INTERNATIONAL UNION OF PHYSIOLOGICAL SCIENCES

15 Mai 2008

Memorandum to: Member Societies

Report of the Long Range Planning Committee

Following you will find the report of the Long Range Planning Committee established by Council in April 2005. The committee has worked during the past three years to prepare this report which was reviewed with Council at their meeting in December 2007. We now would like to present it to you the member societies of our Union. Several of the recommendations have already been implemented or will be in the near future, but there are others that will be further discussed at the next Council meeting and presented to the 2009 General Assembly for approval prior to implementation.

If you have comments you wish to provide the committee and/or Council please send them to the IUPS Secretariat in Paris (*orsoni@chups.jussieu.fr*).

I wish to extend my sincere thanks and gratitude to the members of the Committee, Allen Cowley (Former President of IUPS), Cecilia Hidalgo (Member of Council of IUPS) and Yasunobu Okada (Vice-President and Secretary, XXXVI IUPS Congress, Kyoto) and to the Secretary to the Committee, Susan Orsoni (Executive Secretary of IUPS) for all their efforts on this project. We also thank those societies and individuals who kindly replied to our questionnaire.

Sincerely,

Denis Noble, Chair
(Former Secretary General of IUPS)

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EXECUTIVE SUMMARY

This is a critical period of transition for the physiological sciences and for IUPS. There is a new academic challenge, represented by the rapid rise in popularity of what has become called Systems Biology. And there will soon be major changes in organisation and administration of IUPS. This is therefore a good time to reassess priorities and organisation.

The role of IUPS should be a global one. While its congresses, meetings and organisation are naturally dominated by those regions of the world where our science is well-developed, they represent only 10-15% of the world's population. IUPS has an obligation to the 85-90% in the developing world, the under-developed world and what are called the 'war zones'. It should be a world beacon. We strongly recommend that its four year cycle of Congresses should be continued as one of the most visible parts of that beacon. Ways should be found to increase participation from poor and developing countries.

We recommend a re-orientation of priorities towards the integrative end of the physiological sciences, partly to meet the challenge of Systems Biology, and to service the growing awareness in the health care industries that integrative physiology is relevant and necessary.

We propose some re-assignment of responsibilities amongst the Officers. In particular, the Treasurer should be freed of day-to-day administration to focus on long-term financial goals, while the Secretariat should take on this administration and should be developed under the wing of a successor to the position of Secretary-General. We need a long-term strategy aimed at developing a successor to the Executive Secretary.

More attention should be given to public relations, including the website and the Newsletter.

IUPS should have a higher degree of visibility at Regional Meetings.

We recognise that IUPS's relations with other international bodies like ICSU and UNESCO are small, but we consider them to be important precautions should the world situation deteriorate to the point at which important principles like the Universality of Science and freedom of movement of academics become threatened again.

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Future of the Physiological Sciences - how to guarantee it?

> *Physiology is the study of the functions and integrative processes of life at all levels of structural complexity between the molecular level and that of the whole organism. It includes all organisms, and frames function in evolutionary, environmental, ecological and behavioural contexts. It embraces a cross-disciplinary approach to modern science, through which physiologists aim to achieve translation of this knowledge into human health.*

This definition correctly places physiology as a key discipline among the biological sciences and provides a conceptual framework to visualize the **Mission of IUPS** as fostering its study worldwide. We think IUPS, in its inherent role as an international body, carries a major responsibility for all of the world's population, not just those countries in which physiology is highly developed. By the criteria we propose later in this report, those countries may account for no more than 10-15% of the total world population.

To achieve this mission we need a re-positioning of our science. For, at the beginning of the 21st century, the physiological sciences stand at an important crossroads. The reason is that there is a widespread perception that the molecular biological and genomic revolutions have run into major problems. They are far from complete of course. As recent IUPS Congresses have shown, molecular biology and molecular genetics now infuse many areas of physiological research. That will continue to be the case for the foreseeable future. Yet it is already clear that the task of interpreting the molecular and genetic data at higher functional levels is immensely difficult and will take a long time to accomplish. The health benefits promised by the Human Genome Project are slow to arrive. Too much was promised too soon. Integrating the molecular and genetic data into understanding of function has proved to be a daunting task.

As defined above, "Physiology" by nature represents the fundamental science which provides the basis for all the life sciences including medicine. That is why the Nobel Prize for life science fields is called "The Nobel Prize in Physiology or Medicine". Nevertheless, some universities have reorganized their departments so that very disciplinary departments such as physiology, anatomy and so on no longer exist. However, it must be pointed out that abolition of disciplinary departments may cause drawbacks not only to education but also to the creation of the coming generation of researchers in interdisciplinary fields. Interdisciplinary researchers need also to have a very firm grounding in at least one disciplinary area.

These are some of the reasons why a new buzzword has emerged: that of 'systems biology'. There is no agreement on how this should be defined, and various alternative, but less popular, names are also current, including 'integrative biology', 'integrative physiology', and 'computational biology'. In this report, for consistency, we will use 'systems biology' (hereafter without quotation marks), but the alternative nomenclatures would do equally well and should be understood. Despite its rapid rise in popularity, no-one can yet be sure whether systems biology as a description of this area is more than a fashion. Whether or not the term is a fashion, we strongly think that the goal of understanding biological function in an integrative way is a long-term one and that the physiological sciences should play a major role in this aim since physiology is by its very nature integrative, whether at molecular or systems levels.

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Despite the lack of agreement on definitions and aims, funding agencies in many countries (including USA, EU, UK, France, Japan) have already launched substantial initiatives, and national organisations exist in some countries that have already produced (Cassman et al 2005 [1], UK Academy of Medical Sciences and Academy of Engineering, 2007 [2]) major reports on how the field should be developed and funded. We think that this development should be seized as a major opportunity for the physiological sciences.

There is a danger that physiology will be by-passed as the opportunities in systems biology gather momentum, whereas our discipline is indeed in a pole position to benefit. How the physiological community can position itself to take advantage of our training and interest in the integrative processes of function will in large measure be determined by how the next generation self-identifies with "physiology". This currently represents a major challenge that must be faced.

IUPS initiatives like the Physiome Project should be presented as one of the essential contributions that physiology can make to systems biology since physiological interpretation of genomic data absolutely requires insight at higher functional levels. The view that we have to wait until bioinformatics, proteomics and genomics have delivered their 'complete' analyses needs to be countered urgently. The reality is the other way around. Even gene ontology projects will depend on higher level insights for their success.

