BIOCHEMISTRY OF VISION

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The Sense of Vision

In general, all living things respond to the stimulus of light. Almost all multicellular organisms have specialized light receptor cells in which light energy can cause changes in a light-sensitive pigment. In most invertebrates, the light receptors do not function as eyes and as a result, they are unable to form images. However, they are able to perceive the presence of light and can detect any changes in light intensity. As a result, some of these receptors can give no indication of the direction of the light source and hence the animal responds mainly by random movements. However, there are some cases in which light receptors are arranged in such a manner as to indicate direction (Keeton and Mc Fadden 1983). One of the earliest forms of 'vision' is known as 'phototaxis' which is a light-controlled motion. This phenomenon has been observed in some photosynthetic bacteria such as *Chromatium*, which move selectively towards illuminated areas rather than dark places. The exact mechanism of this movement is unknown; however, it is likely that the energy needed to move is provided by the light which produces adenosine triphosphate (ATP) in the photosynthetic process. Hence, the bacterium cannot move in dark places since there is no production of ATP. However, the organism will start moving again as soon as it finds an illuminated area (Suppan 1994).

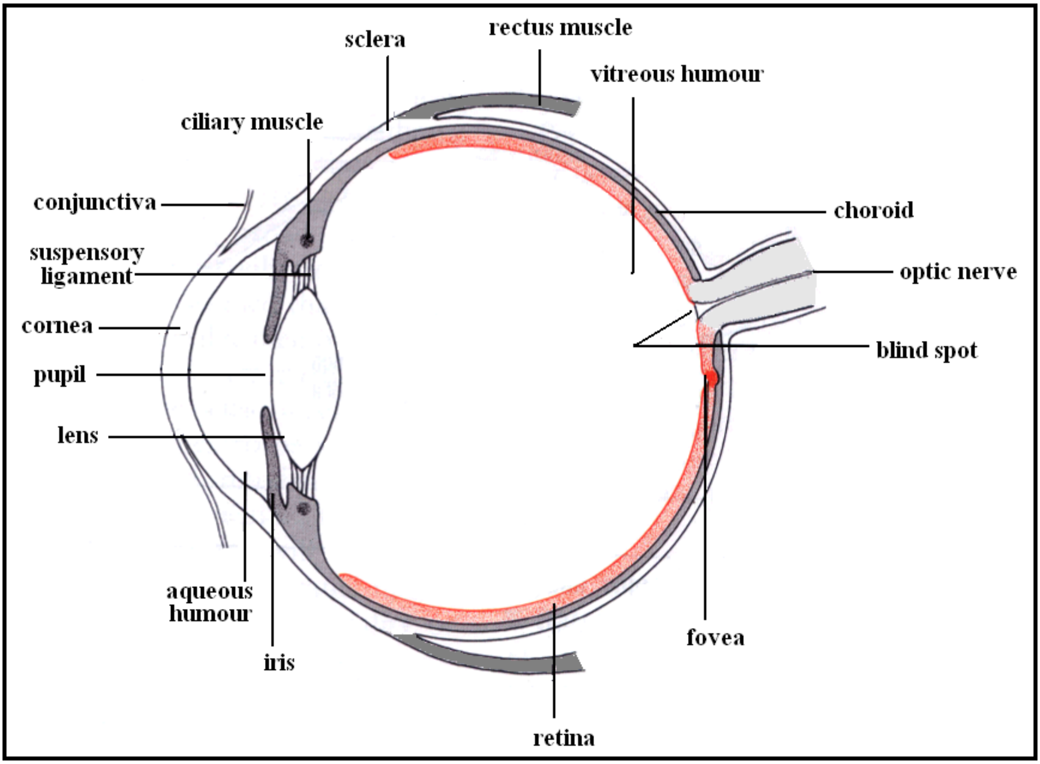
In higher life forms, they have more complex eyes that generally have a lens which is capable of concentrating light onto a photosensitive area. This increases the sensitivity of the eye to dim light. It also increases the ability of the eye to perceive direction and movement. The light from each source is focused onto some of the receptor cells at any moment. There are basically two different types of image-forming eyes in animals; compound eyes and camera-type eyes. Many insects and crustaceans have compound eyes which utilise many closely packed lenses. Each lens is connected with a few sensory cells to form a functional unit known as the ommatidium. The formation of images depends on the pattern of light that falls onto the compound eye's surface. The ommatidia point in various directions and as such will be stimulated by light from different points. Therefore, the brain integrates all the messages received from the various ommatidia and it apparently creates an image that corresponds to the total of many smaller images (Keeton and Mc Fadden 1983). Various animals such as molluscs and vertebrates posses a camera-type eye which uses a single lens system to focus light onto a photosensitive surface, known as the retina, which functions similarly to a piece of photographic film (Keeton and Mc Fadden 1983). The recognition of the shapes of objects involves the formation of an image on this photosensitive area (Suppan 1994).

For humans, the term 'vision' is a complex process of information regarding the environment of a living organism (Suppan 1994). The human eye is capable of detecting a variety of colours, forming images of objects miles away, and responding to as little as one photon of light. However, it is actually the brain that 'sees'. In order to understand vision, it is necessary to know how the eye generates sensations, and then follow these signals to the visual centres of the brain, where images are perceived. Hence, this article will focus mainly on vision in humans.

The Human Eye

The shape of an adult human eye (Figure 1) is like a globe with a diameter of approximately 2.5 cm, that fits into the bony sockets in the skull. The globe of the eye or eyeball is a three-layered structure which consists of sclera, choroid and retina (Clegg and Mackean 2000).

Figure 1: Longitudinal section through the human eye.



The sclera is a tough but elastic, white outer layer of connective tissue. At the front of the eye, the sclera becomes the transparent cornea, which allows light to enter the interior of the eye and functions as the first constituent of the light–focusing system of the eye (Keeton and Mc Fadden 1983). A delicate layer of epithelial cells forms a mucous membrane, known as the conjunctiva, which covers the outer surface of the sclera and helps to keep the eye moist (Clegg and Mackean 2000). The choroid is a layer of darkly pigmented tissue through which many blood vessels pass and is located just inside the sclera. The choroid is important since it provides blood to other parts of the eye and it functions as a light absorbing layer which prevents internally reflected light from blurring the image. At the immediate back of the junction between the main part of the sclera and the cornea, the choroid becomes thicker with smooth muscles embedded; this part of the choroid is known as the ciliary body. The front choroid forms the donut-shaped *iris*, which gives the eye its colour. The iris consists of smooth muscle fibres arranged in circular and radial directions. By changing size, the iris regulates the amount of light entering the pupil, the hole in the centre of the iris. The pupil is reduced when the circular muscle fibres contract and it is dilated when the radial muscle contract (Keeton and Mc Fadden 1983). Just inside the choroid, the retina forms the inner most layer of the eyeball and contains the photoreceptors (Clegg and Mackean 2000).

The photoreceptors are of two types, referred to as rods and cones. The rod cells are abundant toward the periphery of the retina while the cone cells are abundant in the central portion of the retina. The bipolar cells which are short sensory neurons synapse with the photoreceptors in the retina. The bipolar cells synapse in the retina with longer neurons, i.e. ganglion cells, whose axons form the optic nerve that runs to the visual centres of the brain. There are several sets of synapses present in the retina, which allows the eye to modify the information transmitted from the receptor cells to the brain (Keeton and Mc Fadden 1983). There are no rods and cones present in the optic disc, and as such this region on the lower outside of the retina is a blind spot, i.e. light focused on that part is not detected. The theoretical line through the centre of the lens is referred to as the optical axis (Clegg and Mackean 2000). The fovea or "yellow spot" lies on the optical axis and is the place of most acute vision. This portion contains many cones but few rods (Vines and Rees 1972; Clegg and Mackean 2000).

The second constituent of the light-focusing system of the eye is the lens which is suspended just behind the pupil by a suspensory ligament attached to the ciliary body (Keeton and Mc Fadden 1983). The lens and the ciliary body divide the eye into two cavities. The ciliary body constantly produces the clear, watery aqueous humour that fills the front cavity of the eye. The back cavity, filled with the jelly-like vitreous humour constitutes most of the volume of the eye. The aqueous and vitreous humour function as liquid lines that helps focus light onto the retina. The lens itself is a transparent protein disc that focuses an image on the retina (Vines and Rees 1972).

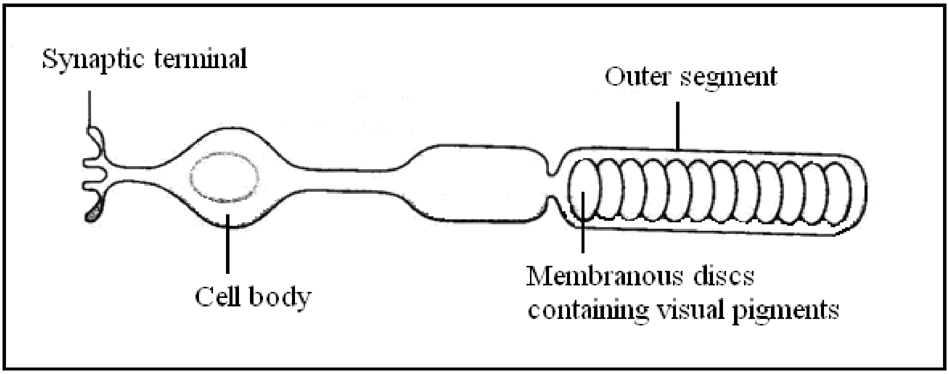
The eye is similar to a camera. The cornea and lens, which are two constituents of the light-focusing system, form an inverted image on the retina. The iris regulates the opening of the lens while the eyelids prevent light from entering and also prevents any possible damage to the surface of the cornea. The ciliary muscle controls the lens so that objects from different distances may be brought sharply into focus. The focusing of light onto the retina can be accomplished by this mechanism and also by the curvature of the cornea (Vines and Rees 1972). The cornea has a refractive index of 1.38; the lens is 1.42 where as the refractive index of both humours is 1.33. The largest difference in refractive index occurs between the air and cornea and therefore it is essential for image formation. The delicate and accurate control is achieved by the lens which acts as a fine adjustment (Vines and Rees 1972).

