characteristic and, therefore are never released from worldly bondage. These souls are called *abhavya* (incapable of salvation). The Jainas do not give any ultimate reason for this endless bondage. After the acquisition of this characteristic the soul passes through a number of stages of spiritual development, technically known as fourteen *guṇasthānas*. This is a very important Doctrine of Jainas.

Once the soul succeeds in acquiring *samyag-darśana*, it is bound to attain emancipation sooner or later. The nature of *samyag-darśana* and its condition viz. the purity of soul we have already described one more than one occasion and shall have again and occasion to do so while dealing with the Doctrine of *guṇasthāna*. The attainment of right attitude (*samyag-darśana*) is followed by the attainment of right knowledge (*samyag jñāna*) and right conduct (*samyag-cāritra*). The soul acquires more and more power for self concentration (*dhyāna*) along with the increase of its purity and consequent attainment of the corresponding stages of spiritual development.

Right conduct means doing whatever is right, good and proper. It represents the rules of moral discipline, which control good behaviour and constitutes the right activities of mind, body and speech. It presupposes the attainment of right knowledge, and right knowledge requires the presence of right faith. Hence right knowledge and right faith, when coupled together make the guidelines for right conduct. The self can follow right conduct only

when it is equipped with right faith and right knowledge. **So, along with right faith and right knowledge, right conduct is a fundamental factor in attainment of *mokṣa*.** There is a close relation between knowledge and action. The *uttarādhyayana sūtra* states that right faith, knowledge, and conduct are interrelated. Through right knowledge one knows the nature of things, through faith one believes in them, through conduct and austerities he attains purity. **By means of purity, one achieves emancipation.** There is a close relation between knowledge and conduct. Conduct is the final fulfilment of knowledge.²⁵

The three jewels of Jainism viz. right faith, right knowledge and right conduct, do not exist in any other substance except the self. One should know that these make the real self and its cause of liberation.²⁶ From the absolute point of view, conduct is only in self-realization and self-absorption. The *Pravacanasāra* states that conduct is dharma; dharma lies in equanimity and equanimity means that state of the self, which is devoid of attachment and aversion.²⁷

GENETIC ENGINEERING

Genetic Engineering is the heritable, directed attention of an organism. Altering DNA or adding new DNA allow us to change the characteristic of a cell or cells. Non germ line alterations are not carried to the next generation. Only half of our *genes* are given to our offsprings, diluting any germline genetic modifications overtime. DNA carries the instructions as *genes*, proteins perform the actions. Regulation of *gene* is as important as *gene* function. Foreign DNA may be rejected. While the human genome project may give us the entire sequence of our DNA, scientist must still determine how all the encoded proteins work.

GENETIC ENGINEERING AND ITS APPLICATION

Genetic Engineering is the method of transfer a *gene* from the DNA of one species to the DNA of another species. Genetic Engineering gets to the very core of how life works and people are inclined to have very strong feelings about it. Genetic Engineering was probably the most

important scientific event of the 20th century. It was the discovery by James Watson and Francis Crick (1953) of the structure of the DNA molecule, which is basis of heredity. Darwin has shown how species might have changed over eons and slow, random natural processes. Watson and Crick gave us the key to moving evolution along much faster, to suit our own purposes.

A DNA molecule is like a string of letters, using a four letters alphabets, easily copied when living cells reproduce. The sequences of letters make sentences, which we call *genes*. One kind of *gene* gives a cell the necessary instructions for making one of the various kinds of protein, used for structures, enzymes, signals and basic mechanisms of life. The other kind of sequence is used as a control mechanism so that a cell can tell when to make which protein and when to do something else.

Scientist learned the language of protein-making *gene* sequences. The language is the same for all form of lives. *Gene* sequences are control sequences and are like switches that turn other *genes* on or off. A control sequences could have different results in different organisms. Some control *genes* are used to turn another *gene* on, and the others are used to turn another *gene* off.

For example a cell needs protein A, but not in much amount. If the *genes* that tells the cell to make protein A is turn on, eventually the control *gene* will sense that there is lot of protein A available, then it will turn off the protein making *gene*. Later when the supply of protein A has is used, the control *gene* will relent and let the protein making *gene* turn back on.

Each different organism has ten thousands different *genes* and make a huge number of proteins. Life is enormously. Complex however, hundreds of *genes* are now understood completely. There are many more *genes*, which have been discovered and associated with some function, but not yet understood very well. There are practical applications of this knowledge. The first practical applications were in medicine, using genetically modified bacteria to make medical drugs such as interferon, human growth hormone

and human insuline. The second kind of application was to modify organisms for agricultural purposes.²⁸

Role of DNA in Genetic Engineering

Invariably genetic Engineering involves DNA modifications. DNA is the genetic material in all known forms of lives. DNA contains *genes* (just as a recipe book contains recipes) that give us many of our physical characteristics. However we are not simply *genes* based machines—the environment we are in also determines our traits. One of the challenges of Genetic Engineering is to determine how *genes* influence our traits and how to modify DNA to alter these traits. *Genes* affecting disorders such as alcoholism provide only predisposition. Having the *gene* for alcoholism may make one prone to alcoholism but does not guarantee that one will become alcoholic, nor does not having the *gene* mean one is immune.

An important distinction in Genetic Engineering is between germline and non-germline cells. In most organisms, there are cells set aside just for reproduction. These are eggs and sperms in human. Non germline cells are all the other cells in the body—muscle cells, skin cells, liver cells etc. If a genetic modification does not alter germline cells, it should not have any effect on the genetic make up of future generations (there are some possible exceptions to this). Thus, if one were to introduce the *gene* for purple hair, but the parent would. **If the *gene* for purple hair were introduced into the parental germline cells, then the children could carry the purple hair *gene*.**

This is complicated in plants because while many plants have germline cells. They can also be propogated asexually by cuttings. Additionally, it is possible to clone animals from single cells. Thus it is possible to clone a mouse from even non-germline cells. So even though introducing the purple hair *gene* into hair cell is not a strictly heritable alteration, it is still possible to grow a whole mouse from a single hair cell (not a hair cell, not a strand of hair).

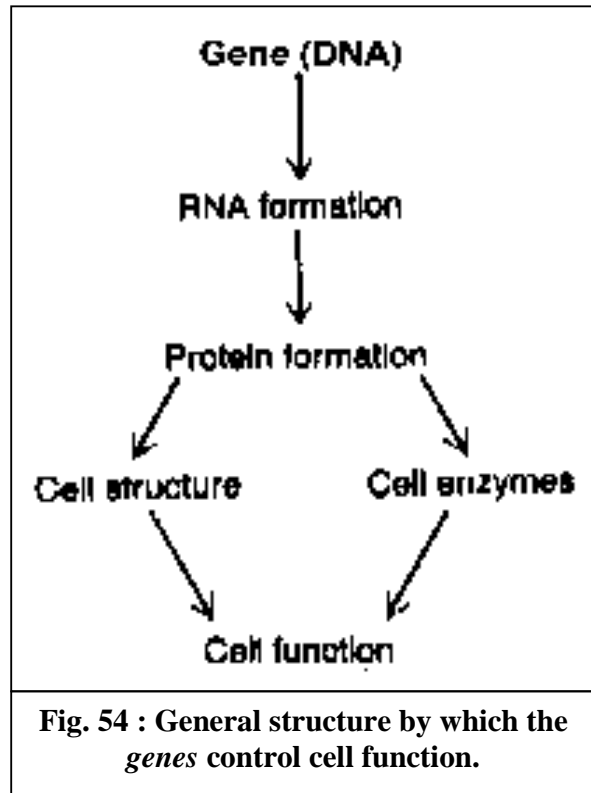
Genetic Control

Virtually everyone knows that the *genes* control heredity from parents to children, but most persons do not realize that the same *genes* control the reproduction of and the day by day function of cells. The *genes* control cell function by determining what substances will be synthesized within the cell—what structures, what enzymes, what chemicals?

