


SAIAE News Bulletin

South African Institute of Agricultural Engineers **October 2007**

Welcome to the October 2007 issue of the SAIAE News Bulletin. The next issue will be the last issue for this year, namely the Christmas edition.

There are two aspects to note in this issue: Watch our masthead, the photo's will vary from issue to issue - so if you have an interesting photo to feature, please let us have it. Secondly there are no news from the Council, but we kick off with the very interesting article of Prof Lyne on the vehicle scheduling system with its various advantages.

We also feature Part 1 of Neil Lecler's article on the overview of water-related research at SASRI with some challenges in the water sector.

Also read the interesting snippets from the UKZN: A Memorandum of Agreement was signed with the IRD; the students of the IRD are really trying to make a difference; Prof Bawa was inaugurated and he wishes that the 'benefit must flow both ways'.

SAIAE also expands its knowledge with an international speaker, Prof. Singh at their function in August 2007.

Friedel Endeman tells about some other, more human engineering, namely the technological masterpiece - the human body!

Enjoy!
Editor.

Challenges of Implementing a Vehicle Scheduling System

Prof Peter Lyne Pr. Eng.

It has been shown that a centralised vehicle scheduling system will have several advantages, for example, regular deliveries at mills with minimum no-cane stops. Furthermore, with fewer vehicles in the system the result should be the maximum utilisation of vehicles and reduced haulage costs for the grower. In contrast, the existing transport system has inefficiencies such as extended cycle times and numerous no-cane stops. Furthermore, over-fleeting within the system translates into higher transport rates, and limits the profitability of a transport operation.

SASRI has been involved with Crickmay & Associates and SA Canegrowers in a SLIP programme exercise in the Darnall and Malelane Mill area, where centralised scheduling systems have been implemented. Some of the problems experienced during these scheduling exercises are highlighted.

Cane availability at zone

In the existing cane transport system, many growers have become accustomed to having specific 'windows' for delivery. This arrangement suits their operation for one reason or another. Some growers with

entrenched rights prefer to deliver during the day only. In a centralised system, stock must be available at the zone whenever it is needed, and growers must therefore be prepared to operate differently to allow the system to function.

Greater communication required

Currently the various stakeholders in the transport industry operate fairly independently; hence the need to communicate with each other is not crucial. This perspective has to change in a centralised system, as any action by any stakeholder has an impact on the system.

Non-scheduled members

Ideally all growers should be part of the centralised system, but as was the case with the Darnall experience, the system may have to cater for people who do not want to participate in centralised scheduling. The more people operating outside of the system, the less flexible the system becomes.

Physical and contractual constraints

There are currently a large number of contracts in place that govern the relationship between the various hauliers and growers. With the present arrangement, specific hauliers service specific growers, and operate within specific routes. To gain maximum advantage from the centralised system, hauliers will have to cross over previously defined boundaries.

Information system issues

Within the transport system there are several separate computerised systems, each operating independently: the actual vehicle scheduling system, the mill LAN and LIMS. Some interfacing is necessary to derive the maximum benefit from the information provided by each system.

Cycle delays

While the scheduling may allow a certain time period for delivery from a certain location, delays are sometimes introduced which interfere with the expected times of arrival. Closer management and discipline can quite often resolve the issue. Further, any delays must be communicated back into the system, so timeous adjustments can be made. Commercial GPS based systems are available to automate this requirement.

DRDs to loads per day

Stakeholders are customary to the daily rateable delivery protocol. They may have to adjust their thinking in terms of 'loads per day' rather than 'tons per day' which is more appropriate in the new system.

Mindset change required

Given the complexities of these challenges, one may be tempted to think that moving to a new system is too much trouble. The reality is that all the problems described above are issues that can be resolved. It does, however, call for some flexibility and a mindset change.

In order to reap the economic benefits of a centralised scheduling system, people must be prepared to adopt a new approach to cane transport. Studies conducted at SASRI show that there can be significant savings per mill area, so it therefore makes sense to improve our transport system and save millions of Rands.