Recommendations:
It is **recommended** that in the Congresses to take place in Japan (2009) and the UK (2013) ways should be found to debate the essential role that the physiological sciences must play in systems biology. In the case of Kyoto, this would involve building on plans that are already in place both to highlight physiology's role in systems biology in one of the special lectures and in one of the whole-day-symposia to follow that lecture.

It is **recommended** that the editors of *Physiology* might consider devoting an issue to physiological approaches to systems biology. We also **recommend** that IUPS should interact with the editors of other journals that are welcoming work in this field. These include *Physiological Genomics* (an APS journal), *Experimental Physiology* (a journal of the Physiological Society in the UK that has 'Translation and Integration' as its subheading), and *Progress in Biophysics and Molecular Biology* (which publishes focussed volumes in the area). It is important that systems biological work should appear in journals that physiologists read.

It is **recommended** that we should encourage physiologists to approach the topic of "systems biology" in the right spirit and do their best to integrate the lower level functions with those of the higher levels. It is important to note here that the word 'systems' is being used in a sense that overlaps with its use in 'systems physiology' but is not identical with it. This is especially so in Japan, because in Japanese the term "systems physiology" is often used as the equivalent to "physiology of higher brain functions". As this example shows, the perception of what 'systems' means can vary quite widely.

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[1] Cassman M, Arkin A, Doyle F, Katagiri F, Lauffenburger D and Stokes C. *International Research and Development in Systems Biology,* World Technology Evaluation Centre Inc., Baltimore, USA (2005). www.wtec.org/sysbio/welcome.htm,.

[2] *Systems Biology: Improving Health and Wealth*. Report of the UK Academy of Medical Sciences and Academy of Engineering (publication date 1 February 2007).

Some physiologists have reacted to the development of systems biology with a degree of scorn: aren't we (i.e. systems physiologists) already doing that, and have been doing so for at least a century? This is understandable, and the point being made is correct, but we believe that attitude misses one of the main points and is too complacent.

There is a political/historical issue here. Our colleagues working at less complex levels of biological science have seen the need for integrative work, but they have chosen to present their mission as a new discipline rather than work under the umbrella of physiology as classically understood. We, in IUPS, should respond positively but critically to this development. Taken in the right spirit, a physiological approach to systems biology could be the saviour of systems physiology and could also strengthen systems biology. It should be made clear that we cannot and will not wait until work at lower levels of biological organisation has been completed. In multilevel integration of function, work has to proceed at all levels since insight may come from any level.

What is the right spirit? We propose a return to the precepts of one of the great founders of physiology as an experimental science: Claude Bernard. In his *Introduction à l'étude de la médecine expérimentale* (1865) he laid the foundations of physiology as an empirical, experimental science. This is well-known, and was a great influence on the development of physiology not only in France but also in the UK, Germany, Japan, USA and elsewhere. It is less well-known that he anticipated the coming of systems biology in the sense that he realised that mathematics would eventually play a major role: "Cette application des mathématiques aux phénomènes naturels est le but de toute science" (the application of mathematics to natural phenomena is the aim of all science). He realised also that this was not possible in physiology in the mid 19th century but that it had to come some day in the future when our quantitative knowledge was sufficiently advanced.[3] By launching the Physiome Project IUPS has recognised that that day has arrived. We are, however, in danger of missing a major opportunity if we do not link that initiative and other initiatives within IUPS, such as physiological genomics, to the systems biology approach.

It is therefore **recommended** that the Physiome Committee be renamed to become the "Physiome and Systems Biology Committee". When the Physiome Project was launched (at a satellite of the 1997 Congress) we could not have anticipated that the appeal of Systems Biology would develop so rapidly. The present reality is that reference to Systems Biology is far more widespread than to the Physiome.[4] We believe that, had that been known, IUPS would have considered launching the Physiome as a major part of Physiology's contribution to Systems Biology.

It is **recommended** that IUPS and its member societies should promote or encourage problem-based joint meetings and joint researches between physiologists and physicists, mathematicians, engineers, or computer scientists. These concrete collaborations may train talents and manpower to study systems biology by physiology-driven, not purely genome-driven, approaches.

[3] The Paton Lecture, *Experimental Physiology*, 2008, **93**, 16-26

[4] A Google search in December 2006 using "systems biology" yielded 2.2 million hits. A search for "physiome" yielded 83,000. By early January 2007 the "systems biology" hits had grown to 3.4 million. "Physiome" had hardly changed (in fact slightly lower at 80,400). There is a huge bandwagon moving towards systems biology.

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It is **recommended** that due attention should be given to a systems biology orientation when proposing new officers of IUPS. At least one of the key officers (i.e. members of the Executive) should be someone who can pilot IUPS through the systems biology developments during the next decade or so, just as Allen Cowley did for the field of physiological genomics. It is still uncertain how systems biology will develop, how large the funding opportunities will be and how the physiological sciences will contribute and benefit. But it is already clear that the funding for systems biology will be substantial. The EU Framework 7 program, for example, is planning large investment in bio-simulation, and Japan has already done so.

Finally, in this section we wish to emphasise a word of caution that would be relevant to our later recommendations on public relations, the website and a PR committee. As we have already indicated, the Human Genome Project was oversold with too much promised too soon. There is a similar, perhaps even greater, danger with systems biology. We need to recognize the immensity of the challenge and be realistic about the time scale. Just paired simultaneous knockouts (i.e. animals with 2 genes knocked out, which would check for back-up functions where a single gene knockout reveals nothing) would be 300 million strains of animals! If we needed to check for 3 simultaneous gene knockouts (and how many biological functions have at least two back-up mechanisms?) we are talking of trillions. Reconstructing quantitative understanding of physiological function may well take centuries, not decades. People need to understand the consequences of combinatorial explosion. 25,000 genes is in fact a huge number when physiological interactions are considered, not a small number.

Of course, we can argue that there will be many benefits arising from insights and predictions on the way to more complete knowledge. But giving any impression that understanding at systems levels is 'just around the corner' would be misleading.