Fig. 54 illustrates the general scheme of genetic control. Each *gene*, which is a nucleic acid called deoxyribonucleic Acid (DNA), automatically controls the formation of another nucleic Acid, ribonucleic Acid (RNA) which spreads throughout the cell and controls the formation of a specific protein. Some proteins are structural proteins, which in association with various lipids and carbohydrates form the structure of various organelles. By far the majority of proteins are enzymes that catalyse the different chemical reactions in the cell. For instance,

enzymes promote all the oxidative reactions that supply energy to the cell, and they promote synthesis of various chemicals, such as lipids, glycogen, adenosine triphosphate (ATP) and so on.

For the formation of each cellular protein there is usually only a single *gene* pair in each cell. It is estimated that cells of the human being have over 1,00,000 such *gene* pairs, which means that as many as 1,00,000 different proteins are formed in different cells, though not all of these in the same cell.²⁹



Regulation of *gene* expression

Regulation of *gene* expression is as important as *gene* function. DNA codes for protein, which perform actions like making hair or carrying oxygen in our blood. Imagine if we grow hair in our mouths, teeth on our heads. In order to avoid such misshapes, all *genes* are regulated. Contained within our DNA sequence are elements known as promoters and repressors that allow individual cells to control which *genes* are expressed. This is how the individual cells in our bodies know which *genes* to use. These are *genes* specific to each tissue (muscle, brain, liver etc.) in our bodies as well as "house keeping *genes*" which are present in all cells. Expressing *genes* in the appropriate tissue at the appropriate time is very important. Cancer, defined as any uncontrolled growth is ultimately a result of misregulation of *gene* expression.

Genes may be expressed in specific locations (e.g. tissue specific *genes*) at specific times (e.g. embryo-specific *genes*) or in response to environmental stimuli (e.g. light-responsive *genes*). Viruses are powerful Genetic Engineering tools because of their ability to target specific tissues and express specific *genes* in those tissues. One of the reasons that herpes virus is potentially useful for treating brain diseases because it infects brain cells and express specific *genes* in brain cells. The challenge is to disable the herpes causing *genes* while introducing functional beneficial *genes*.³⁰

The evidence accumulated in genetics makes it virtually certain that not all the *genes* present in cell are active in directing the specific processes of protein synthesis. *Gene* action can be switched on or off in response to the cell's stage of development and external environment. In multi cellular organisms, moreover, each cell has a complete copy of organisms genetic instructions though different kinds of cells come to express different parts of genome. That is to say that a skin cell, a nerve cell, and a bone marrow cell from the same person all contain the same *genes*, the differences in structure and function among these cells result from the selective expression and repression of certain *genes*.³¹

DNA repairs and DNA "Proof reading"

During the hour or so between DNA replication and the beginning of mitosis, there is a period of very active repair and "Proof reading" of DNA stands. That is, wherever in appropriate DNA nucleotides have been matched up with the nucleotides of the origin template strand, special enzymes cut out the defective areas and replace these with the appropriate complimentary nucleotides. This is activated by the same DNA polymerizes and DNA ligase that are used in the process of replication. This repair process is referred to as DNA proof reading. Because of repair and proof reading, the transcription process almost never makes a mistake. But when a mistake is made, this is called MUTATION, it in turn will cause the formation of some abnormal protein in the cell, often leading to abnormal cellular function and some times even to death.³²

A variety of agents in the cells environment, both chemical and physical, can damage DNA. Organisms have developed a variety of mechanisms for repairing copying errors produced by damaged DNA, usually by enzymatically excising them. The enzymes DNA polymerase then catalyzes the replacement of the excised segment with the correct nucleotides, using the undamaged DNA strand as a template. Eucaryotic cells have a greater variety of DNA repair mechanisms than to bacteria. Malfunctioning of the repair mechanisms can lead to genetic disease, abnormal function, or cancer, xeroderma pigmentosum, a lethal human disease that is recessively inherited, involves several defective repair mechanisms.³³

Control of enzymes activity

There are two principal methods by which the cells control proper proportions and proper quantities of different cellular constituents :

- (i) The mechanism of genetic regulation.
- (ii) The mechanism of enzyme regulation.

The *genes* can be either activated or inhibited. Most often, these regulatory mechanisms function as feed back control systems that continually monitor the cell's biochemical composition and make corrections as needed. But, on occasion, substances from without the cell (especially

some of the hormones) also control the intracellular biochemical reaction by activating or inhibiting one or more of the intracellular control systems.

Control of cell growth and reproduction

We know very little about the mechanisms that maintain proper numbers of the different types of cells in the body. However, experiments have shown at least three ways in which growth can be controlled :

- (i) Growth is often controlled by growth factors that come from other parts of the body. Some of these circulate in the blood, but others originate in adjacent tissues. For instance, the epithelial cells of some glands, such as pancreas, will fail to grow without a growth factor from the sublying connective tissue of the gland.
- (ii) Most normal cells will stop growing when they have run out of space for growth. This occurs when cells are grown in tissue culture, the cells grow until they contact a solid object and then growth stops.
- (iii) Cells grow in tissue culture often stop growing when minute amount of their own secretions are allowed to collect in the culture medium. This, too, could provide a means for negative feed back control of growth.³⁴

IMPACT OF GENETIC ENGINEERING

Introduction of new procedures and new products realized through Genetic Engineering will have a profound effect on public health, agriculture and food industries. Treatment with genetically engineered enzymes that lower cholesterol or saturated fatty acids, can have a great impact on cardiovascular diseases. Genetic Engineering in itself is not a discipline but a powerful tool. Biocompatible pesticides and herbicides can be made through Genetic Engineering to keep the environment clean. Genetic screening becomes obligatory for employment, life insurance acceptance would have questionable social implications. The development of human and animal proteins will open new vistas for diagnosis and therapy. Vaccines remain one of the best approaches to control infectious diseases. Bacterial, viral,

fungal, amoebal and trypanosomes are the major causative agents. **A successful experiment has been established by the eradication of small pox globally in 1977.**

The recombinant live vaccines are particularly promising in their wide applicability and possibility of combining multiple antigens. The use of manipulated somatic cells in the therapy of genetic diseases is imminent. Beneficial modifications of the germline of domestic animals is a distinct possibility.

DNA fingerprinting

Forensic scientists are able to read the DNA sequences and find differences among species. They reduce base names down to letters "A", "C", "I", "G". Then scientists read the sequences of these letters by looking at one half of the ladder. Although the majority 99.9% of the letter sequence on a human DNA strand is identical, there are portions of each strand that differ from individual to individual. **Thus in a DNA strand three billion letters, one tenth of one percent difference translates into three million separate spelling difference. These are differences that scientists examine in the process known as DNA finger printing to determine identity and heritage.** Unfortunately for purpose of forensic DNA finger printing, scientists do not read all three billion letters. Instead, to save time and money, scientists look at very small handful of sites of variation. Along the DNA strand, or genome, there are regions where the base pair sequences repeat themselves. For instance, one person could have the sequences of T-A-C-T-G repeat three times and another person could have the same sequence repeat twice or appear only once. Thus, these normally biologically insignificant sequences repetitions create spelling difference in particular areas. In general forensic scientists cut the DNA strands with an enzyme at these point of repetition. **Then they record the repetition variations by reducing the data into a bar code type expression.** When comparing DNA samples from crime scene evidence to a suspect's DNA

sample, scientists will compare the "**bar code**" information from each site of variation. If "bar code" differs between the evidence and the suspect's DNA at any point, that particular suspect is usually ruled out as a possible source of DNA evidence. However, if the "bar codes" are the same along all points of variation tested, the suspect is considered more likely to have left the evidence.³⁵

