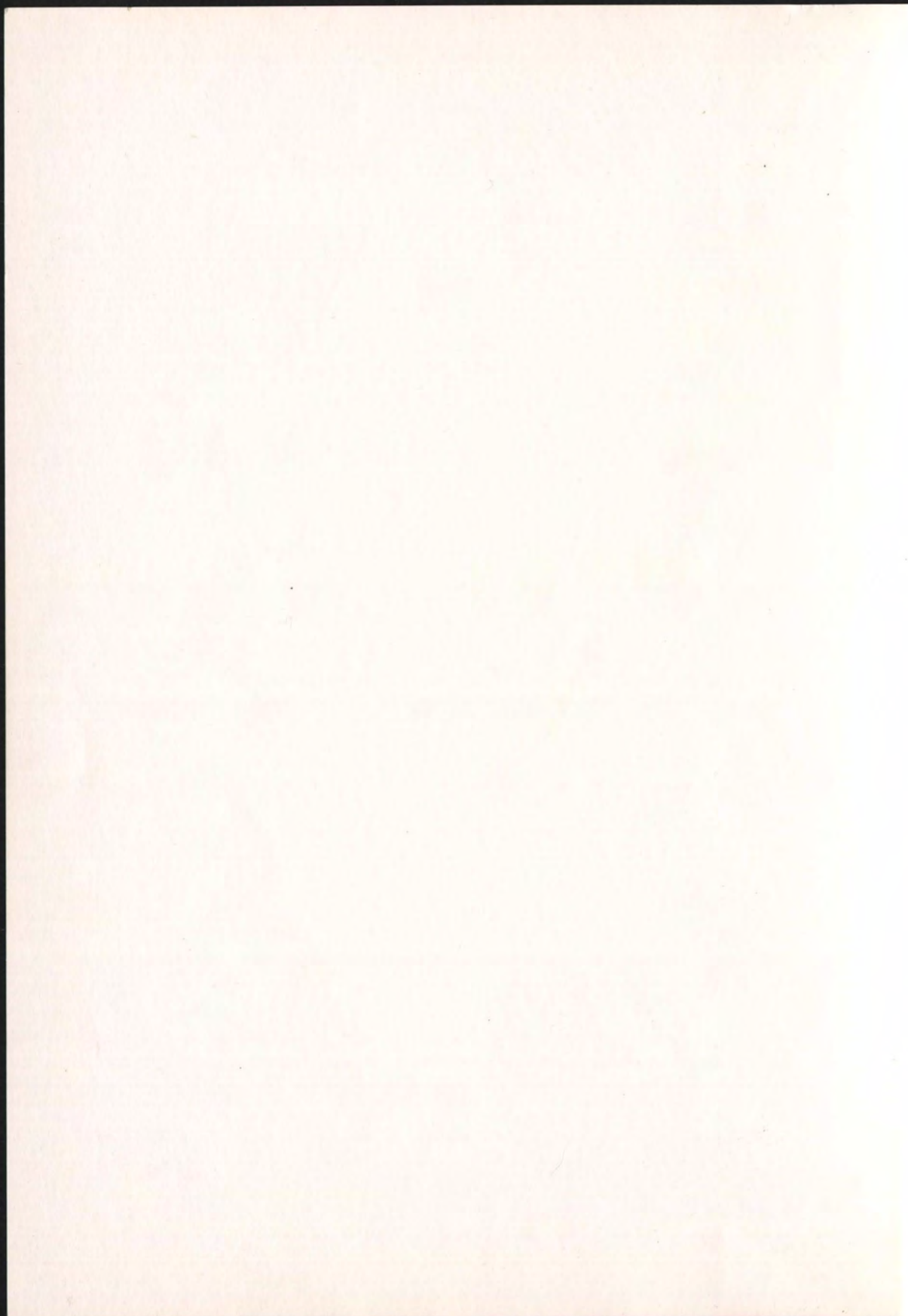

CLASSIFICATION

of the species

LEPTOSPIRA INTERROGANS

and history of its serovars

E. KMETY
H. DIKKEN



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PREFACE

During their evolution all living organisms tend to develop a great number of varieties. In order that these may clearly be differentiated it is necessary to arrange them in a certain logical order, while for accurate reference and communication the naming of varieties is also required.

In the *Leptospira* field the situation became pressing in the 1950's, by which time over 40 different serotypes, now referred to as serovars (serovarieties) were recognized. A first attempt to arrange them in a certain order was made by Wolff and Brown in 1954. During the following years this first list became enlarged and amended several times. By 1973 the Subcommittee on Systematic Bacteriology of the International Commission on Bacteriology, and it was agreed that the new serovar list should be founded on original descriptions and other relevant data available for the species *Leptospira interrogans*.

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This work was made possible only by the assistance of colleagues in collecting and translating original publications in Japanese, Chinese and Russian. The help of Dr. J. Coghlan in reviewing this paper carefully is most appreciated. The authors also acknowledge with great thanks the work of Mr. A. Wolters, who has given us many years of patient secretarial assistance.

May, 1992

E. Kmety
H. Dikken

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PREFACE

During their evolution all living organisms tend to develop a great number of varieties. In order that these may clearly be differentiated it is necessary to arrange them in a certain logical order, while for accurate reference and communication the naming of varieties is also required.

