LIGHT, LIFE AND MANKIND

Starting in issue 4.4, I will be presenting a series of papers based on the theme of 'Light and Life', which was the congress theme for the 1990 Okinawa-based ILTA meeting. This series will trace the importance of light in the birth and development of the Earth. It will then examine the influence of light in the production of the first primitive cell, a simple DNA envelope with its non-nucleated construction, the birth of life itself, and the enrichment of the primordial soup in which this cell developed to form first its enclosed cytoplasm around the membrane-separated nucleus, and then the evolution of motive force through the extension of a single flagellum, to the first grouping of cells together to form a multicellular life-form. These three cell types, the prokaryote, the eukaryote and the flagellate, are still with us, literally "with us" as members of the human race. Viruses and bacteria are prokaryotes and so, in a manner of speaking, is the erythrocyte; normal mammalian cells, including those important to defence of the body such as mast cells, fibroblasts, leukocytes and lymphocytes, are eukaryotes; and spermatozoa are flagellates. In a previous 'Letter to the Editor' (*Laser Therapy* 3:4, 187), it was suggested that cells transcribe and store information from the light which has activated them in the genetic material, and that re-exposure to light carrying the same information can cause reactivation of the cell. This could explain that some processes which do not require light, or which at least usually take place in darkness, can be activated by light.

With very few exceptions, we are all light dependent organisms, both members of the animal and plant kingdoms. Our lives are ruled by the circadian cycle, and if we are deprived of light, we grow pale, and wither both physically and intellectually. Only the strongest-willed can live long, deprived of light. Those who have to work out of kilter with the circadian cycle, such as night shift workers, or those in the late-night/early morning entertainment business, usually demonstrate some physiological changes, such as irregularity in menstrual cycles, and psychological changes all traceable to the lack of normal day-night life rhythm. The entire food cycle depends on light: photosynthesis stores energy in plants. Animals eat the plants and in doing so release a small fraction of that energy into their own bodies. The animals are in turn devoured by other animals, and the energy is exchanged again, in an even-smaller quantity. The animals die, and the tiny amount of originally light-inspired energy is transferred through decay to the earth, and thence to the plants again.

In ancient Chinese there is a word '*ishokudohgen*', which has the dual roots of 'eat' and 'medicine'. There is a school of thought which believes that food, both plant and animal in origin, is a natural medical repository of curing and toning properties, each different type of food being beneficial to a certain illness, organ or other part of the body. This storehouse of curative and restorative powers is light-mediated, and the food is carefully selected in order to pass on as much as possible of the stored beneficial properties to the consumer.

From the discovery and taming of fire, man had at his command an artificial light source, and so could turn night into a semblance of day. A large number of artificial light sources have been used, including the light from captive fire-flies, simple wooden torches, candles, animal oil lamps, natural and coal-gas, the incandescent lamp, gas and carbon arc lamps, and fluorescent tubes. The therapeutic properties of these were explored, but it was not until the turn of this century that a reliable and powerful man-made therapeutic light source was developed by Professor Nils Finsen in Denmark which finally replaced the sun as the healing light, relieving practitioners from the time constraints and the sometimes fickle properties of heliotherapy. The next milestone, and the one which concerns us most, was the birth of the laser in 1960, successfully first developed by Dr Theodore Maiman in Malibu, USA.

In the 3.5 billion years since the birth of the first living cells, however, and for at least 2.5 billion years before that, the sun has gone on shining, and we take it so much for granted, especially since, in the last century, we have developed the generation of electrical energy so that at any time, with the click of a switch, we can turn night into day. With the click of a switch, we can also harness the surgical and medical powers of that special light energy, laser. But this ease of access must never be abused or taken for granted. The "laser face-lift" boom of the early-mid seventies, from which we in the laser therapy field are still suffering, must never be repeated. The only way we can all help assure that will never occur is to concentrate on developing existing applications in a sound, clinical way, and by trying wherever possible to back up clinical applications with controlled scientific and clinical experimental studies, and of course reporting these studies in *Laser Therapy*!

