IUPS Newsletter

7

September 2004

CONTENTS

Editorial September 2004 issue

The next big event for IUPS is obviously the World Congress in San Diego next year. In a somewhat historical context, I describe briefly elements of the process, which has created the framework for this very promising Congress.

The IUPS President, Allen Cowley, has written a very interesting and thoughtful article about the global manpower needs for integrative systems physiologists. Although the prospects for future progress are very bright, Allen Cowley draws attention to the many problems we have in securing the manpower needs. Part of the problem lies in the difficulties, now felt increasingly in many countries around the world, with regard to animal experiments. As a current member of The Royal Society's Animals in Research Committee, I am very well aware of the issues in the UK. Many school teachers, and even many scientists, are insufficiently aware of the arguments for animal research. The Royal Society therefore issued a document (Policy document 01/04) earlier this year entitled 'The use of non-human animals in research: a guide for scientists', which could be helpful in many contexts. This report can be found at: http://www.royalsoc.ac.uk

There are great scientific developments in China and the IUPS President and the two Vice-Presidents went to Beijing this past summer to speak at a major conference. In an interesting article, Irene Schulz describes the impressions from this event.

There are great hopes that Europe, also scientifically, is beginning to get its act together. As a Council Member of Academia Europaea I have had to follow these developments closely and have written briefly about recent events, which are likely for the first time to lead to the establishment of a European Research Council.

Ole H. Petersen
Secretary General of IUPS

The 2005 San Diego Congress

One of the most important tasks for IUPS is to organize International Congresses of Physiological Sciences at four year intervals. The next congress, '*From Genomes to Functions'*, will be held in San Diego, California from 31st March – 5th April 2005, in parallel with and as part of FASEB's EB 2005. The 2005 San Diego Congress is the result of the successful bid made by Stanley Schultz, at the IUPS General Assembly in St. Petersburg in 1997, to bring the IUPS Congress back to the US for the first time since the 1968 International Congress in Washington D.C. This was in fact my first International Congress and also the occasion for my first visit to the US. I remember well this magnificent event and the generosity of The American Physiological Society (APS) in awarding travel grants to many young physiologists from Europe (I was one of them) at a time when travel money was considerably more limited than is now the case, at least in Western Europe. In 1968 I had very little feeling for the magnitude of the task of mounting a major international Congress. This time it has been my privilege to participate in the process.

There are basically two tasks involved in setting up a Congress: the practical (physical) arrangements and the organization of the scientific programme. The two are obviously connected. The IUPS 2005 National Organizing Committee chaired by Shu Chien has been in charge of the decisions that had to be made with regard to the physical framework and the practical organization of the Congress. Obviously the APS office, and particularly the Executive Director, Martin Frank, and the Meetings Manager, Linda Allen, have had to shoulder a very major burden. We can be confident that San Diego will provide a memorable setting and the state-of-the-art facilities that will make the Congress as enjoyable and efficient as possible.

The most difficult part of any Conference Organization is to get the scientific programme right. It can, of course, never be right for everyone. To achieve the appropriate balance between the different subject areas within the vast family of Physiological Science is in itself very difficult, but when this is combined with the need also to achieve a balance between chairs and speakers from different countries, then the task is extraordinarily difficult. The

usual, and indeed inevitable, solution is to arrange for an International Scientific Programme Committee composed of experienced physiologists from a wide range of countries active in physiological research. The difficult and time consuming task of chairing this committee fell to Walter Boron and as Vice-Chair of the Committee I can testify that Walter has taken this task very seriously. Walter has used his vast experience very wisely to guide the Committee through many difficult decisions to arrive at what I and most of the physiologists I have spoken to regard as an impressive programme covering the full range of the best physiology can offer today.

The International Scientific Program Committee, at its Novermber 2003 Meeting in Landsdowne, near Washington D.C. Front row from left: Chin, Kaneko, Chien, Wright, Petersen, Boron. Second row: Kurachi, Block, Sefton, Gordon. Third row: Sigmund, Cowley, Nicoll, Saltin, Attwood, Schulz and Hunter (photo taken by Martin Frank).

The details of the final programme are on the Congress website (http://www.iups2005.org). There are several important elements and some innovations. A major part of the programme is made up of tracks, each track being composed of, for example, 3 symposia and 3 featured topics. A typical symposium consists of four 30 min presentations by Invited Speakers, whereas a Featured Topic is usually made up of two major presentations from Invited Speakers with additional room for two speakers selected on the basis of the submitted abstracts. While the tracks cannot cover the whole of Physiology, they are wide-ranging: *Calcium Signaling*, *Cardiac Physiology*, *Ecophysiology for the 21st Century*, *Education*, *Epithelia*, *Feeding Fuel and Fat* (Energy Metabolism), *Genomics*, *Mechano-/Chemotransduction*, *Muscle-Exercise*, *Neural Control of Locomotion* (From Genes to Behavior), *Renal Control of Blood Pressure*, *The Regulatory Brain*, *Thermoregulation and Energetics*, *Tissue Dynamics in the Lung* and *Vascular Physiology*. Outside the tracks there are a numerous free-standing symposia as well as a number of distinguished lectures, including the Fenn Lecture on the Opening Day to be delivered by the Nobel Laureate Peter Agre and of course Allen Cowley's President's Lecture.