In the *Leptospira* field the situation became pressing in the 1950's, by which time over 40 different serotypes, now referred to as serovars (serovarieties) were recognized. A first attempt to arrange them in a certain order was made by Wolff and Broom in 1954. During the following years this first list became enlarged and amended several times. By 1978 the Subcommittee on the Taxonomy of *Leptospira* (TSC), of the International Committee on Systematic Bacteriology considered that the last official list of 1967 was due for revision, and it was agreed that the new serovar list should be founded on original descriptions and other relevant data available for each serovar.

It took many years to compile and study all the information required to describe the correct history of the individual strain that represents each serovar of the species *interrogans*. As a result of these laborious studies the new revised list was finally drawn up and completed by Dr. M. Cinco with a list of serovars of the species *Leptospira biflexa*. This revised list was accepted by the TSC in 1986 and published in 1988.

All those collected data together with the references of the publications from which they were drawn, are considered to be of value to leptospirologists. The information in this document may serve as an encyclopedic reference or otherwise for further studies.

Moreover a further updated list of serovars is included, together with the latest relevant information, in particular on recently described Chinese strains.

This publication deals only with strains classified within the species *Leptospira interrogans*. A similar study on the strains of the species *Leptospira biflexa* has been left to those more specialised in that field.

This work was made possible only by the assistance of colleagues in collecting and translating original publications in Japanese, Chinese and Russian. The help of Dr. J. Coghlan in reviewing this paper carefully is most appreciated. The authors also acknowledge with great thanks the work of Mr. A. Wolters, who has given us many years of patient secretarial assistance.

May, 1992

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During their evolution all living organisms tend to develop a great number of varieties. In order that these may clearly be differentiated it is necessary to arrange them in a certain logical order, while for accurate reference and communication the naming of varieties is also required.

In the *Lepidoptera* field the situation became pressing in the 1950's, by which time over 40 different serotypes, now referred to as serovars (serovarieties) were recognized. A first attempt to arrange them in a certain order was made by Wolff and Brown in 1954. During the following years this first list became enlarged and amended several times. By 1978 the Subcommittee on the Taxonomy of *Lepidoptera* (TSC) of the International Commission on Systematic Bacteriology considered that the last official list of 1967 was due for revision, and it was agreed that the new serovar list should be founded on original descriptions and other relevant data available for each serovar.

It took many years to compile and study all the information required to describe the correct history of the individual strain that represents each serovar of the species *intertextus*. As a result of these laborious studies the new revised list was finally drawn up and completed by Dr. M. Cincin with a list of serovars of the species *Lepidoptera bifera*. This revised list was accepted by the TSC in 1986 and published in 1988.

All those collected data together with the references of the publications from which they were drawn, are considered to be of value to lepidopterologists. The information in this document may serve as an encyclopedic reference or otherwise for further studies.

However, a further update of the serovars is needed, together with the latest relevant information, in particular on recently described Chinese strains.

This publication deals only with strains classified within the species *Lepidoptera bifera*. A similar study on the strains of the species *Lepidoptera bifera* has been left to those more specialized in that field.

This work was made possible only by the assistance of colleagues in collecting and translating original publications in Japanese, Chinese and Russian. The help of Dr. J. Cincin in reviewing this paper carefully is most appreciated. The author also acknowledges with great thanks the work of Mr. A. Wolter, who has given us many years of patient secretarial assistance.

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1. INTRODUCTION

The first attempt to introduce some order into the growing number of serologically different strains of *Leptospira* was undertaken by Wolff and Broom in 1954. They formulated the first principles to differentiate serovars*, previously designated as serotypes, on the basis of their serological characteristics using rabbit immun sera which were the only practical criteria available at that time. It was considered that two strains "belong to different serotypes if, after cross-absorption with adequate amounts of heterologous antigen 10% or more of the homologous titre regularly remains in each of the two antisera" (WHO, 1956). For convenience, serovars with close serological affinities were assembled within a serogroup.

Some years later a further subdivision into 'sub-serotypes' was introduced. Strains were classified as 'sub-serotypes' if "in repeated tests less than 10% of the homologous titre remains in one antiserum but 10% or more in the other antiserum after cross-absorption with adequate amounts of heterologous antigen" (WHO, 1959).

However further studies on the antigenic structure and its relevance to classification, indicated that the taxon 'sub-serotype' was not a reliable concept since it did not define which of the two related strains should be recognized as the 'serotype' and which as its 'sub-serotype' (Kmety, 1966).

At its meeting in Moscow in 1966 the Subcommittee on the Taxonomy of *Leptospira* (TSC) accepted the above mentioned objections and abolished the taxon 'sub-serotype'. As a consequence the definition of a 'serotype' was amended as follows: "two strains are considered to belong to different serotypes if, after cross-absorption with adequate amounts of heterologous antigen, 10% or more of the homologous titre regularly remains in at least one of the two antisera in repeated tests".

Along those lines all previously designated 'sub-serotypes' had to be reclassified as 'serotypes' and a newly approved list (WHO, 1967) was drawn up containing 124 named 'serotypes' divided into 18 serogroups.

It should be noted that this list does not differentiate saprophytic and parasitic-pathogenic strains, in spite of the decision taken at the TSC meeting in Moscow (1966) to consider those two groups as 'complexes' of a monospecific genus *Leptospira*. The two 'complexes' were given the names 'interrogans' and 'biflexa' that had previously been allocated as specific names for the parasitic/pathogenic and saprophytic groups respectively. It was not until the TSC meeting in Manchester in 1986 that the biological properties, growth at 13°C and resistance to the purine analogue 8-azaguanine, were recognised as being sufficiently stable differentiating markers to allow both 'complexes' to be regarded as separate species known as *L. interrogans* and *L. biflexa*. Members of the species *L. interrogans* are for both properties negative and members of *L. biflexa* are for both positive.