Recombinant DNA Technology

Recombinant DNA technology allows the DNA to be divided into small fragments which can be studied at the nucleotide level and analyzed functionally. The plasmid and foreign DNA are cut by this restriction endonuclease (EcoRI in below example) producing intermediates with sticky and complimentary ends. Those two intermediate recombine by base pairing and are linked by the action

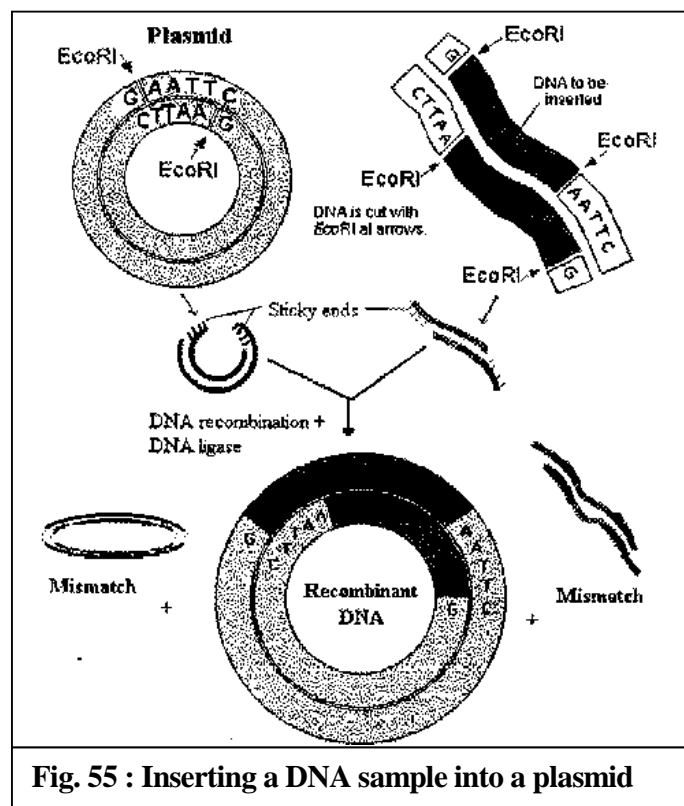


Fig. 55 : Inserting a DNA sample into a plasmid

of DNA ligase. A new plasmid containing the foreign DNA as an insert is obtained. A few mismatches occur, producing an undesirable recombinant. The term recombinant DNA literally means the joining or recombining of two pieces of DNA from two different species. Recombinant DNA techniques allow an investigator to biologically purify (clone) a *gene* from one species by inserting it into DNA of other species, where it is replicated along with the host DNA. Actually the term includes a variety of molecular

manoeuvres, including cleaving DNA by microbial enzymes called endonucleases, splicing or recombining fragments of DNA, inserting eucarotic DNA into bacteria so that large quantity of the foreign genetic material can be produced, determining the nucleotide sequence of a segment of DNA, and even chemically synthesizing DNA.³⁶

General Approach to Clone DNA

The general approach to clone DNA is as follow :

DNA is extracted from cells and cut by the restriction endonuclease enzyme into several segments. Plasmid DNA is also cut by the same enzyme and then the plasmid and cell DNA are mixed together and joined with an enzyme DNA ligase to give recombined DNA. Each of the resulting plasmids contain a piece of DNA from the cell. Under appropriate conditions bacteria absorb the recombination plasmids. If the host bacterium is sensitive to the antibiotics tetracycline and ampicilin, it will not grow in their presence. However, the plasmids with its resistance *genes* all the bacterium to grow. When a single bacteria divides on an agar plate, each of the millions of daughter cell carries an identical copy of the original plasmid containing the inserted DNA from the cell. By this technique the total nuclear DNA from a cell may be divided into many clones, each clone having a point of DNA of the cell from which it was extracted. Such a collection of thousands of clones constitute a genomic library.³⁷

Manipulation of embryos

The nucleus of the fertilized egg can be removed and a nucleus from white cells of a mother or father can be inserted and if development continues then we have an offspring which is a zerox copy of mother or father. **We have to know how to turn these *genes* on and off. By introducing the *gene* at the two celled stage we can expect the desired result.** In other words we have to manipulate embryos in virto. It is possible to collect embryos from females, culture them in virto, freeze and store them indefmitely in liquid nitrogen. We can later bring them back to activity, sex

them and transfer them back to the reproductive tract of recipient to obtain normal offspring.

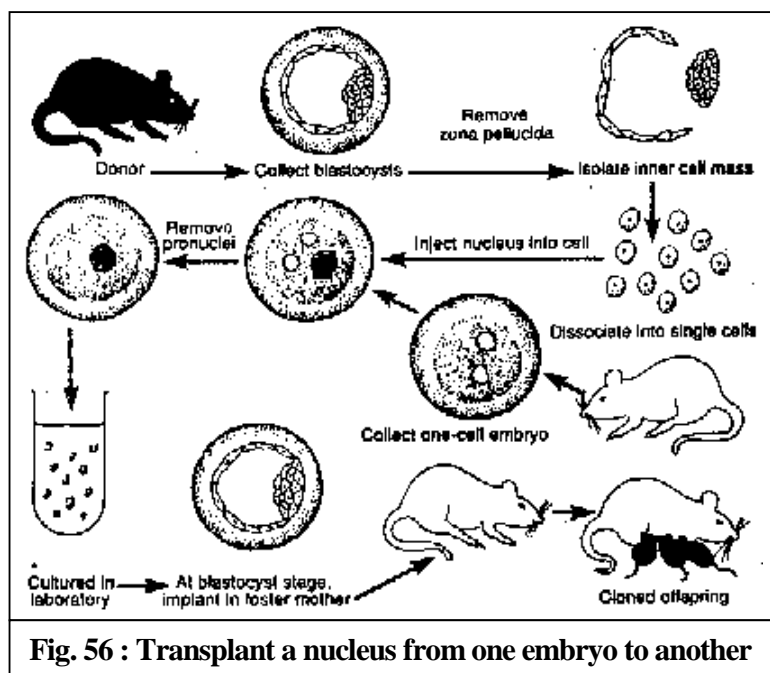
Individual embryos can be divided into two resulting in identical twins or 3 or 4 parts making them triplets and quadruplets. These techniques can be used to increase the female reproductive rate analogue to artificial insemination used in males in animals. Production of bull calves by embryo transfer is an efficient means of amplifying *genes* of the best cows through their sons.³⁸

Clones

Clones are individuals that are genetically identical. In theory it should be possible to produce identical copies of yourself : take one of your body cells, remove the nucleus (which contains the *genes*) and implant this into a one celled embryo which has had its own nucleus removed. Then your *genes* will control the development of a duplicate of your self.

We can however produce several genetically identical individuals by splitting up the embryo at an early stage. At the eight cell stage, for instance, each cell can reform a whole embryo. But these approaches produces only a finite number of clones from the embryo. The cloning of mice is shown below :

With the development in genetic Engineering, biologists have preferred techniques for introducing *genes* from one organism into another organism. The result—a cow, say carrying a human *gene* among its own genetic material—is called a transgenic animal.



The most popular way of producing transgenic animals is to inject *genes* directly into one of the pronuclei in a newly fertilized egg. This delicate task is performed by holding the egg in a suction tube, piercing the egg and pronucleus with a micropipette **to inject the foreign gene**. Remarkably this crude procedure works some of the time at least. **The foreign gene is permanently incorporate into the genetic material of animal.** Some may also damage the host's genetic materials creating what are known as insertional mutations.

In spite of these problems, "microinjections" has created many transgenic mammals—including mice, rats, pigs and sheep. The first to emerge from the laboratory, in 1981, were mice carrying a *gene* for growth hormone. These grew up to 50% larger than their counterparts.