Between the last IUPS Congress held in the US (in Washington D.C. in 1968) and the 2005 San Diego Congresses, IUPS has held International Congresses of Physiological Sciences in many exciting locations: Munich (1971), New Delhi (1974), Paris (1977), Budapest (1980), Sydney (1983), Vancouver (1986), Helsinki (1989), Glasgow (1993), St. Petersburg (1997) and Christchurch (2001). It has been my great privilege to attend all these events and I am now looking forward to San Diego in March/April 2005. Physiology has undergone very substantial changes since 1968 and some have spoken of the subject's relative decline, particularly in relation to Impact Factors for the physiological journals, as compared to the more molecular branches of biology. However, Physiology at its best is in many ways in a stronger position now than ever before. The APS journal *Physiological Reviews* is very representative of international physiology. It has separate US and European Editorial Boards as well as Associate and Corresponding Members of these editorial boards from Africa, Asia, Australia and South America. For me it has been very pleasing and indeed gratifying to note the

general increase, over the years, in the Impact Factor rating for *Physiological Reviews*. In fact the latest figures (2003 Journal Citation Reports) show that *Physiological Reviews* is now ranked, with respect to Impact Factor, as number 3 of ALL journals, only just behind *Annual Reviews of Biochemistry.* Let us hope and assume that this is a happy omen for the International Congress of Physiological Sciences next year in San Diego. Do visit the Congress website regularly to be up-dated on important deadlines and all details of the scientific programme.

Ole H. Petersen

Global Manpower Needs for Integrative Systems Physiologists

One of the perspectives gained over the past several years of my IUPS Presidency is that there is an emerging recognition everywhere I travel of the need to revitalize and train more integrative systems physiologists. This is not just a post-genomic perspective held by scientists in the United States, but it has been a theme reiterated by the scientists with whom I have interacted at meetings in, France, Germany, Denmark, Italy, the Czech Republic, Hungary, the United Kingdom, Canada, Brazil, Japan and China. It appears that it has become widely recognized that it is now acceptable to advocate the goal of carrying out research in ways that will provide an understanding of the behavior of the whole living organism, which is another way of saying that there is a recognition that we need to be doing more physiology. In a recent editorial in the journal *Physiological Genomics* related to systems biology, I stated that "an increasing number of scientists have recognized that in this post-genomic world, it is imperative that our institutions of science be proactive in creating ways to converge functional genomics and integrative physiology. The limitations of pure reductionism to help us understand complex function have become abundantly apparent. It can be argued that this type of restructuring work is premature. But many, including me, have chosen to believe that now is the time to begin building the scientific infrastructures that will enable an integrated understanding of the function of complex organisms and chronic diseases. How much more data do we need to add to the already more than 12,000,000 computer searchable references represented in PubMed before we begin to take this task seriously?" (*Physiol Genomics*. 2004 Feb 13; 16(3):285-6.). I suggested that now is "the time for a convergence of scientific experts in genomics, proteomics, metabolomics, biochemistry, bioinformatics, biophysics, cell and molecular biology, the ***physiological sciences***, and computer modeling to bring about new levels of understanding of the emergent properties and functions of living systems."

It is evident that the physiological sciences represent one of the most important elements of the so-called "systems biology" approach for the understanding of complex integrated biology. There is in this regards,

however, increasing strain upon our universities to train the physiologists needed to design and carry out meaningfulstudies that can link the 36,000 genes and more than 150,000 proteins to valid pathways of complex function and disease. Because of these challenges, over the past several years, there have finally been efforts to project the global manpower needs for integrative systems biologists. Although the numbers and projections are moving targets, some quantifiable data exist from the United States and several regions of the world. As reviewed in this article it is evident that there is indeed an enormous global manpower shortage to meaningfully carry out such work.

About a year ago I participated in a meeting organized by the Life Sciences Research Office (LSRO) sponsored by the American Physiological Society (APS) and the American Society for Pharmacology and Experimental Therapeutics (ASPET) to obtain a perspective on the status within the United States of integrative/systems physiology and to ascertain the manpower needs in this area of science. In preparation for that conference, the IUPS also forwarded the relevant questions of this LSRP survey to each of the IUPS Commission Chairs and Council members in an effort to gain a more global perspective regarding some of these issues. In the present newsletter, I shall (with permission) summarize the results of the LSRO survey (Life Sciences Research Office (2003) *The Status and Future of Integrative and Organ Systems Sciences in the United States.* (Falk, M & Emenaker, N., eds.) Bethesda, MD: Life Sciences Research Office, Inc.) together with information gained from the other sources represented in **Figure 1** in an effort to provide some semi-quantifiable perspectives of the present global manpower needs for integrative systems physiologists.

Global perspectives on status of integrative/systems physiology: current status and supply/demand issues.

Information obtained from the following sources:

1. Life Sciences Research Office (Bethesda, Md., US)
2. APS Survey of Chair persons of US Medical Schools
3. American Association for the Advancement of Science
4. National Science Foundation (US)
5. IUPS Survey of Council and Scientific Commissions
6. Commission of the European Communities
7. UK Life Sciences Committee
8. British Pharmacology Society
9. Personal communications (Industry and Academia)

Figure 1

Top ten countries by highly cited scientists (Figure 2). It is useful to first gain some perspective on those countries or regions of the world where the most highly cited scientists currently reside. As cited from the *Scientist* (August 2003), these are the United States followed by the UK, Germany, Canada, Japan, France, Switzerland, Sweden, Italy and Australia. Since the statistics obtained from the LSRO survey of US academic institutions represent a large proportion of the overall scientific activity, the LSRO survey may reflect major directions of manpower needs for integrative/systems physiologists. As cited by the National Science Foundation Survey, 25-30% of all those entering college in the US intend to study science, but fewer than half actually even complete a baccalaureate degree over five years (data compiled in 2001). Despite an upward trend for the general area of science over the past 20 years, the number of Ph. D's trained in biological sciences and engineering has been declining since 1996. These reductions stem from a declining number of foreign-borne students seeking graduate degrees in the US and increasing availability of opportunities in their own countries. In 1999, 74% of the foreign Ph.D. students intended to remain in U.S., but by 2001 only 50% had done so due to opportunities at home. The decline in the training of foreign-born students has inevitably continued to erode since 9/11 given the well recognized difficulty in obtaining US visas. As pointed out in an editorial in *Nature Genetics* 34:233, 2003, however, "If foreign born scientists in the US are taking advantage of the increasingly attractive opportunities in their home countries, that ought to be a net gain for international science, while at the same time giving young American scientists a bit more leverage in their own marketplace".