In view of the continuous flow of newly described serovars, a growing number of controversial typing results, incomplete documentation, etc., the serovar list of 1967 has become more and more obsolete. As no new revised official list was drawn up, individual authors began to publish their own lists (Turner, 1972; Dikken and Kmety, 1978; Johnson

* The term serovar was substituted for serotype at the TSC meeting in Jerusalem in 1973.

and Faine, 1985). This situation led the TSC to assess once more all aspects of classification of leptospire including the revision of the criteria, the standardization of serotyping methods, the principles governing the recognition of new serovars, etc. Also new approaches to the classification of bacteria have been carefully evaluated, including the use of monoclonal antibodies and the identification of genetic characteristics.

First principles to be followed in the classification of leptospire were the only practical criteria available at that time. It was considered that two strains "belong to different serotypes if, after cross-absorption with adequate amounts of heterologous antigen 10% or more of the homologous titre regularly remains in each of the two antisera" (WHO, 1976). For convenience, serovars with close serological affinities were assembled within a serogroup.

Some years later a further subdivision into 'sub-serotypes' was introduced. Strains were classified as 'sub-serotype' if "in repeated tests less than 10% of the homologous titre remains in one antiserum but 10% or more in the other antiserum after cross-absorption with adequate amounts of heterologous antigen" (WHO, 1979).

However further studies on the antigenic structure and its relevance to classification, indicated that the term 'sub-serotype' was not a reliable concept since it did not define which of the two related strains should be recognized as the 'serotype', and which as its 'sub-serotype' (Kmetz, 1986).

At its meeting in Moscow in 1986 the Subcommittee on the Taxonomy of Leptospire (TSC) accepted the above mentioned objections and abolished the term 'sub-serotype'. As a consequence the definition of a 'serotype' was amended as follows: "two strains are considered to belong to different serotypes if, after cross-absorption with adequate amounts of heterologous antigen, 10% or more of the homologous titre regularly remains in at least one of the two antisera in repeated tests". Along those lines a previously designated 'sub-serotype' had to be reclassified as 'serotype', and a newly approved list (WHO, 1987) was drawn up containing 134 named 'serotypes', divided into 18 serogroups.

It should be noted that this list does not differentiate saprophytic and pathogenic strains, in spite of the decision taken at the TSC meeting in Moscow (1986) to consider those two groups as 'complexes' of a non-specific genus *Leptospira*. The two 'complexes' were given the names 'leptospira' and 'biflexa', that had previously been allocated as specific names for the pathogenic and saprophytic groups respectively. It was not until the TSC meeting in Manchester in 1986 that the biological properties, growth at 13°C and resistance to the penicillin analogue 8-oxazamidine, were recognised as being sufficiently stable differentiating markers to allow both 'complexes' to be regarded as separate species known as *L. interrogans* and *L. biflexa*. Members of the species *L. interrogans* are for both properties negative and members of *L. biflexa* are for both positive.

In view of the continuous flow of newly described serovars, a growing number of contradictory typing results, incomplete documentation, etc., the serovar list of 1987 has become more and more obsolete. As no new revised official list was drawn up, individual authors began to publish their own lists (Turner, 1977; Dijkken and Kmetz, 1978; Johnson, 1979). The term serovar was substituted for serotype at the TSC meeting in Leiden in 1973.

2. PRINCIPLES OF *LEPTOSPIRA* CLASSIFICATION.

Although the principles of the present classification described in the previous paragraph have fulfilled a useful role for many years, there have been reports of discrepant typing results that indicate some weaknesses in the typing methods. Therefore it was thought necessary to revise some of those principles to ensure that the new list should be founded on an improved basis.

Firstly the definition of the taxon 'serovar' had to be more explicit and the serological typing methods more carefully standardized. Secondly the impact on the present classification of newly developed diagnostic tests such as the monoclonal antibody technique, restriction endonuclease analysis and others had to be taken into account. Moreover, agreement had to be reached on the guidelines to be followed in the recognition of new serovars.

All these items were discussed repeatedly during the last TSC meetings of 1978, 1982, 1986 and 1990.

2.1 Amendments to the definition of 'serovar'.

During the meeting of the TSC in Manchester in 1986 the following revised definition of a 'serovar' was agreed: "Two strains are said to belong to different serovars if after cross-absorption with adequate amounts of heterologous antigen more than 10% of the homologous titre regularly remains in at least one of the two antisera in repeated tests".

This modification may reduce the risk of a false evaluation of the serological difference between two closely related strains. It was also introduced because of the more general use of the two-fold serum dilution technique in place of the split or interlocking ten-fold dilution scheme known as the Dutch scheme (Schüffner and Mochtar, 1927; Wolff, 1954; Dikken and Kmety, 1978), which makes a minimal 10% difference in residual titres inapplicable. Another reason for the amendment to the definition was the improved standardization of the absorption test which considers absorption to be well balanced if the absorbing strain still agglutinates to a maximum of 1% of the original titre. This would mean that, according to the old definition a 9% (10% - 1%) difference would have to be accepted as the basis of a valid description of the new serovar. This is avoided by the new definition.

2.2 Standardization of typing methods.

Standardization of methods is a self-evident necessity in classification studies in order that comparable results may be obtained by the different laboratories. During each meeting of the TSC this item has been discussed but some questions still remain unanswered. However a number of recommendations were agreed at the TSC meetings in Munich 1978 (Minutes, 1982) and Boston 1982 (Minutes, 1984).