Overview of water-related research at SASRI – Part 1

Neil Lecler

The sugar industry invests in water related research which has both strategic and tactical importance. An overview of the water related research to which the South African Sugarcane Research Institute (SASRI) is giving attention follows:

The integrated nature of water resources management is shown in the figure below. What happens in the field has an impact on the catchment and what happens in the catchment impacts on the field.

Thus, assuming an irrigated context, having a field with the best, disease-free varieties and the healthiest of soils is of little value if there is no water in the dams or rivers to irrigate the fields.
Running dams dry has happened, for example, in the Zimbabwe sugar industry in the early nineties. Consequences can be severe, with thousands of people losing their jobs and livelihoods. Thus, it is important to focus research at a level that is not just at the field.

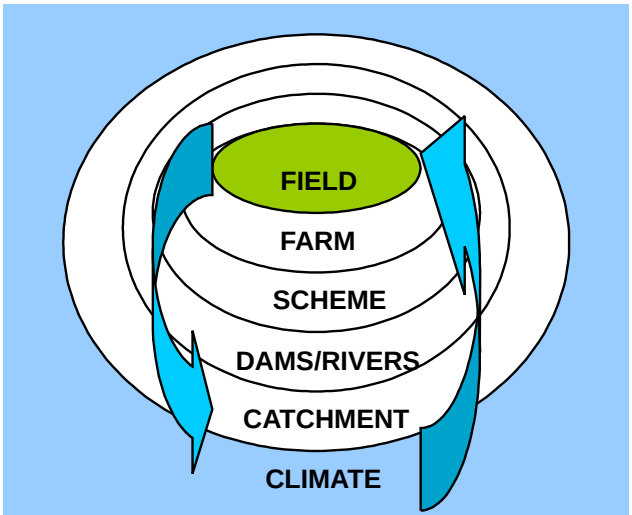
The field has to be considered in the wider context of the catchment, and even in the context of a changing climate, with the effects of global warming threatening. With reference to catchment management, there have been major changes in legislation.

Implementation of the 'new' South African Water Act of 1998 promises amongst other things:

- Water allocation reform (WAR)
- Formation of catchment management agencies (CMA's)
- Issuing of water licences and potential to issue licences for streamflow reduction activities

Some of the challenges in the water sector include:

- Limited availability of water and the need for reform in water allocations
- Water resource planning issues
- The development and implementation of institutional arrangements which provide incentives for water conservation
- Development and implementation of operational strategies, procedures and systems to help ensure equitable, efficient and effective water utilisation
- Global warming and climate change
- Development of ecologically sustainable farming systems which ensure returns per amount of water used
- The replacement of entrenched ideas and systems which are no longer optimal.



The integrated system for water management

The research response to these challenges needs to be at both catchment scale and at the field scale, and to support both strategic and operational decision-making.
Through the appropriate development and integration of hydrological (rainfall-runoff), network analysis (complex water supply and demand accounting), irrigation and crop yield models, various scenarios and planning studies can be undertaken. For example, the consideration of different water allocation amounts, reservoir operating rules, irrigation systems/scheduling approaches, potential streamflow reduction activities and the impact on all of these by climate change. There are many questions that need to be addressed by such systems. Existing water resource planning tools and methods used by DWAF cannot answer all these questions adequately. SASRI is therefore collaborating with local and international consultants, universities and the Water Research Commission, in an effort to contribute to the development of appropriate water resources planning and operational tools and systems. Particular areas of interest are water allocation and licensing, potential streamflow reduction activities and the support and promotion of innovative institutional arrangements such as fractional water allocation and reservoir capacity sharing/water banking, which offer attractive incentives for more efficient and effective water use.

UKZN Snippets

Swastika Maney

UKZN collaborates with French research institute

The University of KwaZulu-Natal and L'Institut de Recherche pour le Dévelopment (IRD) recently signed a Memorandum of Agreement that involves collaboration on issues surrounding land degradation. Over the next four years, the School of Bioresources Engineering and Environmental Hydrology, based on the Pietermaritzburg campus, will host a cohort of French scientists from the IRD. The overall goal of their initial project is to address poverty and enhance environmental security through the assessment of different aspects of land degradation and the development, promotion and adoption of strategies which enhance the productivity of degraded land. Their research will focus on understanding hillslope soil erosion dynamics and local and regional effects of land degradation on runoff, sediment transport and rehabilitation. This will initially involve work in the headwaters of the Thukela Catchment in the Potshini Catchment, which is the site of the School's ongoing Smallholder System Innovations Research programme.

