Volume 4 Number 1

December, 2003

ESLAS

WAVELENGTHS

The Newsletter of the EUROPEAN SOCIETY FOR LASER AESTHETIC SURGERY

MESSAGE FROM THE PRESIDENT

Dear ESLAS Colleagues,

Welcome! ……. Or should I say, 'Welcome back!' First of all, a very belated but none-the-less sincere welcome to you all *via* this long-delayed issue of *Wavelengths*! As I wrote to you at the end of March, we have had some problems with this issue of *Wavelengths* due to the ill-health of the managing editor, but I am happy to say that we are once again 'on the go'. 2003 is the Year of the Sheep under the Oriental 12 animal zodiac, but there should be nothing 'sheepish' about our plans for ESLAS for the rest of this year. In my last message to you in the previous issue of *Wavelengths*, I promised that the Executive Committee were planning to move ahead rapidly to make ESLAS more dynamic, and most of all, to make it YOUR Society. Global concerns, war and strife have diverted us completely from our chosen course, but the next item on our agenda is ***definitely*** the ESLAS Web Site, and as I write, a new, dynamic and more informative site for you all has been launched to enable better communication between us all and to help towards the continuing education so necessary for practitioners using lasers in aesthetic surgery.

Mario A Trelles MD PhD, ESLAS President

Please visit the new ESLAS site at www.eslas.com. Your feedback is very welcome.

2002 5th ESLAS/AREDEP Meeting

Towards achieving that goal, in May of last year our very successful 2002 5th ESLAS meeting was held jointly with the 7th meeting of *l'Association de Recherche en Esthétique Dermatologique et Plastique* (AREDEP) in the Pitié Saltpétrière Hospital in Paris, and a very successful meeting it was. For those of you who were there, the meeting report elsewhere in this issue of *Wavelengths* will bring back happy memories, and for those of you who were not there, well, you should have been! You missed a superb meeting.

I should like to take this opportunity to thank Dr Isabel Catoni, the President of AREDEP and also of the joint meeting, for allowing us to 'share' her meeting, the end result of which was mutual enrichment for both groups, the primarily plastic surgeon-based membership of ESLAS learning from the primarily dermatologist-based membership of AREDEP, and *vice versa*.

6th ESLAS Meeting, Rome, December 2003

Because of the aftershocks from September 11th 2001 which are even now still rumbling around the world, amplified of course by the recent Gulf War in Iraq and continued unrest in the Middle East, the selection of our meeting venue for this year and the meeting plans were thrown absolutely into chaos. Our original venue of Tel Aviv in Israel was perforce moved to Istanbul, but of course that too was fraught with potential problems. However, as I wrote to you in March of this year, the preparations for our forthcoming Congress in Rome this December are "full steam ahead" thanks to the hard work and devotion of Dr Luigi Rusciani and his team, and with the much-appreciated collaboration with the Executive and Membership of the European Society for Laser Dermatology (ESLD). Once again with this collaborative effort, both Societies will have the best of both worlds for all their members, I am truly confident that it will again prove to be a first class event and must for all ESLAS members to attend! Please see the new ESLAS website for the programme-at-a-glance, and also the full programme (in Adobe PDF format).

The 'Perfect' Light Source?

One interesting nugget which emerged very strongly from our last meeting, and at a number of important meetings since such as Laser Firenze 2002 (Prof. Leonardo Longo) and the first Anti-Aging World Conference, Paris, 2003 (Prof. Jean-Jacques Legrand), is that there is really no such thing as a 'perfect', almighty light source, coherent or non-coherent, for laser aesthetic surgery, including ablative and nonablative skin rejuvenation, despite what the manufacturers would have us believe. The message is that, to deliver the best aesthetic laser (or non-laser) care to our patients, we really have to look at combining systems to optimize the phototreatment results of each system. When thinking about which systems might work well together in a complementary manner, so that the final effect is actually better than a sum of all the component parts of the systems to be combined, we have to go back to our basic photobiology, firmly based on the precepts of photophysics and photochemistry, and look carefully at wavelength specificity of selected targets. To that end, please see the article in this issue of *Wavelengths*, the first in a series to bring us all up to speed on the photobiological basics on which phototherapy is very firmly based.

It is not possible physically or photobiologically for a yellow light to have the same immediate effects as a near infrared one, since even the subpurpuric flashlamp pulsed dye laser works in visible-light specific mode, mostly involving pigmented chromophores in a photochemical manner, while near infrared light works to effect photophysical rotational and vibrational changes at the level of the electrons of atoms making up the molecules in the target proteinous substances, mostly the membranes of cells and subcellular organelles. That the ultimate reaction is also a secondary photochemical one cannot be refuted, but it is a secondary reaction which is triggered by the primary reaction at a totally different biological target and level in the dermis. Please see the article elsewhere in this issue on the phototherapeutic basis of nonablative skin rejuvenation.

Keratinocytes or 'Cytocytes'?

Recently, attention has been focused by Professor Kira Samoilova (Institute of Cytology of the Russian Academy of Sciences, St. Petersburg, Russia) and her colleagues on the effects of a combination of noncoherent but polarized visible red and infrared light on transcutaneously irradiated blood, compared with unpolarized light of the same parameters. The target was a small rectangular skin patch (3 cm x 5 cm) at the base of the spine in volunteer human subjects. The radiant flux (or energy density) was approximately 12 J/cm^2 for both light sources. Irradiation of the subjects with the combined polarized visible and infrared light led to a statistically significantly faster increase in the growth promotion activity of human keratinocytes in the entire circulating blood, which was a consequence of the transcutaneous photomodification of blood and its systemic effect on the entire circulating blood volume.

In an extremely interesting incidental finding to the main direction of the study, a dramatic increase in the presence of the circulating blood of both pro-and antiinflammatory cytokines was also noted, telling us that the dermis is not the only target we should be considering in nonablative skin rejuvenation, but also the mother keratinocytes in the basal layer of the epidermis. In fact, these interesting cells have been christened 'cytocytes' because of the large range of cytokines they synthesize following irradiation and photomodulation with the appropriate combination of wavelengths. This has exciting implications in nonablative photorejuvenation, and turns our existing theories a little bit on their heads, in that we might consider, in the very first step of our treatment regimen, the epidermal keratinocytes as our first target, using very low incident levels of photon density, then followed by the present techniques involving delivered thermal damage (DTD) in the superficial and upper reticular dermis. Exciting thoughts!

Theory into Practice

At the Instituto Médico Vilafortuny, putting my words above about combining different modalities into action, we have been experimenting with the combination of a number of wavelengths and wavebands in what we refer to as 'combined nonablative skin rejuvenation', using both laser and noncoherent light sources. The combination of a subpurpuric pulsed dye laser with a near infrared diode laser has proved extremely effective, preceded by a single session of gentle powder-based epidermal peeling to get rid of the 'old' stratum corneum before the first photorejuvenation session. We are also experimenting with treatment using the yellow cut-off filter of an IPL source followed immediately by nonablative Nd:YAG laser at the primary 1064 nm line over the deeper wrinkles. Yet another combination is the application of a frequency-doubled Nd:YAG laser (532 nm) at nonablative settings followed immediately by a nonablative 1064 nm Nd:YAG beam. In both of the former, we apply the epidermal peel before the first treatment session of the nonablative photorejuvenation regimen.

We have found that all of these

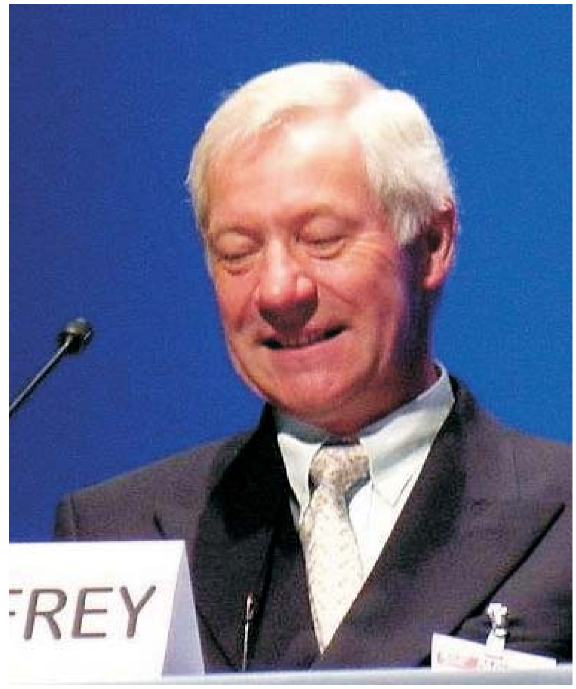
combinations offer a result superior to the use of the individual components on their own, and indeed some of the lasers we use are designed specifically for other applications, such as laser depilation, rather than nonablative photorejuvenation. The secret is to examine the laser-tissue interaction, or rather the photon-tissue interaction, and to adjust the parameters so that the desired effect is achieved in the dermis, while leaving an intact and healthy epidermis over the area of interest so that the inflammatory wound healing stage can quickly be induced, followed by neocollagenesis and neovascularization in the upper regions of the dermis.