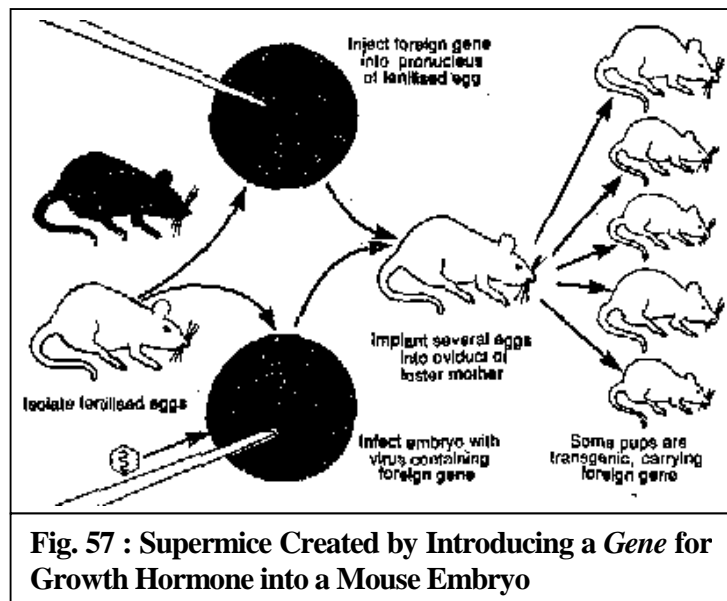


Fig. 57 : Supermice Created by Introducing a Gene for Growth Hormone into a Mouse Embryo

Another way to create transgenic animals is to take advantage of viruses (retroviruses) that naturally infect cells. These retroviruses insert their own *genes* into the genetic materials of a cell. The Genetic Engineers take away the key infecting parts of the retrovirus and add to this foreign *gene* of their choice. Such a recombinant retrovirus made from artificially combined bits of *genes*, can then carry foreign *genes* into the embryonic cells. The embryo is infected with this engineered virus at four or eight cell stage. The difficulty is that virus may not infect all the cells of the embryo. If it infects some of them we get a chimera, that is all cells are not genetically identical. To begin with this technique is being tried to infect the stem cells of bone marrow as a therapeutic intervention in certain blood disorders.³⁹ Below fig. 57 shows the creation of supermice.

Gene Therapy

Gene therapy is the introduction of a *gene* sequence into a cell with the aim of modifying the cell's behaviour in a clinically relevant fashion. It may be used in several ways i.e. to correct a genetic mutation (as for cystic fibrosis), to kill a cell (as for cancer) or to modify susceptibility (as for coronary artery disease). The *gene* may be introduced using a virus (usually a retrovirus or adenovirus) or by means of lipids or receptor targeting. There is now almost universal agreement that *gene* delivery to somatic cell to disease is ethical, and that *gene* therapy should take its place along side other forms of medical treatment.⁴⁰

Population genetics (The *genes* in populations)

In the study of heredity the first question that arises is how the genotype of an individual is formed from the constituents of the genotypes of his parents. This is the genetics of individual or **basic genetics**. One may also enquire how the genotype in a fertilized egg cell influences the developmental pattern of organisms and thus realizes its potentialities. This is the **developmental genetics**. An individual, at least an individual of a sexually reproducing species, is not, however, biologically complete in itself. Its biological role is actualizing through its membership in a reproductive community, a mendelian population. A mendelian population consists of individuals among whom mating may or do occur. An individual is mortal and temporary; a mendelian population has a continuity through time. The genetic process in mendelian populations are the subject matter of **population genetics**. Population genetics has been defined as the study of the precise genetics composition of population and various factors determining the incidence of inherited traits in them.⁴¹

Population genetics is founded on a principle enunciated independently by Hardy in England and Weinberg in Germany in 1908. Let us consider the results when a human population consisting of tall (TT), intermediate (Tt) and short (tt) individuals were allowed to mate at random. Even after several generations of interbreeding it will be found that there will be some individuals who all tall (TT) some intermediate (Tt) and some

short (tt). In other words, we cannot produce a race which is pure or uniform in height.

The Hardy-Weinberg law states that "the relative frequencies of each *gene* allele tends to remain constant from "generations to generation" in the absence of forces that changes the *gene* frequency. Thus, the study of *gene* frequencies, and the influences which operate to after the "*gene* pool" and their long term consequences is the central theme in population genetics.

Factors which influence the *gene* frequencies

The Hardy-Weinberg law assumes that human population is static. But in reality, human population and consequently human *gene* pool is never static. There are several factors which influence the human *gene* pool is never static. There are several factors which influence the human *gene* pool. The following are some factors :

(i) Mutation—Mutation implies a change in the genetic material of an organism which results in a new inherited variation. Mutation is a rather regular phenomenon in nature. It is now recognized that mutant *genes* are so wide spread in their occurrence that every one of us might be harbouring a few or many of them. **According to modern Genetics, the entire body structure of man and every other animal and plant cell have been built through hundreds of millions of years by means of a long succession of mutation.**⁴² The cause of spontaneous mutation is not yet known. The Jain doctrine of *karma* says cause of mutation is *karma* of individual organism. Accumulated *karma* of living organism direct mutation of *genes*. All the activities of *genes* are determined by *karma* of individual organism. But we know that certain external influences such as ionizing radiation and certain chemicals are capable of producing mutations experimentally and there is no reason to believe that man is exception. **Most mutant *genes* are believe to be harmful. But there are instances where a mutant *gene* could be beneficial e.g. sickle cell anaemia.** The heterozygotes of sickle cells trait were found to be resistant to *falsiparum* malaria. Some mutant *genes* remain

"neutral" in that they do not harm or impair the survival ability of the carriers.

(ii) Natural Selection—Darwin proposed the theory of natural selection or survival of the fittest to explain evolution. Natural selection is the process where by harmful *genes* are eliminated from the *gene* pool and *genes* favourable to an individual tend to be preserved and passed on to the offspring. When DDT was first used, it was lethal to houseflies. Today, not many houseflies are killed by DDT. This is an example of natural selection in response of DDT, the resistant variety of houseflies have become the usual form. The forces which operate in the animal kingdom do not apply in human populations because man by his superior intelligence has interfered with natural selection in every conceivable way by changing the environmental conditions under which people live and by advances in technology, public health and medical care services.

(iii) Population Movement—Because of industrialization, increased facility for earning, ways of living and education, people are moving—sometimes on a large scale. From rural to urban areas. Such population movements will lead to changes in the distribution of *genes*, affecting both the areas of immigration and emigration. The intermixing of people makes new genetic combinations possible.

(iv) Breeding structure—If all marriages were to occur in a random fashion, the effect would be the attainment of a genetic equilibrium. In practice, however, mating tend to occur selectively within various sub groups based on religion, economic and educational status and family relationships. In open societies, there is more freedom in mating. For instance doctors tend to marry doctors or nurses, musicians tend to marry musicians. This type of mating is called "assortative mating", or birds of the same feather flocking together. The genetic consequences of assortative mating have not been adequately studied.