The IRD is a French public science and technology research institute that conducts scientific programmes contributing to the sustainable development of countries of the South, with an emphasis on the relationship between humans and the environment. In this way, the IRD scientists at UKZN hope to make a difference in people's lives. They aim to provide solid foundations for the implementation of science-based land and water resource management. This will ultimately improve the livelihoods of the people in the upper catchments of the degraded and overgrazed lands in KwaZulu-Natal.

At a function inaugurating the agreement, Professor Bawa emphasised the importance of establishing new linkages. He said that in the past the University has tended to reach out to the United Kingdom and the United States, but that it is now spreading into new areas. “Linkages with institutions in France and other parts of Europe open up new vistas for us”. Jean-Marie Fritsch, head of the IRD's South African operation, commented on the crucial role partnerships such as this one play in the way in which they do business.

Professor Bawa said that the Memorandum of Understanding with the IRD is more than just an intellectual engagement; it deals with local development issues that constitute some of South Africa's major challenges. He expressed the hope that the benefit UKZN receives from such a partnership is counterbalanced. “The benefit must flow both ways”, he said.

News from the branches

SAIAE expands its knowledge

SAIAE Pretoria branch had a successful evening held at ARC-ILI on 20 August 2007, with an international known speaker in the food industry, Prof R. Paul Singh, present at this event.

Mr FP Dafel, Chairman of the Pretoria branch, presented a talk on the new CPD credit system that is currently being implemented by ECSA. He informed the SAIAE members about the new system, how to earn credits, when the members must renew their registration, where can they find the information and how to enter the data. This was a good informative presentation and much relevant to all the members.

Professor Paul Singh was the next speaker to amaze us, with his highly sophisticated work done with the cooling of agricultural products. Prof Singh is a Professor at the University of California, of the Department of Biological and Agricultural Engineering and the Department of Food Science and Technology. Prof Singh presented a talk on the thermodynamic aspects involved in the cooling of agricultural products. The mathematical formulas that were developed to determine the heat transfer between air and the product was explained to the audience as well as the innovative methods to prove the developed formulas.

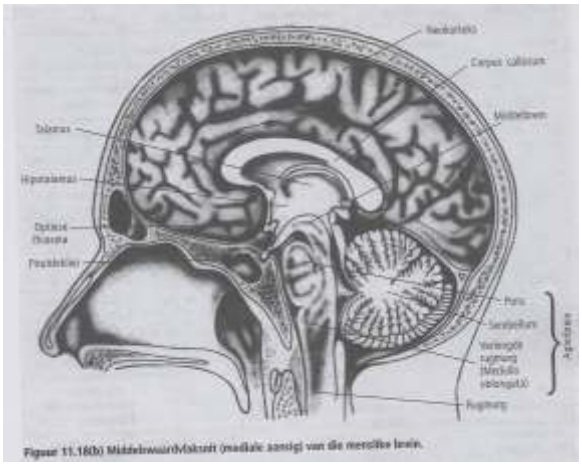
The talk form Prof Singh was based on a case study that they did on strawberries. The strawberries are harvested and placed directly into the final packaging. The packed product is placed in cartons and stacked onto pallets. The case study focused on the cooling of the strawberries by means of forced cooled air over the product as it is stacked onto the pallets. Prof Singh explained how the airflow and cooling was modeled and measured in the individual packaging and over all the pallets.

It was a great learning experience to listen to someone who is working on such a high technical level and with innovative solutions to their challenges.

More information on the new CPD credit system, can be gathered from ECSA's website at: www.ecsa.co.za

Engineering of the human body

Friedel Endemann Pr Eng.



1. Introduction

The human body is one engineering masterpiece, a perfectly designed physical, chemical and electrical structure, or 'machine'. Its design and structuring was nothing but a miracle. It incorporates most basic formulae, principles and laws of engineering, physics and mathematics. To some extent also electrics and electronics, all in a superb manner.