Reports on all of these techniques, and more, are currently under consideration by a number of journals, and we'll keep you informed of the outcome. Naturally, the 2003 ESLAS meeting will have presentations of these as part of the scientific programme, by which time I hope we will have a very large patient base so that the studies will have well-advanced from the preliminary stage.

A Word of Thanks for the ESLAS Past Secretary-General

This summer, which was frightfully hot in Europe, has come to an end and as Autumn ticks away the last days to Winter, ESLAS is continuing with the preparations for its Annual Congress to be held in Rome in December, under the Presidency of Professor Luigi Rusciani (*Catholic University of Sacred Heart*), with the collaboration with the European Society for Laser Dermatology.

Now the ESLAS Board must meet to look into the details of, and prepare the forthcoming Annual General Meeting, and as we analyse the milestones we have achieved over these



Dr Alan Godfrey,past ESLAS Secretary-General

years, the hard work done by the former General Secretary, **Dr. Alan Godfrey** of Oxford, is one of the things that stands out in our mind.

We are greatly indebted to him for all he did at the start-up of the Society, particularly with regard to its legal structure. His labours, which are thus of great importance still today deserve our respect and recognition.

As ESLAS Secretary-General, Alan was well aware of how to perform his job, always discreet, and he paved the way for today's General Secretary, Dr. John Carruth.

All of the above, together with all that is done by Doctors P. Kontoes, who combines the work-intensive posts of Honorary Treasurer and Membership Secretary, and R. G. Calderhead, who is now in charge of producing the Newsletter and Website, make ESLAS a force to be reckoned with and able to keep its members up-to-date as regards what's on worldwide in laser surgery and related applications, which will certainly be seen in the December meeting.

I look forward to personally welcoming as many as possible of you in Rome in December!

Vilafortuny, Spain. October 2003

OPEN LETTER FROM THE ESLAS BOARD

Dear ESLAS members,

When is a Member not a Member?

As you know, we had a very successful meeting held jointly with AREDEP in Paris last May. Despite the many positive factors of the meeting, including the large number of attendees, the excellent organization and the high quality of the presentations and discussions, there was one negative and somewhat disturbing facet that arose from the meeting, which has somewhat saddened all of us on the ESLAS Board.

In every issue of this newsletter, our very hard-working Membership Secretary and Treasurer, Dr Paraskevas Kontoes, urges the membership to become current with their dues. As you will see from his report elsewhere in the newsletter, many of you have not done so, neither for 2002 nor 2003, but you are still receiving this issue of *Wavelengths* (at some considerable cost to the society) in good faith and in the belief that you will recognise your duty to the society, and cough up what is not an unreasonable fee if you compare it with other societies.

Very sadly, adding insult to injury, not a few of you claimed the reduced registration fees to last year's meeting by right of being ESLAS 'members', and as your names were on the register (although not marked up as having paid), those hard working souls on the reception desk took your word for it, and charged you the reduced registration fees. By 'members' in inverted commas, we mean those of you who are members only on paper but not 'in good standing' with your 2002 or 2003 membership fees. We are sure you know who you are, and we hope that you will now do the right thing and send off your membership fee to Dr Kontoes post haste.

For those of you reading this who ***are*** ESLAS members in good standing, i.e. with membership fully paid up to and including 2003, and who likewise were members in good standing for 2002 and thus were fully entitled to the discount at the Paris meeting, please disassociate yourselves from this letter! We on the ESLAS Board would like to thank you for your much-appreciated and very necessary support: we say 'necessary', because our society depends almost 100% on the membership fees as its main source of revenue, which supports ventures like this Newsletter, the improved ESLAS web site which will be unveiled in a couple of months' time, and enables us to advance funds to ESLAS meeting organisers so that the site booking fees, hotel block bookings, initial mailings, *et cetera*, can be accomplished. It's very simple .... No membership fees, no ESLAS!

The reception desk staff at our meeting this year will be well advised as to who ***are*** ESLAS members in good standing, so the same trick which succeeded at the 2002 Paris meeting will not be allowed to be perpetrated at our 2003 Rome meeting this coming December. Please, get up to date with your ESLAS membership! Thanks in advance for your cooperation.

ESLAS Board Members

OPEN LETTER FROM THE "WAVELENGTHS" MANAGING EDITOR

Dear ESLAS Colleagues, this is a brief letter to apologise to you all, particularly to the ESLAS Board, for the extreme tardiness of this issue of the newsletter. The road to Hell, they say, is paved with good intentions, and after the excellent meeting in Paris last year, I fully intended to get this issue of *Wavelengths* out so that you would all feel the society was looking after you, and keeping you informed and in touch.

Unfortunately, "…the best laid schemes of mice (and Glen) aft gang aglay" to paraphrase Robert Burns, Scotland's national poet, and in my case, ill health intervened late in the summer of last year, which instead of improving, tended to worsen, reaching its nadir in spring of this year. For those not familiar with the Doric (Scots tongue of Rabbie's time, around the end of the 18th Century), 'aft gang aglay' means '*in many instances do not go the way one hopes*'. I have to admit that I withdrew from my duties, not only the Newsletter, but also the ESLAS website, of which I had been invited to become Webmaster. It was not until summer of this year that I started to take up the reins again, and I would like to thank Dr Mario Trelles and Dr Paraskevas Kontoes and their staff for the enormous amount of support and encouragement which they selflessly gave me: without it, there would have been no *Wavelengths*, and no website. Mario and Vakis, sincere and grateful thanks.

Hopefully, the days of "gangin' aglay" have now come to an end, and I intend to see next year in with at least two issues of *Wavelengths* to make up Volume 5. I am sure the absence of the *Wavelengths* and the website is one of the main reasons why we have not seen as many members' subscription renewals as we should have. Now both the newsletter and the website are back, and I hope that those of you who are reading this, and who have not paid their subscriptions up to date, will hasten to do so. The list of fully-paid up Members in Good Standing (and those still to pay) can be viewed on the website. This list would not have been possible without the diligent work of Ms Evita Thomaidou, the hard-working secretary to the Membership Secretary -- thanks, Evita!

The society depends almost entirely on the membership fees to finance its day-to-day running, so please, dear colleagues, let's get ESLAS into 2004, a leap year, with a solid number of Members in Good Standing. For my part, I will not let you down as I have done over the past year, so you will not be able to make the absence of the newsletter and the lack of an up-to-date website your excuses any longer.

Thank you for your understanding, and for your active support of ESLAS.

R Glen Calderhead,

Tochigi, Japan.

MEETING REPORT: 5th ESLAS and 7th AREDEP MEETINGS

May 24th-26th, Pitié Saltpétrière Hospital, Paris, France.

Disaster to Triumph

Following the terrorist attacks in the USA of September 11th, 2001, our plans to hold the 5th ESLAS meeting in Stuttgart were thrown into disarray by the financial repercussions in the aftermath of that terrible day. The number of international air travellers dropped dramatically, air fares rose, and companies the world over were forced to tighten their belts with the result that sponsorship for meetings was very difficult to obtain. However, in a stroke of genius, the ESLAS meeting was accepted as a co-event with the 7th meeting of l'Association de Recherche en Esthétique Dermatologique et Plastique (AREDEP) in the Pitié Saltpétrière Hospital in the heart of the beautiful French capital of Paris. Potential disaster was converted to potential triumph, and as those who were among the over 400 attendees will attest, potential triumph was converted into the real thing in this very successful joint meeting.

Day 1: Friday, May 24th (ESLAS)

Within walking distance of the river Seine, in the XIII Arondissement, the location of the joint ESLAS/AREDEP meeting was the modern Pitié Saltpétrière Hospital, used every year by AREDEP for their annual meeting, and an excellent venue it certainly proved to be. Under the more than able orchestration of the congress company EuroMedicom, led by Mme Catherine Decuyper, a network of interlinked marquees was erected at the entrance to the congress site wherein the dining facilities were located, and which also comprised the commercial exhibition areas. The waterproof nature of the marquees was (unfortunately) very sorely tested, as the rain visited the meeting. April in Paris may be the subject of song, but May in Paris was WET. However, the rain did nothing to dampen the spirits of attendees of the joint. meeting, and the exhibition and refreshment areas were never empty. The greenish-blue light due to the filtering effect of the tent material was very soothing …. free phototherapy for the attendees and the exhibitors!

