Taxonomic Note

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Proposals to clarify how type strains are deposited and made available to the scientific community for the purpose of systematic research

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The principle of designating type material in codes of nomenclature in support of taxonomic descriptions is an important aspect in linking the names of taxa to the descriptions and the biological material to which they are meant to refer. In the case of species and subspecies type strains, one can examine those strains physically and carry out appropriate experimental work to confirm existing findings or expand on the dataset. As such, the availability of such strains is of central importance in a comparative science. The present article examines a number of issues relating to the availability of this important material and raises a series of points for public debate.

Prokaryote taxonomy is the aspect of prokaryote systematics that deals with the characterization, classification and nomenclature of prokaryotes. Without an established taxonomy, one would also not be able to identify existing organisms efficiently, nor would one be able to recognize an organism that was previously not classified as novel. Taxonomy, as a part of systematics, is also a comparative science, and one of the key elements is to compare biological material and data gathered on that material. Like all sciences, a key element is to be able to verify the data collected and test or expand on hypotheses based on those data. In such a system, the strains that are studied play a central role, and making them available is a major contribution to being able to authenticate the scientific literature based on them. Codes of nomenclature have traditionally used the principle of typification (or name-bearing types) as a way of providing biological material in support of taxonomic observations and hypotheses. Major revisions in the International Code of Nomenclature of Bacteria (the Bacteriological Code) (Lapage *et al.*, 1992; De Vos & Trüper, 2000; De Vos *et al.*, 2005; Tindall *et al.*, 2008) have resulted in a unique system where the availability of the appropriate type material, the type strains of species and subspecies, plays an important role. Key elements in the development of the current system relied on a community effort to clarify the value of the existing taxonomic names and concepts attached to them (Ad Hoc Committee of the Judicial Commission of the ICSB, 1976; Skerman *et al.*, 1980, 1989). The participation of individual collections in providing repositories for designated type material and neutral, impartial means of distributing it, as well as the formation of organizations and institutions such as the World Federation of Culture

Collections (WFCC) and the World Data Center for Microorganisms (WDCM) (Gibbons, 1974), has also been important in creating a stable foundation for the discipline. Co-ordination, understanding and dialogue among the collections holding the type strains, the body responsible for the content of the Bacteriological Code, those responsible for bringing names into circulation and the scientific community involved in systematic research have played a crucial role in developing the present system. Thus, it is possible to make reference to all names known to be validly published under the Bacteriological Code, determine their relationships to one another (i.e. which are considered to be synonyms), locate the associated descriptions and also determine the location of the appropriate type material for the vast majority of names in use according to the Bacteriological Code (see <http://www.bacterio.cict.fr>, <http://www.taxonomicoutline.org>).

This community effort has led to the development of a mutually beneficial system, whereby the information and biological material that one needs to carry out further systematic research or identify organisms is widely available and accessible. Thus, a scientist who discovers a novel species can only do so because of access to data and type material for existing species. A pre-requisite for formally describing novel species is that both the data and the appropriate type strains are made available in the same fashion that allowed the scientist access to the existing strains and the data prior to designation as a type strain. However, there have been significant changes in recent years that relate to both the way published information is made available and also the economic importance of and access to deposited strains of micro-organisms. In the case

of published information, there has been a rapid shift from a solely printed-page system and libraries as the physical locations of the information to electronic forms of communication and virtual libraries. Economics has also played a role in determining the way that information is made available and production costs are recovered. In the case of micro-organisms, there has been an increased awareness of the economic potential of novel strains in what seems to be a vast, untapped prokaryotic gene pool. This has resulted in the expectation that a novel species could well be the source of novel pharmaceutical products, novel enzymes or novel processes of commercial importance. Thus, it should come as no surprise that there is a desire either to restrict access to such strains or to limit the possibility that others may use them in their screening programmes.