Photoreceptors: Rods and Cones

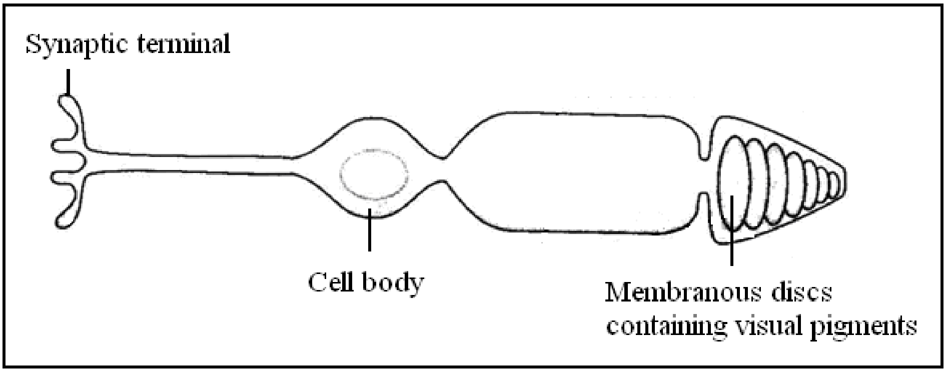
The retina contains millions of photoreceptor cells. These are referred to as rods and cones and the names of these cells come from their individual shapes. The human retina contains approximately 125 million rods and 6 million cones. The rod cells are abundant toward the periphery of the retina while the cone cells are abundant in the central portion of the retina (Keeton and Mc Fadden 1983). Each rod cell or cone cell has an outer segment with a stack of folded membranes or discs, in which visual pigments are embedded (Kimball 1983).

The visual pigment in the rods is built into the membranes of the flattened vesicles in the outer segment and is referred to as rhodopsin (Keeton and Mc Fadden 1983). In the cones, the visual pigment is known as iodopsin (Clegg and Mackean 2000). They are thought to be three types of cone cells which contain different forms of iodopsin and as such they respond to light of different wavelengths (Clegg and Mackean 2000). One responds best to red light, one to green and the other to blue. In general, colours are detected as a result of the relative degree of stimulation of the three types of cones. The sensation of white light is observed when all three types of cones are stimulated equally (Clegg and Mackean 2000). The cone cells are concentrated in a central part of the retina, called the fovea, and as a consequence a person can only perceive the colour of an object if its image falls close to the fovea or in the direct line of vision (Kimball 1983).

Figure 2: Structure of the (a) rod cell and (b) cone cell.



2 (a)



2(b)

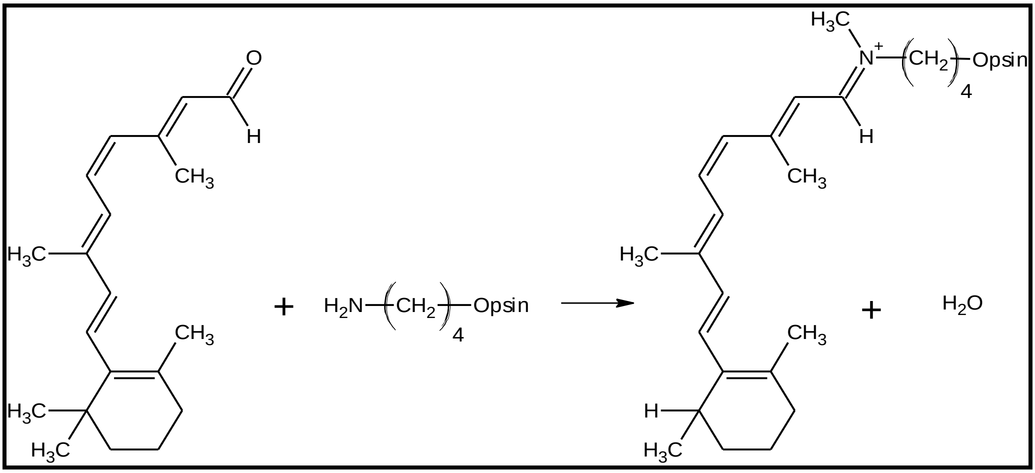
The brain receives information through an intermediary optical nerve and has no direct contact with the photoreceptor cells. Therefore, the ability to observe images is dependent on the brain, which determines the location of the photoreceptor cell that passes the impulse to any nerve fibre. Rod cells are more sensitive to small amounts of light. Cone cells provide sharper images and this is due to the ability of the brain to map images based on the position of the photoreceptor cells, which conveys the nerve impulse to the brain (Casiday and Frey 2000). It is possible for a number of rod cells to share the same nerve fibres, in some cases as many as 150. On the other hand, each cone cell is connected to the brain by an exclusive nerve fibre. In some cases, few cone cells may share the same one. As a consequence, the fovea provides sharper and clearer visual impression in the brain compared to the other parts of the retina. This image is precisely analysed by the tightly packed cones which individually or in small groups send separate impulses to the brain. An image that falls on the rods is not analysed in detail compared to the cones because rods are not as tightly packed and also as a large number of rods send only one set of impulses to the brain (Beckett 1976). Therefore, when the brain receives an impulse from the fibres connected to the rods, it has no way of determining precisely from which one of the rod cells the impulse originated (Kimball 1983). Consequently, the images are not as sharp as those of the cones. The signals from the rods are combined where as those from the cones are distributed between many nerve fibres. Hence, the rods have greater sensitivity in dim light (Casiday and Frey 2000). The rods located at the outermost edge of the retina are not able to form images. However, they function as a trigger reflex that turns the eyes in the direction of the object which may lie just beyond the normal limits of sight (Beckett 1976).

Photochemistry of Vision and Signal Transduction

The process of vision is triggered by the photochemical isomerization of the light absorbing pigment molecule retinal, which is the aldehyde derived from Vitamin A, bonded to a membrane protein called an opsin (Wayne and Wayne 1996). Rods contain their own type of opsin, which combines with the conjugated polyenal, 11-*cis*-retinal, in the retina to form the red-purple, 11-*cis*-imine which is also known as rhodopsin or 'visual purple' (Figure 3) (Coxon and Halton 1987).

Rhodopsin consists of 348 amino acid residues that are grouped mainly into seven hydrophobic, alpha helix segments which pass between the two sides of the photoreceptor membrane (Wayne and Wayne 1996; Casiday and Frey 2000). The 11-*cis*-retinal functions as a chromophore, and is the main receptor for photons which enter the eye. The 11-*cis*-retinal absorbs light in ultraviolet region. However, the maximum absorption is shifted to 498 nm when it is attached to an opsin molecule (Atkins and de Paula 2002).

Figure 3: The reaction which links 11-*cis*-retinal to opsin.



The initial stage in monochromic vision after the photons hits the rod cell, is the photoisomerization of 11-*cis*-retinal to all *trans*-retinal (Figure 4) (Casiday and Frey 2000). This occurs when a photon promotes the π electron in a $\pi \rightarrow \pi^*$ excitation. This excitation weakens the π components of the double bond thus allowing free rotation about the bond between carbon 11 and 12. This photoisomerization occurs in about 200 femtoseconds and causes the conjugated carbon chain to become straightened (Casiday and Frey 2000; Atkins and de Paula 2002).

The irradiation of rhodopsin causes a number of subsequent changes in the conformation which are seen by the appearance and disappearance of a series of intermediates of varying colours (Wayne and Wayne 1996). These light induced changes in 11-*cis*-retinal and opsin are referred to as the 'bleaching' of rhodopsin. The initial isomerization does not cause any change in the shape of the opsin protein, which is the twisted conformation of all *trans*-retinal that is referred to as bathorodopsin. The bathorodopsin is not stable enough to stay in this arrangement for long. Due to the rigidness and elongated shape of the all *trans*-retinal, the isomer does not fit into the site on the protein. As a result, the protein begins to change its shape in a very short period of time (10^{-9} s) (Casiday and Frey 2000; Wayne and Wayne 1996). A series of intermediates are produced (Table 1), each of which absorbs at different wavelengths. Eventually the protein expels the all *trans*-retinal, to give free opsin and all *trans*-retinal (Casiday and Frey 2000). The energy of the excited state, which resulted from the interaction of opsin with retinal, is lowered and this causes a red shift. The shift will be larger for stronger interaction. The absorption maximum moves towards the blue and the shifts are smaller as the more highly strained structures of lumirhodopsin and metarhodopsins are formed (Wayne and Wayne 1996).

Figure 4: The photoisomerization of 11-*cis*-retinal all *trans*-retinal.