Following the opening ceremony conducted by the President of AREDEP and of the joint meeting, Dr Isabelle

Isabel Catoni MD, Meeting President

Benjamin Ascher MD,
ESLAS Scientific Secretary

Catoni, and the ESLAS Board (President Dr Mario Trelles, Secretary-General Mr John Carruth, Membership Secretary/Treasurer Dr Paraskevas Kontoes, and Scientific Secretary, Dr Benjamin Ascher), the first of the five round table sessions comprising the day's programme got underway, on the subject of vascular lasers. This session covered an array of systems and application methods, ranging from the targets of vascular lasers to bare fibre indications and endovascular application. The session concluded with a panel discussion following the lectures from the session chairs, Drs Lannigan and Hebrant.

The second session was on ablative lasers, focusing mainly on laser ablative rejuvenation. In this contest, an interesting paper was presented on the laser stimulation of fibroblasts in this application. Naturally, the merits of the CO_2 versus the Er:YAG were examined. Drs Trelles and Kaufmann, the session chairs, presented the experts' points of view, and the session concluded with a round table discussion. An excellent lunch was then served in the undersea atmosphere of the marquees.

The third Round Table of the day, and first of the three in the afternoon, was on the hot topic of nonablative . photorejuvenation, in which a range of laser- and non-laser sources was presented in the nonablative rejuvenation of photoaged skin. Interesting combinations of lasers and intense pulsed light (IPL) filters were presented in addition to other pharmaceutical strategies to overcome the lack of patient satisfaction with the visible result of nonablative photorejuvenation, where more often than not the excellent histological improvement in the superficial dermal collagen rearrangement is not echoed in the intact 'old' epidermis. Dr Peter Bjerring gave the chairman's lecture, followed by a round table with all the speakers participating.

Paraskevas P Kontoes MDPhD,
ESLAS Ho. Treasurer & Membership Secretary

The use of laser energy rather than the cold scalpel in surgical procedures is always a controversial topic, and the next Round Table focused on laser surgery. Laser assisted upper and lower blepharoplasty, incisional laser applications and specific surgical applications of the Er:YAG laser were among the topics presented. A very thought-provoking presentation of a more philosophical nature on the medical applications of light was giver by Dr Arie Orenstein. This was followed by the usual round table session.

Advances in laser technology and better understanding of the laser/tissue and laser/pilosebaceous unit have led to improved applications of the laser in hair removal, the subject of the final Round Table of the day. Laser and IPL sources were presented with a range of experiences from the experts. Dr Troilius gave the Chairlady's presentation, and the following round table closed the meeting for the day.

Day 2: Saturday, May 25th (AREDEP)

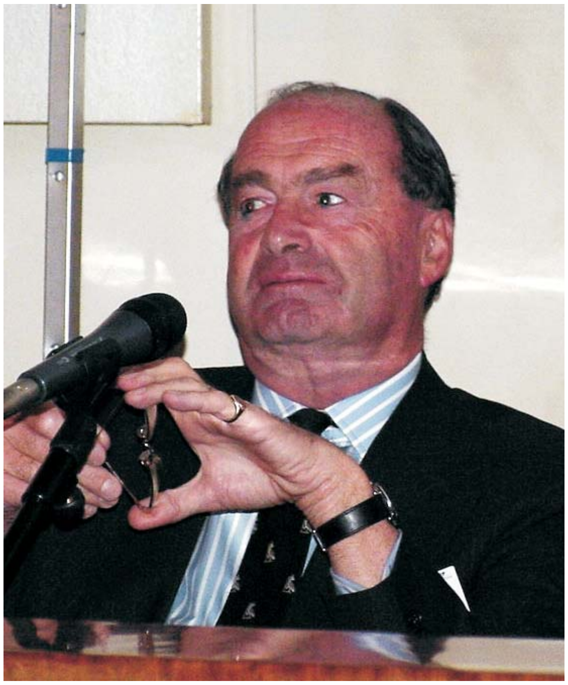
Following the same structure as on Day 1, Day two saw five round table sessions on dermatological and plastic surgical applications of laser and other modalities. In addition, specific body area-related aspects of aging were examined, and a session was included discussing the medicolegal pitfalls waiting for the unwary surgeon. The opening Round Table was on the treatment of acne scarring, in which the state-of-the-art of acne scar treatment was presented. A series of experts presented one clinical case each which was then discussed by the floor and the expert panel. An interesting technique of dermabrasion under water hyperpressure was also presented.

Mario A Trelles MD PhD
ESLAS President

Hyper- and hypo pigmentation was the subject of the second Round Table. The state-of-the-art of facial pigmentary diseases was presented, followed by a range of geographically-centred treatment regimes for melasma in Tunisia, Iran, Morocco and France. The session was rounded off with a discussion on vitiligo and its treatment.

Undesirable side effects, or accidents, are the scourge of the plastic surgeon and dermatologist. Fillers have their own associated problems, and these were discussed in the next Round Table. The state-of-the-art of new fillers was presented, followed by individual experts giving their own experiences on the management of problems associated with a particular filler. The session was concluded with an overview of the complications associated with fillers and their treatment. Obviously, prevention is better than the cure.

This final session of the morning



John AS Carruth MD PhD FRCS
ESLAS Secretary-General

was followed by the undersea atmosphere of the marquees and an excellent, if somewhat rain-swept, lunch.

The first of the two afternoon Round Table very interestingly dealt with the topological analysis of ageing and treatment, looking specifically at body areas, such as the face, nose, mouth, arms and legs, each being dealt with by an individual expert. The pos and cons of cosmetic facial surgery were then examined in the final presentation.

The final Round Table of the day dealt with the extremely important medicolegal aspects of aesthetic surgery, and with the increasing number of patients who resort to lawsuits following what they believe to be 'bad' treatments, some understanding of this area is essential for the surgeon in aesthetic practice. Presentations ranged from the purely legal standpoint, through the importance of excellent clinical photography (after all, the camera never lies!) in solving patients' complaints, and what methods of defence does a surgeon have against his or her patients' complaints.

"La Seine est une fleuve ......"

The Saturday evening allowed participants in the congress to mingle in the informal 70's themed atmosphere on board a péniche, "*La Balle au Bond*", safely and permanently moored to the solid bank of the river Seine.

Of course some amongst us, already running just a little late, were left more than a little high and dry (or rather, high and wet) due to the vagaries of one of the infamous Parisian taxi drivers, who well overshot the drop-off point and had us scrambling down the bank of the Seine, hailing all and sundry craft until we saw the friendly lights of *La Balle*. We were extremely relieved, as we were labouring under the misapprehension that this was to be a dinner cruise, and we were certain we had literally missed the boat!

Due to the vagaries of the weather, there was occasionally as much water above decks as there was flowing beneath the solid hull of this traditional converted commercial narrow boat. However, ample supplies of good basic food (plus, of course, *le bon vin*) and a somewhat compact dining area soon had strangers talking as friends.

The muted roar of wine-fuelled conversation was hastily silenced when we were treated to a series of superb piano pieces and other munificent musicological mystery tours, outstanding among which was our very own Dr Catherine Gaucher, whose ivory-tickling skills rivaled the professionals. Extra spotlights on the performers were occasionally enhanced by the massive flood lights of passing river cruisers, whose passengers must have been indeed envious of our jollifications.

A great evening was had by all, despite the attempts of the weather gods to dampen our party spirits, and *'Sur les ponts de Paris'* was hummed in a variety of keys and rhythms as revelers weaved their meandering way up from the 'quai' to the road, to taxi and thence to slumber, soothed by memories of our river-rocked festivities.

Day 3: Sunday, May 26th (ESLAS/AREDEP)

Bright and early at 08:30 on this sunny Sunday (except for some of the revelers from the previous evening), the final half day of the meeting started, consisting firstly of a very ambitious schedule of live surgical demonstrations of the lasers and IPL systems presented in the previous days' didactic sessions. A grand total of 20 systems from 10 manufacturers were presented in live surgery from the suite of operating theatres of Professor J-C Bertrand's maxillofacial surgical department at the Pitié Saltpétrière Hospital.

The real-time live surgical images were beamed up to large television monitors in the meeting hall, with a two-way sound system enabling the operating surgeon to explain what she or he was doing with the system in question, and allowing session moderators and members of the audience to ask questions of the surgeon. The sessions were held in two different operating theatres, sometimes with two systems being used almost simultaneously in the one room, and images and sound were (almost) seamlessly switched between the surgeries, orchestrated by Dr Glen Calderhead who was coordinating the entire practical session. Dr Calderhead has mentioned that he would like to offer a sincere and special word of thanks to the sometimes hard-pressed head nurse and her staff, the sound and vision technical operators, and Mme Catherine Decuyper of EuroMedicom who masterminded the set-up.

Live surgical sessions were presented on lasers in vascular surgery, lasers and IPL sources in nonablative photorejuvenation, ablative laser resurfacing, and finally hair removal with lasers and IPL sources.