2.2.1 The preparation of rabbit immune serum.

For classification purposes, a pooled antiserum from two or three rabbits should be used with a titre between 10.000 and 50.000. It is recommended to prepare the sera by repeated intravenous injections of well grown living cultures of an approximate density of 2×10^8 organisms per ml. (see for more details Minutes 1982 of TSC meeting Munich, 1978). One

must take into account the possibility that in some strains there may be a thermolabile antigen(s) as well as the usual thermostable antigens (Borg-Petersen, 1971, 1972; Babudieri, 1972; Kmety, 1972). In order to distinguish both types of antigen other methods of immunization have been adopted (Dikken and Kmety, 1978).

2.2.2 Microscopic agglutination test (MAT).

In standardizing the MAT, two important points should be noted:

- a. the correct density of the culture used as antigen;
 - b. the determination of the end-point of agglutination (titre).
- a. The density of the antigen is known to influence the end-point of agglutination and consequently the titre of the serum (Borg-Petersen and Fagreus, 1949; Jareková, 1986). Therefore the TSC (WHO, 1965; Minutes 1984 of TSC meeting Boston, 1982) recommended the use of well-grown living cultures with an approximate density of 2×10^8 leptospirae per ml.. However, differences in the length of the leptospiral cells may influence the real density of the reacting antigen determined nephelometrically (Jareková, 1986) who found lower densities (approximately 1.5×10^8 leptospirae per ml.) to be more suitable for the test.
- b. The end-point of the reaction is defined as the reciprocal of the highest dilution of serum in the serum-antigen mixture, in which 50% or just more of the cells are agglutinated (WHO, 1965; Minutes, 1984 of TSC meeting Boston, 1982).

2.2.3 Agglutinin-absorption test.

The absorption test should be well balanced in order to ensure that neither over nor under absorption takes place. To achieve this, the amount of concentrated living absorbing antigen with a density corresponding to McFarland standard No. 10 (Dikken and Kmety, 1978) or determined otherwise (Minutes, 1984 of TSC meeting Boston, 1982) should be appropriate to the height of the antibodies of the immune serum to be absorbed. If lower titre antibodies are to be absorbed, lower amounts of absorbing antigen have to be used to achieve a well balanced absorption.

It is recommended that 1 part of immune serum should be mixed with 24 parts of concentrated antigen in 3 equal amounts at 10 minute intervals. The absorption is considered to be adequately balanced when the absorbed serum has a residual titre of 0,5 - 1,0% of its original titre against the absorbing antigen (see for more details Minutes, 1984 of TSC meeting Boston, 1982). Even in the case of complete absorption the test may be considered in balance provided no substantial reduction of the homologous serum titre is apparent.

2.3 New techniques and their impact on classification.

In recent years new diagnostic techniques have been developed which provide a deeper insight into certain biological properties of leptospirae. Monoclonal antibodies were found to confirm not only serological differences between serovars, but in some cases they also

allow one to differentiate strains within the same serovar (Terpstra, Kmety, personal communications).

The possibility of distinguishing strains with different properties within a single serovar may be of importance in epidemiological studies, in determining sources of infection in the MAT as well as in the preparation of a vaccine.

Restriction endonuclease analysis (REA) has given similar results and allowed one not only to confirm the genetic identity of strains but also to distinguish strains that are indistinguishable serologically. Typical examples are the two 'genotypes' recognized in serovar *hardjo* infections (*hardjoprajitno* and *hardjobovis*). However, in a few cases similar REA patterns were reported in strains evidently belonging to different serovars (Terpstra and Korver, Bolin, personal communications).

It should also be remembered that Borg-Petersen (1972) had already reported the presence of a thermolabile antigen in strain Ictero I. This observation which was confirmed by Kmety (1972) provides an additional possibility as a means of differentiating strains within a single serovar. However, the stability of such thermolabile antigens requires further investigation.

These examples indicate that the presently recognised taxon 'serovar' will probably be further differentiated by applying these new techniques. The additional information provided may have an impact on the pathogenesis and epidemiology of leptospiral infections.

However it was realised (TSC meeting Manchester, 1986) that further and broader studies along those lines are required before the usefulness of these new techniques in the classification of leptospires can be sufficiently evaluated with a view to their introduction on a routine basis. It was decided that for the time being the serological methods that have for so long been the basis of *Leptospira* classification should continue to be used.

2.4 Serovar recognition.

After many years of discussion, the TSC at their Manchester meeting in 1986 finally approved the following principles whereby newly isolated strains may be accepted as new serovars. Accordingly the new serovar list was prepared and accepted for publication.

2.4.1 Serovars published before 1954.

For serovars described before 1954, the year of the first published classification system of Wolff and Broom, no typing criteria were formulated. Those serovars were treated individually. Publications which contained serological studies of new isolates and proposals for their naming were accepted as valid descriptions provided that the serovar status of the strain was confirmed at a later date by at least one Reference Laboratory (RL). Publications that only mentioned the isolation of the strain without descriptive data were not accepted as valid. However in such cases any subsequent publication with relevant data (serology and naming) on the strain was accepted.