(v) **Public Health Measures**—Advances in public health and medical care services do effect the genetic endowment of people as a whole. More lives are now being saved by advances in medical sciences than ever before. For instance, Ramstedt's operation which was introduced in 1912 has saved many children suffering from congenital pyloric stenosis. Individuals with genetically conditioned retinoblastoma may be saved by timely surgery. The provision of insulin has saved the lives of diabetics. The carriers of hereditary diseases, malformations and constitutional weaknesses are able to survive and pass their *genes* to their progeny. Public health measures are thus decreasing the selection rates and increasing the genetic burden. This has led some scientists to prophesy that "Medicine will harm in the long run by helping them in the short run".⁴³

PREVENTIVE AND SOCIAL MEASURES

The basic principles of genetics were laid down by Mendel and Galton towards the close of 19th century. But it is only during the past few years the science of genetics including human genetics has made rapid progress. The discovery of the biological role of nucleic acid, the uncovering of the structure of genetic information and its role in regulating life processes and discoveries, the importance of which can hardly be over estimated, with increasing control of communicable diseases and infant mortality, abnormalities are assuming a proportionately greater importance in medical practice. **Over 2300 hereditary diseases have been identified and more are added to the list every year.** According to many authors, genetically conditioned disease with a clear genetic component account for 25-40 percent of all cases treated by the health services.⁴⁴

Human genetics is much more than the study of mere hereditary diseases and inborn abnormalities. It has emerged as a basic biological science for understanding the endogenous factors in health and disease and the complex interaction between nature and nurture. Owing to rapid specialization, several branches in genetics have come into being e.g. cytogenetics, biochemical genetics, clinical genetics, pharmacogenetics, immunogenetics, microbial genetics, population genetics and so on. Achievements in these fields have created a basis for effective medical and

preventive intervention in many diseases, and also possibly of "Genetic Engineering" i.e. of controlling the traits of an individual.

Health and Promotional measures

(a) Eugenics—Galton proposed the term eugenics for the science, which aims to improve the genetic endowment of human population. Eugenics has both negative and positive aspects.

(i) Negative eugenics—Hilter sought to improve the German race by killing the weak and defective; this was negative eugenics. Nobody in the civilized world would approve of such a measure to improve the human race.

On the other hand, if people who are suffering from serious hereditary diseases are sterilized or otherwise debarred from producing children, there should be serious objection to marriage. The aim of negative eugenics is to reduce the frequency of hereditary disease and disability in the community to the least possible degree. However the question one would ask is how far negative eugenic measures would be helpful in eliminating genetic defect? The simple answer is that in spite of eugenic sterilization, new cases of hereditary diseases will continue to arise in the population partly because of fresh mutations, and partly because of marital alliances between hidden carriers (heterozygotes) of recessive defects. Nevertheless, it may be hoped that should eugenic measures be applied, hereditary diseases would become less frequent.⁴⁵

(ii) Positive eugenics—This is a more ambitious programme than negative eugenics. It seeks to improve the genetic composition of the population by encouraging the carriers of desirable genotypes to assume the burden of parenthood. At present, positive eugenics has very little application. Its realization is difficult for two reasons :

(a) The majority of socially valuable traits—let us say—intelligence and positive character features, though partially determined biologically are not inherited in such a simple way as, blood groups. These traits have a

complex, multifactorial determination, both genetical and environmental. It would be difficult to expect, therefore, that positive eugenic measures will yield direct results.⁴⁶

(b) Euthenics—Mere improvement of the genotype is of no use unless the improved genotype is given access to a suitable environment, an environment, which will enable the *genes* to express themselves readily. Throughout the course of history, man has been adopting environment to his *genes* more than adopting his *genes* to environment. Studies with mentally retarded (mild) children indicated that exposure to environmental stimulation improved their IQ. Thus the solution of improving the human race does not lie in contrasting heredity and environment, but rather in mutual interaction of heredity and environmental factors. This environmental manipulation is called euthenics and has considerable broader prospects for success.

(c) Genetic Counseling—The most immediate and practical service that genetics can render in medicine and surgery is genetic counseling.⁴⁷ Genetic Counseling may be prospective or retrospective.⁴⁸

Most genetic counseling is at present retrospective i.e. the hereditary disorder has already occurred with in the family. A survey carried out by the WHO showed that genetic advice was chiefly sought in connection with congenital abnormalities, mental retardation, psychiatric illness and inborn errors of metabolism and only a few sought premarital advice. The WHO recommends the establishment of genetic counseling centres in sufficient numbers in regions where infectious disease and nutritional disorders have been brought under control and in areas where genetic disorders have always constituted a serious public health problem (i.e. sickle cell anaemia and thalassemia).⁴⁹

The methods which could be suggested under retrospective genetic counseling are :

- (i) Contraception
- (ii) Pregnancy termination

- (iii) Sterilization depending upon the attitudes and cultural environment of the couples involved.⁵⁰

Specific Protection

Attention is now being paid for the protection of individuals and whole community against mutagenes such as x-rays and other ionizing radiations and also chemical mutagenes. Patients undergoing x-ray examination should be protected against unnecessary exposure of gonads to radiation. X-ray examination of the pregnant uterus to determine the presence of twins or the lie of the foetus is to be strongly deprecated. Rh haemolytic disease of the new born which is a genetically determined immunological disorders is now preventable by immunization of anti D globulin.

Early dignosis and treatment

(a) Prenatal Diagnosis—Amniocentesis in early pregnancy (about 14-16 weeks) has now made it possible for prenatal diagnosis of conditions associated with chromosomal anomalies (e.g. Down's syndrom); many inborn errors of metabolism (e.g. Tay-sach disease, galactosemia, Maple syrup urine disease, Alpha thalassemia and neural tube defects). The indications for prenatal diagnosis are listed in following table :

Indications for prenatal diagnosis⁵¹

S. No.	Indications	
a.	Advanced Maternal age, previous child with chromosome aberration, intrauterine	Cytogenetics (amniocentesis, chorionic villus sampling)
b.	Biochemical disorders	Protein essay, DNA diagnosis
c.	Congenital anomaly	Sonography, Foetoscopy
d.	Screening for neural tube defects and trisomy	Maternal serium alpha-fetoprotein, and chorionic gonadotropin

Amniocentesis—Examination of a sample of amniotic fluid makes possible the prenatal diagnosis of chromosomal anomalies and certain metabolic defects. The procedure can be used as early as 14th week of pregnancy when abortion of the affected fetus is still feasible. The diagnosis of chromosomal anomalies is made by culture and karyotyping of fetal cells from the amniotic fluid, and of metabolic defects by biochemical analysis of fluid.

Screening of newborn infants—We have today a long list of screening test for the early diagnosis of genetic abnormalities—sex chromosome abnormalities, congenital dislocation of hip, PKU, congenital hypothyroidism, sickle cell disease, cystic fibrosis, Duchenne muscular dystrophy, congenital adrenal hyperplasia, G6PD deficiency etc.

Neonates should be routinely examined for congenital abnormalities, particularly dislocation of the hip, which can be simply corrected at this stage. Bio-chemical screening of newborn infants was first used for PKU in 1966. Heel-prick blood samples are usually collected at 5-10 days after birth, several drops of blood are collected on filter paper (the Guthrie card) which is sent to screening laboratory.

Screening of newborns for congenital hypothyroidism is carried out in most developed countries. Sickle cell disease can be detected cheaply and reliably by hemoglobin electrophoresis using Guthrie blood spots. Neonatal screening for cystic fibrosis is based on the measurement of immunoreactive trypsin in Guthrie blood spots.

Recognizing preclinical cases—We have today a pretty long list of screening tests for the early diagnosis of hereditary diseases. For example, heterozygotes of phenylketonuria can be detected by a phenylalanine tolerance test. A simple urine examination for sugar after morning breakfast is good enough to detect diabetics. Examination of sibs and close relatives of diabetics by a glucose tolerance test will often reveal preclinical case of acholuric jaundice. A raised serum uric acid should arouse suspicion of gout. Sickle cell trait can be uncovered by subjecting the red cells to reduce

oxygen tension. Thalassaemia minor can be detected by studying the blood picture.

Genetic counseling can have the greatest impact when individuals or couples at genetic risk are identified prospectively i.e. before they have developed symptoms themselves or produced their first affected child. Prospective counseling is technically possible only when carriers can be accurately identified. To some extent, the established genetic population screening services may serve as models for the development of future genetic screening programmes.⁵²

Once diagnosed some of the genetic conditions can be treated with complete or partial success by medical and surgical measures. For example, diets low in phenylalanine are now prescribed as treatment for PKU children. Persons suffering from haemophilia can be greatly helped by administering antihemolytic globulin, which promotes the clotting of blood, modern surgical techniques have brought great improvements in dealing with cases of spina bifida.