Top 10 Highly cited scientists by country

Rank	Country	# of highly cited	% of high cited	# of places	Scientists per places	Cited per million population
1	US	815	66.7	90	9.06	3.16
2	UK	100	8.2	24	4.17	1.72
3	German	62	5.1	21	2.95	0.78
4	Canada	42	3.4	15	2.80	1.53
5	Japan	34	2.7	14	2.43	0.27
6	France	29	2.3	11	2.64	0.50
7	Switzerland	26	2.1	5	5.20	3.78
8	Sweden	17	1.4	10	1.7	0.29
9	Italy	17	1.4	10	1.70	0.29
10	Australia	17	1.4	9	1.88	0.96

The Scientist, Aug.2003

Figure 2

Why the need for integrative and organs systems sciences? Based on the summary report of this LSRO conference, six major reasons were cited as

to why there is a need for more integrative and organs system sciences. First, "findings from the reductionist sciences can only be extrapolated to a refined and defined discrete molecular or cellular phenomenon". Second, "findings from the reductionist sciences differ relative to the integrative and organ systems sciences in their focus and generalizability to intact animals and organ systems". Third, integrative sciences represent a crucial component in biomedical experiments directed toward advancing the fight against debilitating and life-threatening diseases. Fourth, integrative sciences provide the infrastructure to support a wide variety of scientific fields including: physiology, pharmacology, toxicology, nutrition and developmental biology. The integrative sciences are therefore crucial supportive sciences. Fifth, integrative sciences are vital for discovery, validation and development of the research required to relate genes to complex functions and diseases. Sixth, the integrative sciences are necessary for drug development including verification to establish relevance, identification of targets to pursue, and evaluation of therapeutic safety and efficacy issues prior to initiating phase I human clinical trials.

Current Trends in U.S. Physiology and Pharmacology (Figure 3). The following information was obtained from three sources: the American Association for the Advancement of Science Report (AAAS) published in the journal *SCIENCE;* Dissertation Abstracts for the Integrative and Biomedical Sciences (1980, 1990, 2000); and the *American Journal of Physiology* (AJP) and the *Journal of Pharmacology and Therapeutics* (ASPET). It is important to recognize that the surveys and questionnaires from which this data was obtained were based on the following definitions. "***Reductionist Sciences***" are defined as those "aimed at identifying molecular and cellular events, studied in purified form or in isolated systems and include genomics, proteomics, biochemistry and cell biology". "***Integrative and***

Current Trends in US Physiology and Pharmacology
AAAS report in the journal SCIENCE

1. Integrative and Organ System Sciences Employment Announcements (1982,1991, 2000).
2. Dissertation Abstracts for the Integrative and Biomedical Sciences (1980, 1990, 2000).
3. AJP and JPET Integrative Publications Classifications (1980, 1990, 2000).

Figure 3

Organ Systems Sciences (**IOSS**) were broadly defined as "studies relying on animal models to provide specific tissues, individual organs or entire organ systems; and narrowly defined as "studies relying on animal biology to understand physiological function in the context of the entire animal, organ or organ systems model".

One way used to gain a perspective on the need for integrative and organ systems physiologists was to count the employment announcements appearing in ten random issues of *SCIENCE* over the last several decades.

Integrative and Organ System Sciences Employment Announcements Appearing in 10 Random Issues of *Science*

	Total Announcements	"Broad" Announcements	"Narrow" Announcements
1980	1,531	3.4%	0.8%
1990	2,056	7.8%	1.3%
2000	3,377	4.1%	0.5%

Figure 4

As summarized in **Figure 4**, compared to 1980 there has been nearly a doubling of the total job announcements in *SCIENCE* over the past 20 years. It is also clear that there has been proportionately only a very small increase (0.6%) in announcements advertising for individuals carrying out integrative and organs systems scientists (IOSS) as "broadly defined". At the same time, there has actually been a slight reduction (0.3%) in the percent of "narrowly defined" announcements seeking individuals who can carry out experiments and understand physiological function in the context of the entire organism. These data would suggest that academic institutions (largely within the US) at the beginning of the 21st century were not seeking to expand their faculties in the area of integrative systems physiologists.

Dissertation Abstracts for Integrative and Biomedical Sciences in English

	Total Biomedical dissertations	Total "broad" dissertations	Total "narrow" dissertations
1982	2,458	1,008 (41%)	422 (17%)
1991	4,870	1,481 (30%)	521 (11%)
2000	4,082	1,305 (32%)	262 (6.4%)

Figure 5

AJP and JPET Integrative Publications Classifications

		Total articles	"Broad"	"Narrow"
AJP				
	1980	711	75%	67%
	1990	1,406	77%	65%
	2000	1,463	66%	45%
JPET				
	1980	419	61%	43%
	1990	534	73%	44%
	2000	606	56%	24%

Figure 6

Dissertation Abstracts. **Figure 5** represents the total number of biomedical dissertations in English during this same time period (comparing years 1982, 1991, 2000). These data indicate that there has been a nearly 10% reduction in the percent of dissertations carried out in the area broadly defined as integrative systems biology and within the narrow IOSS definition of "research relying upon animal biology to understand function in the entire animal, organ or organ systems model". However, as reflected in the scientific journals of the APS and ASPET (**Figure 6**), the total number of articles considered as integrative systems biology has not changed nearly as drastically. For example, compared to 75% in 1980, currently 66% of the publications of the APS represent studies that rely on animal models (as broadly defined) and 45% are studies related to context of the entire animal organ or organ systems model down from 67% in 1980 (as narrowly defined). In contrast, it would appear that pharmacologists were carrying out considerably less research in the area of narrowly defined integrative systems sciences as represented by only 24% in the year 2000 compared to 43% in 1980 and 1990.