2.4.2 Serovars published after 1954.

For serovars published after 1954 the following criteria were applied:

1. Serovars must be validly published and not only reported.
2. The material is considered to be validly published if it contains at least the results of comparative serological tests on related serovars i.e. these with coagglutination over 10%. It should also contain data on the history of the strain (source, locality, date of isolation, ecology, etc.).
3. The name of the serovar attached to the first valid description is the accepted one. Names that are not in accordance with the International Code of Nomenclature of Bacteria and Viruses (IC) are corrected.
4. The status of a newly described serovar should be confirmed by at least one RL. Without that confirmation a provisional status is given and it is marked on the list of serovars by the symbol "+".
5. A serovar with an incomplete serological description is recognized only if its separate serological status is confirmed by a RL. As long as confirmation is lacking the serovar is marked on the official list of serovars by "i.t." (incomplete typing).
6. In cases where validly described strains give rise to controversial typing results when subjected to confirmatory testing, they are listed with the symbol "++" until a final decision on their serovar status can be taken.
7. Strains published without historical data or without an adequate serovar name, i.e. not according to the IC, but which have a confirmed serovar status, are marked by "i.d." (incomplete documentation).
8. If the serovar status of a strain has been determined by a RL but the description has not yet been published, the new serovar is not included on the official list, but is placed in the Annex. After it has been validly published it will automatically be recognized and transferred to the main list.

3. ARRANGEMENTS OF SEROGROUPS AND SEROVARs.

3.1 General considerations.

In the previous sections it was shown that the serovar is now regarded as the fundamental element in *Leptospira* classification. This means that it is the basic taxon.

Already in the early years of leptospiral research it became clear that different degrees of serological relationship among serovars could be recognized. Borg-Petersen (1944) was apparently the first to introduce the serogroup concept into the classification system in his study of strains related to serovar *hebdomadis*. During the following years this concept became accepted because it was useful to group together serologically related serovars. This approach had already been taken into account in the first classification system of Wolff and Broom (1954), who divided the 46 known serovars into 20 serogroups.

The term serogroup has not been exactly defined and it has no official taxonomic status. However, for practical purposes it remains a necessary component of the present classification system. In addition, more detailed antigenic studies of a number of the recognized serogroups have shown the possibility of distinguishing well defined sub-serogroups (subgroups) within some serogroups by factor analysis (Kmety, 1967; Dikken and Kmety, 1978).

In principle, each serogroup is named after the earliest described serovar within the serogroup.

Serogroups, as well as the serovars they contain, are listed in this publication in chronological order. This arrangement reflects the historical aspects of the development of leptospiral research and the justified priorities according to the IC.

3.1.1 Serogroups

The growing number of serovars within certain serogroups became so large that the homogeneity of some groups decreased considerably, reducing their practical impact. This required in some cases a rearrangement into smaller groups with a higher degree of homogeneity. For instance, the original *Hebdomadis* serogroup contained more than 30 serovars of which some showed very little serological relationship to one another. It was therefore decided to divide the group into three separate serogroups according to their serological affinities viz.: *Hebdomadis*, *Sejroe* and *Mini*. This decision was made at the TSC meeting in Boston in 1982 (Minutes, 1984). Concurrently the *Autumnalis* group was divided into three separate serogroups known as *Autumnalis*, *Djasiman* and *Louisiana*.

A third change agreed to at the Manchester meeting in 1986 (Minutes, 1987) concerned the reestablishment of the *Sarmin* group. The serovar *sarmin* had been provisionally included in the *Icterohaemorrhagiae* serogroup in spite of its low grade affinity with that group. After some new serovars were described that were shown to be closely related to *sarmin*, the reintroduction of a *Sarmin* serogroup appeared to be justified.

The new list was further extended by another two more serogroups, *Ranarum* and *Manhao*. Recently, the introduction of a new serogroup named *Kenya* has been proposed (Korver and Terpstra, 1990, personal communication) as the serovars *kenya*, *peru* and *vargonicas* show serological relatedness. This suggestion has not yet been discussed by the TSC and therefore this serogroup is not included in the attached list of serovars.

In spite of these rearrangements there still remain, within some serogroups, clusters of serovars that are more closely related to one other than to the others. This was supported by the results of studies on the antigenic structure of strains by factor analysis and by the use of monoclonal antibodies. It was suggested therefore that such serogroups should be divided into subgroups (Dikken, Kmety, 1978). However, the decision to do so has been postponed until further information on the subject becomes available.

It also has been found that whereas some serogroups are evidently related antigenically to one other, others show no such relationship. For instance, while members of the Hebdomadis, Sejroe and Mini groups display a clear intergroup relationship and a similar serological relationship exists between groups Bataviae, Tarrassovi and Shermani, no cross-agglutination occurs between members of many other serogroups. Another well known close relationship observed in the past is that shown by the members of the Icterohaemorrhagiae and Canicola serogroups.

This intergroup relatedness suggests a possible evolutionary origin.

3.1.2 Serovars

As serovars are considered as infrasubspecific taxa, they are not covered by the IC. For practical purposes however, since serovar is the basic taxon in *Leptospira* classification, the principles and rules applied by the IC to species, have been observed.

Although a few individual serovars have been described in the past as being the sole member of a serogroup, it was agreed by the TSC meeting in Manchester in 1986 (Minutes, 1987) that such individual serovars should be placed provisionally in the serogroup to which they show the closest serological affinity until other closely related serovars have been described, and found to be fit to form a new serogroup with an existing individual serovar.

3.2 Present arrangement of serogroups and serovars.

Icterohaemorrhagiae serogroup - 1915

In the serovar list of 1967 (WHO, 1967) the Icterohaemorrhagiae serogroup consisted of 13 serovars, including *sarmin* and *weaveri*, both of which are now considered to be members of the reestablished Sarmin serogroup (see paragraph 3.1.1) and *budapest*, which recently was withdrawn from the list.