After a much-needed coffee break, two final didactic sessions were presented on the use of the eximer laser in the treatment of psoriasis and vitiligo, and a very important session on safety aspects to the operator and ancillary staff of firstly the laser plume in ablative and incisional laser surgery, and secondly the use of the laser in ophthalmology.

The final round table session was chaired by Mr John Carruth, comprising all the chairmen and chairladies of the practical and didactic sessions.

Dr Isabelle Catoni then officially closed the highly successful joint ESLAS/AREDEP meeting, and all attendees adjourned swiftly to the subaquatic atmosphere of the marquees where the final lunch was vastly enjoyed, washed down with copious quantities of highly potable wine.

In Conclusion

This first joint meeting of AREDEP and ESLAS was an unqualified success, as it brought something of interest to the table of both societies which they would not have been able to accomplish on their own. It also considerably swelled the number of attendees, and left the door open to the possibility of a similar joint venture in the future. Dr Catoni is to be heartily congratulated on the successful presidency of the joint meeting, with its 400 attendees, 12 round table sessions, and 60 presentations, not to mention the 20 live procedures and the evening afloat on La Balle du Bonde. Both Drs Catoni and Trelles would like to thank Mme Catherine Decuyper of Euromedicom, whose faultless behind-the-scenes management of all aspects of the congress and its environments was as usual professional and first class, allowing the scientific side of the congress to proceed seamlessly.

Readers are urged to watch carefully for such an opportunity to present itself again, and not to miss the next one. More information on the 2003 ESLAS meeting, which will be once again a joint meeting, although not with AREDEP, can be found elsewhere in this edition of *Wavelengths*.

Paris, August 2002, Isabelle Catoni

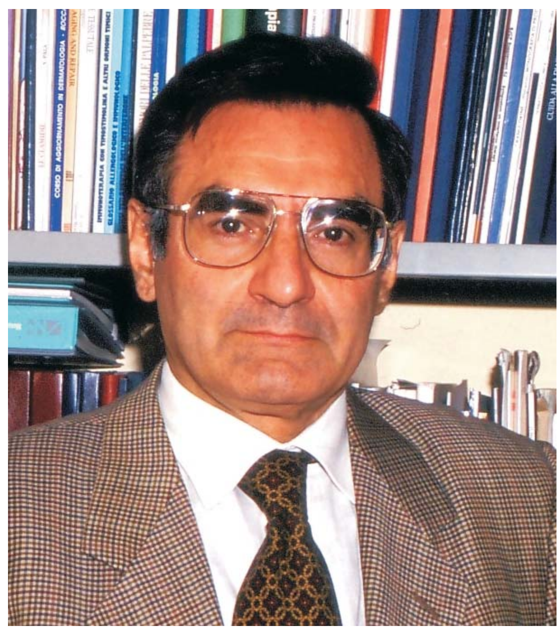
Cambrils, August 2002, Mario A Trelles

6th ESLAS Meeting: ESLAS 2003, Rome, Italy

Dear ESLAS Colleagues,

It's a great pleasure for me to invite you to Rome for the 6th Congress of the European Society for Laser Aesthetic Surgery. Laser surgery today is a field of enormous promise and potential. The number of physicians interested in this approach increases every year, and the variety of laser procedures being offered in public healthcare centers is in continuous expansion. The objective of the Congress is to examine the current state of our rapidly changing art, the possibilities we can offer patients for treatment of pathological and unaesthetic skin lesions. Activities have also been planned for those physicians who are new to the field, activities that will provide them with the basic concepts and guidelines for choosing the right laser for the lesions they will be treating. And we've put together an international faculty of world-renowned experts, who will give us a complete update in the important field of skin cancer.

Rome is honored and pleased to host this important event, and I assure you that all of us will have numerous opportunities to enjoy the beauty of this eternal city and its cultural and historic riches. On behalf of the Program Chairmen and the Organizing Committee, together with the Catholic University of the Sacred Heart, I'd like to express my sincere hope that you'll join us. I look forward to seeing you!



Luigi Rusciani, MD

Luigi Rusciani MD

6th INTERNATIONAL CONGRESS of the EUROPEAN SOCIETY FOR LASER AESTHETIC SURGERY (ESLAS)

PROGRAMME 'AT-A-GLANCE'

Friday, December 12th	Saturday, December 13th	Sunday, December 14th
09:00~09:30 - OPENING CEREMONY	09:00~10:45 - SYMPOSIUM 2 CURRENT STATUS OF LASER HAIR REMOVAL	09:00~10:45 - SYMPOSIUM 6 VASCULAR TREATMENT: CURRENT STATE-OF-THE-ART
09:30~10:30 - KEYNOTE PRESENTATIONS		
10:30~11:00 - Coffee Break	10:45~11:00 - Coffee Break	10:45~11:00 - Coffee Break
11:00~13:00 - SYMPOSIUM 1 NONABLATIVE SKIN PHOTOREJUVENATION	11:00~13:00 - SYMPOSIUM 3 ASSOCIATED TECHNIQUES	11:00~13:00 - SYMPOSIUM 7 FUTURE OF LASER AND LIGHT THERAPY
13:00 ~ 15:00 ---- LUNCH	13:00 ~ 15:00 ---- LUNCH	13:00~13:20 - SELF-ASSESSMENT CLOSING REMARKS
15:00~18:30 LIVE SURGERY SYMPOSIUM	15:00~16:30 - SYMPOSIUM 4 PIGMENTED LESIONS and TATTOOS	
	16:30~16:45 - Coffee Break	
	16:45~18:15 - SYMPOSIUM 5 ABLATIVE RESURFACING	ESLAS

MESSAGE FROM THE MEMBERSHIP SECRETARY & HONORARY TREASURER

Dear Colleagues,

As we draw near the year end, and the 6th ESLAS meeting in Rome, I would just like to take this opportunity to remind you that your 2003 Membership dues are now extremely well overdue, apart from those faithful few souls who have in fact paid. Our society depends to an extremely large extent on the income from membership fees. I appreciate that with the absence of the Newsletter and the Website, many of you may have felt disinclined to part with your hard-earned cash, but now you have no excuse! *Wavelengths* is back, and a new, vibrant website is there for you.

You can check on the Members Lists on the website to see if you need to pay, or even if your payment has not been recorded for some reason. Contact details can be found on the site, so you can let me know if there is any problem. Gradually, the Members-only pages will be expanded so that you will really feel that this is 'your' website. So please, colleagues, let me have your outstanding membership dues as soon as possible!

Paraskevas P Kontoes MD PhD

Honorary Treasurer and Membership Secretary

PHOTOTHERAPY UNVEILED: THE PHOTOBIOLOGICAL BASICS BEHIND NONABLATIVE SKIN REJUVENATION WITH LASERS AND OTHER LIGHT SOURCES.

PART 1: LIGHT – ITS PROPERTIES AND PARAMETERS

R Glen Calderhead FRSM[1,2] and Mario A Trelles MD PhD[z]

1: Japan Phototherapy Laboratory, Tokyo, and SG Biomedical, Kassemba, Tochigi, Japan; and 2: Instituto Médico Vilafortuny /ANTONI DE GIMBERNAT FOUNDATION, Cambrils, Spain.

PREVIEW

The application of nonablative light sources in the rejuvenation of photoaged skin is expanding rapidly, but the photobiology behind the processes by which a particular type and dose of light can repair damage (which was actually also caused in the first place by light) is imperfectly understood. Although the main concept of nonablative skin rejuvenation is centred on the creation of a controlled zone of delivered thermal damage (DTD) in the upper dermis under a cooled epidermis, the incident light energy, in the form of photons, does not simply stop at the DTD zone but continues on into the surrounding dermal tissue, mediating athermal photoreactions in the periphery of that thermal effect. These athermal reactions, at a cellular and subcellular level, contribute a great deal to the modulation of the wound healing process instigated by the DTD to produce the final hoped-for results. This article examines the range of athermal photoreactions which occur simultaneously with the thermally-mediated effects in nonablative skin rejuvenation, and also to a great extent in laser ablative resurfacing, and attempts to show the importance of these photobioreactions in achieving good clinical results. This first part of the series may well appear as 'old hat' to experienced users of lasers and light sources, buy we feel it is important to start from the basics, rather than having to return to them to try and discover why tissue has failed to react to the incident light in the expected manner, and a possibly unhappy patient as a result. A thorough understanding of the basic properties of light and its parameters is extremely important when trying to appreciate the complexities of light-tissue interaction. Without this understanding, moreover, no-one should be using any form of light source on patients.

