NC-IUPHAR was initiated in 1987 at the Xth International Congress of Pharmacology in Sydney. In 1989, the Executive Committee of IUPHAR named Paul Vanhoutte (Hong Kong) as Chair of a revised and enlarged committee, with Michael Spedding (France) as Secretary (1990). This committee energetically expanded its activities and the number of subcommittees (to 33), eventually producing the first official compendium on the occasion of the XIIIth International Congress of Pharmacology in Munich in 1998. Robert Ruffolo (USA) was Chair of NC-IUPHAR from 1998-2002. Michael Spedding became Chairman in 2002 and was elected again in 2006, and assumed the post of Secretary General of IUPHAR in July 2015.

In April 2015, Steve Alexander became Chair, and a new Executive Committee was formed comprising Steve (Chair), Arthur Christopoulos (Deputy Chair), Anthony Davenport (Funding Liaison), Doriano Fabbro (Industry Liaison) and Adam Pawson (Executive Secretary), tasked with overseeing the management and future direction of NC-IUPHAR.

NC-IUPHAR and its partners are developing a knowledge environment that will enable students and scientists in academia and industry, working in areas related to pharmacology and drug/target research, to exploit the full potential of the considerable amount of information on drug action available in the published scientific literature. This knowledge environment will be a valuable tool for basic and clinical scientists seeking new approaches for drug discovery research, and the diagnosis and treatment of disease, and a valuable teaching resource for students of pharmacology and translational medicine.

NC-IUPHAR has the objectives of:
1. Issuing guidelines for the nomenclature and classification of all the (human) biological targets, including all the targets of current and future prescription medicines
2. Facilitating the interface between the discovery of new sequences from the Human Genome Project and the designation of the derived entities as functional biological targets and potential drug targets
3. Designating polymorphisms and variants which are functionally important
4. Developing an authoritative and freely available, global online resource, originally called the IUPHAR database, in collaboration with the British Pharmacological Society (BPS), which is now accessible via the IUPHAR/BPS Guide to PHARMACOLOGY database (GtoPdb; http://www.guidetopharmacology.org), with a remit to:
   - provide access to data on all known biological targets
   - enable students and scientists in academia and industry, working in areas related to pharmacology and drug/target research, to exploit the full potential of the considerable amount of information on drug action available in the published literature
   - provide an entry point into the pharmacological literature for basic and clinical scientists from other disciplines
   - provide an integrated educational resource with access to high quality training in the principles of basic and clinical pharmacology and techniques
   - foster innovative drug discovery

Statement from the Chair

Since I have taken over from Michael Spedding the reins of NC-IUPHAR, I have been even more in awe of the masterful way in which he organised meeting after meeting with a full program of presentations of cutting edge scientific achievements at our twice-yearly committee meetings.

More than that, the breadth and depth of knowledge he was able to bring to bear allowed a continuing level of high achievement in terms of one of the major outputs of NC-IUPHAR – its publications. I’m looking forward to continuing our long collaboration even though our roles and titles have changed recently.

Our publications are a key feature of NC-IUPHAR, alongside the IUPHAR/BPS Guide to PHARMACOLOGY database (GtoPdb; http://www.guidetopharmacology.org), of course. Our long-term relationship publishing reviews in Pharmacological Reviews, together with the more recent link with the British Journal of Pharmacology, are vital elements of our profile since they provide a feedback mechanism whereby we have an objective measure of our
usefulness for the pharmacological community (see Appendix III). As Michael has noted on many occasions, an H-index close to 80 is a testimonial to the work of NC-IUPHAR over the last two decades. A major consideration for the Executive Group of NC-IUPHAR is the continuation of the pipelines which feed into those two journals. We are working with Eliot Ohlstein, the Editor for NC-IUPHAR, to ensure these retain the same strength and currency which we have enjoyed with previous publications from NC-IUPHAR. Part of the forward strategy will be to explore how we might increase our coverage of non-traditional areas. Thanks to the hard work of colleagues like Bill Catterall and Rick Neubig, alongside Anthony Davenport, Tony Harmar, John Peters and many others (see the long list of NC-IUPHAR members and Subcommittee Chairs in Appendices I and II), we have had really good in-depth coverage of GPCR, nuclear hormone receptors and ion channels. We are looking to identify the scope for representing the enzymes and transporters, which present distinct challenges for the online database and for NC-IUPHAR publications.