In the said list serovar *budapest* was given provisional status pending further investigation. Its separate serological status described by Füzy and Csóka (1962) and studied by Babudieri (1966) was not confirmed by any other RL. However, Kmety (1974) reported that serovar *budapest* was serologically identical to *mankarso*. At the TSC meeting in Manchester (1986) Terpstra presented the results of his investigations which indicated that by using monoclonal antibodies, the strain representing serovar *budapest* behaves as a strain of serovar *copenhageni*. These conflicting results could be caused by a possible mixed culture with varying proportions of each of the components.

Serovar *budapest* has therefore been omitted from the Revised List (Kmety, Dikken, 1988).

Serovar *icterohaemorrhagiae* can be represented by either of the two original published strains viz: Ictero No. 1 (Inada and Ido, 1915 a and b) or RGA (Uhlenhuth and Fromme, 1916).

As the authenticity of the strain Ictero No. 1 was under discussion for many years, the TSC selected RGA as reference strain (Minutes TSC meetings 1966 and 1986). However, after the publication of the detailed description on the history of strain Ictero No. 1 by Yamamoto and Yanagawa (1990), the TSC decided during its meeting in Osaka (1990), to recognize the authenticity of this strain. Since it had been isolated earlier than RGA, the TSC decided to replace RGA by Ictero No. 1 as reference strain, notwithstanding its serological difference from RGA caused by an additional thermolabile antigen in strain Ictero No. 1 (Borg-Petersen, 1972 and Kmety, 1972).

Because of their serological differences both strains, RGA as well as Ictero No. 1, are included in this paper and in the attached serovar list. Comparative typing studies performed only with strain Ictero No. 1 may lead to confusing typing results.

Two new serovars have been included in the *Icterohaemorrhagiae* group, viz. *tonkini* and *gem*. Another strain, LT 60-69, has now been also confirmed as a new serovar named *bogvere*, but since its valid description has not yet been published it is listed in the Annex. A Chinese strain Lai placed in the Annex of the Revised List of Serovars (Kmety, Dikken, 1988) and two Korean strains have recently been found to be validly published and are therefore included in the attached updated list as serovar *lai*, *hongchon* and *yeonchon*. As a result of these findings the serogroup consists of 15 serovars.

Hebdomadis serogroup - 1918

During the TSC meeting in Boston in 1982 (Minutes 1984) it was agreed that the large Hebdomadis serogroup should be divided into 3 separate groups, viz. Hebdomadis, Sejroe, and Mini. The new Hebdomadis group now contains 12 serovars, including three new ones *goiano*, *sanmartini* and *manzhuang*. After the list of 1988 was published, serovar *manzhuang* was described, and has now been added to the attached updated serovar list.

On the basis of the results of factor analysis two sub-serogroups (subgroups) were suggested (Dikken and Kmety, 1978) viz. subgroup Hebdomadis containing serovars *hebdomadis*, *kambale*, *nona* and *maru* and subgroup Borincana with serovars *borincana*, *worsfoldi*, *jules*, *kabura*, *kremastos* and *goiano*. The serovars *sanmartini* and *manzhuang* have not yet been studied by factor analysis.

Autumnalis serogroup - 1923

It was decided at the TSC meeting in Boston in 1982 (Minutes 1984) to divide this group into 3 separate groups; Autumnalis, Djasiman, and Louisiana.

In the new Autumnalis group the serovar *sumatrana* was omitted as it was serologically indistinguishable from *bulgarica*. Serovar *butembo* has been transferred provisionally from the Cynopteri serogroup to the Autumnalis group as its relationship with serovars within this group appears stronger. If in the future new strains are isolated with serological affinity to *butembo*, it is possible that they may be considered as constituting a separate serogroup. In the Revised List of 1988 the serogroup Autumnalis was extended by the addition of the

following serovars: *alice*, *mujunkumi*, *weerasinghe*, *carlos*, *srebarna*, *lambwe*, and *bim*. The Chinese serovar *nanla*, only recently published, is added to the enclosed updated list. However, the serovar status of *nanla* has not yet been confirmed by a RL.

By rechecking the original literature dealing with serovars *alice* and *weerasinghe* it was discovered, after the list of 1988 was published, that no descriptions had been given for either serovars. They will therefore have to be removed from the main list and placed within the Annex.

Moreover discrepant typing results have also been reported for serovar *alice*.

With these omissions and the addition of *nanla* the group now contains 14 serovars.

Pyrogenes serogroup - 1923

The group was originally designated Australis B by Alston and Broom (1958). In the WHO list of 1959 the name was changed to Pyrogenes. Since the publication of the WHO list of 1967 the group has been extended by the official recognition of the following serovars: *camlo*, *guaratuba*, *princestown*, *kwale*, and *varela*. However, because of some typing discrepancies that have recently come to light serovar *camlo* has now been included only tentatively (marked ++) in the attached updated list of serovars. Two new serovars, *menglian* and *nigeria*, represented by strain S 621 and strain Vom respectively were described after the publication of the 1988 list and they have now been included in the attached updated list of serovars.

Bataviae serogroup - 1926

Since 1967 the Bataviae serogroup has been extended by only one serovar, *rioja*. During the TSC meeting in Boston (1982), strain Swart was accepted as the new reference strain of serovar *bataviae* in place of strain van Tienen. Also the designations of some of the reference strains, given in the WHO list of 1967, were changed to conform to the reference publications; thus the reference strain for serovar *kobbe* became CZ 320, for *brasiliensis* An 776, for *balbao* 735 U and for *claytoni* 1348 U.