While it is acceptable to restrict access to an organism that a scientist may feel is particularly valuable, there has been a temptation also to publish information on such organisms in an environment where one would not expect such restrictions. Paradoxically, the purpose of deposit for patent purposes is to guarantee that the biological material used to enable the patent can, in fact, be obtained, irrevocably. While the process of obtaining such strains is strictly regulated, it would be wrong to infer that such strains are not available at all. In fact, patent law dictates that, once published, the material must be made available to those skilled in the art to practice the invention for demonstration purposes until a patent expires, after which time there are no longer any legal grounds to bar anyone from using the material to practice the invention. There are, however, differences in the way patents are handled in practice (Meredith, 2001; Tindall, 1999), and obtaining such strains is not without its problems. As a consequence, the International Committee for Systematics of Prokaryotes (ICSP) and its Judicial Commission have now ruled that the use of strains as type material where restrictions have been imposed is no longer allowed under a recent revision of the Bacteriological Code (Tindall *et al.*, 2008; Labeda & Oren, 2008). Despite this, a number of difficulties remain that hamper access to type material to a greater or lesser degree.

The changing economic environment has also had an effect on the way that collections are funded and also their search for ways of obtaining additional revenue. Clearly, certain strains that are sold in large quantities are vital to the income of a collection, and there is an understandable need to protect that source of income. However, at the same time, many strains were deposited in collections decades ago, in a completely different environment, where one could not foresee the current trends. This is particularly problematic for strains that were deliberately deposited in institutions with a long-term commitment to make them available for the purpose of scientific research by the scientific community. This is the rationale for the development of the current system of designating and depositing type material under the Bacteriological Code (Lapage *et al.* 1992; Tindall *et al.*, 2006; together with

subsequent revisions). It is, however, no longer sufficient to have unwritten agreements or principles, and it would be appropriate to examine the whole issue on a more formal basis. It is important to define clearly the conditions under which type strains are deposited and made available. An important aspect centres on clarifying the conditions under which strains are deposited and the clear definition of the rights that are passed to the collection at the time of deposit. The latter uses the principle of the 'bundle of rights' or 'copyleft' (Dedeurwaerdere, 2006) and seeks to avoid disputes over ownership, and has interesting parallels in the computer programming industry, among others, where concepts such as the GNU General Public Licence (GPL) have developed. A discussion is also warranted of the mechanisms whereby collections can be funded so as to ensure that the costs of preservation and maintenance are fairly borne.

The following points are central to the issue of the deposit and availability of type strains.

(i) Type strains are the nomenclatural types of species and subspecies and the primary reason for deposit is their use in comparative and reference work in systematic research.

Note: this should be self-explanatory and is a central element of the Bacteriological Code.

(ii) In the case of bacteria and archaea, the designation of type strains is governed by the Bacteriological Code, and it would be appropriate to consider such strains as being held in trust by the collection(s) for the ICSP and the international scientific community for the purpose of systematic research.

Note: the ICSB/ICSP, one of the standing IUMS ComCoFs (Committees, Commissions and Federations), is the committee that is responsible for overseeing the working of the Bacteriological Code (to become the International Code of Nomenclature of Prokaryotes) and the publication of the IJSB and IJSEM. Its actions sanction both the use of names and their association with designated type material.

(iii) The deposit of type strains in collections does not require that ownership is transferred to the collection at the time of deposit.

Note: the transfer of full ownership rights to the collections is not a pre-requisite for making strains available for comparative systematic work.

(iv) Type material is deposited on the understanding that the type strain will be made available irrevocably via the collection and that it can only be withdrawn from distribution as type material by the collection if it is found to be unsuitable (contaminated, not authentic, no longer viable, etc.) or by actions of the Judicial Commission as empowered by the Bacteriological Code, which are to be documented.

Note: neither the depositor nor the collections should put a time limit on the length of the deposit of type material at the

time of deposit. Given the special nature of type material, it should be self-explanatory that, unless there are good reasons for having to withdraw type material from distribution, the continued availability of that material is of central importance. Actions of the Judicial Commission may affect the status of a strain as a type strain, e.g. rejection of a name or designation of an alternative strain as the type.

(v) The collection number applies to type material held in accord with Rule 30 (3a) and the status of the strain may not subsequently be altered.