Rehabilitation—Finally, rehabilitation, with many genetic or partially genetic conditions causing physical or mental disability, much can be done for the patient and for his family in helping him to lead a better and more useful life.

Transplantation organ and tissues—It is a common misconception that genetic diseases are, by their nature, untreatable. This stems from a lack of understanding of the modifying effects of the environment on expression of the genotype. As in all medical therapy the treatment of genetic disease depends upon modifying the environment so that any harmful expression of the mutant *gene* can be counteracted. Thus in the disease phenylketonuria the expression of mutant *gene* is counteracted by putting the affected person on a diet low in phenylalanine. Similar dietary manipulations can effectively control many other inborn errors of metabolism. As a result of the developments in somatic cell and molecular genetics, researchers have elucidated the precise molecular defect in many genetic disorders, often making it possible to neutralize the defect by application of appropriate

drugs or dietary changes. On occasion, surgeons can counteract the consequences of a mutant *gene* by using bone marrow, kidney or even liver transplants. The increased understanding of immune mechanisms involved in organ rejection has greatly increased the ability to transplant these tissues and organs. In other cases, surgical repair of physical defects can be extremely effective treatment.⁵³

Immuno-Genetics—Immunity is the ability of an individual to recognize the "self" molecules that make up one's own body and to distinguish them from such "non-self" molecules as those found in infectious micro-organisms and toxins. This process has a prominent genetic component. Knowledge of the genetic and molecular basis of the mammalian immune system has increased in parallel with the explosive advances made in somatic cell and molecular genetics.

There are two major components of the immune system, both originating from the same precursor "stem" cells. The bursa component provides B lymphocytes a class of white blood cells that, when appropriately stimulated, differentiate into plasma cells. These latter cells produce circulating soluble proteins called antibodies or immunoglobulins. Antibodies are produced in response to substances called antigens, most of which are foreign proteins or polysaccharides. An antibody molecule can recognize a specific antigen, combined with it, and initiate its destruction. This so called humoral immunity is accomplished through a complicated series of interactions with other molecules and cells; some of these interactions are mediated by another groups of lymphocytes, the T lymphocytes, which are derived from the thymus gland, once a B lymphocyte has been exposed to a specific antigen, it "remembers" the contact so that future exposure will cause an accelerated and magnified immune reaction. This is a manifestation of what has been called immunological memory.

The thymus component of the immune system centres on the thymus derived T lymphocytes. In addition to regulating the B cells in producing humoral immunity, the T cells also directly attack cells that display foreign antigens. This process, called cellular immunity, is of great importance in

protecting the body against a variety of viruses as well as cancer cells. Cellular immunity is also the chief cause of the rejection of organ transplant. The T lymphocytes provide a complex network consisting of a series of helper cells (which are antigen specific), amplifier cells, suppressor cells and cytotoxic (killer) cells, all of which are important in immune regulation.⁵⁴

The genetics of antibody formation—One of the central problems in understanding the genetics of the immune system has been in explaining the genetic regulation of antibody production. Immunobiologists have demonstrated that the system can produce well over 1,00,000 specific antibodies, each corresponding to a particular antigen. It would be difficult to envisage that each antibody is encoded by a separate *gene*—such an arrangement would require a disproportionate share of the entire human genome. Recombinant DNA analysis has illustrated the mechanisms by which a limited number of immunoglobulin *genes* can encode this vast number of antibodies.⁵⁵

COMPARISON—SañKRAMAᅇA OF KARMA AND GENETIC ENGINEERING

Gene pool 100 years ago, or 1000 years ago, we are the same people genetically; what is changed is the way we live and govern our behaviour. Crime is not an individual problem, but a social problem. The way to predict which individuals are going to be violent today cannot be done by testing their blood in Lab. The best way to predict who is going to be violent is to see where and how they live. Today's criminal violence is not about brain chemicals about poverty, the gulf between rich and poor, racial polarization, urban squalor, a lack of person responsibility, family breakdown and the deterioration of civil society.

However social and environmental factors alone are not enough to explain violence and crime. If that simple minded view were true, then everybody born in the ghetto (hardship) would be a criminal, and everybody born in plenty would be a model citizen. The truth is more complex. All the research show that anger and hostility are their visible outcomes such as crime and violence—are caused neither solely by the environment nor by biology. ***Genes do not make criminals—neither does "gangsta" rap.*** The mix is what is deadly; the combination of *genes* and environment,

temperament and character. There are individuals who are violent because of what is going on in their heads, and there are societies in which violence flourishes. In no other domain of human behaviour are nature and nurture so thoroughly intertwined.⁵⁶

Men are proof that DNA is not necessarily destiny and that character traits can override genetic predisposition. In the case of Daniel, his strong character worked to overcome what could have been a genetic problem. Even though Russell did not have a disadvantage at birth, he still was miserable. Just as a person can be tall and not play basketball. **You can have happy genes and feel terrible.** If you feel your own level of harm avoidance is too high, there are plenty of ways to improve your outlook on life, such as working on a positive attitude, changing jobs, losing a few pounds, taking a vacation, exercising or even indulging in an occasional hot fudge sundae.⁵⁷

The pattern of brain waves fits with what is known about the role of the right and left frontal areas in the control of emotional expression. The right side seems to be more involved in controlling negative emotions, where as left side plays more of a role in positive emotions. The anxiety felt by Valerie may be because the more dominant side of her brain, which is the right side, is sending out more negative controlling signals than the left side, which send out the positive controlling signals.⁵⁸

Violence and aggression also have genetic roots. Some people are born with shorter fuses and are more likely to lash out at others. Numerous studies show that altering the levels of a single brain chemical can completely change an animal's level of aggression. A simple manipulation of a single *gene* can turn a meek and mild rat into a crazer killer. The same brain chemicals are found in humans, and certain people are driven to violence by a force within them. Their life long struggle will be to consciously override what they are programmed to do.

How we think is also a product of genes. The evidence that IQ is largely inherited is over whelming. **Some genes determine how quickly the brain can process information.** Others may control particular circuits, such as those for mathematical calculation or perfect pitch. What we have always called "God given talents" are known in laboratories as genetically endowed

traits. The encouraging news is that *genes* do not always play their strongest role until adulthood.⁵⁹

The news are shocking to Maria and her parents. Who never suspected she was anything but a healthy young woman. Further test revealed she had a rare condition. Present in about 1 out of 20,000 (XY) births called androgen insensitivity syndrome. There was a crippling mutation in the *gene* for the androgen receptor—the protein that senses the presence of male sex hormones. Maria was born with a normal Y chromosome and TDF *gene*. Her development train should have been directed in the male direction. But because there was no receptor to sense the androgen, it was a circular track. No external male features were formed, and the train was routed back to the female track. That is why her external genitalia and secondary sex characteristic were those of woman. The only difference between Maria and any other woman was that Maria had internal tests and an incompletely developed Vagina, which would seem irrelevant to her ability to leap over hurdles.