Strain LT 21-74 that has been recognized by reference laboratories after the Manchester meeting (1986) as representing a new serovar, provisionally named *santarosa*, has not yet been published. It has therefore been placed in the Annex of the Revised list of 1988 and in the Annex of the attached updated list.

Also another not published serovar *losbanos*, with reference strain LT 101-69, is placed in the Annex, although some discrepant typing results have been reported.

Grippytyphosa serogroup - 1928

In the list of 1967 the Grippytyphosa serogroup consisted of only two serovars, *grippytyphosa* and *valbuzzi*. Since then it was agreed to transfer *canalzonae* from the Cynopteri serogroup into the Grippytyphosa group and to further extend the group by four new serovars, *vanderhoedeni*, *ratnapura*, *muelleri* and *huanuco*. It had been suggested that *huanuco* should form a separate serogroup, but since it would have been the only member of that group it was decided to place it provisionally in the Grippytyphosa group as it shows some relationship with members of that group.

Canicola serogroup - 1933

The Canicola group now contains two more serovars than it did in the 1967 WHO list, viz.: *portlandvere* and *kuwait*. In the Annex 2 of that list the serovar name attached to the strain LT 1014 was given as *azuli*, but that name was never validly published. When published in 1969 by Tedesco et al. the serovar was named *galtoni*, and this name has been accepted in place of *azuli*.

On the basis of factor analysis it has been suggested that the group should be divided into two subgroups viz: Canicola and Schueffneri (Dikken and Kmety, 1978).

Australis serogroup - 1937

Since the list of 1967 was compiled the group has first been extended by four serovars: *hawain*, *soteropolitana*, *ramisi*, and the incompletely described Chinese serovar *rushan*. Serovar *nicaragua* was included in the WHO serovar list of 1967 under the laboratory code LT 990 on a provisional basis as no publication was known. The strain was subsequently submitted to factor analysis, which confirmed its serological status (Dikken and Kmety, 1978). In 1982 Sulzer described the serovar under the strain designation 1011, which consequently replaces the previous laboratory code.

Serovar *pina*, strain LT 932 which is included in the WHO list of 1967 with a footnote, "provisional classification, pending further work" has not been included in the present list as it has not yet been published. Since the strain was typed by Galton who considered that it represented a separate serovar it has been placed in the Annex to the new serovar list (1988).

Further investigations have shown that serovar *bangkok* is indistinguishable from serovar *australis* (Kmety and Terpstra, personal communications) and it has therefore been omitted from the Revised List of 1988.

Lately serovar *bajan* has been described. The serogroup now contains 13 serovars.

Pomona serogroup - 1937

In the WHO list of 1967 the serogroup contained 6 serovars of which two, *monjakov* and *kennewicki* have been shown by agglutinin-absorption and by monoclonal antibody tests to belong to serovar *pomona*. They have therefore been excluded from the Revised List. The group now includes serovar *tsaratsovo*, although some discrepant typing results were reported by Hathaway et al. (1985). It also includes a Chinese serovar *kunming* in spite of a lack of data on its history.

Javanica serogroup - 1938

Since the publication of the WHO list of 1967, eight new serovars have been added to the Javanica serogroup which now contains a total of 14 serovars. Six of them were already officially recognized by the TSC Manchester, 1986, and they are included in the Revised List of 1988, viz.: serovars *menoni*, *fluminense*, and four Chinese serovars *A 85*, *dehong*, *menrun* and *yaan*. Two additional Chinese serovars, *mengma* and *zhenkang* were only published recently and are therefore included in the attached updated serovar list.

The serovar status of three new serovars *fluminense*, *mengma* and *zhenkang* are still under investigation, and the other four new Chinese strains have incomplete documentation (i.d.). The serovar designation A 85 does not agree with the requirements of the IC and will have to be changed. (Probably to *mengla*, personal communications).

One other serovar, referred to as *vargonicas*, reference strain 24, although confirmed by RLs, has not yet been validly published and has therefore been placed in the Annex to the Revised List of 1988.

In the list of 1967, Annex 2, serovar *ceylonica* was included while still unpublished, with the reference strain given as Dyananda. When published by Nityananda et al. (1969) the strain name was given as Piyasena. This name has therefore been given to the reference strain on the Revised (1988) and attached lists.

Sejroe serogroup - 1938

The Sejroe group is now formed from about half the number of serovars contained in the previous enlarged Hebdomadis group. It now contains 19 serovars.

Serovar *nero*, having been found to be indistinguishable from *saxkoebing*, is no longer included. Serovars *gorgas* with strain LT 829, *recreo* with strain LT 957, and *trinidad* with strain LT 1098 were included in the 1967 Annex 2 list, but were unpublished at that time. When the publication appeared (Sulzer et al., 1982), they were given different reference strain designations 1413 U, 380 and TRVL 34056 respectively. As proposed by Dikken and Kmety (1987) these designations were accepted by the TSC (Manchester, 1986) and they replaced the original designations.

According to the results of factor analysis (Kmety, 1977) the Sejroe serogroup can be divided into 3 subgroups:

- Sejroe with serovars *sejroe*, *polonica*, *balcanica* and the additional serovar *istrica*;
- Saxkoebing with serovars *saxkoebing*, *haemolytica*, *ricardi*, and two additional serovars *nyanza* and *dikkeni*;
- Wolffi with serovars *medanensis*, *wolffi*, *hardjo*, *gorgas*, *recreo*, *trinidad*, and 4 additional serovars *roumanica*, *caribe*, *geyaweera* and *guaricura*.