It is **recommended** that IUPS and its member societies should find ways to establish productive interactions with other disciplines, such as structural biology, biophysics, ecology and clinical medicine, among others. These interactions are probably best dealt with at the level of national societies and individual universities since there are many different patterns of organisation developing as many universities have reorganised their departments so that separate departments of physiology, anatomy, biochemistry, pharmacology etc no longer exist.

There exist both pessimistic and optimistic opinions on whether this development matters. Our view lies between these extremes. Universities and even research institutes should be organized both with disciplinary and interdisciplinary departments. Abolition of the former will cause drawbacks to education and to the creation of the coming generation of scientists required for any interdisciplinary field. Abolition of the latter will interfere with development of new interactions between sciences including physiology. In principle, physiology has been, is and will be a well-defined discipline although cross-disciplinary approaches are adopted in physiological studies. In practice, however, we must ceaselessly assert an indispensable role of physiology in the modern biology era by illustrating physiological achievements in the clarification of mechanisms of complex biological functions. This is one of the reasons we have emphasised the need for effective PR, and that IUPS should extend its logo to indicate its relevance.

Our recommendations regarding Systems Biology also address the question of the relation of physiology to physics, mathematics, engineering, computing and other physical sciences. All the comments on the questionnaire recognize their importance and recommend organizing the

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related Committees, Commissions, symposia, poster session and meetings with these interfaces in mind.

Under this section, we comment on how IUPS should react to recent developments in structural biology. Since structure and function are complementary, physiological functions should be understood on the basis of dynamic changes in structure of molecules and systems. But also dynamic structure changes during functioning can be understood only on the basis of physiological understanding. In a broad sense of the word, of course, Structural Biology is connected to Physiology by its very nature. However, current progress in Structural Biology is taking place in fields closer to Molecular Biology or Biophysics and is developing with the help of just a small number of physiologists. We think that this interface should also be taken into account when developing the Commission structure of IUPS and in the development of programmes for Congresses.

Finally, we deal with the relations with clinical medicine. Physiology is, of course, a basic science. However, one of the final goals is to elucidate the functions and their mechanisms in the human body. Therefore, knowledge of physiology must meet clinical needs. Thus, the royal road to meet clinical need is to promote and develop Physiology as Integrative (systems) Biology. Again, the need to present physiological sciences as one of the translational sciences is apparent.

The interaction is both ways. Clinical aspects often give hints for physiological studies. That is why Physiology has a sub wing, Pathophysiology, at the interface to clinical research. However, we have problems on both sides at this interface. Clinical people have little time for research, while an increasing proportion of physiologists come from non-medical fields or are not medically trained. It is easier to identify this problem than to propose its solution. Exchange and interaction with the International Society of Pathophysiology is important.

IMAGE and PR

First of all, it is **recommended** that IUPS should broadcast the above definition of physiology and an indispensable role of physiology in the modern biology era.

It is **recommended** that IUPS should add a suitable motto or rider to the IUPS logo. Since physiology is the means by which genomic and proteomic data can be translated into function at all levels of the organism, IUPS should broadcast this fact widely.

It is **recommended that IUPS should form** a Communications Committee chaired by a member of Council. One of the functions of this committee would be the IUPS website. We learnt a lot about the website of the Physiological Society of Japan, and we suggest that the Committee could also learn by consulting some of the website managers of the larger national societies. The possibilities are large. One that we considered was the provision of a physiological 'wikipedia', answering questions about physiological science by the general public. If we wish to attract young people into our science, this could be one way of achieving that aim. (*Since this Report was first drafted, Marjan Rupnik was named to council in the summer of 2007 and has been working on this.)*

It is **recommended** that the Communication Committee should consider the future of the IUPS Newsletter. In the form in which it was created, it falls between being a standard newsletter and a

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website news and affairs service. There could be better ways of serving the function that the Newsletter was created to serve. (We note that this also is meant to be one of M. Rupnik's functions.)

ROLES OF OFFICERS

In various parts of this report we suggest that some key areas should be made the responsibility of particular officers of IUPS. Here, we summarize the recommended changes to those roles.

President: We believe that, usually, the President of IUPS should not carry a particular portfolio. The President should be free to represent the Union generally, and to act in particular areas when necessary (a good example of this in recent times was the role played by Ewald Weibel in dealing with the aftermath of the St Petersburg Congress).

Vice Presidents: One of the Vice Presidents should be responsible for Internal Affairs (interaction with the member societies) and the other Vice President should be responsible for External Affairs (interaction with other international organizations).

Treasurer: The Treasurer's role should be redefined in order to play a strategic role in relation to finance and to chair the Finance Committee recommended below, but to no longer deal with day to day finances.

Secretary-General: Under the administrative structure we are recommending, the Secretary-General would be responsible for overseeing the running of the Union including the Secretariat, and should be responsible for routine management of finance as well as the general affairs of the Union. In practice, much depends on the relations between the President and the Secretary-General. This has varied in the past and has depended on the particular people holding these offices. We think that it is correct to leave this relationship relatively fluid, to be defined in practice by the office holders themselves.

Executive Secretary: The role of the Executive Secretary is to service the Union's affairs in general and so be responsible to all the Officers (this is in fact the present situation). (See under IUPS Organization: Administration).

FINANCE

It is **recommended** that IUPS should form a Finance Committee chaired by the Treasurer, who would be relieved of day-to-day management of IUPS finance (see recommendations on Administration) and so more available for strategic initiatives. The Finance Committee could either be simply a subgroup of Council or it could also include some powerful friends of the physiological sciences (see Star Committee funding proposal below). As a matter of urgency the Finance Committee should consider the system of dues, the problems of currency shifts, and the best way to ensure that IUPS is financed effectively and fairly.

It is **recommended** that IUPS should not undertake setting up a separate central office for fund raising. In the experience of members of the Committee, some of whom have long experience of

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fund-raising, successful fund-raising (the only kind worth having) requires professional expertise, which is expensive. We do not see a way in which IUPS could fund this kind of work directly since the Union is simply too poor to take that kind of risk with its resources.

It is **suggested** that the Finance Committee should consider the following options, which are not mutually exclusive:

(i) Engage fund-raisers who are remunerated by receiving a fraction of funds raised. This option would require a convincing 'sales pitch'. Professional fund-raisers employed in this way would need to know that they are likely to succeed. The problem for physiology is that, unlike some other medical sciences, it is not perceived to be immediately relevant to pharmaceuticals or medical devices. That is a perception rather than the reality. But perceptions matter. However, we think that this may change in the future as translational research becomes perceived to be relevant and if physiology can identify itself as relevant. Hence the need for an effective PR.