Maria is an example of how a little knowledge of genetics can be dangerous. The officials thought that XY must mean male, but in fact many other *genes*, most of them on other chromosomes, are necessary to distinguish a man from woman. **And since Maria was a woman under any definition except in the vocabulary of their particular *gene*, other *genes* must play a role in the behaviour that we consider to be female or male.**⁶⁰

I think therefore I am (Rene Decarts). Native talents and native intelligence, Innate, Inborn. Derived from the constitution of mind, as seem to being derived from experience all due to *Genes*.⁶¹

As individuals there is no doubt we want to live longer, or at least look younger, we have a strong instinct to survive jointly with an acute sense of morality, which has pushed us to improve living conditions that prolong life. Not to mention the power of human vanity. We still fantasize about discovery a "fountain of youth" but now search for longevity has turned inward to look at our genetic code. **By discovering the *genes* that control aging, perhaps we will be able to prevent or at least slow the process.** More likely we will be able to prevent or at least slow the process. More likely, we will be able to prevent some of the diseases, disability and discomfort that accompany aging. Perhaps the most important result of

discovering the genetics of aging will be to understand what can be changed. These are some aspects of mental and physical decline that cannot be avoided, but enjoyment of our final years certainly can be increased through medical advances, healthy living and positive thinking.⁶²

By the first decade of the twenty five century we will know the entire sequence of the human genome. Ever one of more than three billion nucleotides that make up the 1,00,000 *genes* that constitute our genetic patrimony. Deciphering the meaning and function of those *genes* will be slower but success is inevitable. Already an entire new field has emerged called "**Functional genomic**" dedicated to figuring out what *genes* do. At the same time new technologies are emerging to exploit this information with drugs and by manipulating the genetic information itself. So far the manipulations are being performed only on animals, Dolly the sheep being the first well known example, but humans are just a few steps away.⁶³

Supporters of international Human genome Project argue convincingly that mapping the entire genome will help produce new drugs, reduce birth defects and allow us to live longer and healthier lives. The focus of attention so far has been on **discoveries of genes for cancer and other physical illness.**⁶⁴

Families sought to marry their offspring with people of high rank and stature. People from particular religions or races sought their own kind. The highest social classes, the blue bloods, sought to preserve the purity of their lines.

The difference is that in the near future science will give us the power to do it more quickly, more accurately and more decisively, we will select mates not because of some superficial trait like a prominent family : **we will be able to read their DNA as easily as an x-ray.** Nor will we settle for the randomness of sexual blending of sperm and egg. With all its billions of possible combination when we can build desired combination to the letter.⁶⁵

In future a person who complains of depression or anxiety could have a DNA test to check the **serotonin genes**. People with compulsive behaviour such as gambling, drinking, drugs or promiscuous sex, would be checked for **dopamine genes**. Eating disorder or obesity? Look at the **genes for leptin**, the leptin receptor, and its largest. A new technology called DNA chips, already under development by a biotech firm called **afymatrix**, will make **an entire DNA blueprint as easy to read as supermarket bar code.**

Doctors will not be the only ones to read this information, insurance companies, which profit by charging based on risk factors such as smoking would be very interested in genetic predispositions toward addiction or mental disorders. The military, which today rejects people who took medication as teenagers to control attention deficit disorder, might want to know **about genes for rebellious temperament**. Employers might be interested in **genes for loyalty**. Religious orders would be wise to discourage high novelty seekers, while the maker of sport cars would want to forget them with ads. Dating services should have revealing new ways to match people, imagine how excited certain school administrator would be to track students who are bright, troubled or aggressive.

We will all have new ways to understand people and label them, discriminate against them or help them. The technology is coming, how to use it is upto us.⁶⁶

Rather problems with this kind of "*gene therapy*" on brain cells would arise because it usually would be used to clean up damage rather than prevent it, and it is good for only one generation. The best way to **fix a gene** before it is passed on to the next generation is to go into the germ cells in the sperms and eggs, an approach to this germline therapy has already been developed, at least in mice. Now DNA is introduced into the cells that are grown in a culture, then mixed together with natural cells from a early embryo. Some of the resulting babies will have the **engineered genes** in their germ cells and can pass them on to the next generation.⁶⁷

Andrew married a woman he met in college, and they had two beautiful children. Andrew and his wife were thoroughly modern and dutiful parents, reading to their babies and playing classical music in the nursery. Before the children were conceived, Andrew and his wife had gone to their geneticist for routine counseling. **The doctor has offered to run their DNA through the scanner and discuss any modification they might want to consider.** Andrew, of course was opposed to Genetic Engineering, but they were a little concerned Andrew's wife had a brother who was paranoid schizophrenic, a condition with strong genetic roots. The doctor assured them that routine screening would **weed out such obvious flaws in the DNA.** Several mental conditions, obesity, extreme hyper activity, socially

limiting shyness (SLS) and criminal aggression all had been virtually had been virtually eliminated through routine genetic screening before conception. People no longer aborted babies with obvious problems : such babies were no longer conceived.⁶⁸

An example of this experimental switching of genders was shown with two rats, known as Morks and Mindy and recorded on video. Mindy was genetically female and dosed with deprived of testosterone and injected with female hormones. The X rated video of their first encounter, made of UCLA researcher Roger Gorski has a simple and decidedly unromantic plot : Mindi meets Mork, Mindi mounts Monk, Mindi leaves Mork.⁶⁹

Adaption studies suggest that in these cases most of the similarity between relative is **due to genes** rather than specific family environments. For example, the correlation between a biological parents and child is about 15% compared to less than 1% for an adoptive parents and child, websters defines personality as the sum total of the physical, mental, emotional and social characteristics of an individual. Since the 1920's hundreds of family, twin and adoptee studies of IQ have been reported in the scientific literature. The main conclusion is that roughly half of the variation in IQ scores is caused by genetic differences.⁷⁰

It is now technically feasible to take a *gene* from one species and make it part of the genome (genetic 'blue print') of another species. A toxin producing *gene* from a bacterium can be added to come to make it pest-resistant. The *gene* that makes a firefly glow at night can be added to a plant's DNA to make the leaves light up when the crop is ripe. A cow can be engineered to produce a drug in its milk. Human *genes* can be added to a pig's genome so that it grows organs for transplantation to mass without being rejected by the patients.⁷¹

The advances in genetic science raise multiple legal issues that emphasize the need to educate and train legal minds to comprehend and cope up with the challenging task that would arise in the legal field. Acquiring knowledge of genetic science in context of law and law enforcement should be tempered with concern for social and cultural effects of the New Genetics, **so that a human being doesn't come to be viewed as a bundle of mere *gene* cells.** The genetic science instantly brings into sharp

focus that in a human body, besides the human cells that compose its totality, there lies a separate and independent entity, which cannot be seen or analyzed in terms of cells and that entity will alone be concerned with scientific, legal and ethical norms which should be devised to regulate and control the progress of genetic science for the betterment of all human beings and the vast biodiversity that surrounds it. If there be detected genetic component to various traits relating to individual's behaviour, personality including intelligence, anger, aggressiveness and social conduct, anxiety and addiction, let there be devised a *gene* therapy that prompts the mankind towards world peace and economic prosperity. The term trait is meant, in its broadest sense, to include physical attributes, mental or physical abilities, dispositions and capabilities. Most discussed enhancement technology is one in which a person's genome is altered.⁷²

Jaina *karma* theory helps us to understand the complexities of personality traits of human beings. Jainian approach for modifying human behaviour through the practice of right faith, right knowledge and right conduct is also psychological in nature. Compared modern psychological approach through the application of principles of repression, inhibition, redirection and sublimation. Jainian approach is rather an attempt to overhaul the wholeness of an individual. **It involves only psychological approach, a short of non drug theory.**⁷³

Jaina *karma* theory seems to be so sophisticated that it appears to have shown the seed of modern Genetic Engineering. Jaina principle of "*saṅkarmaṇa*"—Ingression propounds the theory that *karma paramāṇa* can be modified through some variation by following principles of Jaina *karma* theory. This clearly indicates towards the possibility of changes in the *genes* in modern times. Jaina *karma* theory had thus paved the way for such transformation in human beings, the ideas of which have led to the development of modern Genetic Engineering.⁷⁴

A lady doctor from America, Louise L. hay—You can heal your life—hay house, 3029 Wilshire Blvd, Santa Monica, A 90404 U.S.A., p. 12-13) The original English version of the quotation is as follows : "Resentment that is long held can eat away at the body and become the disease we call cancer. Criticism as a permanent habit can often lead to arthritis in the body.