In previous Editorials, I have dealt at length with terminology, and there has been one paper specifically dedicated to that subject (*Laser Therapy*

3(4), 177). However, I still see and hear those hardware-based terms, especially 'low-power laser', cropping up in written and spoken presentations. A 20 W CO₂ laser can be used in laser therapy, with the correct spot size, to give sufficiently low incident power and energy densities: a spot size of 10 cm, the diameter of a typical medium-sized crural ulcer, will give an incident power density of 0.25 W/cm², and that is with an output power of 20 W. 0.25 W/cm² will not give any direct photothermal response, and at that low incident photon density, the H₂O molecules, normally the absorption medium of 10,600 nm infrared energy, do not absorb the incident energy in the same photothermally destructive way. Instead, the transport mechanisms in the cellular membranes in the target tissue are activated at a photophysical level, in turn activating the photocascade in the cytoplasm to produce a photochemical-like reaction: but it is a secondary reaction: the primary activation occurs in the membrane. Please, let us look more at, and talk more about, the *reaction* between the incident energy and the target tissue, than the hardware which produces this reaction.

The argument continues on the effectiveness of coherent (i.e. laser) versus noncoherent but monochromatic light sources (Kubota and Ohshiro, *Laser Therapy* 3) 127–133), now added to by the nonpolarized versus polarized light sources, the latter being further subdivided into linear-, right-handed- and left-handed polarization. For an excellent study on this please see Peter Bolton's article (*Laser Therapy* 4(1), 33) working in the Guy's group under Mary Dyson, on the effect of polarized light on the release of cell growth factors from a macrophage-like cell line. This compared two light sources identical in broad-band wavelength and energy density, but with different degrees of polarization (14% and 95%): the 95% polarized light evoked the greater reaction in the irradiated cultures. It is absolute undeniable that, in monolayer cell layers *in vitro*, monochromatic noncoherent light is as effective as laser light. It has been shown experimentally *in vivo*, however, that the photon density of the monochromatic laser energy, in other words, the coherence factor, gives much more of a reaction than noncoherent monochromatic light at the same incident energy densities. The Mesters published an early paper which compared the effects of laser, narrow-band monochromatic nonpolarized light, and the same narrow-band light but polarized, on a tissue model. With the laser effect (which was greatest) normalized at 100%, the polarized light gave approximately 65%, the nonpolarized light 15% and the unirradiated control, 0%. It was argued at the 1991 Anaheim ISLSM meeting that for *in vitro* work, monochromaticity and polarization are more important than coherence, while for *in vivo* tissue, coherence is most important, but right-

handed and linear polarized coherent light were most effective: the argument continues. I would welcome the views of any of the protagonists and antagonists in this journal.

By the time this issue reaches you, **London Laser 1992** will have come and gone, and we will be gearing up for volume 5. As always, we are hindered in the regularity of our publication by the papers we have to publish. The rejection rate continues at around 1 paper in every 5–6 received. Some of these are due to the fact that the papers are more concerned with surgical applications, HLLT, than LLLT: however, others are sent back because of incomplete or incorrect parameter reporting. Let me add once again, we will welcome papers both experimental and clinical, and will try to keep a balance between these. However, and it is a big 'however', parameters **MUST** be reported correctly. We need:

- Laser type, maker and model
- Beam mode and type (e.g. multimode, continuous wave)
- If pulsed, please provide the average power, the peak power, the pulse width and the interpulse interval
- Incident power at the tissue
- Spot size (area in cm²)
- Irradiation time per shot in seconds
- Number of shots per session
- Total number of sessions
- Details of laser set-up (scanning system, clamp to hold light source steady, etc.)

Any other parameters would of course be welcome, but the above set of parameter information must be supplied as requested.

Finally, on behalf of the Editorial team, I wish to bid farewell to Mary Lawrence, from the Wiley Journal Production Department. Ms Lawrence was involved from the very inception of the journal as the journal's production controller, and has worked hard and long to get the journal back onto track after the problems in the early days. I would like at the same time to welcome Andrew Hyde who is coming in as Ms Lawrence's successor to handle the journal's production side. Please, when considering publication of your scientific and clinical data, make Mr Hyde's job (and mine) much easier, and send them first to *Laser Therapy*! This is after all the only journal in the field dedicated to LLLT and photobioactivation, but without papers, there is no journal: without the journal, a lot of the progress which has been made in the legitimization of LLLT will be lost. As always, it's up to us all to get our facts, and the conclusions drawn from them, down in black and white, and disseminated to the others working in the field. I look forward to hearing from you!

Toshio Ohshiro
Editor-in-Chief