(ii) There is a rapidly growing biotechnology industry in many parts of the world, which will increasingly use translational science and technology. If IUPS acts on our recommendation to extend its logo to emphasize its relevance, it may be possible for it to provide a consulting service to enable investors to obtain scientific advice on new scientific developments. IUPS would maintain a database of experts and in return receive a commission.

(iii) Form a Star Committee with people of influence and contacts. This could be formed as an expert advisory committee to the Treasurer and Finance Committee.

All these initiatives are long-term. We are not convinced that there is a way in which IUPS can readily increase its fund-raising in the short term. We therefore take a conservative and cautious view on the administration.

IUPS Organisation: ADMINISTRATION

IUPS administration has developed serendipitously. The present Executive Secretary began as a part-time secretary to two successive French Secretaries (J. Scherrer and R. Naquet). She acquired considerable archival knowledge of IUPS and, when Denis Noble was made Secretary General in 1994, it was agreed that Sue Orsoni should continue to operate in a part-time position as Executive Secretary to IUPS responsible to Denis Noble in Oxford but from the Paris office of her other part-time position. A similar arrangement has continued during Ole Petersen's period as Secretary General. In our view this has been a great advantage to IUPS. For close on 30 years there has been continuity and clear corporate memory while there has been little or no cost of maintaining an office.

We received many comments on the question whether IUPS should continue with a permanent secretariat or whether it should revert to a rotating one. A strong majority, almost unanimity, favoured the maintenance of a central office in a single location. The question of establishing an independent Secretariat will depend in large part on financial means. (Since 1994 the IUPS Secretariat has been graciously housed in the CNRS laboratory of Dr. Jacques Mallet in Paris at little or no additional cost to the Union.)

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We **recommend** a mixed approach which would resemble that of the historical development of Sue Orsoni's role. We consider that IUPS is not financially secure enough to establish a separate fully-operational central office immediately. We therefore **propose** that, in the first instance, the successor to Sue Orsoni should be chosen after the choice of a Secretary General to succeed Ole Petersen has been made. The new Secretary General should then appoint a Secretary working in the same location as him or her who could then be trained to become a possible successor as Executive Secretary in due course. This approach has the advantage that, initially at least, the Secretary and Secretary General would work in close association with each other, as happened in the early days of Sue Orsoni's appointment. If it works, then the new secretary could become in due course the new Executive Secretary. If it does not work, then the same process could begin again with the next General Secretary, and so on until a full Executive Secretary emerges.

We also **propose** that consideration should be given to fusing the administrative offices of Secretary General and Treasurer. For various reasons, cost included, we do not think that IUPS can justify running two separate administrative offices, or taking on the cost of establishing an independent IUPS Secretariat. There is a question of control and audit, of course, but that can be dealt with both by having proper auditing procedures (as now) and by having a Treasurer whose role is that of oversight on finance, but without having to administer the details.

COMMISSIONS and COMMITTEES

Reform of the Commissions has already gone a long way, with reduction and rationalisation. This should be a continuing process responding as the needs of the Physiological Sciences develop, as happened after the last General Assembly when a new commission replaced one that was less active. IUPS should define and declare its Mission so that it can define and declare its intermediate-range Missionary Projects. The Committees and Commissions may then be rearranged and/or launched according to the Mission Projects, and also to be reconsidered every few years at the time of each Congress. The current IUPS Missionary Projects include the promotion projects of Physiome, real-time functional imaging, teaching Physiology through the Education Committee, support for Physiology in developing countries, and public relations on scientific topics in IUPS.

We draw the attention of Council to the fact that some of the most critical replies to the questionnaire concerned the Commissions, including the following three examples:

- they do not really have much to do; they should be modernized; their structure needs to be completely revisited; commissions still appear to be unwieldy and/or invisible
- commissions should have better worldwide representation and increase the presence of participating societies;
- should be more organ based, as these will not vary with current fads in science

ETHICS

It is a decade since *Ethics of Life* (1997, UNESCO) was published following a meeting at UNESCO arranged by the Ethics Committee of IUPS. The questions addressed then are still important, but many new ones have arisen. More will do so in the near future. We **recommend**

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that Council should redefine the role and size of this committee. It needs to be chaired by someone who will be active. Quite apart from the urgency of some of the ethical issues arising from advancing physiological science, it is important for IUPS to be *seen* to be active in this area. Penny Moody-Corbett (Canada) accepted this responsibility in 2007.

IUPS MEETINGS:

International Congresses

There has been a major change in the international scene so far as congresses are concerned. From the first International Congress in Basel in 1889 through to the middle of the last century, the IUPS Congresses were seen as *the* major international event for physiological science. Two developments have threatened that role.

The first is the break-up of the physiological sciences into separate systems-oriented areas, with strong international meetings of their own. This has happened in virtually all areas: neuroscience, cardiovascular, respiratory, cellular & molecular, reproductive, endocrine…. These developments mirror a similar development in publications, with many journals now focussed on particular systems rather than on physiology as a whole. There has therefore been a multiplication of international meetings so that the IUPS Congress is now just one of many amongst which people may choose to present their work internationally. Understandably, many scientists prefer to do so where they are likely to encounter the greater number of other scientists working in their specific area. People often have to limit their number of international meetings for cost and time reasons.

The second is the dominant position taken by North American meetings, which have become major international meetings in their own right occurring annually. To a lesser extent, the same phenomenon has occurred in one or two other countries that have a strong national society with an international reputation. There are significant differences though even amongst this group of countries. The UK society, for example, regularly holds joint meetings with other physiological societies all over the world, and so plays an international role that is much appreciated by those societies.

We therefore detect a clear difference in attitude to IUPS Congresses from the different regions of the world. What we may caricaturise as the North American-UK position is sometimes (but by no means always) one of scepticism. The only submissions of evidence that proposed the possibility that IUPS should cease to hold congresses after 2013 came from the strongest national physiological societies for which it can be argued that the IUPS Congresses represent the smallest degree of added value over and above their own meetings.

However, the view looks very different from the rest of the world. Attending a regional meeting such as the FAOPS Congress reminds one how much regions of the world outside the USA and Western Europe value the international congress format.