One of the milestones of last year was the successful application to the Wellcome Trust to fund a project termed ‘The Guide to Immunopharmacology’, led by Jamie Davies in Edinburgh and bringing together collaborators from six countries as co-investigators on the application.

A further milestone of 2015 was the publication of the Concise Guide to PHARMACOLOGY 2015/16. Amongst other properties of this publication, it represents the only remaining printed issue of the British Journal of Pharmacology. We anticipate another issue in this series in the summer of 2017; work towards this has already started.

I would like to welcome formally new colleagues to the membership of NC-IUPHAR (see Appendix I) and to the GtoPdb team in Edinburgh, and to thank a number of colleagues for their contributions to NC-IUPHAR in the last year, some of whom have decided to step down from the committee. Their altruism and dedication to NC-IUPHAR and pharmacology in general has made a significant contribution to help maintain the profile of the discipline at a time when there is fragmentation in both the industry and academia. I see part of the future role of NC-IUPHAR being to continue a trend propounded by Michael in the championing of good science and, principally, good pharmacology. This particular role is definitely a challenge for NC-IUPHAR, but working together with other IUPHAR committees and the huge numbers of scientists worldwide which are represented through IUPHAR.

Current and future directions for NC-IUPHAR

NC-IUPHAR is perhaps the most public success of IUPHAR, and is engaged in a major task; to define all the main drug targets encoded by the human genome, and annotate them in a database freely accessible world-wide...and, importantly, link them to therapeutics and pharmacological target validation.

Major efforts continue to define the main variables in drug/receptor interactions including the parameters that can lead to variation in receptor function and pharmacology (i.e. biased signalling, splice variation, receptor polymorphisms, hetero-oligomerisation, allosteric modulation, post-translational modification, epigenetic targets, non-coding RNAs, and linkage to multiple signalling cascades). These areas are of great interest because they may considerably expand the repertoire of potential targets for drug development, and are under evaluation by working groups, which will lead to a number of reports about issues which are of crucial importance for pharmacology. All these areas have been or will be worked on for relevance for pharmacology, and additionally may be useful funding application areas to ensure the future sustainability of NC-IUPHAR activities, and the GtoPdb project.

The immense recent growth of knowledge about drug targets, with their crystal structures, has had a dramatic impact on drug discovery and pharmacology, and importantly, NC-IUPHAR classifications have been widely adopted. In the past year, we have made great strides to proactively include new drug targets in the GtoPdb, and recruit experts to advise on them; to date we have >2700 annotated protein targets in the GtoPdb, with >8300 ligands, including all

- 3 -
approved drugs (~1900) (See Appendix IV).

There is growing research interest, academically, clinically and industrially, in the pharmacology of immunity, inflammation and infection in defining the immunological/inflammatory targets in disease states, with their main pharmacology. Within the research community, there is an urgent need for a pre-competitive, unbiased resource that will integrate high-level expertise in immunity, inflammation and infection, pharmacology and medicinal chemistry. At present, immunological and pharmacological knowledge are held by separate communities and the best resources fall short of what is needed. GtoPdb is the best molecular pharmacology database, but is currently limited in the immunity, inflammation and infection area. We have successfully applied to the Wellcome Trust for funding to extend GtoPdb into this arena, and to produce a ‘Guide to IMMUNOPHARMACOLOGY: Integration of targets, diseases and therapies into an expert-driven database’.

Immune/inflammatory/ infection responses and disorders have become an increasing focus of pharmacological R&D. We will enrich GtoPdb with kinome resources linking to diseases to assist selection of new targets, tool compounds and drugs. Suggested priorities are established (JAK, PI3K, IKK) and less validated (RIPKs, IRAKs, MAP3Ks) target kinases in innate immunity.

This will later extend to adaptive immunity and kinases in selected pathogens. New data will be linked according to the existing GtoPdb expert-curation model but with a strong focus on translational aspects (e.g. clinical benefit, biomarkers and biological endpoints). In addition an immunology-orientated portal will be developed.

Co-applicants include kinase, immunity/inflammation and parasite biology experts: Michael Spedding, Francesca Levi-Schaffer, Clare Bryant, Christian Doerig, Stephen Anderton, Steve Alexander, Doriano Fabbro and Anthony Davenport. Data selection will be guided by new IUPHAR expert subcommittees set up for this task.

We owe thanks to many folk for the success of this proposal, including for their inputs to the preparation phase and letters of support (to whom we have already communicated our appreciation).