Current status of Integrative and Organ Systems Scientists (IOSS) in the US. The following information was obtained by LSRO from 163 (of the 414 departments) physiology and pharmacology departments in the United States with a response rate of 40%. It is encouraging that "US physiology and pharmacology department chairs overwhelmingly responded that IOSS approaches are important in maintaining academic scientific research programs". 83% of the respondents thought there was an important need, 13% a qualified need, while only 4% thought there was no need for IOSS scientists. When queried if they "perceive this issue to be a problem" 124 chairs responded with written comments, 81% indicating it was an important problem. However, as seen in

Current status of Integrative and Organ Systems Scientists (IOSS) in the United States.

Collected from 163 Physiology and Pharmacology Departments with a response rate of 40% (LSRO).

1. Total faculty change from 1991 to 2001 = reduced 30% (despite 20% reporting overall increase in size).
2. 38% report fewer full-time IOSS tenured faculty.
3. Only 22 programs (of 65) anticipate hiring limited number of faculty IOSS members within the next 5 years despite increasing aging of current faculty.

Figure 7

Figure 7, it was found that during the last decade of the 20th Century (1991-2001) there was an average reduction of 30% in faculty who could be defined as IOSS scientists in the United States, despite 20% of these departments reporting an overall increase in size. Among these departments, 38% also reported fewer full-time IOSS tenured faculty. It is remarkable that despite the feeling of a need for IOSS scientists and recognition that these scientists contribute to their departmental research efforts, 31.8% (41) of the respondents did not anticipate hiring IOSS scientists in their department in the next five years, and 24% (31) anticipated hiring no more than one. Conversely, 44.2% (57) did anticipate hiring more than one IOSS scientist over the next five years, suggesting that at the time of this survey (2002-2003), the majority of departments recognized the need and were making plans to hire IOSS scientists. Such projections in face of the aging of their current faculty in these areas of research are indeed rather feeble given the stated relevance and important of such scientists. The reasons for not being more aggressive in hiring IOSS scientists most often stated were research funding, university support, and animal rights issues.

Loss of Training Curriculum. Regarding the state of training of scientists in the area of integrative and organs systems biology, 70.5% of the responding departments reported no change in IOSS courses since 1991, although it was unclear from the survey how often these courses were taught or how many students were involved in them. It was, however, also indicated that the organ systems courses suitable for graduate students had been reduced, eliminated or incorporated into significantly condensed courses. The 66 physiology and pharmacology departments that responded to this survey emphasized that there was currently a dramatic reduction in the competency of students capable of carrying out integrative and organs systems research. Specifically, 66 programs indicated that in 1991 they were training more than ten students capable of doing IOSS and *in vivo* whole animal research while in 2001 only 12 programs could make this statement.

The LSRO survey on the current status of integrative and organ systems scientists in the United States was summarized as follows.

- Total number of faculty employed in physiology and pharmacology departments was unchanged for 76.7% of respondents
- Total number of IOSS faculty employed in physiology and pharmacology departments was unchanged for 52% of respondents, whereas 36.3% reported a decline in their numbers. Declining departments led increasing departments by more than 3:1.
- Total number of tenured IOSS faculty employed in physiology and pharmacology departments was unchanged for 46.5% of respondents, whereas 38.1% reported a decline in their numbers.
- Total number of non-tenured IOSS faculty employed in physiology and pharmacology departments was unchanged for 61.3% of respondents.
- Total number of IOSS courses was unchanged for 70.5% of respondents, yet 75.8% of departmental chairs report dropping IOSS courses.
- Total number of PhD students in physiology and pharmacology departments was unchanged for 74% of respondents.
- Total number of PhD graduate students capable of conducting IOSS research in U.S. physiology and pharmacology departments was unchanged for 59.7% of respondents, while 30.5% reported a decline. Declining departments led increasing departments by more than 2:1. The average number of PhD graduate students capable of conducting IOSS research in these departments has declined.
- Demand for academic IOSS faculty in the next five years is not promising as 1.1 positions per department have been projected.

International Union of Physiological Sciences (IUPS) Survey. At the time the Life Sciences Research office was conducting the US survey on the current status and supply and demand issues of integrative/systems physiology, the IUPS also conducted an informal survey; a small sampling of eleven regions of the world represented by the council of the IUPS (**see Figure 8**) for the nations and regions using the same questionnaire as the Life Sciences Research Office for the US survey. Although, this survey is largely anecdotal and only a limited number of regions were surveyed, one can still

obtain the flavor of what may be happening in these various regions of the world.

Figure 8

United Kingdom. The most informative response was received from the Life Sciences Committee of the United Kingdom (now the Biosciences Federation). This response went far beyond the survey questions since the national curriculum related to the education of integrative of systems scientists in the U.K had just been independently explored by the Animal Science Group of the UK (the Life Sciences Committee). This report emphasized that within the national curriculum in the UK animal dissection is no longer a requirement in the A Level Biology practical assignment and is no longer in the main body of the courses except for some demonstrations. The report reflected on the fact that course content has changed drastically over the past 2-3 decades from an emphasis on evolutionary integrative biology to "bio-molecular" science, which they refer to as "modern bioscience". It was stated that students "have little practical knowledge of animal form and function". At the undergraduate level (B. Sc University Students) the focus of most syllabi is on non-whole animal topics. Commonly there is no dissection during undergraduate years.