Note: this is to prevent restrictions being placed on the distribution of a strain after the initial deposit and acceptance of the strain as a type strain.

(vi) On deposit of the type strain, the minimal conditions are that the collection has the right to replicate, store and conduct relevant research on the strain (or its derivatives) and store data on and distribute the strain (or its derivatives) to scientists who wish to undertake scientific studies on the strain (or its derivatives).

Note: even in the absence of the transfer of full ownership rights to the collection, this would ensure that the collection may carry out the necessary work involved in the accession, characterization, storage and distribution of type strains (or their derivatives). Certain rights may be specifically denied, such as commercial exploitation.

(vii) Holding the type strain in this fashion does not infringe the rights of persons, institutions or organizations that have other claims to the strain, for example commercial exploitation of the strain or use of that strain under intellectual property right regulations.

Note: like most Codes, the Bacteriological Code deals with naturally occurring organisms and not constructs of human making. Naturally occurring strains may be used commercially or in intellectual property right claims. Holding type strains in collections should not infringe these rights.

(viii) The deposit of type strains in a collection is independent of other collections, other institutions or other persons.

Note: this is to ensure that each deposit in a collection is such that other collections, institutions or other persons do not have to be contacted prior to release of the strain. Ideally, an agreement should be reached early on in the history of a strain that accompanies the strain at the time of transfer within the scientific community, so that each recipient of the strain is aware of the conditions that accompany it.

(ix) The deposit of the type strain in collections should be such that the transfer to and distribution by other collections is not subject to conditions that would contradict points (i)–(viii). The transfer to other collections is not to be precluded and additional conditions are not to be imposed when strains are transferred between collections.

Note: a central element in systematics is to have type material widely available. While agreements may be reached between

collections that ensure some of the points listed above are to be observed, these should not preclude the bona fide transfer of type material between collections.

(x) In the event that a collection ceases its activities with respect to the distribution of type material, all existing samples of preserved type material will be transferred to one or more surviving collections to ensure their continued availability to the scientific community. The ICSP should be contacted and informed of the intention of the collection to cease distribution and which collections will receive the material.

Note: this parallels conditions laid down under the Budapest Treaty, dealing with strains deposited for patent purposes. This further emphasizes the need to recognize the central importance of type material in comparative systematic research.

It should be a pre-requisite of deposit in a collection, in accordance with Rule 30 (3a) of the Bacteriological Code, that collections confirm that they accept these conditions. This would also have the secondary effect of helping to define more precisely what is meant by a permanently established culture collection [Rules 18c and 30 (3a)], a publicly accessible service collection [Rules 27 and 30 (3b)] or a recognized culture collection (Rule 27, note 1) within the context of the Bacteriological Code. This would also parallel, in principle, agreements between culture collections and the World Intellectual Property Organization (WIPO) within the framework of strains deposited for patent purposes. The topic of commercial exploitation and sharing of any subsequent benefits does not fall under the Bacteriological Code, nor do restrictions placed on strains at the time of deposit that would restrict the use of type strains beyond the scope of bona fide systematic research. It should be emphasized that the deposit of a strain in this fashion, with the intent that it becomes a type strain, does not preclude that it may also be deposited under different conditions in the same (under another accession number) or another collection(s) in parallel. A particular strain may be deposited as a type strain under the conditions proposed and also deposited under the Budapest Treaty, although the number issued for patent purposes could not be cited as referring to the type strain. The strain may also be held in collections that do not agree to such conditions, but deposit solely in such collections would not conform to the requirements outlined here.

Laying down clearly how type strains are to be deposited would benefit depositors, the collections and end users of the strains, since it is evident that there may be some misunderstanding or uncertainty about the fate of a type strain once it is deposited in a collection and circulated within the scientific community. This issue should be discussed by the ICSP as well as by the collections themselves and within culture collection organizations such as the WFCC, ECCO, UKFCC, JFCC and USFCC, federations of societies such as IUMS and FEMS and individual societies such as the Society for General

Microbiology, the American Society for Microbiology and other regional or national microbiological societies, and appropriate policies developed and implemented.

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