Further details will be surfaced in due course but we are also pleased that the British Pharmacological Society will continue to support the core Guide to PHARMACOLOGY resource during and after this project.

While technical decisions remain on exactly what interfaces and data structures are instantiated, we envisage both an immunology-oriented portal will be developed.

Any parties with Immunopharmacology interests we have not yet engaged with are welcome to make informal contact as we go forward.

Finally, working with the University of Edinburgh Drupal Website Service, and with funding from ASPET, Simon Maxwell has spearheaded the development of the IUPHAR/ASPET Pharmacology Education Project, an education portal that will be closely linked with the GtoPdb. It will provide access to high quality training in the principles and techniques of basic and clinical pharmacology, and is due for public release shortly at Experimental Biology 2016.

Further details about the recent activities of NC-IUPHAR, updates and developments to GtoPdb, and activities of the GtoPdb team can be found in our March 2016 newsletter. Additionally, the guidetopharmacology blog allows the database team to share feature developments, technical updates, articles or events at a greater level of detail and cross-linking than shorter postings typical of the other three networks (guest posts are welcome).

Organisation of NC-IUPHAR

Core Committee

The Core Committee of NC-IUPHAR, comprising the Executive Committee and Core Members is listed in Appendix I. The biannual core NC-IUPHAR meetings are themed and we have established an alliance with the Japanese Pharmacology Society who pay the travel for two members*, but who are invited according to the meeting themes. We welcome our new Core Members, John Cidlowski, Francesca Levi-Schaffer, Joerg Striessnig and Mary Vore.

Corresponding Members

In order to broaden the expertise of the core committee, the number of corresponding members (see Appendix I). Corresponding members attend selected meetings of NC-IUPHAR and are invited according to the meeting themes.
They include representatives of the major pharmaceutical companies.

**Evolving Pharmacology Group**

Anthony Davenport leads a group which monitors the ‘de-orphanisation’ of GPCRs and evolving pharmacology of drug targets in general. Particularly important and timely breakthroughs are included in the Hot Topics section of the database along with email alerts.

**Clinical Translational Pharmacology Group**

In order to provide advice on the translational aspects of drug target pharmacology, a subgroup (see Appendix I) of clinical pharmacologists (core member, Sir Colin Dollery) discuss how best to respond to the wishes of our clinical colleagues and to translate activity at drug target sites to clinical efficacy.

**Subcommittees**

Chairpersons (see Appendix II) propose a list of experts, ratified by NC-IUPHAR, to ensure adequate representation of the field. The chairperson of each subcommittee plays a critical role co-ordinating the actions of the subcommittee, organising meetings, finalising documents and the website pages. However, we encourage postdocs to join the subcommittee, as chairs simply do not have enough time to fill in the various template fields - postdocs can therefore get publication credits, and several NC-IUPHAR publications have become citation classics. The h-index of NC-IUPHAR is >74. The subcommittees meet to establish consensus on classification, and to ensure that the NC-IUPHAR guidelines are complied with. We now have more >90 subcommittees (see Appendix II).

**Acknowledgements**

We are very grateful to our sponsors. We are also immensely grateful for the work done by our colleagues in NC-IUPHAR and all the contributing chairs and subcommittee members. It is a privilege to be associated with so much work freely given for the good of science. We repeat that NC-IUPHAR is a global resource and all scientists are welcome to contribute (contact: enquiries@guidetopharmacology.org).
Appendix I: Membership of NC-IUPHAR

Executive Committee
Stephen Alexander, UK - Chair
Arthur Christopoulos, Australia - Deputy Chair
Doriano Fabbro, Switzerland - Industry Liaison
Anthony Davenport, UK - Funding Liaison
Adam Pawson, UK - Executive Secretary

Core Members
Stephen Alexander, UK
Arthur Christopoulos, Australia
John Cidlowski, USA - NHRs Liaison
Anthony Davenport, UK - Chair Evolving Pharmacology
Doriano Fabbro, Switzerland
Kozo Kaibuchi, Japan
Yoshikatsu Kanai, Japan*
Francesca Levi-Schaffer, Israel
Eliot Ohlstein, USA - Editor
Joerg Striessnig, Austria - VGICs Liaison
John Peters, UK - LGICs Liaison
Alex Phipps, UK
Mary Vore, USA