For reproduction, this amazing body is still miraculously developing from only one fertilized cell with a combination of genes and DNA strings into a perfect human being, in mother's womb. This is not surprising, since it was designed by the perfect Creator, Who does not make any mistakes and Who founded all existing laws of nature, which is the basis of the entire universe, also created by Himself.

2. Macro composition of the body structure

2.1 The skeleton.

This forms the basic structure of the body and is supported and manoeuvered by a complicated system of some 650 muscles. The adult human skeleton consists of some 206 different bones, of which most are in pairs, symmetrically arranged in both sides of the body, each with a specific purpose.

2.2 The brain.

This is the main and most important and wonderful component ('computer'), of the body, with the main portion housed in and protected by the scull. It extends down into the spinal marrow, housed in and protected by the back bone. It manages all the other components of the body with the uniquely designed structure, 'soft ware', programming and a most high tech 'electrical wiring' system.

2.3 The limbs (head, jaw bone, neck, back bone, arms, hands, fingers, legs, feet, toes).

These are all the moving parts of the skeleton, held together by a superbly designed set of joints or wrists, (acting mainly as 'hinges' and 'ball joints'), supported and controlled by a complicated muscle-, ligament- and sinew system.

2.4. The muscles, ligaments, sinews, diaphragms and fibre tissue.

The first three, amongst others, support, move and control all the moving parts of the body, comparative to a sophisticated set of single action hydraulic and pneumatic cylinders and springs acting on a set of hinged

components (bones). Latter two mainly assist in containment and support of the organs, glands and other components of the digestion system.

2.5. The digestive system (mouth, stomach, gall bladder, pancreas, liver, intestines).

This is the main food ('fuel') intake and physical/chemical 'processor', processing (mixing, screening, filtering, refining, converting, digesting) 'crude fuel' and water into purified, usefully composed liquid, 'fuel' for energy, and waste.

2.6. The bladder and colon

This is the 'exhaust system' ('waste tank and -bin') containing the waste of processing and purification.

2.7 The organs (hart, lungs, liver, kidneys, pancreas, testicles, ovaries).

These are the secondary chemical and physical working, generating and/or processing components, with the heart being the second most important component of the body and the lungs being third.

2.8. The sense organs (eyes, ears, nose, tongue, skin and / or tissue under the skin).

These are the observing and/or detecting components, such as cameras, microphones, detectors, sensors, scanners etc.

2.9 The glands.

These are the components of a very sophisticated physical/chemical generating, releasing and 'injection' system of the body.

3.0 The nerve system

This is the 'electrical- and electronic wiring system', 'driving' all the components of the body from the 'computer' in a driving or 'motoring' mode and from a 'scanning' system of receptors ('sensors') in the body back to the computer in a sensorial mode.

3.1 The blood and vein system.

This can, most simply, be seen as analogous to the lubrication system of an engine, feeding oil from a pump to all moving parts. Also in conjunction with a small subsoil water drainage system similar to that of a bowling pitch. The blood is the most important substance in the body, performing multiple functions in **all** the actions of the body components. Most important of which is probably the energy and oxygen supply to the 'computer'.

3.2 The skin.

This is the protective cover for the tissue of the entire body, somewhat similar to the paint of a motor car body or the casing for sensitive electronic equipment. It is, at the same time, also the 'heat exchanger' between the body and surrounding air.

Functioning of the components of the body, (from an engineering point of view).

3.3 The skeleton.

This is the supporting framework for the entire body structure, permitting only the deskinning and deboning of the meat, to movement.

Observing and analysing the bone design and -structure, it is also clear that most principles and formulae of the engineering subjects strength of materials and structural design had been incorporated long before they had been formulated.

3.4 The brain

This 'computer' has a much larger, uncomparable, most comprehensive computing capacity than any other known computer. It does not require any upgrading, replacement of components, loading of soft ware and operates by itself without the use of an external operator. It can even think and reason for itself, because the operator is the human mind, which is part of the superb computer system. This is the portion of which least is known, totally out of bounds for human understanding.