The reasons for this situation were stated as follows:

- Given the intense competition to register undergraduate students in science subjects, animal dissection was viewed as a disincentive to do so.
- There has been a reduction in the laboratory component of Biology courses. This was attributed in part to reduced time allocated to teaching as the U.K. system moved toward the U.S. semester system and modular degree programs.

- There has been substantial Government cost cutting whereby staff/student ratios have been reduced and laboratory sessions that require considerable staffing have fallen by the wayside.
- The use of animals for students doing honors projects has presented problems as well due to the fact that most Universities lack animal facilities, or if present, they are very expensive.
- There are fears from animal rights groups and considerable bureaucratic delays and cost in order to obtain Home Office Education licenses.
- Regarding the undergraduate level situation in the UK, students at many UK universities do not receive the education they need to make informed choice of future careers, which has contributed to the current chronic shortage of integrated systems scientists.
- The supply and demand situation at the post-graduate level in the UK reflects some of the same problems. The shortage of such scientists is well recognized, but little has been done to address the problem. Efforts to recruit such scientists have resulted in few, if any, applicants from the UK, and research is also hampered by a well recognized major shortage of qualified animal technicians.

The reasons for the present situation in the UK were attributed to two major factors. First, the anti-vivisectionists have been very successful based on a long history of engaging in rigorous lobbying activities to local governments and parliament. They have created a climate of fear with many examples of extreme violence. There has been enormous pressure brought to bear on animal breeders to abandon business. The most publicized of these being the Huntingdon Life Sciences, a major drug testing company that was nearly bankrupt by the activities of the anti-vivisectionists. This climate of fear and intimidation has led to the delay and establishment of animal research centers such as the primate center in Cambridge. The second major reason for the present situation was attributed to the overall cultural changes that have occurred within the country. These changes include the increased urbanization of the population with loss of understanding of the realities of

animal use. They include the increased awareness of environmental changes and a desire to prevent further erosion leading to increases in vegetarianism, antagonism against the use of furs for clothing, and a trend toward a preference for "natural foods" leading to changes in farming procedures.

What is being done to change this situation in the U.K.? As in many countries in the industrialized world, public opinion polls have supported animal experiments for biomedical research as needed. Efforts are being made in the U.K. to present the facts for the continued need for integrative and systems biology using whole animals. Funds for these activities can be obtained from the pharmaceutical industry and by medical organizations with progress in this field represented by the formation of the "campaign for medical progress" currently ongoing within the U.K. There is also a recognized need to change the National Curriculum to consider ethics of animal experimentation in secondary schools and there is effort to change the curricula at all educational levels.

A separate report was sent by Dr. Sara-Jane Stagg representing the ***British Pharmacological Society*** that also conducted a survey relevant to the IUPS questionnaire. Most of the information was reflected in the report of the U.K. Life Sciences Committee, but the report placed greater emphasis on the concerns of the U.K. pharmaceutical industry regarding the manpower needs for integrative systems physiologists. It was emphasized that there is a rapidly diminishing number of undergraduates capable of carrying out hands-on *in vivo* laboratory studies. Industry is very concerned due to the difficulties of recruiting employees for *in vivo* work related to drug discovery. Industry has emphasized that even for those going to spend their life in molecular biology it was important to understand what colleagues do in *in vivo* research and how it relates to the whole drug discovery process. The reasons presented by the Pharmacological Society for the

Do the majority of the universities in your country have "integrative and organs systems scientist" faculty members? (IUPS)

Australia	Yes and No
New Zealand Physio. Soc.	Yes
Chile	No
Scandinavian Physio. Soc.	Yes
Danish Nat. Committee	Yes
Finnish Physio. Soc.	Yes
France	No
India	Yes
Japan Physio. Soc.	Yes
Russia	Yes
USA (Med Schools)	Yes

Figure 9

reduction in the opportunities for *in vivo* work were much the same as reflected by the U.K. Life Sciences Committee. This included cost of maintaining animal facilities in universities; the cost of providing the necessary training for undergraduates and the cost for government licenses; the cost and intrusiveness of the security necessary to protect such work from animal rights protesters; and the difficulty to find people to staff this work within the universities especially practical classes with animals that require high levels of supervision. Finally, the ethical problems with the use of animals were again cited.

Since 1990 has the number of such faculty members increased/decreased? (IUPS)

Australia	Decreased
New Zealand	Increased and Decreased
Chile	Decreased
Scandinavian	Decreased
Danish	Increased
Finnish	Decreased
France	No Answer
Germany	Decreased
India	Increased
Japan	Decreased
Russia	Decreased
	Decreased

Figure 10

Efforts are being made in the U.K. to address some of these problems. The British Pharmacological Society has invited pharmaceutical companies to contribute grants to departments that would assist in the cost of courses. This would include hands-on *in vivo* laboratory studies. They have received donations from six companies as of one year ago and the society also provides some funds. As of 2002 this pharmaceutical "partnership challenge" was providing grants to ten departments within the U.K. The Pharmacological Society has joined with The Physiological Society and industry to develop two short vacation courses of one week's duration in London and Scotland where students will learn about *in vivo* pharmacology and physiology. In 2002 there were 70 applications and support for 27 places for these courses.

Do you foresee a tendency within the next 5 years for additional hires? (IUPS)

Australia	No
New Zealand	Yes and NO
Chile	No
Scandinavian	No
Danish	Yes
Finnish	No
France	?
Germany	No
India	Yes
Japan	No
Russia	No
USA	Yes (IUPS)

Figure 11

Are "integrative and organs systems Ph.D. students" in general capable of doing *in vivo* whole animals research?