It is worth reminding ourselves how different the situation looks in different regions. Using some rough criteria we can divide the world into 5 types of region:

1. Countries with strong, self-sufficient societies, capable of holding meetings that are themselves comparable to international congresses.

2. Countries with strong but smaller societies.

3. Countries in the developing world.

4. Countries in the underdeveloped world.

5. Countries in the "war zones"

Only those national organisations in the first category view the IUPS Congresses with varying degrees of scepticism. Yet, even in these regions, many value the experience of participating with the rest of the world. Positive comments on the San Diego Congress, even on the part of people from the US, reflected this. It is worth noting that the countries we would unambiguously put into this category, have a combined population of around 600 million, but nevertheless account for about 10% of the total world population.

As mentioned at the beginning of this document, IUPS carries a major responsibility for the other 90% of the world's population, and a particularly strong responsibility in the last three categories. If the finance were available to do so, we would surely be implementing major programmes to help the scientific and health development of these regions, including scholarships and travel grants to bring scientists from such regions to international meetings. This is one of the reasons why we **recommend** that more should be done via organisations like ICSU, UNESCO and TWAS. (See separate section)

We do not therefore think that the option of abandoning the International Congresses after 2013 is a responsible one. It so happens that the last Congress and the next two are hosted by societies in the first category, and we think it is very good for IUPS that this should be so. It gives the organisation a long run of Congresses in countries with very strong and large societies. But we only have to think about Congresses in the future held in China, India, South America and, eventually, Africa to realise the great importance attached to the International Meetings by these countries. We should not abandon them simply because the first category doesn't entirely need them.

We considered the arguments for and against the 4 year cycle. This was introduced in 1989 following many years of a 3 year cycle in order not to compete with IBRO. This reason has less force than it did. There are so many other international meetings that we would, ideally, wish to avoid competing with. It is simply impossible to schedule our meetings to avoid all the relevant clashes. There is no longer a strong reason to single IBRO out. However, we do not think that IUPS should return to a 3 year cycle.

Instead, we **recommend** that IUPS should have a greater presence at the Regional Congresses (FAOPS, FEPS, ALACF, AAPS). This could be achieved by holding the Council meeting between IUPS Congresses at one of the Regional Meetings. There may sometimes be exceptional reasons why the mid-term Council meeting should be held at the site of the next Congress, but there is no general need for this, other than perhaps the meeting of the ISPC. If inspection of the future Congress site and organisation is required, that can be achieved by one or two of the Officers visiting the site. This was done (by Weibel and Noble) during the run up to the St

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Petersburg Congress and the meeting of the Executive Committee in Christchurch prior to the New Zealand congress.

Greater involvement of IUPS in the Regional Congresses would strengthen the connections to the regions, and it could also be of great benefit to the weaker regional meetings, in say South America and Africa. IUPS should play a missionary role in this regard. As we emphasised at the beginning of our Report, this is one of the major justifications for its existence.

Regional Federations and Meetings

If we visualize the IUPS central mission to be the promotion of Physiology worldwide, we should place especial emphasis on working closely with the 5 regional physiological societies listed in the IUPS web page (Africa, Asia/Oceania, Europe, Latin America and Scandinavia). (Scandinavia is really a part of FEPS – but has its own regional group because not all the countries there have their own societies)

IUPS should consider how to implement joint activities with these regional societies (see our recommendations on Congresses). As an example, we could hold workshops and courses in their respective regions. We should also find ways to increase the participation of physiologists from all over the world at the IUPS congress. A possible mechanism may be to invite each regional society to organize one symposium at each IUPS congress. We are well aware that physiology is not developed to the same extent in all regions of the world. Yet, the overall excellence of the IUPS Congress will not be put at risk by having just 2 or 3 symposia that might be of lower scientific quality than the rest of the program. Furthermore, the beneficial effects for physiologists that belong to less privileged countries of actively participating as speakers at the IUPS congress largely offset this potential risk. There are also areas of research that are primarily, though not exclusively, of regional interest. Examples include Chinese medicine (FAOPS) and new drugs from tropical plants (Africa and South America).

IUPS should become more involved in the regional meetings as well; at these regional meetings two or more IUPS commissions could jointly organize special symposia to bring to the region the latest advances in physiology in their areas of expertise. IUPS could also sponsor specific educational activities.

Ideally, the IUPS Council should have a liaison member for each of the five regional physiological societies, as is now the case in Cecilia Hidalgo's relationship with ALACF, Akimichi Kaneko's with FAOPS and Ole Petersen's with FEPS. These liaison persons should make sure that the regional societies are effectively informed of all IUPS activities, and could also bring back to the IUPS Council matters arising at the regional societies, as well as names of possible candidates for Council or speakers at the IUPS Congress.

In addition, the IUPS website should allocate space to activities of the five Regional Societies.

Another way to foster the development of physiology worldwide is to ensure access to *Physiology*, the joint IUPS/APS journal. This journal should be freely accessible to physiologists who live in countries where they cannot afford the price of subscription.

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RELATIONS with ICSU, UNESCO, TWAS

In recent years, the interaction between these bodies and IUPS has been small, and may well continue to be so. An exception was the hosting (in 1995) of the last IUPS meeting on Ethics, following which UNESCO sponsored the publication of the book (*Ethics of Life*) arising from the meeting. Some have raised the question whether these organisations are any longer important to IUPS.

We take a long historical view. ICSU and UNESCO have played major roles in times of world crisis. Notably, ICSU arose out of the chaos in the academic world following the First World War, which badly affected IUPS Congresses for some years, and it established the Principle of the Universality of Science and defended the free movement of scientists. With the end of the cold war, the end of apartheid, and the general trend towards globalisation and liberalisation, the need for these defences may appear less acute. But we should remember that, even today, there are regions of the world that are far from accepting these principles. There are nations in all parts of the world that never send representatives to our Congresses and do not adhere to IUPS. We believe that it is essential that IUPS and other scientific unions should remain vigilant, and the ICSU umbrella could be important again should world events take a bad turn for the worse. Extremism, climate change, population pressures, new clashes of ideology, could all pose threats to world stability of a kind that may encourage the voices of intolerance and boycott. We believe that it is fundamental that IUPS should stand firmly for the principles under which our science can flourish, and that requires international collaboration and supranational organisations. In addition, it appears that those societies that adhere through their National Academy might not continue their support of IUPS if the IUPS were to resign from ICSU. Thus we recommend that the IUPS maintain its membership in ICSU

May 2008

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SUMMARY OF RECOMMENDATIONS

Future of Physiology

It is **recommended** that:

1. Future Congresses promote the essential role that the physiological sciences must play in systems biology and other interdisciplinary areas.