The brain has two major compartments, left and right, and its function is permanently split between a fully automatic mode (the subconscious) and a 'manual' mode controlled by the 'owner', which is the human mind. The former is programmed to have automatic control over the unvoluntarily functions such as the heart ('pump'), the digestion system and the 'unplanned' 'scanning' and / or sensing and reacting actions, through the 'wiring harness'. It is to some extent comparable to the auto pilot system of modern aircraft.

The latter manages all the 'planned' actions according to the will of the 'owner', also through the 'wiring harness'. All arbitrarily movements of the body is managed by the

mind, while all static actions such as maintenance of systems, changes, responses, all gland actions etc are managed by the automatic mode. The composition and functioning of the blood is managed by the brain (computer). It must scan the blood on a continuous basis to monitor and adjust as required, the 'loading' (c o m p o s i t i o n a n d 'charge') of the blood, immune system etc. The 'computer' must continuously read, analyse and convert into comprehendable 'signals' for the mind and the other components it serves, all 'signals' received from sensing organs, 'sensors', detectors and ‘scanners'.

The body can heal ('repair') itself after injury in almost every area, except the brain, spine and nerve system. This is of such delicate design and construction that it is, to a large extent, irreparable after physical damage.

3.5 The limbs

These are the attachments allowing the body to be a normal 'machine' in terms of mobility, working, operating, 'fuel' intake etc. The design of each i. t. o. structure, attachment and movement is completely functional to make the normal body versatile and almost fully independent.

The structure of the arm from the shoulder joint to the fingertips is the most versatile 'tool' for the body. The complete construction can act like a crane with vertical and lateral movement with hoisting. The hand is like a 'grab' for the 'crane' or vice grip and with the fingers it can do the finest piece of work.

3.6 The muscles, ligaments and sinews.

Apart from functions discussed above, the neat design, composition and grouping of these is such that the entire skeleton framework is held together, supported and balanced with every movement of the body. If it was a man made machine with only part of the flexibility in structure and

movement, this would have required a countless number of cylinders, springs, fixtures and welds.

Considering that the back bone is the only connection between the upper and lower parts of the skeleton and the weakest link in the skeleton and what a weight lifter athlete can do, it is clear how perfectly the muscles and associated components are arranged.

3.7 The digestive system.

The broad, basic function has been mentioned above. The processing entails the very complex process of secretion and 'injection' of several chemical substances (such as enzymes and hormones) by numerous glands and the pancreas, liver and gall bladder. This is comparable to a computer managed system of sensors and injectors, injecting ingredients and catalysts into the contents of a processing tank or channel.

During 'processing', usable and required nutrients, trace elements of minerals, vitamins, liquids etc are isolated and absorbed in the peritonium and sophisticated structure of the 'walls' of the intestines from where it is transferred into the blood through a very sophisticated process. It is unlikely that these processes could ever be copied and imitated to perfection by engineers, physicians and scientific chemists.

3.8. The bladder and colon.

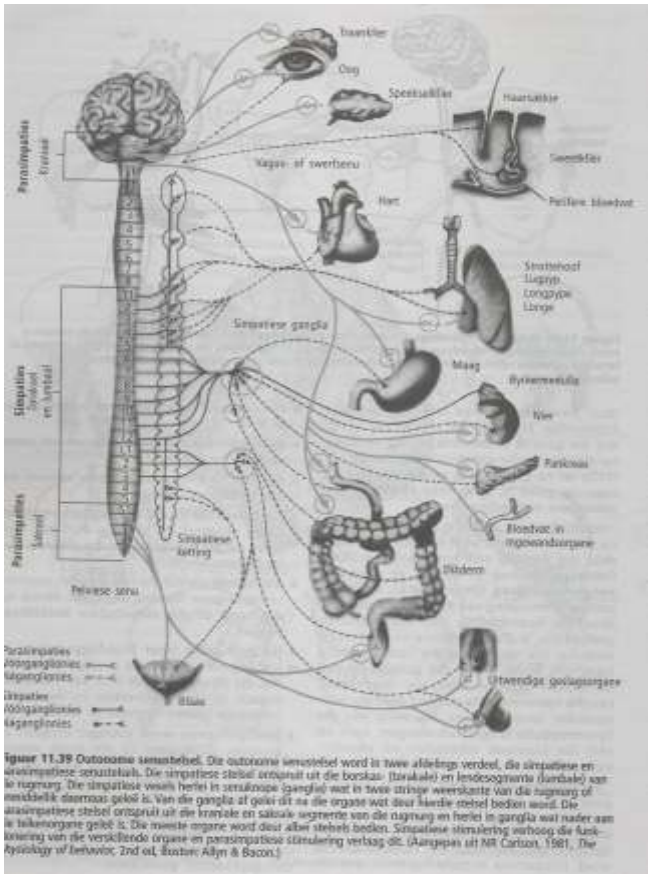
Unusable dissolved substances of liquids in the blood are filtrated out by the kidneys with water and drained into the 'waste tank' (bladder). When full, the bladder is emptied under full control of the 'manual' mode of the 'computer'. For the purpose, the bladder is equipped with a very effective 'valve' system in the outlet system. In the retention mode, latter is partially controlled by the 'automatic' mode of the 'computer'.