Australia	Yes
New Zealand	Yes
Chile	No
Scandinavian	No
Danish	Yes
Finnish	Decreasing #'s
France	?
Germany	Yes and No
India	Yes
Japan	Yes
Russia	Yes
USA	Yes

Figure 12

IUPS overall survey results. The next series of figures reflects the responses of the 12 countries and regions that were surveyed as represented on the map of **Figure 8.** It is evident from these overall responses that the majority of the universities within these regions still employ integrative and organs systems scientists among their faculty (**Figure 9**). However, since 1990 nearly all countries, with the exception of Denmark and India, indicate that they have experienced a decreasing number of IOSS faculty members within their universities (**Figure 10**). Furthermore, few foresaw a tendency within the next five years for additional hires (**Figure 11**), except Denmark, India and the U.S.A. Regarding the courses offered in the curriculum within the universities, the responses suggest that some opportunities still exist within nearly every country for students to participate in a course that provides some level of integrative and organs systems science. However, when asked whether integrative and organs systems Ph.D. students were capable of doing *in vivo* whole animal research, the answers were rather ambivalent (**Figure 12**), although the majority believed that most were indeed capable of this.

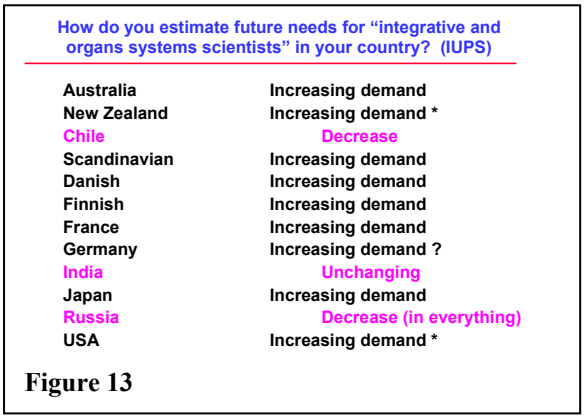

Figure 13

In response to the question regarding the future needs for IOSS scientists (**Figure 13**), it was indicated that in general there is an increasing demand for scientists trained to carry out integrative organs and systems research and teaching within their countries and regions, with two exceptions (Chile and Russia). With few exceptions, all of these countries believe that this is an important problem (**Figure 14**). Interestingly, the problem was viewed as both

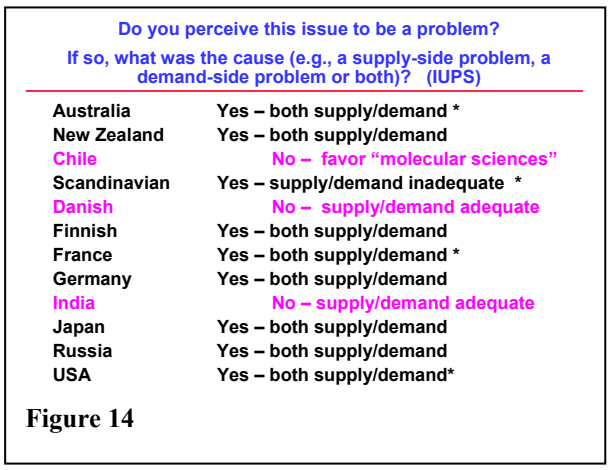

Figure 14

supply side and demand side perhaps suggesting that at this time serious movement has not yet begun to rectify these needs. This is also reflected by the answers given to the question as to whether they foresee a tendency within the next five years for additional hires, with most of the countries responding in the negative (Figure 12).

Anecdotal comments from our colleagues in industry. An effort was also made to survey the view of pharmaceutical and biotechnology industries. Unfortunately, the responses provided to the LSRO survey were insufficient for meaningful assessment. For this reason, I personally contacted some individuals from a number of companies who agreed to reflect their own personal views on the state of affairs regarding manpower needs for integrative systems physiologists.

- A summary of discussions with several scientists who have started Biotech Genome-based Discovery Companies concluded that pharmaceutical and biotechnology industries "now must outsource to Universities to move from target gene identification with a differential expression or phenotype in a gene knockout mouse to needing a proof-of-concept using an in vivo disease model – integrative physiologist/pharmacologist is needed for this". Others shared similar opinions of pharmaceutical and biotechnology industries: Paul Vanhoutte (Servier, Belgium) – "a great need but very few candidates"; Peter Morsing (Astra Zeneca) – "now recognize a great need, but there are few candidates"; Mark Fishman (Novartis) – "integrative biology is clearly important to drug discovery"; and Bruce Markham (Pfizer) – "a dearth of candidates now and a growing need".

- Global head of *in vivo* pharmacology and member of APS, Peter Thoren, M.D., Ph.D. stated the following. "No doubt that the state of *in vivo* sciences in preclinical departments in Sweden is very unfortunate. Grants are much too small and the number of new graduates is too low. Until now, we have experienced no major problem in recruitment

of ‘in vivo’ personnel but the future looks grim. I expect that we will get into major problems within a few years. The number of graduates goes down and many of the graduates do not have the broad knowledge in basic anatomy, histology, pharmacology and physiology as we used to recruit. Swedish students with a medical background seldom go into preclinical work any longer.”

- Terry Opgennorth, Ph.D. (Abbott) believes that there is a shortage of *in vivo* scientists, which are at the top of the hiring list and this makes it difficult to recruit. However, *in vivo* people are coming from different backgrounds, which include gene knockout labs (primary training not in physiology or pharmacology) and M.D. degrees, to fill the positions. “If one has broad systems training there are great opportunities.”