2. The editors of physiological journals might consider highlighting physiological approaches to systems biology and bioengineering.

3. Physiological societies work with grant agencies and funding institutions to improve the representation on their committees of this discipline

4. IUPS and its member societies promote or encourage problem-based joint meetings and joint researches between physiologists and physicists, mathematicians, engineers, or computer scientists. Similar productive interactions with other disciplines, such as structural biology, biophysics, ecology and clinical medicine, among others are required.

5. Education play an important role in achieving all of these aims and in enthusing the young with the substantial challenges of our discipline.

Image and Communication

It is **recommended** that:

6. IUPS broadcast the above definition of physiology and the indispensable role of physiology in the modern biology era.

7. IUPS add a suitable motto or rider to the IUPS logo.

8. A Communication Committee will be formed chaired by a member of Council. One of the functions of this committee would be the IUPS website.

9. The Communication Committee consider the future of the IUPS Newsletter.

Role of Officers

It is **recommended** that:

10. The President of IUPS should not carry a particular portfolio. The President should be free to represent the Union generally, and to act in particular areas when necessary

11. One of the Vice Presidents should be responsible for Internal Affairs.

12. One of the Vice Presidents should be responsible for External Affairs.

13. The Treasurer should play a strategic role in relation to finance and so should chair the Finance Committee.

14. The Secretary General is responsible for overseeing the running of the Union including the Secretariat.

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15. The Secretariat of IUPS should be responsible for routine management of finance as well as the general affairs of the Union.

16. The role of the Executive Secretary is to service the Union's affairs in general and so be responsible to all the Officers

Finance

It is **recommended** that:

17. IUPS should form a Finance Committee chaired by the Treasurer, who would be relieved of day-to-day management of IUPS finance. Consideration should be given to transferring the administrative responsibilities of day to day finance to the Executive Secretary.

18. IUPS should not undertake setting up a separate central office for fund raising. Instead, among other solutions: engage fund-raisers, seek assistance from the industry, or form a "Star Committee" with people of influence.

IUPS Organisation: Administration

It is **proposed** that:

19. In the first instance, the successor to the current Executive Secretary should be chosen after the choice of a new Secretary General who will appoint a secretary working in close association with him or her.

20. Consideration be given to renaming the Physiome Committee to become the "Physiome and Systems Biology Committee".

Ethics Committee

21. We **recommend** that Council should reemphasize the importance of Ethics in the field of physiology and needs to be led by someone active in this field.

International Meetings

We **recommend** that

22. The International Congresses be continued after 2013 and the call for invitations for 2017 should be issued.

23. IUPS have a greater presence at the Regional Congresses (FAOPS, FEPS, ALACF, AAPS).

24. The IUPS consider how to implement joint activities with the regional societies.

25. More should be done via organisations like ICSU, UNESCO and TWAS.

26. The IUPS maintain its membership in ICSU

APPENDIX 1: The Questionnaire

In this appendix we summarize the responses to the Questionnaire.

1. IUPS has reacted to recent developments in biological and medical science, including the Human Genome Project and the rise of Systems Biology, by (a) re-organising its Commission structure and (b) by forming the Physiome Committee that has launched the Human Physiome Project. Are there other ways in which IUPS could meet the new challenges?

The overall responses indicated that IUPS should continue what it is doing (running international meetings), but put more emphasis upon the role of physiology in the so-called area of "systems biology". It would appear that this is consistent with the directions and emphasis in the Physiome Project. The implication is that a greater effort should be made to raise awareness of this Project.

2. Is physiological science placing itself well in relation to the development of Systems Biology? If not, how should it do so?

There is clearly confusion among the respondents as to what is meant by systems biology so many of the answers are clearly not meaningful in this regard. For those that understand that systems biology is really more than just physiology as we know it, there is rather strong support for these approaches (in silico computational approaches for hypothesizing the emergent properties of the system – going from both top down and from bottom up). However, it seems evident from the majority of the comments that these approaches are not the way most physiologists are presently thinking, indicating that the leaders of the IUPS are themselves not positioned or inclined to advance the field of systems biology.

3. Some universities have reorganised their departments so that separate departments of physiology, anatomy, biochemistry, pharmacology etc no longer exist. Does this development matter, or does it rather create new interdisciplinary opportunities?

It is widely stated that this matters a great deal, although it was also evident from the comments that few really thought that we (IUPS, and the regional and national societies) could really do anything about it. It was also believed by a number of the respondents that the integrative sciences would always be needed and that no matter what department or its name, the techniques and physiological approaches would survive as needed.

4. Interfaces with the physical sciences, including physics, engineering, computing, are becoming increasingly important. How should IUPS reflect these developments?

There was strong support for promoting these interfaces. Most of the suggestions regarding what the IUPS should do related to encouraging these interfaces though greater inclusion of theoretical and analytical approaches into our scientific programs and publications and through promotion of the Physiome Project and recruitment and collaborative programming between IUPS and the scientific societies representing these quantitative disciplines.

5. How can IUPS react to recent developments in structural biology?

There is a strong feeling from those who responded that IUPS and physiologists should strongly embrace the revolution in structural biology since it is of great importance for understanding physiological functions and, as was emphasize by Peter Hunter, very important for physiome modeling.

6. Does physiological science place itself well to meet clinical needs?

The answers were overwhelmingly no! This was considered to be a major problem. We think that this is a major challenge for IUPS and for physiology in general. In many countries, there are fewer physiological scientists with medical qualifications, and even fewer with clinical experience.

IUPS ORGANISATION

7. What are the needs of the international community of physiological sciences that IUPS could and should satisfy?

This was a broad and open-ended question and as one might expect there were a variety of opinions. However, two main areas were most frequently cited: first, the need for education and training programs in the developing nations of the world; second the need to promote and sustain interactions among physiologists through the World Congresses and encouragement of such activities regionally. Three main areas emerged:

- **Support of education and research in developing countries**. A variety of activities were proposed, including providing more support to regional organizations, but the lack of sufficient funds to do this was also acknowledged.