Unneeded and indigestible ingredients of the 'fuel' after digestion are transferred as waste to the lower part of the colon, the rectum ('waste bin') where it is accumulated and disposed of as required. Also the rectum is equipped with a very effective 'valve' at the bottom, fully controlled by the 'manual' mode of the 'computer'.

3.9 The organs

All the organs are managed by the 'automatic' mode of the 'computer', with expansion and contraction of the lungs with expansion of the chest, automatically being switched to the latter mode only when the 'manual' mode is put 'at rest'.

- **The hart** is nothing other than the equivalent of two coupled positive displacement diaphragm pumps with suction- and non return delivery valves, feeding into two separate perfectly designed and equipped 'pipe (or tube-)' systems, the veins, also equipped with 'check valves' to prevent reverse flow. It pumps the blood under pressure to all the



Figuur 11.39 Outonome senustelsel. Die outonome senustelsel word in twee afdelings verdeel, die simpatiese en parasimpatiese senustelsels. Die simpatiese stelsel ontspruit uit die borskas- (torakale) en lendesegmente (lumbale) van die rugmurg. Die simpatiese vesels herlei in senuknope (ganglia) wat in twee stringe weerskante van die rugmurg of middellyf daarmee gekoppel is. Van die ganglia af gaan dit na die organe wat deur hierdie stelsel bedien word. Die parasimpatiese stelsel ontspruit uit die kraniale en sakrale segmente van die rugmurg en herlei in ganglia wat nader aan die teikenorgane gelee is. Die meeste organe word deur albei stelsels bedien. Simpatiese stimulering verhoog die funksionering van die verskillende organe en parasimpatiese stimulering verlaag dit. (Aangepas uit NR Carlson, 1981, The Physiology of behavior, 2nd ed, Boston: Allyn & Bacon.)

cell structures in the body, from where it is returned to the suction side of the 'pumps'.

The hart is in fact also a low voltage power generator, of which the potential difference between two points (voltage) can be measured with a galvanometer. Muscle action in the hart with the pumping movements generates this power and this is the basis for measurement of irregularities in the 'hart beat' with an electro cardiograph.

As mentioned above, the 'pump' is solely managed by the 'automatic' mode of the 'computer'. Each 'hart beat' is signalled by an electrical impulse from the 'computer'.

- **The lungs**.

They are the 'gas exchangers' of the body. Fresh air is drawn into the lungs by expansion of the walls and within split seconds distributed into the many small air pockets (like balloons), the alveoli, where the oxygen molecules are separated and the gas exchange between the blood and the air takes place. Oxygen is transferred into the blood and at the same time and similarly, the product of the internal combustion process in the body cells, warm carbon dioxide, is transferred from the blood into the air, from where latter is breathed out.

This happens through a sophisticated process of diffusion through two membranes in the 'walls' of the alveoli, also a process unlikely possible to be copied to perfection.

- **The liver**

This is in fact also a gland, the biggest in the body and the organ with the largest diversity of activities. A.o. it produces and store certain food- and non-food elements, stores blood, secretes, 'injects' gall into the gall bladder as part of the digestion system. Together with

the kidneys, it also forms the 'purification system' of the body, with the liver screening and transforming toxic and unwanted substances from the ‚fuel'. All the many sophisticated functions of the liver are managed by a system of 'sensors' and 'electronic signals' via the auto mode of the 'computer'.