HISTORICAL BACKGROUND

Although the laser is very often one of the first devices which springs to mind when thinking of the nonablative rejuvenation of photoaged skin, and is certainly the only light source suitable for efficient photoablative skin resurfacing, it must be remembered that in the acronym which makes up 'laser', the 'L' stands for 'light', and light has a much longer medical history than the mere 40-plus years of the laser. Phototherapy can be traced back to over 4000 years ago, when the Ancient Egyptians empirically understood that the sun was not only a source of light but also of life, as seen in Figure 1. They were also employing sunlight in medicine, for exam-

Addressee for correspondence
R Glen Calderhead FRSM
SG Biomedical, 599-3 Kassemba, Tsugamachi,
Shimotsuga-gun, Tochigi-ken, Japan 328-0113
Tel:+81-282-28-0043
e-mail: docrgc@cc9.ne.jp

Fig 1: Section from an Ancient Egyptian frieze depicting the Pharaoh Amentopop IV (BC 2002) and his wife standing under the sun in their garden. Note that the rays of the sun all end in little 'hands', which are patting humans and plants alike. Also note that the hands of the rays immediately in front of the faces of the Pharaoh and his lady are holding the ankh, the Ancient Egyptian symbol of life. This shows that for the Ancients, the sun was not just a source of light but also of life, for humans and plants alike.

ple in the treatment of vitiligo, by using the porphyrins from a crushed parsley-like herb to photosensitize skin before exposing the area to the sun thereby inducing a strong sunburn, followed by hyperpigmentation in the depigmented area. The Greeks called phototherapy using sunlight 'heliotherapy', and around 400 BC, the 'father of medicine', Hippocrates, actually prescribed heliotherapy for both physical and psychological problems, noting that depression was more common in Greece during the winter than in the summer months, and linking this with the beneficial physio-psychological effects of sunlight. The efficacy of heliotherapy continued to be reported in writings from the days of Hippocrates throughout the era of the Roman Empire, but with the fall of the Empire the use of heliotherapy fell into oblivion, and did not emerge again until the early Middle Ages, around the beginnings of the 1000's.

The Dawn of Phototherapy

Much nearer our own times, during the 19th century, the era of the industrial revolution, the skies over Europe were filled with clouds of smoke from the new coal- and wood-burning machinery. This filtered and cut down on the essential part of ultraviolet radiation necessary for building strong bones, and the bone disease, rickets, was rife. Tuberculosis was the scourge of Europe. It was found that further damage could be prevented in both diseases by moving the patient to an area with clear air and abundant sunlight, for example in the mountains or beside the sea, and the concept of the sanitarium was born.

By the end of the 19th century, red light therapy was used to treat many eruptive skin diseases, and Fubini had already shown that red light increased the metabolism of cells through specific action on the mitochondria ….. there is nothing new under the sun! However, the sun is a fickle therapeutic agent, particularly in northern Europe, and a reliable artificial light source was not available until the Danish physician and scientist Niels R Finsen developed his arc lamp which was capable of delivering a wide waveband of ultraviolet (UV) visible and infrared (IR) components, which could be selectively delivered with a series of solid quartz and water-filled filters. In 1903 Finsen was awarded the Nobel Prize for medicine for his work with the UV treatment of lupus vulgaris, and has been recognized as the father of modern photobiology by having one of the most prestigious prizes in photobiology named after him. Einstein expounded his quantum theory in 1904, on which much of the basics of stimulated emission of radiation (the 'SER' of 'LASER') were based. In the mid 1950's the excess of bilirubin in neonates, until then frequently fatal, started to be treated with blue light phototherapy.

Modern Phototherapeutic Sources

In the USA in 1960, Dr Theodore Maiman narrowly won the race to fire the first laser, using as his laser medium a doped ruby crystal, and producing a beam of intense deep red light, so powerful that it could drill through a stack of razor blades. This led to the output power of the ruby laser being jokingly measured in Gillettes rather than watts. In 1961 the HeNe and Nd:YAG lasers appeared on the scene, followed in 1963 by the argon laser and the gallium arsenide (GaAs) diode laser, and in 1964, the CO_2 was developed. Many other substances were found to be capable of creating laser irradiation, but these early lasers have remained until now the most commonly used systems in laser surgery and medicine, with the addition of the fixed and tunable dye lasers, and the use of different rare elements in combination with the basic YAG crystal, enlarging the YAG family to include the holmium and erbium YAGs. Amongst them, the reader will recognise several which are now applied in both ablative and nonablative resurfacing, the latter now including the 595 nm subpurpuric pulsed dye laser, and laser diodes operating at yellow, red and near infrared wavelengths.

In the late 80's, therapeutic systems based on the xenon flash lamp appeared in Japan, mostly designed for pain attenuation, delivering an intense beam of broad waveband pulsed light from the near infrared down to the blue waveband (an explanation of wavelength and waveband follows below), and intense pulsed light or IPL joined the laser as a therapeutic tool. Much more sophisticated (and expensive) IPL systems were later developed using a range of cut-off filters to deliver narrower wavebands by progressively filtering out the shorter visible wavelengths. The recently developed second generation of IPL systems offers two sets of filters: one which selectively blocks off the longer wavelengths of infrared energy, in addition to the shorter visible light cut-off filters, thus giving a much narrower waveband and offering better target specificity.

Another comparative newcomer to phototherapeutic sources is the superluminescent diode, the sLED. Originally associated with a very weak output, an extremely divergent beam and having an output which varied extremely widely from the specified wavelength, modern sLEDs are much more powerful, can have collimation and even focusing optics built into their glass envelope, and have extremely narrow, almost laser-like wavelength outputs. Large numbers of sLEDs can be mounted in panels and can deliver clinically useful dosages over comparatively short treatment times, thus earning them a place in the armamentarium of phototherapeutic light sources.

PROPERTIES OF LIGHT

Given that the energy from a laser or other phototherapeutic source is in some form of light, using the term loosely to cover both visible and infrared energy, although strictly speaking it only covers the former, then the beam of energy must follow the physical properties which govern light. Light incident on a target can undergo four main primary reactions. It can be totally reflected from the target, as in the case of

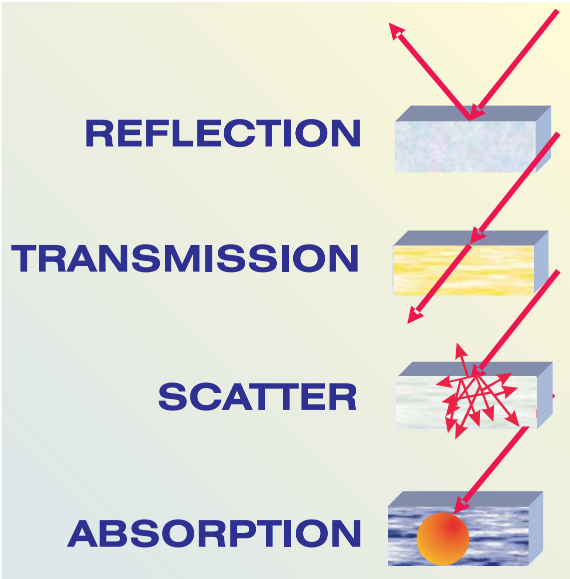


Fig 2: Four primary reactions of light incident on a target. Reflection. Transmission. Scatter. Absorp-

a mirror, or a polished metallic surface. It can be transmitted through the target, emerging on the side contralateral to the incident side more or less unchanged, such as through clear window glass. It can be scattered by particles in the target substance, so that the light may still be transmitted, but the photons are scattered from their original path: an example of this is opalescent glass. The light may be absorbed in the target, a process whereby the photons give up their energy to the target material: this energy may be transferred in the form of heat, or as an athermal energy transfer (Figure 2). In biological tissue, all four of these events can occur, depending on the characteristics of the target tissue and the wavelength incident on it. Most wavelengths are to some extent reflected from the stratum corneum of the epidermis. Some wavelengths are transmitted at least some distance into the skin, and are then scattered by the inhomogeneous nature of the many cell types and proteins which make up the dermis. In this way a very narrow beam of laser or light energy can involve a very large volume of tissue. For anyone using phototherapy, the most important of these four characteristics is absorption, because without absorption, there can be no reaction …. the first law of photobiology. It is necessary therefore to consider what the ultimate target of the incident light is. There is no point in trying to target biological pigments in a pigment-specific manner with a mid-infrared laser, for example, and there is no point in trying to involve a large volume of tissue with a light source which has poor scattering characteristics.

Light emerging from a light source can be altered before it is incident on the target tissue. It can be gathered and homogenized into a 'beam' with a set of condensers, and the beam can be passed through a lens either to focus, or to defocus it, even in the case of a conventional filament bulb, although the photon density is very small. In the case of a laser such as the Nd:YAG or carbon dioxide (CO_2), no condensing of the beam is required, because the laser energy emerges from the cavity in a beam which is already parallel, or collimated. In the case of a laser diode, however, the laser energy emerges in a highly divergent beam, but can be gathered by a set of collimating condensers, which is the principle the ubiquitous laser pointer depends on for its small but powerful point of light (Figure 3). Focusing or collimating laser energy is very much in the realm of laser surgery and laser ablative resurfacing, and so does not have much relevance to this article, but it is important when considering beam manipulation to produce the required photon density on the target tissue.