Past Chairs (Ex Officio)
Paul Vanhoutte, Hong Kong
Bob Ruffolo, USA

Corresponding Members
Susan Amara, USA
Tom Bonner, USA (Past Core Member)
Michel Bouvier, Canada
Thomas Burris, USA
William Catterall, USA (Past Core Member)
Steven Charlton, UK
Moses Chao, USA
Steven L. Colletti, USA
Graham Collingridge, UK
Sir Colin T. Dollery, UK (Founder and Past Core Member)
Richard Eglen, UK
Steven Foord, UK
David Gloriam, Denmark
Gillian Gray, UK
Debbie Hay, New Zealand
Allyn Howlett, USA
Franz Hofmann, Germany
Yu Huang, Hong Kong
Ad P. Ijzerman, The Netherlands
Michael F. Jarvis, USA
Bong-Kiun Kaang, Korea

Ex Officio
Sam Enna, USA - IUPHAR President
Michael Spedding, France - IUPHAR Secretary-General
Petra Thürmann, Germany - IUPHAR Treasurer
Simon Maxwell, UK - Educational Site Project Leader
Jamie Davies, UK - Database Chair/Principal Investigator
Joanna Sharman, UK - Senior Database Developer
Adam Pawson, UK - Senior Database Curator
Elena Faccenda, UK - Database Curator
Christopher Southan, Sweden - Senior
Cheminformatician/Curator
Veronika Divincova, UK - Project Administrator
Elspeth Bruford, UK - representing HGNC
Amrita Ahluwalia, UK - BJP Editor-in-Chief

Clinical Translational Pharmacology Group (core member Sir Colin Dollery)
Ed Bullmore, UK
Robert Dow, UK
Garrett Fitzgerald, USA
Alex Phipps, UK
Patrick du Souich, Canada
David Webb, UK
Don Birkett, Australia
### Appendix II: NC-IUPHAR Subcommittees (listing of chairs)

#### G protein-coupled receptors Subcommittees

<table>
<thead>
<tr>
<th>Subcommittees</th>
<th>Chair</th>
<th>Liaison</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-Hydroxytryptamine: Nick Barnes, John Neumaier</td>
<td>Acetylcholine (muscarinic): Arthur Christopoulos</td>
<td>Adenosine: Adriaan Ijzerman</td>
</tr>
<tr>
<td>alpha-adrenoceptors: Dianne Perez</td>
<td>alpha-adrenoceptors: Mika Scheinin</td>
<td>Angiotensin: Sadashiva Karnik</td>
</tr>
<tr>
<td>Apelin: Anthony Davenport</td>
<td>beta-adrenoceptors: Terry Hébert</td>
<td>Bile acid: Anthony Davenport</td>
</tr>
<tr>
<td>Bombesin: Robert Jensen</td>
<td>Bradykinin: VACANT</td>
<td>Calcitonin: Debbie Hay, David Poyner</td>
</tr>
<tr>
<td>Calcium-sensing: Ed Brown, Hans Bräuner-Osborne</td>
<td>Cannabinoid: Roger Pertwee, Allyn Howlett</td>
<td>Chemokine: Philip Murphy</td>
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<tr>
<td>Cholecystokinin: Laurence Miller</td>
<td>Complement peptide: Peter Monk</td>
<td>Corticotropin-releasing factor: Richard Hauger, Frank Dautzenberg</td>
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<tr>
<td>Dopamine: Raul Gainetdínov</td>
<td>Endothelin: Anthony Davenport</td>
<td>Estrogen (G protein coupled): VACANT</td>
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<td>Formylpeptide family: Richard Ye</td>
<td>Free fatty acid: VACANT</td>
<td>Frizzled: Gunnar Schulte</td>
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<td>GABAβ: Bernhard Bettler</td>
<td>Galanin: Andrew Gundlach</td>
<td>Ghrelin: Birgitte Holst</td>
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<tr>
<td>Glucagon receptor family: Laurence Miller</td>
<td>Glycoprotein hormone: Deborah Segaloff</td>
<td>Gonadotropin-releasing hormone: Adriaan Ijzerman</td>
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<tr>
<td>Histamine: Paul Chazot</td>
<td>Hydroxycarboxylic acid: Stefan Offermanns</td>
<td>Kisspeptin: Anthony Davenport</td>
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<tr>
<td>Leukotriene: Magnus Bäck</td>
<td>Lysophospholipid (LPA): Jerold Chung</td>
<td>Lysophospholipid (S1P): Sarah Spiegel</td>
</tr>
<tr>
<td>Melanin-concentrating hormone: Jean-Louis Nahon</td>
<td>Melanocortin: Tung Fong, Helgi Schiöth</td>
<td>Melatonin: Ralf Jockers</td>
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<tr>
<td>Metabotropic glutamate: Cyril Goudet</td>
<td>Motilin: Anthony Davenport</td>
<td>Neuregulin I: Gary Williams</td>
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<tr>
<td>Neuropeptide FF/neuropeptide AF: Jean-Marie Zajac</td>
<td>Neuropeptide S: Girolamo Calor</td>
<td>Neuropeptide W/neuropeptide B: Anthony Davenport</td>
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<tr>
<td>Neuropeptide Y: Dan Larhammar</td>
<td>Neurotensin: Jean Mazella</td>
<td>Neuropeptide Y: Dan Larhammar</td>
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<tr>
<td>Orexin: Christopher Winrow</td>
<td>P2Y: Geoffrey Burnstock</td>
<td>Neuropeptide Y: Dan Larhammar</td>
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<tr>
<td>Peptide P518: Jerome Leprince</td>
<td>Platelet-activating factor: VACANT</td>
<td>Neuropeptide Y: Dan Larhammar</td>
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<td>Relaxin family peptide: Roger Summers</td>
<td>Relaxin-like: Nick Barker</td>
<td>Neuropeptide Y: Dan Larhammar</td>
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<tr>
<td>Tachykinin: Susan Leeman, Steven Douglas</td>
<td>Trace amine: Janet Maguire</td>
<td>Neuropeptide Y: Dan Larhammar</td>
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<tr>
<td>Urotensin: Hubert Vaudry</td>
<td>Vasopressin and oxytocin: Bernard Mouilac</td>
<td>Neuropeptide Y: Dan Larhammar</td>
</tr>
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</table>
Appendix III: NC-IUPHAR publications