- **The kidneys.**

They screen the blood through a complicated process of pressure filtration, selective re-absorbtion of wanted substances and secretion, thereby extracting some water loaded with unwanted substances, as urine. This 'waste' is then drained into the 'waste tank' as mentioned above.

These processes incorporate high tech physical-, mechanical-, chemical- and 'electronic' actions.

- **The pancreas.**

This is actually also part of the gland system in that, a.o. it produces and 'injects' enzymes into the digestion 'channel' and a hormone (insuline) into the blood, converting sugar into 'refined' blood sugar, which is 'injected' into the body cells, for energy. These 'injection' processes are once again very sophisticated transfer processes through the membranes.

- **The testicles and ovaries**.

They are primarily producing cells for reproduction purposes, which in itself has no real bearing on the subject. However, they also produce very important hormones which are 'injected' into the blood, similar to the glands. The function is comparable to some automated injection system for catalysts into a manufacturing or similar

process.

3.10.The sense organs.

Together they act as an observation or searching 'tool' for the body. It senses all the odours, images, sounds in the immediate vicinity, also feel and taste if within reach. Observations are sensed by 'electrical sensors' and from there to the 'computer' via the 'sensorial wiring harness' to react accordingly and as necessary.

It may, to some extent, be compared to internet viewing and -communication on a PC, or a security system connected to a computer.

The eye is nothing else than a camera, with one difference in that it requires lubrication between the 'shutter' (eyelid) and the eye ball. When the eyelid lifts, a tear gland in the outside corner of the eye 'automatically 'releases a small tear drop on the ball and when it closes this drop is spread over the ball to the opening of a tube in the other corner of the eye through which redundant liquid is drained into the nasal channel. Perfect continuous lubrication!

The ear is a mechanical 'microphone'. Almost similar to the electronic amplification of the signal of an ordinary microphone, the sound waves from the ear drum is 'orchestrated' and amplified by a neatly designed set of three small suspended bones between the former and the 'sensor'. The air pressure on both sides of the sensitive ear drum is balanced through a tubular connection between the inside of the drum and the nasal channel. Yet another 'smart' design!

3.11 The glands

There are numerous glands in the body, each one or group responsible for the production of a substance which is required for the effective functioning of the body systems. They differ from man made releasing and injection systems in that each gland is in itself also a small 'factory' manufacturing the substance to be released or injected. That is done from energy and nutrients supplied by the blood. The rate and timing of release is determined by the state and condition of the environment or substance into which they must release or 'inject' and that is picked up by 'electrical sensors', similar to that in any processing facility.

Here the thyroid gland with multiple functions and a.o. managing the metabolism of the body through 'injection' of a special hormone into the blood, is probably the most well known.

3.12 The nerve system.

As already discussed, the functioning is basically the same as an ordinary electrical wiring system. In its simplest form, all 'signals' from the sensing system (receptors) are conducted to the 'computer' for conversion and 'signals' (impulses) from there selectively to any 'working' component in the body. This either to or from the 'manual' or 'automatic' section, depending where the sensing 'signal' was generated and the response required.

The reason for the extension of the brain into the spine is probably to extend the nerve connecting area and shorten the nerve connection ('wiring') to the lower body components.

The time taken for the return signal to reach the reacting component after conversion in the brain, is clearly demonstrated with the accidental touch of a hot plate! It also clearly illustrates the analogy to an electrical wiring system.

An ordinary automated and computerised system can perform a basically comparable function, but certainly not serve so many outlets at the same time. Considering the number of different 'sensors' and detectors sending signals to the 'computer' (basically from each cell or group of cells) and the number of outlets to be served after conversion, all through the 'wiring harnesses' of the nerve system, it is unlikely that any modern, most high tech designed wiring diagram can match that of the entire nerve system.

If an electric wire is cut, the piece of equipment it drives is 'dead'. However, such wire can easily be rejoined. Similarly, if a nerve is cut, the body component it 'drives' is 'dead'. But, the construction of a nerve is so delicate that it can not be rejoined or repaired.