LIGHT SOURCE PARAMETERS

If all who are using the laser or any kind of phototherapy would record and report parameters correctly using the cor-

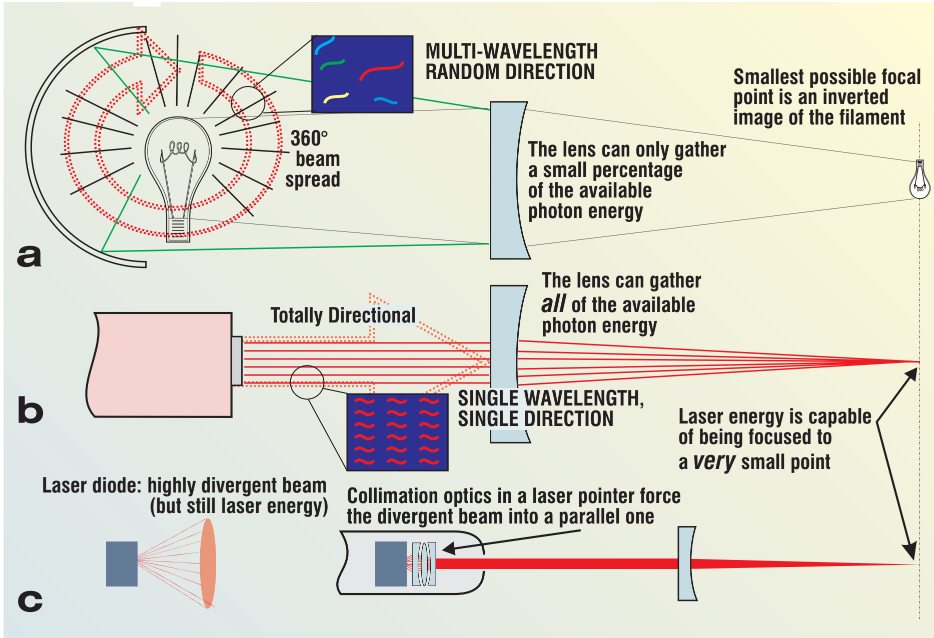


Fig 3: Light emitted from a variety of sources and treated in different ways. a: Light from an incandescent bulb is collected by a parabolic reflector, collimated with condensers and focused: the smallest spot is an inverted image of the incandescent coil. b: Collimated laser energy can be used as it is, can be focused to an extremely small point, or can be defocused. c: A laser diode emits a highly divergent beam which can be used as it is, or be collimated by condensers. Thereafter it can also be focused to a very small point.

rect units and accepted terminology, then it would be much easier for others to duplicate the experimental or clinical work. Slipshod reporting of parameters in one sure way to get a paper ejected by a journal. Readers may imagine that they are completely familiar with all the parameters used in phototherapy, but we suggest you give this next section a thorough read through …. You may be surprised!

All light sources, laser or otherwise, have two sets of parameters: inherent parameters, which are fixed by the type of light source, and adjustable parameters, which can be varied by the user.

Fixed Parameters

Wavelength: The first of the fixed parameters is the wavelength of the light source, although for IPL systems, it is a broad waveband rather than a wavelength, but the waveband in IPL systems is still fixed, being varied with cut-off filters. In the early days, there was real controversy over how light energy was propagated through space. Some held it traveled in discrete particles, known as 'photons' or 'quanta', of energy, and others held that it traveled in the form of a wave of energy: the debates were long and often extremely heated. It turned out that both sides were right. Light energy travels in the form of discrete packets of energy, photons, which travel with a wave-like motion through space. As an interesting side note, the characters used to translate 'photon' into Japanese are 'light child'.

When we look at a waveform, as in Figure 4, it appears as a series of sinusoidal curves and this can tell us several things about the light energy. By measuring the distance from peak to peak, we can find the *wavelength* of the beam, expressed usually in nanometres. One nanometre (1 nm) = 1 x 10^{-9} metres (m). For longer wavelengths of over 1000 nm, the micrometre (the Greek letter *mu*, μ) is sometimes used: 1.0 μ = 1 x 10^{-6} m. By measuring from the baseline to the peak, we can find the ***amplitude*** of the beam. By measuring the number of full oscillations which occur over time, we can measure the *frequency* of the beam, measured in hertz (Hz). The relationship between wavelength and frequency is very important: the shorter the wavelength, the higher the frequency, and *vice versa* (Figure 5). The higher the frequency of a beam of light, the greater is the energy packed into each photon, the lower the frequency, the smaller the photon energy. Since this energy is ultimately transferred to the target tissue, higher amounts of energy will have greater intrinsic effects, and eventually this intrinsic photon energy has the built-in power to damage or even destroy the tissue which absorbs it, such as the photodamage associated with short-wave ultraviolet light and the cytocidal effects of X-rays.

Light is a very small part of the electromagnetic spectrum as illustrated in Figure 6, so called because electromagnetic energy has two sets of perpendicularly opposed sets of sinusoidal curves, propagating in the same direction, one electric and the other magnetic: light therefore can have both electric and magnetic influences on its target tissue. Figure 7 illustrates the broad laser spectrum, ranging from the invisible ultraviolet spectrum (UV-C, 200-290 nm; UV-B, 290-320 nm; and UV-A, 320 – 400 nm), through the visible spectrum (400 nm, indigo to 700 nm, deep red) and the invisible infrared spectrum (700 – 11000 nm) and encompassing all the main lasers and light sources used in surgery and medicine.

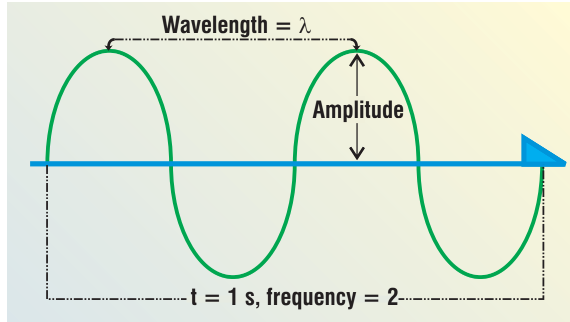


Fig 4: Typical waveform, showing the direction of its propagation, wavelength, amplitude and fre-

Beam type: Another of the fixed parameters is the type of beam generated by the phototherapeutic source. Broadly speaking, this can be pulsed, or

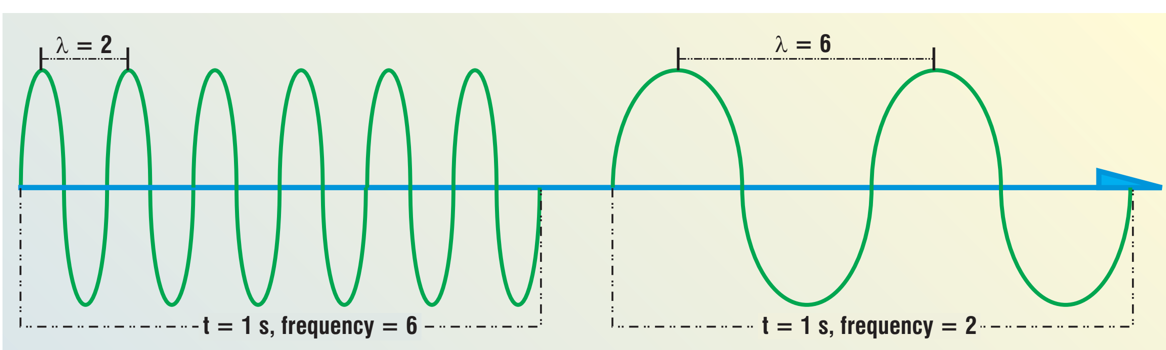


Fig 5: The inverse relationship between wavelength and frequency illustrated. Both beams are travelling for 1 second. The beam on the left has a wavelength of 2 units, and a frequency of 6 Hz. The beam on the right has a wavelength of 6 units, and a frequency of 2 Hz. The shorter the wavelength, the higher the frequency, and vice versa.