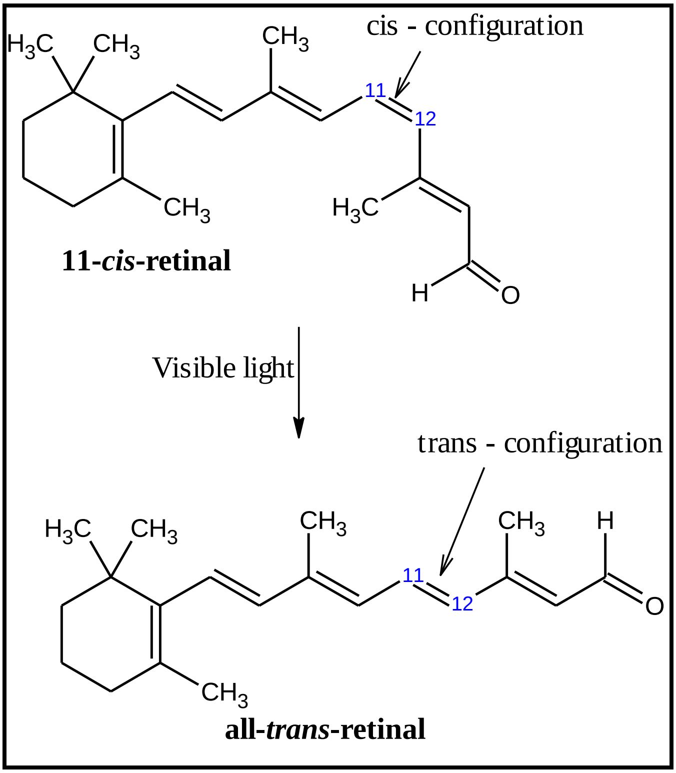
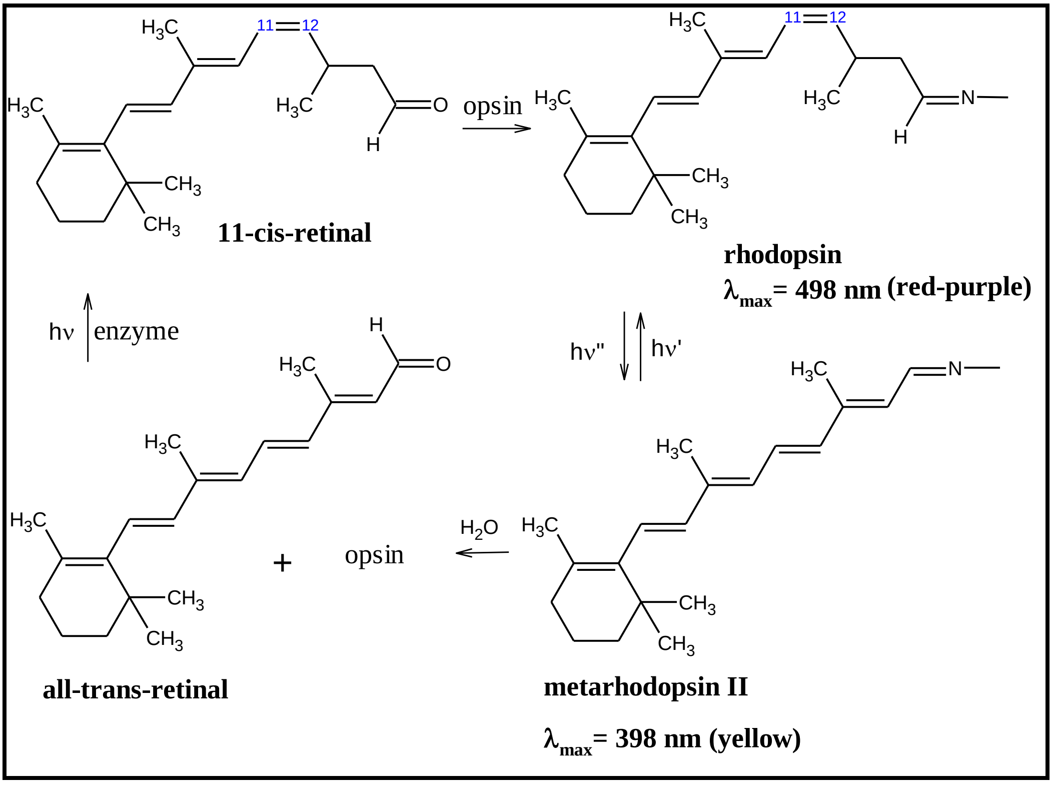


Table 1: Intermediates formed as rhodopsin changes its conformation following the *cis-trans* isomerization of retinal and their characteristic absorbance (Casiday and Frey 2000).

Name of Pigment	λ_{max} (nm)
Rhodopsin	498
Bathorhodopsin	543
Lumirhodopsin	497
Metarhodopsin I	487
Metarhodopsin II	380
all *trans*-retinal (free)	370

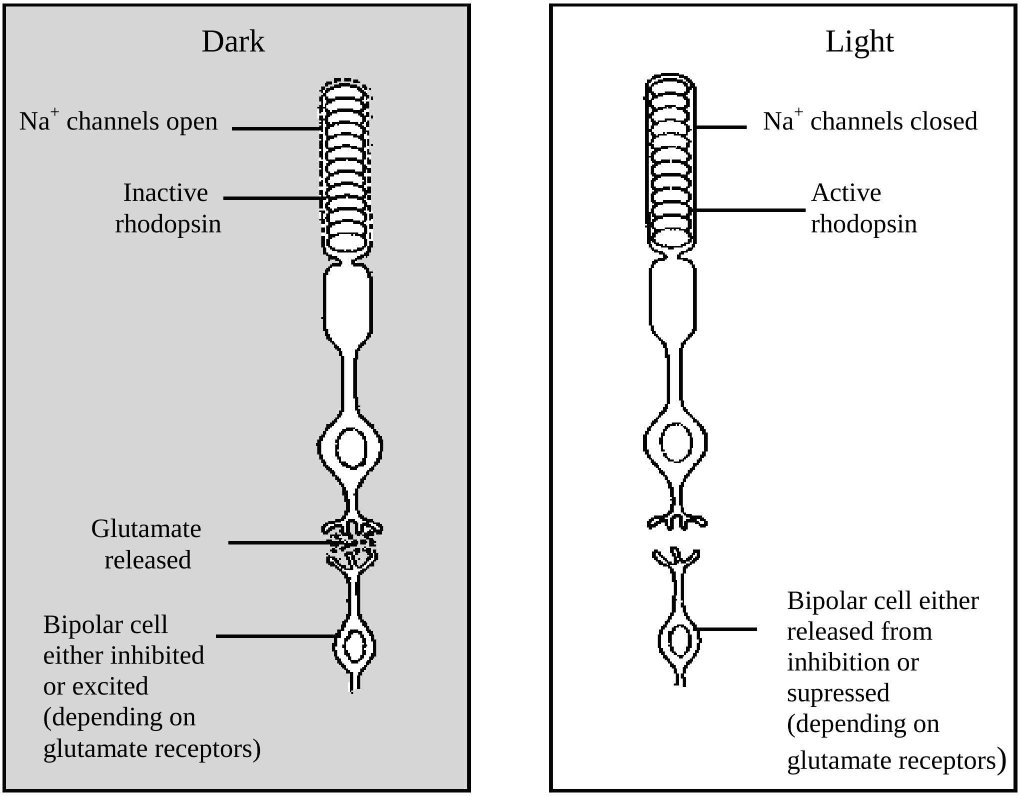
The most important intermediate produced is the yellow all *trans*-metarhodopsin II (Figure 5), which is formed when the light absorbed causes the isomerization of the *cis*-double bond in rhodopsin and it also triggers a nerve impulse (Casiday and Frey 2000; Coxon and Halton 1987). In comparison to the 11-*cis*-imine, the *trans*-metarhodopsin II does not fit into the site on the surface of the protein. As a result the carbon–nitrogen bond becomes exposed and can be readily hydrolyzed to produce all *trans*-retinal and opsin (Coxon and Halton 1987). The *trans*-metarhodopsin II can be transformed to rhodopsin in the presence of bright light through *trans-cis* isomerization (Coxon and Halton 1987).

Figure 5: The reaction scheme showing the formation of *trans*-metarhodopsin II which hydrolyzes to all *trans*-retinal, which is reconverted to 11-*cis*-retinal, and opsin.



The rods and the cones have many Na^+ (sodium ion) channels in the plasma membrane in the outer segment and most of these channels are open in the dark. Therefore, Na^+ ions are continuously diffused into the outer segment and across the narrow stalk of the inner segment. The flow of Na^+ ions that occurs due to the absence of light is referred to as the “dark current” and this causes the membrane of the rods to become depolarized (Raven and Johnson 1996). In this state , the rods cells releases glutamate and regulates the “firing” of two different classes of bipolar cells that have opposite responses to glutamate (Campbell and Reece 2002). In the presence of light, the Na^+ channels in the outer segment begin to close rapidly causing a reduction in the dark current and as a result, the rods become hyperpolarized. The synaptic terminal of the rods slows down the release of glutamate which consequently enhances the activity of one class of bipolar cells and suppresses the activity of the other type (Campbell and Reece 2002).

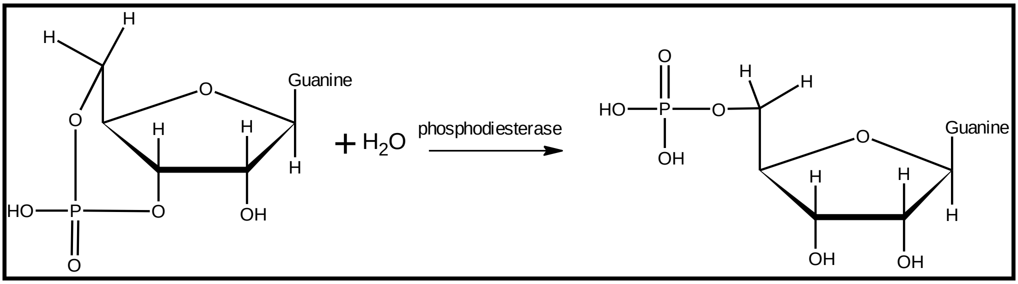
Figure 6: Structure of the rods when depolarized and hyperpolarized.