3.13 The blood and vein system

This is the one system in the body which can not be matched even closely comparable by any man made system in any application. Nothing but liquid (the blood) can perform so many 'programmed' functions in so many ways and for so many purposes. There is no other liquid flow system that can be 'scanned', adjusted, 'charged', 'instructed' and 'directed (managed) in o many ways and to such an extent. A book is required to describe the total management and functioning of the blood.

The immune system of the body is also totally contained by and managed in the blood. This

alone is an engineering study of its own.
Basically the blood serves all the body cells in all the cell structures with all the needs and requirements for performance and / or adjustment. This by 'instruction' and 'charge' and in conjunction with the lymphatic system, in a most delicate process. Most important is probably supplying blood sugar for energy and oxygen for 'combustion' or oxidation.
Structuring for the purpose, of the branching of the large veins from the hart into micro tubes (capillaries) through the body cells and converging again into large veins back to the hart, is a construction wonder by itself. It is estimated that a strip of muscle with thickness of a pin can contain some 500 to 600 parallel capillaries.

3.13 The skin

The function is basically as per the description above. It performs an excellent function as 'heat exchanger' and temperature regulator for the body, unlike any man made cover. Like most other cell structures in the body, it can repair or partially replace itself 'by instinct'in case of injury.

4. Conclusion.

No matter how long ago it happened and despite all other theories, the human body (and those of other species) did not just originate from 'nothing' in some sinister way it was wonderfully designed and structured and it is unthinkable that any human being can harm or destroy this masterpiece of his/hers with abuse or drugs, even with tobacco.


CONTINUOUS TUMBLE ROASTER
Roasting of ANY NUTS
Roasting of ANY GRAIN
Corn Roasting
Soy bean Roasting
Coffee Roasting
Evenly roasted products
• Revolutionary simple concept
• Almost maintenance free
• Continuous Roasting
• Energy efficient
• High Reliability
• Many new product possibilities
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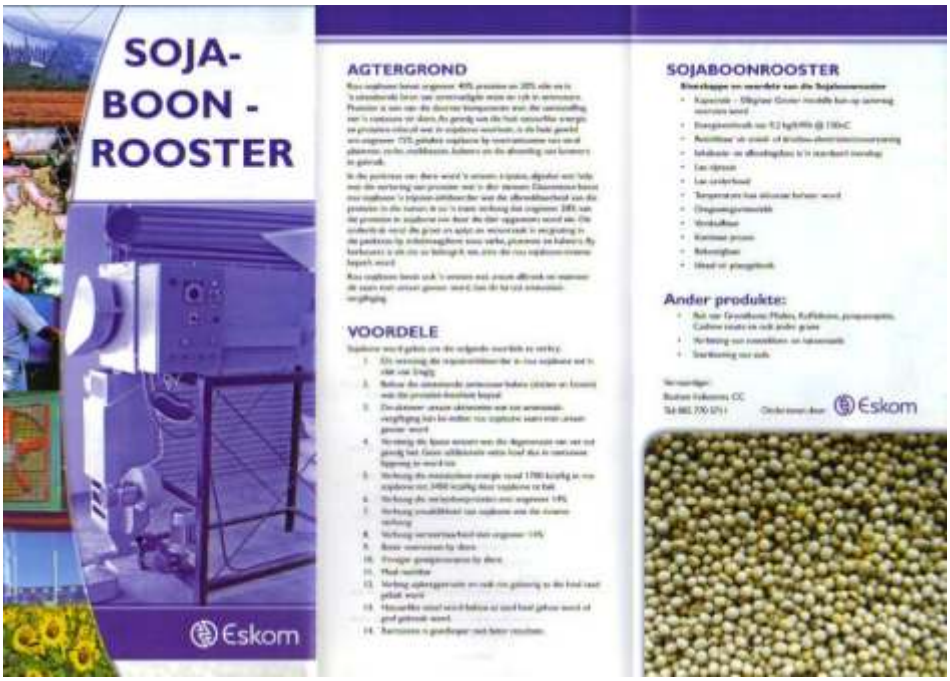
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SOJABOONROOSTER
Ander produkte:
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