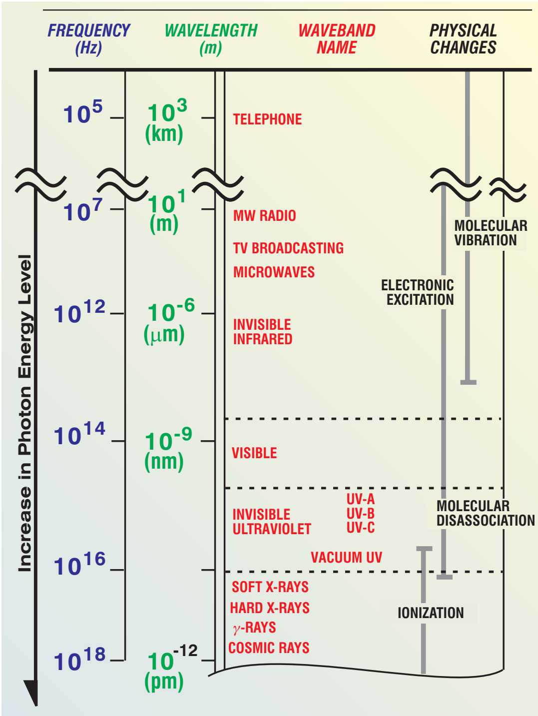


Fig 6: The electromagnetic spectrum, ranging from extremely long-wave telephone transmissions, through radio, microwaves, IR, visible and UV energy and X-rays to ultrashort-wave (and lethal) cosmic radiation. The shorter UV wavelengths are potentially damaging, and the photon energy is such that it can cause the target atoms to fly apart to form ions, hence the term ionizing radiation. The transfer of the milder energy from visible light photons, on the other hand, induces photochemical changes in the target tissue through alteration of electron energy levels, and at high enough levels this can cause a sharp rise in temperature. The longer infrared photon energy causes changes in the rotational and vibrational state of the target molecules, resulting in gentle heating and alterations in molecular structure and membrane permeability.

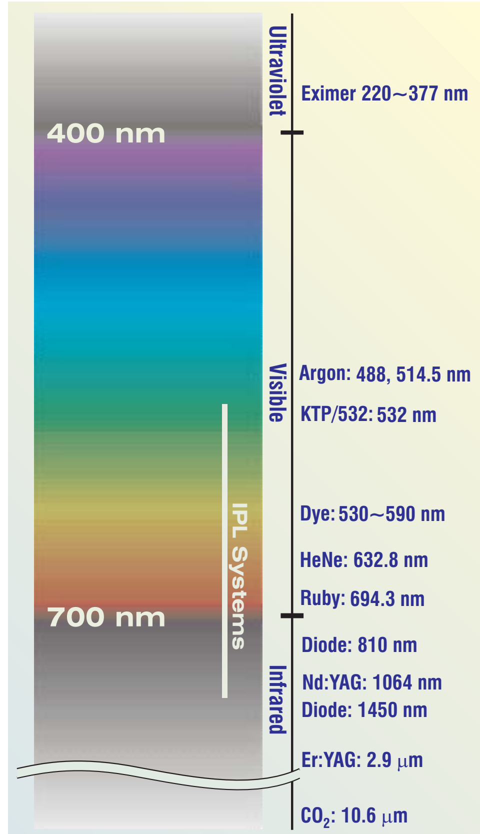


Fig 7: The broad laser spectrum, illustrating on it the position of the most common phototherapeutic sources.

continuous wave (C/W). In a C/W beam, as seen in Figure 8, when the source is activated, the power quickly reaches its maximum set level, usually measurable in watts, and stays there until power to

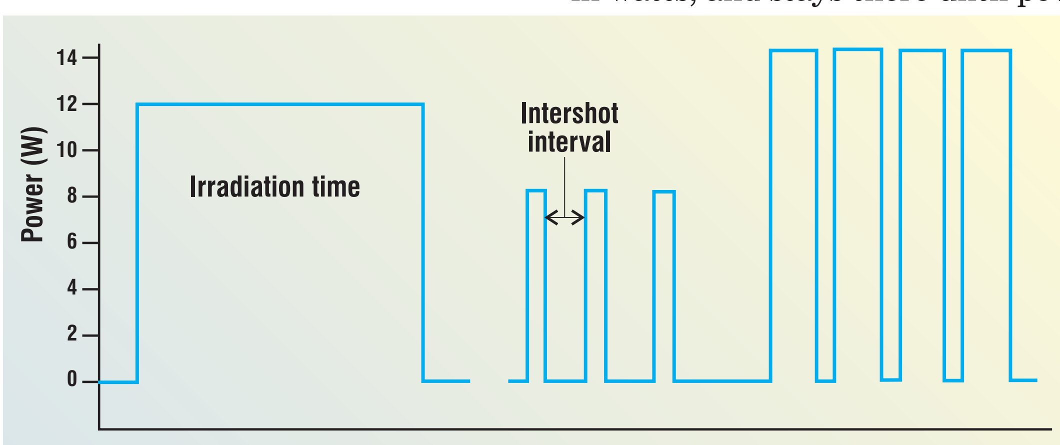


Fig 8: Beam types illustrated. (left) Typical C/W beam quickly reaches the maximum set power and stays there till switched off. (right) The C/W beam can be switched on and off to produce 'shots' of light with a square waveform. The time of each shot and the time between shots can be adjusted, as illustrated on the right, to give different beam patterns.

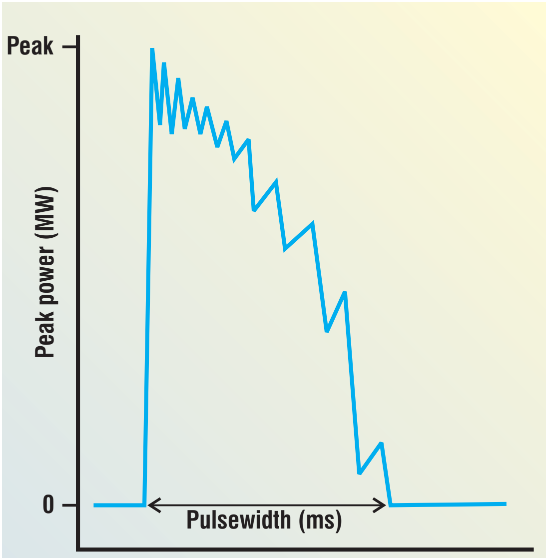


Fig 9: Illustration of a typical true pulsed beam of energy. The very high peak power is reached extremely quickly, then drops off as the light source discharges. The length of the pulse is referred to as the pulsewidth, and can be from 1 millisecond (ms) or less up to several milliseconds.

the source is switched off. This C/W beam can be gated or chopped, *i.e.*, switched on and off either electrically or mechanically, to produce a series of square-wave shots of light with an interpulse interval, the relationship between which can be varied (Figure 8b).

The number of shots per second is usually called the repetition rate or rep rate. This is sometimes called the 'frequency' of the beam, a nice quasi-scientific term beloved of laser manufacturers, but as already explained above each beam of energy already has its inherent frequency which is a function of the wavelength. Gating a C/W beam is also often incorrectly called 'pulsing', but the more correct term is frequency modulation.

A true pulsed beam is completely

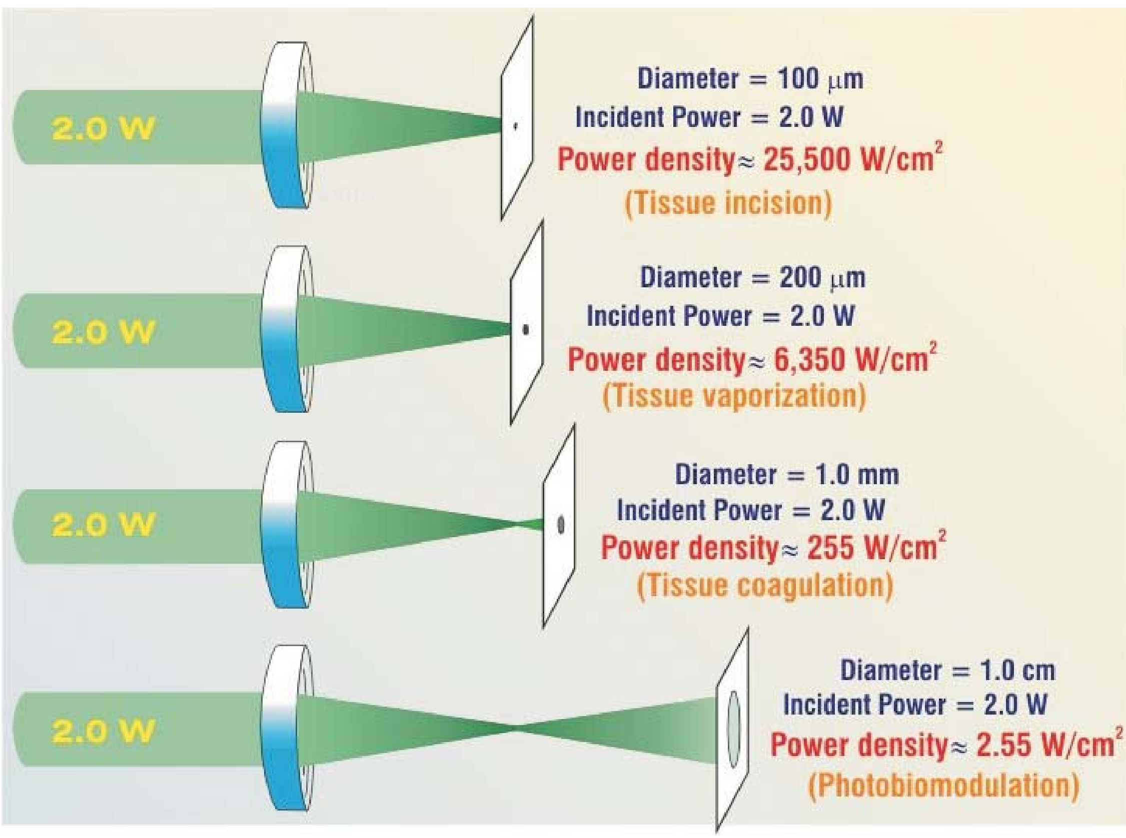


Fig 10: The importance of power density (irradiance) illustrated for a 2 W laser. Simply by altering the spot size through drawing the laser handpiece back from the point of focus, the same 2 W beam is capable of cutting or excising, vaporizing, coagulating and mildly heating tissue, or athermally photomodulating cellular and tissue activity in the treated area.