(a) Rod cell depolarized (b) Rod cell hyperpolarized

Each of the opsin is related to over a hundred regulatory proteins known as G proteins (Raven and Johnson 1996). The *trans*-metarhodopsin II activates the G protein called transducin, which is also contained in the disc membrane of the rods. This transducin activates the enzyme phosphodiesterase, which catalyses the hydrolysis of the intracellular messenger, cyclic guanosine monophosphate (cGMP) (Figure 7) (Raven and Johnson 1996; Casiday and Frey 2000).

Figure 7: Hydrolysis of cyclic guanosine monophosphate by phosphodiesterase.

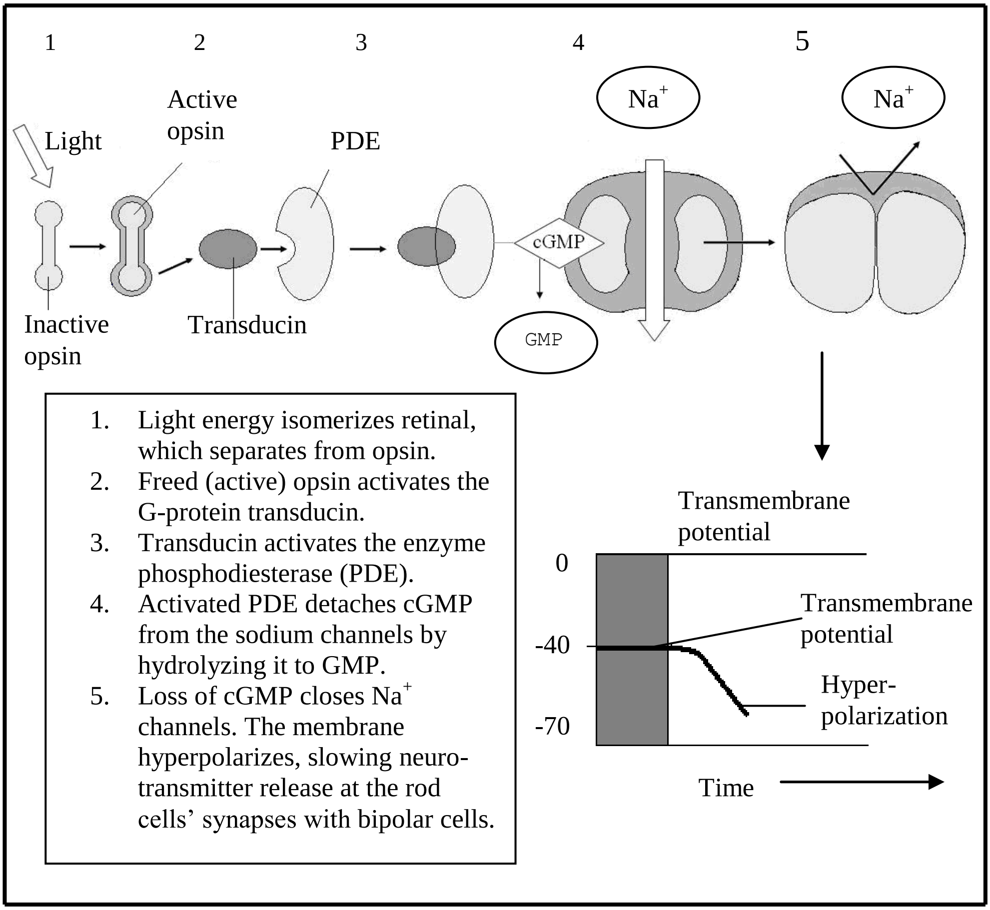


Rhodopsin is inactive in the dark and the cGMP which is bound to Na^+ ion channels in the plasma membrane of the rod keeps those channels open. In the depolarized state, the rod cells release the neurotransmitter, glutamate, which prevents the transmission of an action potential in the ganglion cell (Raven and Johnson 1996; Clegg and Mackean 2000). The hydrolysis of cGMP by phosphodiesterase to guanosine monophosphate (GMP) causes the Na^+ channels in the plasma membrane of the rod to close (Raven and Johnson 1996; Casiday and Frey 2000). The potential of the cell becomes relatively lower than that of the external environment since the permeability of the plasma membrane to the sodium ions is reduced (Clegg and Mackean 2000; Casiday and Frey 2000). When a large charge difference across the membrane builds up, the cell becomes hyperpolarized and this prevents the release of the glutamate. As a result of the large difference in potential, an action potential is produced which passes along the rod cell to the synaptic terminal as an electrical impulse (Casiday and Frey 2000). This electrical impulse is then passed onto the adjoining nerve cell which transmits the impulse to the brain by means of the optic nerve. The brain determines the origin of the nerve impulse and the image is interpreted to produce the perception of sight (Casiday and Frey 2000).

The all *trans*-retinal is isomerized back by a number of slow thermal reactions to the 11-*cis*-retinal which can combine with opsin to reform rhodopsin (Wayne and Wayne 1996). The free *trans*-retinal is reduced to Vitamin A and re-isomerized in a dark, enzyme-catalysed reaction to the 11-*cis* form which is then re-oxidised to 11-*cis*-retinal in the rod. The 11-*cis*-retinal reattaches to free opsin to reform rhodopsin which then waits for the next photon to begin the process again (Suppan 1994).

There are still a few not-so-well understood processes related to vision. For example, the blue light filtering by the carotene-like pigment xanthophyll, present in the tinted region called the “macular pigment”, which prevents damage to photoreceptor molecules, is not well explained in the literature. The $\pi \rightarrow \pi^*$ transition which takes place in the conjugated double bonds of xanthophyll is also responsible for reducing the “chromatic aberration”, which is also not fully comprehended. The deactivation mechanism for the excited xanthophyll molecule is another area which is unclear. Another gray area of vision is how blue, red, and green absorbing cone cells with different forms of iodopsin combine to produce colour vision. Hence, in a way, this article attempts to emphasize the very fact that vision, particularly human vision, is not fully understood and further elaborative high level research work is an absolute necessity for a clearer picture to emerge.

Figure 8: Signal transduction pathway of a rod cell from light reception to receptor potential.



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BIOCHEMICAL AND PHYSICAL CARDIOVASCULAR RISK FACTORS IN AN INDIAN POPULATION

Cardiovascular Risk Factors in a recently-arrived Sikh population in Sydney, Australia

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Abstract: Coronary Heart Disease risk factors were examined in Sikh immigrants from India (132 men and 91 women) aged 17 to 73 years who had lived in Australia for between two months and 34 years. Mean body mass index was 24.5 kg/m^2 for men and 24.3 kg/m^2 for women; this was similar to the Australian population (25.3 kg/m^2 for men, 24.3 kg/m^2 for women), but their mean waist to hip ratio, 0.91 for men (0.89 for Australian men) and 0.84 for women (0.76 for Australian women), was greater. Both men and women had slightly lower total cholesterol but higher triglyceride than the Australian average, while Sikh women had lower high-density cholesterol.

When men with less than two years residence were compared with those living in Australia for greater than two years, the risk of weight gain, abdominal obesity or dyslipidaemia was not increased by residence in Australia. Men with more than two years residence had 1.6 (0.5-3.9) times the incidence of moderately high cholesterol (>6.5), but, in contrast, also had a trend towards lower triglyceride and higher high-density cholesterol.

These Sikh men and women have the same tendency to central fat and raised triglyceride observed in other overseas Indian communities but there is no evidence that risk of weight gain, increased abdominal fat or dyslipidaemia is greater in those who have lived longer in Australia.

Key Words: Risk factors; Coronary heart disease; Australia; Sikhs; Lipid profiles; Acculturation

Introduction

Australia is a multicultural society which has experienced increased immigration from Asia in the last two decades. Acculturation is the process by which immigrants acquire the behavioural patterns, values and attitudes of a new society. The extent and speed of acculturation can have a big impact on health resources as immigrants age and develop chronic diseases. Research on the health and acculturation of migrants is important to inform public health policy (Rissel 1997).

Studies have shown that, in general, immigrants to Australia have a lower total mortality in the first 10 years than the population as a whole, but mortality increases thereafter (McCallum 1990). These studies do not include a substantial Indian component but the following reports are noted concerning West-Asian immigrants. Increased body weight and dietary changes are associated with length of residence in Australia for West-Asian men and women (Bennett 1993). Dietary changes and weight gain have been reported among Vietnamese women in Adelaide (Baghurst et al 1991). A Vietnamese population in Sydney had lower cholesterol than the Australian average, but this had increased, more in men than women, with length of time spent in Australia (Rissel and Russell 1993; Nguyen 1995). Chinese men in Melbourne, though presumed a low risk group, were found to have the same cardiovascular risk as other Australians (Hsu-Hage and Wahlqvist 1993). While the foregoing reports concern immigrants from Asia, no groups from the Indian subcontinent are included in these studies.

Overseas Indian populations worldwide appear to suffer from excess mortality from coronary heart disease (CHD) and non insulin dependent diabetes (NIDDM) compared to the populations to which they have migrated (The Lancet 1986; McKeigue et al 1989). Some reports indicate that this excess may not apply to people from all states of the subcontinent, e.g. Punjab (Balarajan et al 1984), however, even people from this region have been shown to have an excess of physical (non-biochemical) risk factors for coronary heart disease (Williams et al 1994).