- **Organization of IUPS meetings**, including the International IUPS Congress and scientific workshops and conferences in the less developed areas of the world. Some answers suggested displaying the best physiological research at the International IUPS Congress or inviting speakers from some developing countries who do first rate science.

- **Political issues**: Support and advocate animal research, free movement of scientists and non-politicization of science, plus establishing regular communication with national physiological societies.

8. To what extent does IUPS currently meet those needs?

There was a strong consensus that IUPS is currently not serving these needs very well. It has done well in staging a major international congress at regular intervals and has had some success in running workshops and participating in educational sessions in association with IUPS Congresses. Yet, several answers indicate that the visibility of IUPS is not adequate and that limited funds (again) preclude it from fulfilling its role.

9. What changes would you recommend to meet unmet needs?

There was general agreement that IUPS should provide more support to regional organizations and hold more workshops. It was also recognized that financial resources was a major limiting factor toward achieving such activities, but also a recognition that it would be necessary to find and empower good responsible people to engage in such activities. The latter was felt to be as important as the former. Recommendations include a) to develop a program dedicated to the world-wide spread of the physiological sciences, including the organization of educational activities, symposia and congresses in conjunction with developing countries, b) to encourage (and support if possible) activities of the other regional physiology groups (outside of FAOPS that is doing well already), c) to provide regular informative updates on IUPS activities, d) to find good responsible people as executives, not by the present nomination system but by a direct election system, and e) to create a sub-committee or commission to facilitate these activities. The lack of funds available to develop these activities was highlighted once more.

10. Do you think IUPS should be more involved in fostering graduate education in physiology in the developing world?

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The answer was a resounding YES from everyone, though there was also obvious skepticism given the financial limitations of IUPS. Several responses considered this to be an important mission of IUPS. Different proposals were put forward towards this aim: to develop physiology teaching in the developing world through short courses and seminars directed at teachers; to foster long-term collaboration between well established physiology laboratories and laboratories in developing countries (including graduate student training): to teach physiology to clinicians in developing countries to improve the clinical care that they deliver; to serve as a central administration to funnel philanthropic and other forms of assistance to physiology education in developing nations; to ask the developing world what their needs are in this area and go from there.

11. Do you favour a central IUPS Executive Office (currently in Paris) or an office that migrates every few years with one of the Officers?

A strong majority, almost unanimity, favours the maintenance of a central office in a single location.

12. Is the present structure of Officers, Executive, Council and Commissions satisfactory? If not, what would you recommend?

A large majority felt that the present structure is satisfactory. In several cases, there appeared to be a poor understanding of the overall structure of the IUPS. There were several critical comments regarding the commissions, and one criticism indicating that the processes of election to these bodies are clouded by a lack of transparency. More frequent turnover of commission heads and Council members to insure new influx of younger scientists into the organization was also suggested. The detailed comments included:

Council: some critical comments recommend the staff to be more actively involved, and to name a delegate in each country, chosen by each country's physiological society, and not by the IUPS Executive Office.

Commissions: critical comments are listed below:

- they do not really have much to do; they should be modernized; their structure needs to be completely revisited; commissions still appear to be unwieldy and/or invisible
- commissions should have better worldwide representation and increase the presence of participating societies;
- should be more organ based, as these will not vary with current fads in science

IUPS MEETINGS

13. Does the IUPS Congress meet a need and how successfully does it do that?

There were rather mixed views on this question, but the majority opinion was YES. In general, it appears that many feel that the Congress is useful for young scientists to become acquainted with those from other countries, but that many other meetings could in general serve their scientific needs. The merits of the IUPS Congress can be summarized as follows: 1) promotion of personal contacts, 2) counterbalance against continuing specialization to keep "physiology" together, 3) opportunity to listen to outstanding international speakers, and 4) introduction and stimulation for young investigators and students.

14. Does the IUPS Congress ensure worldwide participation of the physiological community, including women and young physiologists?

Despite considerable efforts that have been made to support travel awards to young investigators (men and women) from developing countries, many expressed a clear level of dissatisfaction regarding this issue, not so much regarding the gender issue, but regarding young physiologists. However, most of this concern appears to revolve around the issue that young investigators are more interested in attending more specialized meetings, and suggestions were made to incorporate sessions that are more attractive to

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the young scientists. But the comment was also made that it is necessary not to compromise scientific excellence solely for geographical, gender and age balance.

15. Some International Science Unions no longer hold Congresses. Should IUPS consider this option?

The great majority responded that these meeting are the only visible thing that the IUPS does and that they need to be continued. We should not therefore consider this option. However, the way in which they are organized and structured perhaps needs to be reconsidered.

16. How would you rate the success of recent Congresses (over last two decades)?

The majority of the respondents rated the success of these meetings good to excellent (though recognizing the administrative and financial issues with the Russian meeting). A minority thought that the Congresses were not exceptional given their cost.

17. Is it important to restrict bids for Congresses, e.g. to countries large enough and with societies wealthy enough to bear the burden?

There were many views on this subject. At least half of the respondents though that bids should be so restricted. The remaining generally felt that we should keep an open mind on this subject and perhaps have the wealthy societies contribute more in funding if meetings are held in a less wealthy region. Probably the most valid reply was that local resources and easier accessibility need to be part of the selection process.

18. If IUPS continues to hold Congresses, is the present 4 year cycle correct?

Most thought yes although some said they should occur more often but on a smaller scale. Or better, to have smaller more localized meetings or regional meetings between the four year congresses.

19. What is the role of Regional Meetings?

Most of the respondents felt that regional meetings are very useful and, although not always articulated clearly, it appears that they believe that they can and should serve an important role in promoting science within their unique regions, and that they should be directed towards young physiologists who cannot afford to travel to the larger meetings. Reading between the lines, it seems clear that they do not want IUPS to dictate the form and substance or style of these meetings, but that they should be encouraged and perhaps coordinated by IUPS. That, though, leads to the question of what role the IUPS should play in the lives of the various Regional societies, FEPS, FAOPS, ALACF etc.

20. To what extent are joint meetings or symposia with some other international biomedical societies (such as pathophysiology, pharmacology, biophysics, neuroscience, etc) to be pursued?