Guilt always looks for punishment and punishment creates pain. When a client comes to me with a lot of pain—"I know they are holding a lot of guilt, fear and tension it produces, can create things like boldness, ulcer and even sore feet". I have found that forgiving and releasing resentment will dissolve even cancer, while this may sound simplistic, I have seen and experienced its working.

An excerpt from Ven Dire will be significant in this regard. "The Cancer Conquerors" quoting Grey Anderson. "He discovered how powerful fear, anger and distress are in affecting the immune system. He discovered also that unconditional love, inner peace, giving away love, reducing expectation of others and turning into the powerful effect of meditation and visualization where the seeds for defeating the cancer that was raging in his body.....I recommended that you read this wonderful book and share it with anyone you know who is diagnosed with cancer".

Every worldly soul happens to be confined (not free). The imprisonment is due to bondage of *karma* (*bandha*). Inflow of *karma* is due to *āśrava*, the stoppage of inflow is due to *saṁvara* and the eradication of *karma* is due to *Nirjarā*. *Jīva* can shed the *karmas* and purify his soul with the help of austerities. The six types of *Samvara-samiti*, *gupti*, *yatidharma*, *bhāvanās*, *parīśaha* and *cāritra* will be helpful in eradicating *karma* only if they are carried out with a firm faith in the commands of *Jīna*. The special efforts to destroy *karma* is done through *Tapas* or austerities. Austerity means restraint, which is done willingly by giving away some of the bodily comforts to discipline our mind from passions and pleasures. Austerities are performed at various occasions and in various different ways. All austerities have their own uniqueness.

To achieve *mokṣa* we need the right knowledge, high faith and right conduct known as three jewels of Jainism. Regarding right conduct we must achieve control over our inner desires and reach a single stage where there is no attachment or hatred. Although different people take different vows and despite the outer difference in the observance of these vows, the goal of all is to attain right conduct. As we find in the scriptures there are different vows for monks and nuns and for male and female house holders.

Genetic Engineering is the heritable, directed alteration of an organism. Altering DNA or adding new DNA allow us to change the characteristic of a cell or cells. **Genetics Engineering is the method of transfer a *gene* from the DNA of one species to the DNA of another species. Change of positive characteristic of a cell means to *Samkramaṇa* of *karmas* accumulated with *karma sarīra* available in whole gross body.**

A DNA molecule is like a string of letters, using a four letter alphabets, easily copied when living cells produce. The sequence of letters make sentences, which we call *genes*. One kind of *gene* gives a cell the necessary instructions for making one of the various kinds of protein, used for structures, enzymes, signals and basic mechanisms of life. The other kind of sequence is used as a control mechanism so that a cell can tell when to make which protein and when to do something else. **Altering of protein is the process of *Samkramaṇa* of *karma*.** Scientists learned the language of protein-making *gene* sequences. The language is the same for all forms of lives. If the *gene* for purple hair were introduced into the parental germline cells, then the children could carry the purple hair *gene*.

Every cell of a multi cellular organism contains same blue print of organism but in different type of cells i.e. skin cell, nerve cell, bone marrow cell *genes* operate in different way according to body requirement. **These *genes* are directed by the rising *karmas* to operate according to body requirement. Those *genes* are directed by the rising *karmas* to operate according to nature, duration, intensity and quantity of *karmas* in rise. With the following processes of genetic Engineering we can switch on and off the desired working of *genes*. These can also be said *karma Samkramaṇa* processes—**

Regulation of *gene* expression, DNA finger printing, DNA repair and DNA proof reading, control of enzyme activities, control of cell growth and reproduction, Recombinant DNA Technology, cloning process, *Gene* therapy. *Karmas* can be *Samkramaṇa* by health and promotional measures of *genes*—like eugenics, euthenics, Genetic counseling, change in marriage pattern, specific protein, prenatal diagnosis, screening of new born infants, transplantation organs and tissues and the genetics of antibody formation.

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- ¹ *Dravyasaṃgraha*, 34.
- ² *Dravya Saṃgraha*, 35, *Tattvārthasūtra* IX, 5-9, *Puruṣārthasiddhyupāya*, 202-09.
- ³ *Īryā-bhāsai-sana-dānanikṣepo-tsargāḥ samitayah—Tattvārtha Sūtra* IX.5.
- ⁴ *Samyag-yoga-nigraho guptih—Tattvārtha Sūtra*, IX.4.
- ⁵ *Uttam maksā-mārdavā-rjava-sausa-satyā-samyama-tapastyaga-kincanya-brahmacaryāni dharmāḥ—Tattvārtha Sūtra*, IX.6.
- ⁶ *Anitya-śarana-saṃsāraikatva-ntyatva-sucitva-srava-saṃvara-nirjarā-lokabodhidulabha dharmasrakhyapatva-nucintanam anupreksaḥ—Tattvārtha Sūtra* IX-7.
- ⁷ *Tattvārtha Sūtra*, IX.9.
- ⁸ *Mārgācyavana-nirjarārtham pariśodhavyaḥ Parīśahāḥ—Tattvārtha Sūtra* IX, 8.
- ⁹ *Dās-guptā* : Philosophical Essays, Calcutta university, 1941, p. 179.
- ¹⁰ *HIP*, Vol. I, p. 226.
- ¹¹ Cf. *mukkhena joyanāo jogo savvo vi dhamma-vāvāro-Haribhadra's Yogavimśikā, Kārikā-I*.
- ¹² *Tattvārthasūtra* VII, 2.4.
- ¹³ *Anaśanā-vamaudarya-vṛttiparisañkhyāna-rasaparitāyā-viviktaśayyā-sana-kāyakleśā bhāyam tapaḥ—Tattvārthasūtra* IX-19, *Puruṣārthasiddhyupāya*, 98.
- ¹⁴ *Tattvārtha Sūtra* IX 21-26, *Vyākhyāprajñapti* 25.7.802.
- ¹⁵ *Prāyaścitta-vinaya-vaiyāvṛtṭya-svādhyāya-vyutsarga-dhyānāny uttaram—Tattvartha Sūtra* IX, 20) *Puruṣārthasiddhyupāya* 199, *Vyākhyāprajñapti* 25.7.802.
- ¹⁶ *Sa gupti-samiti-dharma-nupreksā-parīśahajaya cāritraḥ, Tattvārtha Sūtra*, IX.2.
- ¹⁷ *Tattvārtha Sūtra* VIII 3 with *Bhāṣya*.
- ¹⁸ *Ibid*, 4, *Niyamasāra* 70; *Pravacanasāra* III.40).
- ¹⁹ *Ibid*, 16 with *Bhāṣya* and *Ṭikā*.
- ²⁰ *Ibid*, 19-31, *Ratnakaraṇḍaśra Vokācāra*, 66.
- ²¹ *Ratnakaraṇḍaśravakācāra*, 67.
- ²² *Upāsakadaśāṃgassūtra* I.11; *Ratnakaraṇḍaśravakācāra*, 51 : *Tattvārtha Sūtra* VIII.21.
- ²³ *Ratnakaraṇḍaśravakācāra* 150; *Puruṣārthasiddhyupāya*, 40.
- ²⁴ *Samyagdarśana-jñāna-cāritrāṇi mokṣamārgaḥ—Tattvārtha Sūtra—I.I*.
- ²⁵ *Uttarādhyayana Sūtra* XXVIII, 30.35-36, *Sūtrakṛtāṃga* I 12.11; *Viśeṣāvaśyakabhāṣya*, 3, 1126, 1158.
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- ²⁷ *Pravacanasāra* I.7.

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