Sikhs are a religious group with origins in the Punjab who share a uniformity of customs and dietary practices. We have already investigated the concentration of selenium (which protects against cardiomyopathy) in an immigrant Sikh community in a major Australian city (Sydney) and found it to be adequate even though vegetarian diet is common (Dhindsa et al 1998). No data on cardiovascular risk factors on Sikhs in Australia are available. The aim of the present study was to investigate anthropometric, biochemical and cardiovascular risk factors for CHD in this group and to examine any associations which these factors may have with length of Australian residence.

Methods

Sample

Members of the Sikh community living mainly in Western Sydney were invited to participate by a Sikh researcher. The community was informed about the project through the Gurudwaras (Sikh Temples), because most of the members of the community attend the Gurudwaras on Sunday. A list of voluntary participants was made and they were contacted by phone by the principal author to give a written description of the project and to obtain consent. They were informed that they could withdraw at any stage. Written, informed consent was obtained from all subjects prior to the commencement of the study, which had ethics approval from the University of Sydney Ethics Committee.

One hundred and thirty three men and ninety six women volunteered to take part. A questionnaire based on the National Heart Foundation Risk Factor Survey (National Heart Foundation of Australia 1989) was administered to each subject. This questionnaire addressed the areas of: past medical history; participation in regular physical exercise; history and duration of smoking; past and present use of oral contraceptives; alcohol consumption, and the subjects' habitual diet. One man was excluded due to incomplete data. Three women were pregnant; six men (4.5%) and 2 women (2.3%) reported being diabetic. Data on pregnant women were not processed although no differences were found when these subjects were included. The final sample consisted of a total of 94 women and 132 men. All the subjects were Sikhs and they represented a wide range of work force varying for workers and professionals. A majority of these participants were newly migrant to Australia, that is why it was possible to compare the data for with respect to their stay of <2 and >2 years of stay in Australia. Sample selection procedure was approved by the ethics committee. Moreover, this sample size is treated as large for a research where blood collection from the respondents in a community is involved.

Anthropometric measurements

Anthropometric measurements were taken with the subjects dressed in light indoor clothing with shoes removed. Weight was measured to the nearest 0.5 kg using a calibrated spring balance. Height was measured to the nearest 0.5 cm using a wall-mounted tape. A body mass index (BMI) was calculated as weight (kg)/height (m) ^{2}. Waist and hip circumferences were measured using a flexible tape measure at the smallest circumference between the ribs and the iliac crest and the largest circumference in the buttock/gluteal area, respectively. A waist to hip ratio (WHR) was calculated. All measurements were taken by the same trained investigator. Blood pressure and pulse were measured using an Omron automatic digital blood pressure monitor.

Blood collection and biochemical analysis

Venous blood samples were collected from subjects in the morning after an overnight fast. No diabetic subjects were asked to fast, however their blood samples were collected very early and they reported that they were fasting. Samples were centrifuged and plasma used to determine total cholesterol (TC), high density lipoprotein cholesterol (HDL) and triglyceride (TG) concentrations on a Reflotron reflectance photometric analyser (Boehringer Mannheim Diagnostics, Germany) within 24 hours. Coefficients of variation for internal quality control samples were 2.9% for TC, 3.2% for HDL and 1.4% for TG. The accuracy of the Reflotron used in this study is regularly assessed through participation in the Australasian College of Pathologist's Lipid Standardisation Programme. The use of Reflotron for the measurement of lipids have shown to be equally accurate if used by single operator, particularly if problems with finger prick blood collection are avoided (National Heart Foundation of Australia 1989), as was the case in this study. Low density lipoprotein cholesterol (LDL) concentration was estimated using Friedewald formula (Friedewald 1972). Plasma was stored at -20°C for less than one month before immunoturbidimetric analyses of Apo A-I and Apo B-100 using a Turbitime System (Behring Diagnostics, Australia).

Statistical Analysis

Data analyses were carried out using SPSS, Minitab and Statview software packages for Macintosh. The distribution of continuous variables was checked and, if skewed, a log transformation was used before comparing groups by Student t test. Pearson correlation co-efficients were computed to investigate associations between measurements of body fat distribution and lipid levels. Odds ratios were calculated and adjusted for confounding using SPSS. Confidence Intervals (95%) were calculated on mean values using the standard error of the mean, the sample size and the T value for that sample size. For the Australian population samples, the sample sizes and standard errors are published with the data.

Results

Characteristics of the sample are shown in Table 1 with data from the National Heart Foundation Australian population survey (National Heart Foundation of Australia 1989) given for comparison. The biggest difference in behaviour between Sikh males and females was a significant difference in drinking habits, 60% male *vs* 3% female. While there was also a difference in smoking, smoking rates were very low in both men and women. Hours spent at exercise was not significantly different between the sexes. Twenty one percent of males and 29 percent of females consumed a vegetarian diet. When the sample was compared with a national population sample, the BMI was similar to the national average. This was also the case for the waist to hip ratio for men, but the Sikh women had higher waist to hip ratio than their Australian counterparts. Sixteen women had a history of oral contraceptive use but only four were current users, therefore female lipid values were reported as one group.

Table 1: Comparison of characteristics of the study group by gender to the Australian national population: mean ±SD.

1.

Characteristic	Men (n=132)	Women (n=91)	p value[1]	NHF[2] Men	NHF[2] Women
Age (Y)	37.0±11.4	35.0±11.6	0.1	-	-
Age Range (Y)	17-73	17-71	-	20-69	20-69
BMI (kg/cm)	24.5±2.6	24.3±3.7	0.7	25.3	24.3
WHR (cm/cm)	0.91±0.047	0.84±0.083	0.0001	0.89	0.76
BP (Systolic, mm Hg)	127.0±14.5	122.0±21.7	0.07		
BP (Diastolic, mm Hg)	84.0±9.8	77.0±13.8	<0.0001		
Smokers (%)	3	1			
Vegetarian (%)	21	29			
Alcohol (Drinkers, %)	60	3	<0.0001		
Alcohol (Drinks/week)	4.6	0.1	<0.0001		
Vigorous Exercise (Hours/2 weeks)	3.8±13.5	1.7±5.1	0.2		
Nonvigorous Exercise (Hours/2 weeks)	2.4±4.6	2.3±4.5	0.9		

[1] Men vs Women, [2] NHF - National Heart Foundation Australian data, estimated mean, 20 to 69 years of age. Y = Years, BMI = Body Mass Index, WHR = Waist Hip Ratio, and BP = Blood Pressure.

Gender differences in the lipid profiles of the Sikhs are similar to those observed in the general Australian population except for a smaller difference in HDL between Sikh men and women. Mean TG, LDL and apo B concentrations in Sikh males were significantly higher ($p < 0.05$) that the Sikh females, whereas mean concentrations of HDL and apo A1 were significantly lower ($p < 0.005$) in males than females. Data on Australian population (National Heart Foundation (NHF) sample) is given for reference in Table 2, however a comparison of the lipid profiles of the Sikhs and the Australian population sample (Table 2) is not possible because methods of chemical analysis used in both studies were different.

Since triglyceride concentrations have been shown to be higher in those consuming a vegetarian diet (West et al 1990), the mean triglyceride levels of vegetarian and non-vegetarians were compared. In all subjects, the triglyceride level was higher in vegetarians compared with non-vegetarians (1.84±1.00 mmol/L, n=42 *vs* 1.77±1.03 mmol/L, n=172). Among females, triglyceride level was also higher in vegetarians (1.88±1.10 mmol/L *vs* 1.57±0.80 mmol/L), but among males, it was lower (1.88±1.10 mmol/L *vs* 1.90±1.10 mmol/L); none of the foregoing differences were significant.

Table 2: Comparison of lipid profiles of Sikhs with Australian National data: mean ±SD.

Characteristics	**Men (n=132)**	**Women (n=91)**	**p value**[1]	**NHF**[2] **Men**	**NHF**[2] **Women**[3]	**NHF**[2] **Women**[4]
TC (mmol/L)	5.25±0.98	5.00±0.94	0.06	5.42	5.30	5.08
TC (95 % CI)	5.08, 5.42	4.80, 5.20		5.38, 5.46	5.26, 5.34	5.00, 5.16
HDL (mmol/L)	1.00±0.22	1.14±0.30	<0.0001	1.18	1.50	1.44
HDL (95 % CI)	0.96, 1.04	1.08, 1.20		1.18, 1.18	1.48, 1.52	1.42, 1.46
TG (mmol/L)	1.87±1.10	1.60±0.80	<0.05	1.44	1.02	1.02
TG (95 % CI)	1.68, 2.07	1.40, 1.77		1.42, 1.46	1.00, 1.04	0.96, 1.06
LDL (mmol/L)	3.70±0.92	3.40±0.94	0.007			
Apo A1 (mg/dl)	107±27	119±34	0.004			
Apo B (mg/dL)	109±36	96±35	0.01			
Apo A1/B (ratio)	0.98	1.24				

[1] Men vs Women. [2] NHF - National Heart Foundation Australian data, estimated mean for 20 to 69 years of age. [3] Women not using oral contraceptives. [4] Women using oral contraceptives. TC = Total Cholesterol, CI = Confidence of Interval, HDL = High Density Lipoprotein, TG = Triglycerides, LDL =Low density Lipoproteins, Apo A1 = Apoprotein A1 and Apo B = Apoprotein.

Population data is not available on Apoproteins A1 and B in Australia. While the values obtained are within the normal range, apoprotein A1 (associated with HDL), has mean levels towards the lower limit of normal in keeping with the relatively low concentrations of HDL found in both sexes. Apoprotein B (associated with LDL) is within the normal range.