Most respondents thought we should have more joint meetings. The San Diego model was thought to work well. A number of others felt that the 4 year IUPS Congress should continue in the traditional way, but suggested that intervening regional meetings would be well served by joint meetings. It was also noted that, if exciting themes can be found that will interest enough people, it is a good idea to hold the joint symposia within one of the IUPS Meetings or in between. Having joint meetings between the IUPS Meeting and some other international society meeting (such as IBRO) is sometimes risky and needs an enormous amount of effort to pull it together.

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FINANCE

21. IUPS is financed partly from dues paid by national adhering bodies, and partly from a percentage of the Congress Registration fee. The finance is not really adequate to do the job, and severely restricts what IUPS can do. How else should it seek to raise funding?

Many suggested a fund raising office and efforts to obtain support from industry and foundations but there was not much in the way of specific suggestions on how to successfully achieve it, other than numerous references to the pharmaceutical industry. (It may be noted that during the Presidency of Allen Cowley, action along these lines was proposed I proposed and Council supported the idea but it never evolved due to lack of anyone willing to take this task on, nor could we find a way to support it.)

22. Do you favour the creation of a fund raising office?

The vast majority responded YES to this with the qualification that we would need to first find or allocate resources for such an office or to contract some fund raising group to do this. They also raised the problem that sometimes it costs more than it brings in.

RELATIONS WITH ICSU, UNESCO, IBRO AND OTHER INTERNATIONAL ORGANISATIONS

23. IUPS is affiliated to ICSU (International Council of Science) and through this body it has been active in defence of the principle of universality (see ICSU Statute 5). IUPS has also interacted with UNESCO (on the ethics of experimentation). It also interacts with other related scientific Unions, such as IBRO. Are these international activities important? What other activities of this kind should IUPS be involved in?

This question elicited the greatest number of "no comment" and "no idea" of any question asked, indicating that many do not really understand what this is all about, and even some that responded were clearly rather naïve regarding the nature of the ICSU. The majority of the responses, however, indicated that these affiliations with umbrella organizations such as ICSU were important and should be continued.

PUBLIC RELATIONS

24. Do you think IUPS should have a public relations office to increase its visibility worldwide?

It is interesting that most of the individual respondents felt that this was not a high priority and of course raised the issue of how we would support such an office. On the other hand, most of the national societies were strongly in favour of such an office emphasizing the great importance of this to the future of physiology. Some suggested that it should be included in the responsibility of the Secretary General.

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Replies to the Questionnaire

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Irene Schulz
Pierre Magistretti
Ole Petersen
Yung Earm
Malcolm Gordon
Quentin Pittman
Daniel Ricquier
Ann Sefton
Tai Yao

Former Council & Friends
Shu Chien
Sten Grillner
Hans Hoppeler
Peter Hunter
Masao Ito
Stanislav Konturek (Poland)
Erwin Neher
Chumpol Pholpramool
Ewald Weibel

Member Societies
Canadian Physiological Society
Comité National Français des Sciences Physiologiques
Hungarian Physiological Society
Physiological Society of Japan
Korean Physiological Society
Sociedad Mexicana de Ciencias Fisiologicas
South African Nat'l Comm for the IUPS
Sociedad Espanola de Ciencias Fisioloigcas
Thailand
The Physiological Society U K
USA
American Physiological Society
Microcirculatory Society
Latin American Assoc of Physiological Science
Federation of European Physiological Societies

APPENDIX 2: Issues concerning Systems Biology relevant to physiology

"If you want to start an interesting debate at almost any scientific meeting, just bring up systems biology. Latched onto by the scientific and even the lay press as the "next big thing", it is clear that many scientists have misgivings about the subject. The rapidly changing landscape of biology is an exciting notion but one that can be worrisome. Regarded by some as little more than a buzzword and others as the next step in bringing biology from a descriptive to a predictive science, systems biology is host to disagreements fuelled in part by a lack of a uniform definition." (Steven Wiley, *The Scientist,* June 2006)

We agree with this criticism. There is a lack of uniform definition. One of the reasons is that the swing towards a systems approach to biology has been driven by at least four developments with very different emphases on the nature of the subject:

Genomics and proteomics. Having accumulated the immense database that is formed by genomics and proteomics, there is general agreement that the data requires dynamic interpretation in terms of function. At this level, the natural interest has focussed on gene and protein networks of interactions. The great majority of Systems Biology centres and institutes work at this level and rarely move above that of the cell.

Bioengineering. The approach from this area is more truly multi-level, which is a characteristic of engineering in all its forms. This area has a long-established tradition and has been a natural ally of the physiological sciences.

Computational and theoretical biology, including computational physiology. Some even regard Systems Biology as co-extensive with Computational Biology. Together with bioengineering, this is the focus of the IUPS Human Physiome Project.

Systems Physiology, which has a long tradition originating with the work of people like Claude Bernard, but which has been neglected in many universities in recent years as the shift towards molecular and cellular physiology has squeezed out classical systems physiology.

The definitions of Systems Biology naturally differ according to the origin of the scientists within these traditions. There is an opportunity here for physiological scientists to contribute their view of the subject and how it would benefit from being developed within physiology, pharmacology and pathology, as well as within biochemistry, molecular biology and molecular genetics.

We originally drafted a set of principles that seek to define Systems Biology from a physiological perspective. These were eventually developed into the Paton Lecture of The Physiological Society in the UK, which has now been published.[5] In our final Report therefore we decided not to include the preliminary version of that lecture. We conclude this appendix with our concerns. These are:

(i) Few of the systems biology meetings, discussions and reports make adequate reference to physiology (an exception is the UK Report), and very few physiologists indeed are present at international meetings on systems biology.

[5] Noble, D. (2008) Claude Bernard, the first Systems Biologist, and the future of Physiology, *Experimental Physiology*, **93**, 16-36.

(ii) To many people the field has become simply an extension of molecular biology and biochemical pathway analysis so that systems biology currently tends to focus on gene networks and protein cascades, and is integrative usually only up to the cellular level. Remarkably, little is 'seen' or attempted at the higher levels.

(iii) Few centres of Systems Biology are strongly physiological.

(iv) The physiological community has been slow to react.

Yet, we considered the question whether, if IUPS did not exist, which of the other various international systems biology organisations might assume its role. The answer, from those of us with experience of the ICSB and similar Congresses, is 'none'. They are not generally focussing on what we understand to be physiology. This is the reason why we think that it is essential that IUPS should address the needs of Systems Biology at the higher (physiological) levels.

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