different from a C/W beam, as seen in Figure 9. Activation of the source, such as a xenon lamp in an IPL system is short but extremely powerful, resulting in the production of a very high peak of power, measurable in megawatts or higher, which tends to decay back to zero in a series of peaks. Because the energy required to activate the source takes time to build up, the repetition rate of pulsed light sources is usually at best 2 Hz, *i.e.,* two pulses per second. The length of each pulse is called the pulsewidth, and is from 1 millisecond (ms) or less up to several milliseconds. Long-pulsed systems are currently available, of some hundreds of milliseconds, but these macropulses are usually made up of a series of micropulses. The effect in tissue of these two beam types will be dealt with in the second part of this series on light-tissue interaction.

Adjustable parameters

Many systems have a number of parameters which the user can adjust to obtain specific therapeutic effects. These may be set in such a way that the inherent effect of the wavelength of the beam can be controlled or altered.

Output power: The output power of a system is measured in watts (W), although for true pulsed systems this can be megawatts. In the pulsed systems, such as the IPL devices, control of the output power is not usually an option, as the source is usually 'pumped' with a predetermined amount of energy. Other C/W systems will often offer some form of output power control.

Irradiated area (Spot size): The area which the treatment beam irradiates on the target tissue per 'shot' is the irradiated area, or spot size. This can be a circular beam, in which case the beam diameter is given in centimetres or a related SI unit (e.g., millimetres (mm); or it can be a rectangular beam, such as delivered by many IPL systems via the selected treatment head. The area in both beam configurations is expressed in square centimetres (cm^2) or centimetres squared, but *never* centimeters square: 2 cm square is actually 4 cm^2! In the case of a circular beam, the beam area at the tissue is calculated using the well-known formula πr^2, where π is the constant *pi*, 3.142, and r^2 is the square of the *radius*, *i.e.*, one-half of the diameter of the beam *always in centimetres*. For example, a beam with a diameter of 5 mm (r=0.25 cm) would have an area of (0.25 x 0.25 x 3.142) cm^2 = 0.196 cm^2. The area of the rectangular beams is calculated by multiplying the dimensions of the crystal, e.g. a 1.5 cm x 2.0 cm crystal would cover an area of 3 cm^2.

Power density (irradiance): Armed with the output power incident at the tissue, if at all possible, and the irradiated area, the user can calculate the power density, known more correctly as the irradiance of the beam at the tissue, although more experienced laser users will tend still to use the former. The power density (PD) is expressed in watts per square centimeter (W/cm^2), and is arrived at with the formula:

$$PD = OP/IA\ w/cm^2,$$

where OP is the output power in watts and the IA is the irradiated area in cm^2 , worked out as described above. The irradiance is possibly one of the most important parameters for clinicians using C/W and quasi C/W ('superpulsed') lasers, as it gives a true indication of the actual power being delivered to the tissue, which reflects the photon density and will to a very great extent govern the tissue reaction and effect of the laser energy. Because of this, the irradiance is also the most efficient way to control the biological effect in tissue, which will be dealt with in detail in the

Table 1: Different combinations of spot sizes, output powers, irradiances and irradiation times to give the same radiant flux (energy density) of 25 J/cm^2.

P	S∅	{a} (cm2)	PD (W/cm2)	t	E	ED (J/cm2)	Δα
100 W	10.0 cm	78.6	1.3	20 sec	2,000 J	25	—
10 W	1.0 mm	0.008	1,250	20 msec	0.2 J	25	++
1 W	200 µm	0.0003	3,180	8 msec	8 mJ	25	+++
75 mW	3.0 mm	0.07	1.1	23 sec	1.725	25	—

Key to table: P: output power (units as shown). S∅: spot size diameter (units as shown). {a]: irradiated area. PD: power density (irradiance). t: irradiation time (units as shown). E: energy (units as shown). ED: energy density (radiant flux). Δα: graded bioeffects (+++, severe photodestruction; ++, medium photodestruction; +, mild and/or reversible photodestruction; —, bioactivation).

second part of this series of articles, and the irradiance is related to the spot size by an inverse square ratio: in other words, reducing the spot size by ten will increase the actual power at the tissue by 100, and increasing the spot size by four will decrease the incident power by a factor of 16. This is illustrated in Figure 10, in which the reader will see that a 2 W laser beam is capable of the entire range of biological photoreactions from incision and excision (25500 W/cm^2) to pure phototherapy (2.25 W/cm^2) with photobiomodulation at a cellular level, simply by altering the spot size, and always provided of course that the wavelength is appropriate for the tissue being irradiated.

Irradiation time (exposure time): The irradiation time, also known as the exposure time, is the time the laser is incident on the target tissue per single shot, and is measured in seconds (s), for C/W lasers or an appropriate SI unit such as milliseconds (ms: 1.0 ms = 1 x 10^{-6} s) for true pulsed systems. The irradiation time is important when the *coefficient of thermal relaxation* of tissue has to be considered, or *tissue relaxation time* (TRT) in simpler terminology. The importance of this falls within the scope of laser-tissue reaction, so will be dealt with in the following installment.

Laser energy: Armed with the output power and the irradiation time, the user can calculate one of the most abused parameters in phototherapy, the dreaded joule (J). The energy of a beam in joules is calculated by the product of the output power (W) and the irradiation time (s). A 20 W beam with an irradiation of 2 s will deliver an energy of 40 J, but so will a 2 W beam for 20 s, so the statement 'I gave the patient 20 J' gives no idea of the actual parameters used, only the energy of the beam: a joule is physical not a clinical parameter, so if you ever find a stray joule running down a corridor, kill it.

Energy density (radiant flux, fluence): The energy density, more correctly the radiant flux, on the other hand, is an extremely useful parameter, expressed in J/cm^2, and is calculated by the formula ED = (OP x IT/IA) J/cm^2

where OP is the output power (W), IT is the irradiation time (s), and IA is the irradiated area (cm^2). The radiant flux is recognised as the laser dose, and obviously will help determine the final endpoint of the procedure. However, although the energy density is the dose, particularly for C/W lasers it is the power density which is the medicine, and as any pharmacist or clinician will tell you, if the medicine is not correct there is no point in playing around with the dose.

The energy density is certainly an essential part in the reporting of your experimental and clinical work, but in order to enable accurate reproduction of your treatment or research, please be sure to report all three separate parameters: *i.e.*, the incident power, the spot size or irradiated area and the irradiation time. This is because a dose of approximately 25 J/cm^2 can be achieved in a large variety of combinations, a very few of which are shown in Table 1 However, as seen from the table, the bioeffect in the target tissue is dramatically different depending not on the output power, nor on the energy density but on the power density. In other words, from the table a 1 W beam is capable of surgical effects and a 100 W beam can be used in athermal phototherapy, but in both cases the energy density is approximately the same at 25 J/cm^2.

R Glen Calderhead

IN CONCLUSION

We are sure this first part of our series of articles has been heavy going, but thoroughly understanding the properties and the fixed and adjustable parameters of light will take the reader a very great distance towards understanding why particular parameters will achieve particular effects in tissue while others will not, and the control of the incident light really depends 120% on the control and manipulation of the parameters. In Part 2 of our series, we will put these properties and parameters to work in obtaining the desired light-tissue interaction and hence the desired clinical endpoint.

One of the keystones of good scientific writing is the ability for others to follow exactly the clinical or experimental protocol given in an article to duplicate the author or authors' results, thereby giving credibility to both the authors of the article and their scientific or clinical methods, and advancing the application of phototherapy by increasing the therapeutic repertoire of the readers. The accurate reporting of parameters and the use of consistently correct terminology is more than half the battle. Happy writing!