High triglyceride and low HDL are important risk factors for coronary heart disease (Reaven 1993; Austin and Hokansen 1994), especially in women and abdominal obesity is an important correlate of such dylipidaemia (Bjorntorp 1984). Dyslipidaemia includes high TC (>6.5), high TG (>2.0) or low HDL (< 0.9). Therefore, the prevalence of dyslipidaemia, weight gain and abdominal obesity in Sikhs with over 2 years residence in Australia was compared to those with under 2 years residence (Table 3). The prevalence of weight gain or abdominal obesity is not increased in either sex with the length of time in Australia. In men, although there is a trend for increased incidence of high TC in those over 2 years residence, there is also a trend towards a lower TG and higher HDL. In women, the incidence of low HDL is significantly greater in those with longer residence and there is a trend towards an increase in TG. Thus, there is evidence of increased risk of dyslipidaemia in Sikhs who have lived longer in Australia.

Table 3: Anthropometric and lipid risk factors by gender and length of residence: odds ratios, crude (CI), and adjusted for age.

Characteristics	Men (<2 *Y vs* >2 *Y*)	Women (<2 *Y vs* >2 *Y*)
BMI *(>27.5)*	1.40 (0.43-4.39)	0.73 (0.24-2.20)
Adjusted for age	0.97	1.0
WHR *(>0.8, W; >0.9, M)* (	0.7 (0.3-1.5)	1.1 (0.4-3.0)
Adjusted for age	1.0	1.05
TC *(> 6.5 mmol/L)*	1.6 (0.5-5.4)	1.2 (0.2-6.6)
Adjusted for age	1.53	1.13
HDL *(>0.9 mmol/L)*	0.60 (0.28-1.26)	0.34 (0.12-0.99)*
Adjusted for age	0.66	0.34*
TG *(> 2.0 mmol/L)*	0.81 (0.38-1.74)	0.76 (0.28-2.00)
Adjusted for age	0.79	0.69

*p<0.05. Abbreviations as explained in tables 1and 2. *W* = Women, *M* = Men, *Y* = Years and cut off values are shown in italics.

Discussion

In this study we have investigated anthropometric and biochemical risk factors for CHD in an immigrant Sikh community in Sydney. Increased weight gain and a change in distribution of body fat to more abdominal pattern are related to risk of CHD and diabetes (Bjorntorp 1984). In turn, weight gain and increased abdominal fat cause a deterioration in the blood lipid profile (Anderson et al 1988). Mortality rates are reflected by lipid levels (Simons 1986). While elevated TC is strongly associated with increased risk of CHD, an atherogenic lipid profile, characterised by high levels of LDL, TG, apo B, and decreased HDL and apo A1 is a more precise indicator of CHD risk (Despres 1994). High TG and low HDL are particularly important lipid risk factors for CHD and NIDDM in women (Austin et al 1998).

The age range of our sample was similar to that of the NHF Australian population sample (National Heart Foundation of Australia 1989) and the mean BMI of the Sikh men and women was very close to the mean of that sample. WHR was used as an estimate of abdominal obesity in this study. There was a bigger difference between male and female WHR in the NHF sample than in the current study and this is reflected in a relatively high WHR in the Sikh women compared to the Australian average. Direct comparisons with the NHF waist and hip measurements with the sample are difficult as precise information on how the measurement on NHF sample was performed is not available. However, we have investigated a group of Australian Caucasian women (McLaughlin 1993) using exactly the same methodology as used in this study and found that these Australian Caucasian women had a similar mean WHR (0.75) to that of the NHF sample. Hence, we believe it is valid to compare the WHR of the Sikh women we measured with those of the national sample. Thus Sikh women appear to be more abdominally obese than the average Australian woman for the same BMI. Upper body obesity, weight gain and a change in distribution of body fat are potent risk factors for diabetes and CHD (Bjorntorp 1984; Bjorntorp 1990).

Absolute comparisons of lipid values must be interpreted with some caution when different methodologies are used. However, the mean TC of these Sikh men and women is only slightly lower than the Australian average as measured in the NHF sample. The difference between male and female TC is also similar to the NHF sample, as is the mean male HDL. However, the HDL of the Sikh women, while still significantly higher than that of the men, is relatively low and closer to the male values than usually found in Western populations. The mean fasting TG is higher in both Sikh men and women. It appears that the high TG and low HDL usually found associated with abdominal obesity is present in this group of women. The apo A1 levels are relatively low in both men and women. It is interesting that while the Sikh men have relatively high TG, it is not accompanied by low HDL. In view of the well documented effect of alcohol on enhancement of HDL levels, it could be speculated that the high rate of male drinking contributed to the increased HDL in this group; however, HDL was not different between male drinkers and non-drinkers, nor were HDL levels associated with total drinks consumed.

An excess of CHD in migrant Indians compared with other ethnic groups has been reported from areas as diverse as the UK (Marmot et al 1984; Dhawan et al 1994), Singapore (Hughes et al 1990), Uganda (Shaper and 1959), South Africa (Cosnett 1957), Fiji (Sorokin 1973) and Trinidad (Beckles et al 1986). Studies which attempted to explain this excess by examining risk factors for CHD in immigrant Indians have implicated both anthropometric and biochemical factors. Lower HDL and higher rates of NIDDM were found in Indians in Singapore as compared to other ethnic populations (Hughes et al 1990). Low HDL was also found in Indians in Trinidad (Beckles et al 1986) and in Indian women in London (McKeigue et al 1988). Studies which compared male patients with confirmed coronary artery disease who were either: of British origin, Indians in Britian or Indians in India, showed that central obesity associated with hyperinsulinaemia posed a significant risk of atherosclerosis in both the Indian groups. It has been suggested that insulin resistance may be the underlying common mechanism in immigrant Indians leading to diabetes, lipid abnormalities and CHD (McKeigue et al 1991). Recently, it has been shown that apparently healthy young Indian men who were sons of cardiac patients had significantly higher mean plasma insulin and lipoprotein (a) (a potent risk factor for CHD), than a similar group of North European origin (Shaukat et al 1995).

In the current sample, the same tendency to central obesity, high TG and low HDL observed in other emigrant Indian communities is found in this Sikh group, especially in women in whom it is associated with length of time spent in Australia. The major limitations of this study were (i) the sample was collected from the Western Sydney, where most of the participants were settled. Therefore the generalisation of results is limited to that region in principle, but can be extended to Sydney to a grater extent and (ii) the sample selected was non-random. This was because the ethics committee approved only voluntary participation. However, this limitation was minimised by increasing the sample size. The readers should however keep in mind these limitations of the study.

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FREE AND OPEN SOURCE E-LEARNING

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Abstract: This paper focuses on how an affordable, effective, efficient and user-friendly e-Learning solution can be implemented for schools and higher educational institutions with a serious budget constraint. The proposed e-Learning solution utilizes open source software that can be freely downloaded from the Internet. This paper is intended for school teachers who are interested in setting up an e-Learning system in their school.

Keywords:
E-learning, Learning Management System (LMS), Course Management System (CMS), Virtual Learning Environment (VLE) Moodle, open source software, Sharable Content Object Reference Model (SCORM), GNU General Public License (GPL), PHP and MySQL.

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1. Introduction

The Internet and the World Wide Web technologies are bringing a lot of promising solutions to industry and society. One area where the advancement of these technologies matters the most is education.

The buzzword, *e-Learning,* has been around for many years. We have heard or read about it in the news in the form of government announcements and initiatives, school projects, etc. But what actually is e-Learning? Have you seen or used it before? Does your school have e-Learning? If not, why?

Based on several research works on e-Learning [6], one of the major factors contributing to the lack of uptake and implementation of e-Learning systems in schools is simply the lack of money. While computer hardware is getting cheaper and cheaper, the price of software has remained high.

The price of software is determined largely by the cost of licenses that you have to purchase for yourself and every user of the system. Sometimes, not only is the license expensive, but also it is non-perpetual. The high licensing cost will definitely deter many schools from even trying.

In this paper, we propose an effective solution that can be achieved using free and open source software. In the following sections we will explain e-Learning, free and open source software, and Moodle – an affordable, effective and easy-to-use open source e-Learning management system that you can implement for your school.

2. e-Learning

What is e-Learning? Before the dawning of the fashionable e-*word* era, e-Learning was better known as a number of things, such as CAL (Computer Aided Learning), CBL (Computer

Aided Based Learning), CBT (Computer Based Teaching) and CAE (Computer Aided Education). While there are subtle differences between these terms, the main driving force behind the concepts and technologies is very much the same - to enhance learning experiences.

Today, e-Learning activity comes in many forms, from the use of computers alongside traditional methods of teaching such as face-to-face discussion, to activities beyond the traditional classroom settings where teaching and learning is entirely online [12].

With the rapid advancement of computing and communication technologies, we are seeing an increasing number of e-Learning activities nowadays. Many universities and higher-learning institutions now provide e-Learning sites that allow their students to login to receive the latest programme and course information, learning materials, assignments and feedback, laboratory manuals and so on, in the comfort of their home or wherever they are as long as they have access to the Internet. Communication is no longer one-way as the technology also allows students to submit their work and to interact with their teachers online. Moreover, current e-Learning systems can also provide a platform for active discussions and collaborations among fellow students and teachers.

Geographical barrier is no longer a problem for students and teachers alike. Lack of accessibility to course materials and help is no longer an issue - a blessing to distance learners who can now save more than their traveling and accommodation costs, and spend more of their time and energy on the actual learning itself.