Conclusions. It seems evident that there is at this time a great need for the training of more scientists who can carry out physiological research in the context of the entire animal, organ, or organ system. These surveys indicate that the manpower needs for physiologists at the beginning of this 21st century are growing at both universities and in industry. Unfortunately, there is yet no tangible evidence that either is responding to these perceived needs. The great challenge within most countries and universities will now be to restructure curricula and research centers in ways that will stimulate new approaches and lead to the convergence of scientific experts needed to carry out integrative biological research. It would appear evident that to accomplish these goals, it will be necessary to change the ways in which we teach, carry out and fund science. This will require rethinking the ways in which the departments and research centers within our academic institutions are defined and integrated. Enormous opportunities will exist for those able to carry out research that can lead to levels of understanding of the integrated emergent properties of the living systems. More physiologists seem to be desperately needed, and we can only hope that more will soon become trained and that the current directions of science will indeed provide positions for them.

Allen W. Cowley

Visit of IUPS President and Vice-Presidents to China

The Chinese Association for Physiological Sciences (CAPS) in collaboration with the Peking University Health Science Center held the **First International Conference of Chinese Physiological Scientists** (ICCPS) in Beijing from July 14-17, 2004. The congress focused on "Physiological Sciences in the Postgenomic Era". CAPS President, Tai Yao/Fudan University Shanghai, China, Co-President Shu Chien/University of California, San Diego, USA, the Honorary President Qide Han, President of Peking University, Vice-Chairman of Standing Committee of the National People's Congress of P.R. China and Xiao-Min Wang, Secretary of CAPS welcomed participants from different parts of the world. IUPS President Allen Cowley and Vice-Presidents Akimichi Kaneko and Irene Schulz were guests of honour.

On the first day the scientific program included the plenary lecture of Allen W. Cowley on the *"Evolution of the Genetic Map of Cardiovascular Function"*. The lecture focused on two experimental approaches that have begun to provide an understanding of the relationships among genes, environmental stressors and blood pressure. The first approach, which utilizes linkage studies with total genome scans, has led to the first genomic-systems biology map of cardiovascular function. The second approach has been the development of consomic panels of inbred rats that are enabling a broad mapping of cardiovascular pathways and identification of genes related to these pathways. Other lectures dealt with *"Development of Neuronal Circuits"* (Mu-Ming Poo/Shanghai-Berkeley, USA), *"Calcium Signaling in Exocrine Secretion"* (Irene Schulz/Homburg, Germany) and the *"Role of β-Defension in Sperm Maturation"* (Hsiao-Chang Chan/Hongkong, China). Symposia also focused on different aspects of signal transduction, such as function of second messengers, intracellular Ca^{2+} signalling and protein kinases.

In a symposium on *"Endocrinology and Metabolism"* Guoqing Liu/Vancouver, Canada, now back in the Health Science Center of Peking University, presented his interesting finding that homozygous lipoprotein lipase (LPL)

Akimichi Kaneko, Allen Cowley and Irene Schulz in front of the Tower of the Fragrant Buddha at the Summer Palace in Beijing

gene deficiency could be rescued by somatic gene transfer of a beneficial mutant at the neonatal period and these mice developed extreme

hyperlipidemiic phenotype at the later stage, which mimics that of human mutations in the LPL gene. These mice have shown unexpected prolonged blood clotting time and increased platelet aggregation, accompanied by altered red cell rheology. Cross-breeding of these LPL deficient mice with ApoE gene knockout mice created combined extreme hypercholesterolemia and hypertriglyceridemia, which have been used for evaluation of the role of LPL in atherogenesis.

You-Fei Guan (who also returned from the United States of America to the Peking University Health Science Center) has presented evidence that peroxisome proliferator-activated receptors (PPARs) may serve as potential therapeutic targets for treating the metabolic syndrome, including insulin resistance, glucose intolerance or type II diabetes, obesity, dyslipidemia, hypertension, atherosclerosis and albuminuria.

The scientific program continued on the second day with the plenary lecture of Shu Chien/San Diego, USA on the *"Molecular Basis and Genomics of Mechanotransduction in Endothelial Cells"*. Membrane proteins, such as vascular endothelial growth factor receptor, integrins, G-proteins and ion channels are mechano-sensitive. Their activation triggers phosphorylation cascades of intracellular signalling molecules. Temporal and spatial variations in shear stress and stretch can modulate signal transduction, gene expression, and protein expressions of endothelial cells, thus regulating their functions.

In her talk on *"Memory Formation in Rats"* Hsiao-Yuan Lee/Taipei, Taiwan, presented interesting results on identification of 98 cDNA fragments from the rat dorsal hippocampus that are differentially expressed between fast learning and slow learning rats in the "Morris water-maze learning task."

On the last day of the congress Akimichi Kaneko/Tokyo, Japan, talked about *"Neural Mechanisms of Lateral Inhibition in the Vertebrate Retina"* and proposed from his results that an external proton mediates feedback for surround inhibition in the outer retina.

The conference documented the enormous progress of science and technology that China had made since the beginning of the eighties after the "cultural revolution" (1966-1976), which has accelerated during the past decade. We had the opportunity to visit Departments of the Health Science Center and the new Life Science Building of Peking University. Professor Xian Wang, Chairperson of Department of Physiology in the Health Science Center, showed us the institute and demonstrated the research going on in the laboratories including that of her own interests on "the role of Cdk5 in neuroprotection". Like many excellent Chinese scientists she also had spent several years in the USA before she became the Head of the Institute.

Peking University Health Science Center is one of the Nation's leading institutions in modern medical research and education. It was established in 1912 as the first Western Medical School in China and is one of the 10 institutions given priority for funding and development. It is composed of 12 schools and teaching divisions, there are more than 1400 professors and respected members of the Chinese Academy of Sciences. The major fields and curricula taught at the Health Science Center are similar to basic medical sciences and clinical medicine taught at western universities.