NC-IUPHAR publications in Pharmacological Reviews (2015/16)


NC-IUPHAR reviews in the British Journal of Pharmacology (2015/16)


Additional GtoPdb Team publications


## Appendix IV: Database Statistics

<table>
<thead>
<tr>
<th>Target class</th>
<th>Number of targets</th>
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</thead>
<tbody>
<tr>
<td>7TM receptors</td>
<td></td>
</tr>
<tr>
<td>G protein-coupled receptors including orphans</td>
<td>389</td>
</tr>
<tr>
<td>Orphan G protein-coupled receptors</td>
<td>129</td>
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<tr>
<td>Other 7TM proteins</td>
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<tr>
<td>Nuclear hormone receptors</td>
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<tr>
<td>Catalytic receptors</td>
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<tr>
<td>Ligand-gated ion channels</td>
<td>81</td>
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<tr>
<td>Voltage-gated ion channels</td>
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<tr>
<td>Other ion channels</td>
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<tr>
<td>Enzymes</td>
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<tr>
<td>Transporters</td>
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<tr>
<td>Other protein targets</td>
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<tr>
<td><strong>Total number of targets</strong></td>
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</tr>
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<table>
<thead>
<tr>
<th>Chemical class</th>
<th>Number of ligands</th>
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<tbody>
<tr>
<td>Synthetic organics</td>
<td>5303</td>
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<tr>
<td>Metabolites</td>
<td>582</td>
</tr>
<tr>
<td>Endogenous peptides</td>
<td>763</td>
</tr>
<tr>
<td>Other peptides including synthetic peptides</td>
<td>1236</td>
</tr>
<tr>
<td>Natural products</td>
<td>241</td>
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<tr>
<td>Antibodies</td>
<td>169</td>
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<tr>
<td>Inorganics</td>
<td>34</td>
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<tr>
<td>Approved drugs</td>
<td>1256</td>
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<tr>
<td>Withdrawn drugs</td>
<td>67</td>
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<tr>
<td>Drugs with INNs</td>
<td>1942</td>
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<tr>
<td>Labelled ligands</td>
<td>594</td>
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<tr>
<td><strong>Total number of ligands</strong></td>
<td><strong>8328</strong></td>
</tr>
</tbody>
</table>

| Number of curated binding constants              | 14249             |
| Number of binding constants from large scale screens | 31207             |
| Number of references                             | 29049             |

This report was compiled by Adam Pawson and Steve Alexander, March, 2016