Since the course materials are always available and their delivery almost instantaneous, the learners just have to pick up the desired materials and study at their own pace and time. Moreover, some advanced e-Learning systems have the ability to adapt to a student's learning behaviour and to customize the flow and delivery of information to better suit individual needs. For example, the system can change the sequence of material deliveries, quizzes and so on, to help a student through a difficult topic, or reduce the instructions set and quizzes if the topic is too easy. This is an effective way of learning, as compared to the traditional one-to-many and one-size-fits-all methods that meet the requirements of some but often at the expense of others, especially the slower learners.

Although the use of e-Learning system is thriving in higher-learning institutions, we have also heard of successful e-Learning implementation in schools, particularly from developed countries. In the past, only schools with sufficient budget and decent student population could justify and afford such a system. Nowadays, we have a choice of open source e-Learning systems that are readily available, affordable, and easy to implement, manage and use. Thus, many schools in developing countries are also starting to have their own e-Learning systems that are typically implemented using open source software.

3. Open Source Software

Computers are useless without software. They need software to function and to carry out tasks required by the users. Software consists of instructions written for computers using programming languages such as C, C++ and Java. Software copy in human-readable form is called the source code. The source code needs to be compiled or translated into machine-readable code before it can be executed.

In proprietary software, the source code is not released to the purchasers. Without the source code, no one can understand the internal workings of software, let alone change the software to improve or to customize it according to one's need.

Under a strict licensing agreement, it is also illegal to copy, distribute, or modify the proprietary software in any way. Furthermore, some proprietary software is non-perpetual, which means that users are required to pay a subscription fee, on top of the support or maintenance fee. Moreover, the use of the software is often restricted to a fixed number of users[1] and the price of software increases as the user base grows.

On the other hand, open source software has no license fee, except for the optional support fee which users can subscribe to, if required. Open source software also does not restrict the number of users who can use the software. Thus, in terms of cost, open source software offers an attractive alternative to proprietary software.

In terms of usage, open source software allows the user not only the freedom to use, but also the freedom to study and to modify the software. The availability of the source code and its inherent freedom is also appealing to the community of programmers who contribute tremendously to the improvement and the stability of the software. Finally, it is the freedom to share that allows the software to continue to evolve and to reach out to a wider community of users. This is the computing freedom that is seriously lacking in proprietary counterparts.

There are several types of license used for the distribution of open source software. The most widely-used is the GNU General Public License (GPL) [2]. Software under this license is free to download from the software's official website, or from SourceForge [11] or freshmeat [1], which hold the largest repository of open source applications.

Schools that lament the lack of financial support in their pursuit of e-Learning technology can now look to open source as a viable solution to help them take the first step forward. Schools that have been using proprietary software can also seek to reduce their high operational cost by opting for open source alternative instead.

In the next section, we will present a free and open source e-Learning solution that is widely used in many parts of the world.

4. Moodle - An e-Learning Solution

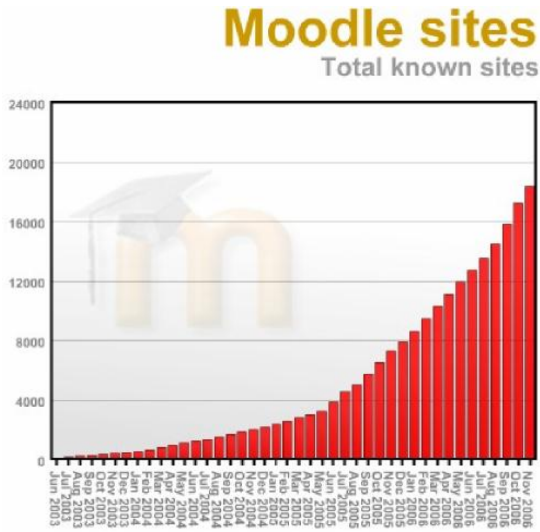
Moodle stands for Modular Object Oriented Dynamic Learning Environment. It belongs to a class of application software commonly known as either Learning Management Systems (LMS), Course Management Systems (CMS), or Virtual Learning Environments (VLE).

Moodle was created by Martin Dougiamas and is licensed under GNU GPL. Moodle is available for download from its official website at http://moodle.org. At the time of this writing, version 1.6.2 is the latest release.

The current version of Moodle can support up to 61 different languages and can facilitate up to 6,000 courses with more than 45,000 students in a single site. The number of registered sites using Moodle at present is about 9,000 spreading across 147 countries. Based on the statistic from the official site, Moodle now has about 2,587,000 users and 242,000 courses world wide. Comparing Moodle to some of the commercial e-Learning LMS, Moodle has captured 54% of the market share in higher education LMS [7]. See Figure 1 and Figure 2 for up-to-date statistics on Moodle.

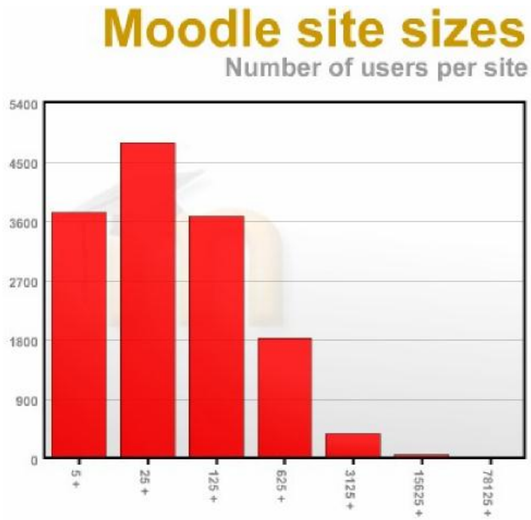
[1]Some software licenses limit the number of users who cam *simultaneously* access and use the system.

Figure 1: Total known Moodle sites [6].



Registered sites:	17928
Courses:	704670
Users:	7176536
Teachers:	1233812
Enrolments:	10955312
Forum Posts:	7874491
Resources:	4452553
Quiz questions:	5202731

Figure 2: Number of users per site [6].



There are 36 sites with more than 20000 users. The site with the most users is moodle.org with 43 courses and 169677 users. The site with the most courses is UNIVERSITE DE NANTES with 13878 courses and 2106 users.

Moodle can be installed on various platforms including Linux, Windows, MacOS X and other systems that support Hypertext Preprocessor[2] (PHP) and MySQL database engine. PHP is a scripting language like any other programming language, except that it is used specifically for computer server programming; whereas MySQL is a popular relational database management system. Both PHP and MySQL are well-known examples of open source software that are used extensively in the computing industry. PHP and MySQL can be downloaded from their official website at http://www.php.net and http://www.mysql.com, respectively.

Course materials and learning activities are organised into web pages in Moodle. Thus, besides PHP and MySQL, Moodle also requires a web server to serve up web pages online. For this purpose, we recommend Apache - a popular open source web server for Moodle. Apache is currently the leading secure web server solution in the market [7]. The bundle of Linux, Apache, MySQL and PHP, commonly known as the LAMP platform, is a well-established and widely tested platform in the web industry.

Since Moodle is primarily a web-based system, a user (i.e. students and teachers) can use any standard web browser to access Moodle. Hence, no additional software installation is required for the users. All the installation work is done at the server side.

Setting up Moodle on a computer server requires you to first install the operating system of your choice, next install Apache, then PHP and MySQL in no particular order, and lastly Moodle. If you wish to run Linux, you can install any Linux distribution[3] either downloaded from the Internet or purchased from a software store. If you are running Windows, you can opt for Microsoft's Internet Information Services (IIS) web server[4] instead of Apache. Moodle works well with either Apache or IIS. Installations of the web server, PHP, MySQL and Moodle is quite simple. All you have to do is to start each of the installation program and follow the on-screen instructions until completion.

For convenience, Moodle also provides Moodle, Apache, MySQL and PHP in a single package to allow you to install the whole bundle at once. The package, however, is only available for Windows and MacOS platform. Independently, Ubuntu has an automatic LAMP installation. Just Google “ubuntu LAMP” for more information.

If you run into any installation problem, you can find plenty of help from the Internet, especially from the software sites. In addition to the installation guides and other articles, there are also forums that gather much valuable information and opinions from various expert users and experienced implementers. You can also post your problems in these forums and there will always be enthusiasts with the know-how to respond to your questions.

[2]PHP actually stands for PHP: Hypertext Preprocessor, which contains the acronym itself as the first word.

[3]At present there are hundreds of Linux distributions for you to choose from. For beginners, we recommend Ubuntu, Fedora, or Mandriva.

[4]IIS is not the default installation for Windows, but you can install IIS from the Microsoft Windows installation disk which comes standard with all Windows machine.

As for hardware considerations, all that is required is a computer to act as your server hardware. Moodle does not require any special hardware to run. In fact, most of the aforementioned open source software is well-known for the capacity to perform well on systems low on resources (e.g. low in processor speed, memory and hard disk space). Linux, in particular, is the preferred operating system used to reinstate antiquated computers for reuse. Hence, if a school can't afford a dedicated server, you can use any reasonably fast computer that is connected to the school network to act as the server. How far you want to invest on the server hardware thus depends on the number of users and courses you plan to serve now and in the future.

Once the hardware and software are in place, you can start creating, developing and uploading your course materials to the server. Course materials consist of a simple hyper-text document (HTML) or a full-fledged interactive page. Moodle provides a simple HTML editor to allow you to create a web page. For more complex pages, you can always use other SCORM-compliant (see below) authoring tools to create the course content and then import it into Moodle.

Moodle was developed with Sharable Content Object Reference Model (SCORM) in mind. Created by the U.S. Department of Defense and Aviation Industry CBT Committee (AICC), and published by the Advanced Distributed Learning (ADL) Initiative, SCORM is an e-Learning standard that aims to enable accessibility, interoperability, and reusability of web-based course content [10]. Being SCORM-compliant also means that Moodle can readily import course content from other SCORM-compliant LMS, thus making migration of courses possible.