The newly established College of Life Sciences at the Peking University greatly improves the teaching and scientific research conditions, speed up the trainee process of highly qualified personnel and the production of scientific and technological research results. Professor Chuanmao Zhang, Director of the Department of Cell Biology and Genetics in the College of Life Sciences, showed us the recently built Institute, the new laboratories and research centers with high tech equipment, library and other modern facilities. The laboratories are still unfinished but scientists and students are already busy working in the labs.

Beside modern medicine, which is mainly "Western medicine", traditional "Chinese medicine" also plays an important role in China. When we visited a Center for "Traditional Medicine" near Peking we were introduced to the

different approaches emphasizing a system of healing based upon the Chinese philosophy of a correspondence between nature and human beings. Therapeutic methods involve different approaches such as acupuncture, herbal medicine and "Qi" the vital force or energy which flows through a system of channels and conduits in the body in order to allow the body to keep a healthy balance and to heal itself in a natural way. There are intensions to integrate both types of medicine. Interestingly a plenary lecture in the Congress on *"Acupuncture and Human Physiological Homeostasis"* by Ji-Sheng Han (Beijing) reported a study, in which heroin addiction was successfully treated with acupuncture and electro-acupuncture. In Western medicine, the standard treatment of heroin addiction is the "methadone maintainance program", whereby the long acting opiate (methadone) is provided freely for life. In the new study, acupuncture was used to stimulate expression of genes encoding opioid peptides to reduce the need for heroin and to pull the homeostasis back to the normal state. Finally the lecturer recommended a combination of acupuncture and appropriate pharmacological intervention for therapeutic purposes.

China is not only of high interest in terms of its scientific development and its attempts to fuse modern science with traditional aspects, but it is also characterized by great hospitality and an enormous wealth of cultural inheritance. Visitors enjoy the beauty of the city with its palaces and temples and the land around it with its cultural and historical buildings and monuments such as the Great Wall. Despite the progress, which has changed the character of the town to a modern metropolis that pulsates with life, preservation of old cultural monuments and old tradition is a major concern.

All these advantages would suggest places like Beijing or other cities in China not only hosting the Olympic Games in 2008, but also top scientific meetings of world wide interests. I think it would be a great idea to have a future IUPS Congress in Beijing.

Irene Schulz

Europe is beginning to get its act together

As chairperson of *Academia Europaea's* Physiology & Medicine Section and member of the Academy's Council, it has been of particular interest to me to witness the recent and rapid development of new initiatives in relation to the so-called European Research Area. There are some very positive developments, although they still need to be translated into real action. Nevertheless, It is my hope that we shall fairly soon see the emergence of a much strengthened European Life Science and hopefully this will also include vigorous Molecular, Cellular and Integrative Physiology.

In a recent paper in *Nature* [1] on the scientific impact of nations, it is shown that the gap in citation rates between the US and Europe is shrinking. The European Union now matches the US in the physical sciences, engineering and mathematics but is, unfortunately, still behind in the life sciences. David King's recent analysis [1] also reveals that different nations get very different returns on their investments into the basic sciences. In terms of 'citation intensity', some of the smaller European countries (for example, Switzerland, several of the Nordic countries and the Netherlands, as well as the UK) do very well, whereas other countries (for example, France and Germany) seem less efficient. However, in spite of the progress made in Europe in recent years, it is undeniably the case that the overall impact of European research in the Life Sciences is below that of the US.

The *European Union* recognized this problem a long time ago and a succession of so-called framework programs have been instituted for Europe-wide networking, but there has been consistent dissatisfaction and justified criticism of the unnecessarily bureaucratic procedures and the obscure evaluation criteria used. In recent years there have been repeated calls for the establishment of a real European Research Council, providing funding simply based on scientific excellence. *Academia Europaea*, the European Academy of Sciences and Letters, in a document published in July 2003 entitled 'Towards a European Research Council' [2], gave strong support for the establishment of a European Research Council. The Academy proposed

four guiding principles for such a body: Independence (from the European Commission), clarity of purpose, focus on fundamental knowledge and scholarship across all disciplines of the natural and human sciences and responsibility for ensuring genuine mobility in training and scholarship of young researchers.

It has been a pleasant surprise to witness the real momentum behind the establishment of a European Research Council that is now apparent. As mentioned in a recent editorial in Science [3], the new constitution of the European Union makes explicit reference to research and a European Research Area 'in which researchers, scientific knowledge and technology circulate freely'. This summer, a large number of European science organizations, including *EMBO*, the *European Science Foundation*, *Academia Europaea* and *All European Academies* issued a statement, published in the 6th August 2004 issue of *Science* [4], calling 'upon those who are entrusted by Europe's people to create the conditions for Europe's long term future to act on the conviction that science is a cornerstone of European Society'. The conclusion is that 'The enlarged European Union, a newly elected European Parliament, and a new Commission should now grasp the historic opportunity to establish without delay a European Research Council.'

The general consensus is that the establishment of the European Research Council will happen fairly soon and that this will make a real difference also to physiological research in the 'old world'. At this point in time, it would appear that we can allow ourselves to be somewhat optimistic about the future.

References

[1] King, D.A. The scientific impact of nations. *Nature* 430, 311-316, 2004

[2] Mittelstrass, J. (Academia Europaea). Towards a European Research Council. A further Contribution to the Debate. http://www.acadeuro.org

[3] Nowotny, H. European research momentum. *Science* 305, 753, 2004

[4] 52 European organizations in all scientific disciplines. Creating a european research council. *Science* 305, 776-777, 2004

Ole H. Petersen