Adobe DreamWeaver, a leading web development tool, has a SCORM plug-in to allow one to create e - Learning content. eXe (e-Learning XHTML Editor) is just one example of an open source SCORM editor.

5. Conclusion

Implementing your own e-Learning solution in your school is not an impossible dream. We have proposed to you Moodle which is currently the leading LMS in many education institutions all over the world.

Moodle is cost-effective – the cost of the software bundle is minimal compared with proprietary software, because you do not have to pay for the high licensing cost, only for the cost of downloading (i.e. Internet connection) or the price of the installation disks. Moreover, Moodle is open source which means that you could freely study, modify and share your own version of Moodle with other schools.

You don't have to be a computer expert in order to setup Moodle. Moodle installation requires only basic computing skills and a little bit of patience to read through the the installation guide, the on-screen instructions, and to search the Internet for solutions if you run into problems. Open source software nowadays is very user-friendly. The installation will pick up most of your system settings and configure the entire system for you. No programming is required. Accessing Moodle courses and their navigation is also very simple – it is just like any web page that you browse on the Internet using your favourite web browser.

Last but not least, one of the reasons for Moodle's success is its compliance with the SCORM e-Learning standard. This provides users and administrators peace of mind knowing that their work and data will survive changes in products and technology.

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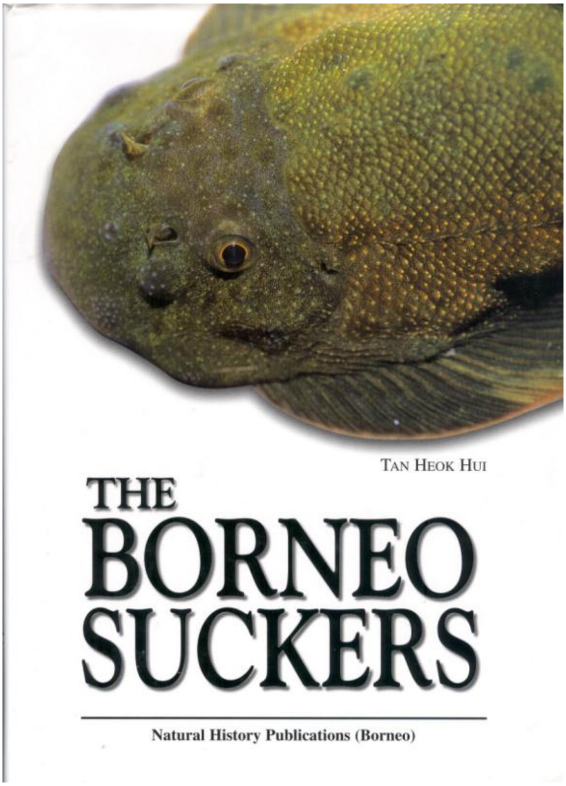
BOOK REVIEW

By Dr Zohrah Haji Sulaiman, Department of Biology, Faculty of Science, Universiti Brunei Darussalam.



Tan Heok Hui, 2006. The Borneo Suckers. Revision of the Torrent Loaches of Borneo (Balitoridae: *Gastromyzon, Neogastromyzon*). Kota Kinabalu: Natural History Publications. 245 pp., 18 colour plates (ISBN 983-812-105-3).

The book provides new information on Balitorids of Borneo namely the *Gastromyzon* and *Neogastromyzon.* Both genera have never been documented as elaborate as this before. The systematics accounts of the genera are excellent and helpful to fish taxonomists. The genus *Gastromyzon* has 36 species, with 21 known, redescribed species and 15 new species. Kuala Belalong in Temburong has 3 new species of *Gastromyzon*: *Gastromyzon aeroides, Gastromyzon cranbrooki* and *Gastromyzon venustus.* There are 6 species of N*eogastromyzon* including 4 new species and Brunei Darussalam records one new species, *Neogastromyzon* Brunei in Kuala Belalong. The book also includes a brief description of the genus *Hypergastromyzon*. The books on Freshwater fishes in Borneo and nearby region on these genera had not been updated. The publication of this book is therefore timely and a highly recommended book for ichthyologists.

ABSTRACT OF CONFERENCE PAPER

This paper was presented during "The Special Symposium: Biology of Cypriniformes" in Wuhan, China 12-15 October 2006

Title: Phylogeny and Biogeography of the South East Asian *Rasbora* (Pisces, Cyprinidae) and associated species inferred from cytochrome *b* DNA

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Abstract:
The freshwater fish fauna of South East Asia is dominated by the family Cyprinidae. One of the genus, *Rasbora* comprises of 55 species and belongs to the subfamily Rasborinae and is distributed throughout the Indian subcontinent, southern China and South East Asia. In this study, phylogenetic relationships among *Rasbora* and associated species (*Boraras*, *Trigonostigma*, *Microrasboras* and *Sundadanio*) were investigated by comparing their cytochrome *b* gene sequences. The results indicated that the various fish species lineages studied evolved at different rates. The phylogenetic tree agreed with the phenogram constructed based on common fish genera by Yap in 2002 which showed groupings of related drainage river basins including the Sundaland (Borneo, Malay Peninsula, Java, Sumatra), southwest Kampuchea, southeast Thailand, Mekong, Chao Phraya, Salween and Mae Khlong in one clade. It was thought that the fauna of southeastern Thailand-southwestern Kampuchea river basin might had been affected by changes in the sea level of Sunda Shelf. The close proximity of Salween to Mae Khlong and Mae Khlong to southeastern Thailand-southwestern Cambodia might explain the genetic relationship of *Rasbora* and its associated species in the present study. The fishes studied except *R.daniconius*, *R.cephalotaenia*, *R.einthovaneii* and *R.tonieri* might had evolved after Pleistocene. It confirmed Brittan's observations in 1954 that *R.daniconius* was closest to the ancestral stock and *R.pauciperforata* and *R.elegans* as later evolving species. The phylogenetic results also showed that genus *Rasbora* shared a clade with *Boraras briggittae, Trigonostigma hengeli*, *Microrasboras rubescens* and *Sundadanio axelrodi.* Bootstrap values supporting *Boraras briggittae* and *Microrasboras rubescens* pair, *Trigonostigma hengeli* and *R.pauciperforata* pair, *Sundadanio axelrodi* and *R.caudimaculata* pair were >50% in all cases.

Keywords: *Rasbora*, river basin, cytochrome *b*, sundaland, pleistocene

CORRIGENDA

Corrections to *Scientia Bruneiana* 2005

RECENT ADVANCES IN MATERIALS FOR WEALTH AND HEALTH by P. Hing
Scientia Bruneiana 2005, pp. 61-76.

Fig. 1 on p. 62 is taken from Ref. 6, p. 402.
Fig. 2 on p. 62 is taken from Ref. 6, p. 402.
Fig. 3 on p. 63 is taken from Ref. 6.
Fig. 4 on p. 64 is taken from Ref. 7.
Fig. 5 on p. 64 is taken from Ref. 2.
Fig. 6 on p. 65 is taken from Ref. 7.
Fig. 7 on p. 65 is taken from Ref. 2.
Fig. 8 (Graph of Moore's Law) on p. 66 is taken from Ref. 1.
Fig. 8 (Photo of Gordon Moore) on p. 66 is taken from Ref. 8.
Fig. 9 (Pentium IV chip) on p. 66 is taken from Ref. 1.
Fig. 9 (Itanium chip) on p. 67 is taken from Ref. 4.
Fig. 10 on p. 67 is taken from Ref. 1.
Fig. 11 on p. 68 is taken from Ref. 1.
Fig. 11 on p. 69 should be **Fig. 12** and is taken from Ref. 1.
Fig. 12 on p. 69 should be **Fig. 13** and is taken from Ref. 1.
Fig. 13 on p. 71 should be **Fig. 14** and is taken from Ref. 1.
Figures on p. 72 should be labelled **Fig. 15** and are taken from Ref. 7.
Figs. 16 on p. 73 are both taken from Ref. 7.
Fig. 17 on p. 73 is taken from Ref. 6.
Fig. 18 on p. 74 is taken from Ref. 6.
Fig. 19 on p. 75 is taken from Ref. 1.
Fig. 20 on p. 75 is taken from Ref. 1.
Fig. 21 on p. 76 is taken from Ref. 1.

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CRYPTOGRAPHY: CAESAR TO RSA by Vasudevan Mangalam
(Note correction to author's name)
Scientia Bruneiana 2005, pp. 77-85.

Last figure on p. 79 is taken from
http://astro.ocis.temple.edu/~dhill001/vigenere/vigenere.html.
Both figures on p. 80 are taken from
http://astro.ocis.temple.edu/~dhill001/vigenere/vigenere.html.
Left figure on p. 83 is taken from
http://en.wikipedia.org/wiki/Image:Ztel1b.jpg.
Right figure on p. 83 is taken from
http://en.wikipedia.org/wiki/Image:Zimmermann-telegramm-offen.jpg.
Left figure on p. 84 is taken from
http://cam.open.ac.uk/projects/stationx/enigma/index.html
Right figure on p. 84 is taken from
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NOTES TO CONTRIBUTORS

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Vasudevan Mangalam

Department of Mathematics, Faculty of Science, Universiti Brunei Darussalam

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Roberts, T.R. 1989. The freshwater fishes of Western Borneo (Kalimantan Barat, Indonesia). California Academy of Sciences, San Francisco. 209 pp.

Campbell, N.A. and Reece, J.B. 2002. Biology, sixth edition. Benjamin Cummings, San Francisco. 1247 pp.

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Dissertation or Thesis:

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