Cynopteri serogroup - 1939

This small group was reduced to one serovar when *canalzonae* was transferred to the Grippotyphosa serogroup and serovar *butembo* to the Autumnalis group. However, a new serovar named *tingomaria* has now been added.

Djasiman serogroup - 1939

The Djasiman group was established at the TSC meeting in Boston in 1982 (Minutes, 1984) with three serovars from the Autumnalis group, *djasiman*, *sentot* and *gurungi*. Recently the group was extended by the addition of two new serovars, *huallaga* and *agogo*.

Serovar *huallaga* was added to this group in the Revised List of 1988.

Although confirmed by a RL, serovar *agogo* was not published at the time of the TSC meeting in Manchester (1986), and has therefore been placed in the Annex of the Revised List of 1988.

Having been published (Hogerzeil et al., 1986) soon after the Manchester meeting the serovar is now removed from the Annex and placed in the attached updated main list.

Sarmin serogroup - 1939

Serovar *sarmin* appeared in the first serovar list of 1954 (Wolff and Broom) when it represented a separate serogroup. Being the only member of that group it was tentatively transferred to the *Icterohaemorrhagiae* serogroup in the list of 1967.

After the valid descriptions of the serovars *weaveri*, *waskurin*, *rio* and *machiguenga*, which are related to *sarmin*, the Sarmin serogroup was reestablished (TSC, Manchester, 1986). Recently serovar *cuica* was described (Pereira et al., 1991). The serogroup now contains 6 serovars.

Mini serogroup - 1941

The Mini group, the third group to be separated from the previous *Hebdomadis* serogroup has been enlarged to 9 serovars by the addition of serovars *ruparupae*, *hekou* and *yunnan*. Serovar *ruparupae* was already included in the Revised List of 1988. The Chinese serovars *hekou* and *yunnan* are recently published and therefore only now included in the attached updated list of serovars. Their serovar status has yet to be confirmed by a RL and they are therefore given provisional status (+).

In the 1967 list of serovars *beye* and *tabaquite* were included with unpublished references, under the strain numbers LT 844 and TVRL 34056 respectively. These have now been changed to 1537U and TVRL 3214 according to the designations given in the original publication of Sulzer et al. (1982).

Tarassovi serogroup - 1941

The Tarassovi group which, in the 1967 list consisted of 10 serovars, has grown considerably and now comprises 21 serovars.

In the last approved list of serovars of 1988, the group extended by 7 serovars: *tunis*, *kaup*, *vughia*, *navet*, *kanana*, *darien* and *mogdeni*.

Since then 4 new Chinese serovars *banna*, *gengma*, *mengpeng* and *yunxian* have been described within this serogroup. These serovars have not yet been confirmed by a RL and they are therefore listed under provisional status (+) in the attached updated list.

Serovars *chagres* and *gatuni*, included in the 1967 list were unpublished at that time and their reference strains were quoted as LT 924 and LT 839 respectively. These have now been changed to 1913 K and 1473 K according to the designations given in the original publication of Sulzer et al. (1982).

Two further strains M 39090 and LT 82 have been studied by RLs and found to represent new serovars. The serovar names that have been suggested are *langati* and *sulzeriae*. As they have not yet been published they are included in the Annex of the Revised (1988) and attached serovar lists.

Ballum serogroup - 1944

The Ballum group was extended by the addition of serovars *kenya* and *ballum* 3. It had been suggested that serovar *kenya*, strain Njenga should form a separate serogroup. However, as it would have been the sole member of that group the TSC at its Manchester meeting of 1986 decided to include the serovar provisionally in serogroup Ballum to which it is serologically related.

Serovar *ballum* 3 was included although it is recognized that the name does not conform to the IC and will have to be changed.

Celledoni serogroup - 1956

The original group has been enlarged by the addition of serovar *anhua* and two Chinese serovars, published as *javanica* 4 and *hainan-whitcombi*. Because the last two names do not conform to the requirements of the IC, it has been suggested by personal correspondence with the authors that the names should be changed to *mengdeng* and *hainan*. As those names have not yet been published, they could not be included in the Revised (1988) and attached list.

Louisiana serogroup - 1964

This group was formed by the separation from the previously large Autumnalis serogroup of the two serovars *louisiana* and *orleans*. It was later extended by the addition of the serovar *lanka*.

Panama serogroup - 1966

In the 1967 list this group consisted of two serovars, *panama* and *cristobali*. Although still unpublished at that time *cristobali* was included with its reference strain LT 940. In the original publication (Sulzer, 1982) the reference strain is designated 1996 K, which now replaces the former one in the Revised (1988) and attached lists. The group has been further extended by the addition of serovar *mangus*, reference strain TRVL/CAREC 137774, with provisional status (+).

Ranarum serogroup - 1972

This new serogroup was established at the TSC meeting in Manchester in 1986, based on the biological properties and the serological relationship of the serovars composing the group.

The group consists of serovars *ranarum*, *evansi* and *pingchang*. Literature on *pingchang* became available only after the list of 1988 was published. The serovar is now included in this serogroup in the attached updated list of serovars. Its serovar status has been confirmed by a RL.

Manhao serogroup - 1978

The establishment of a new serogroup Manhao was proposed in 1979 in a publication of the Chinese Military Institute, the Department of Logistics of the Kunming Military Area and the National Institute for the Control of Pharmaceutical and Biological Products, Beijing, China (individual authors not mentioned). This proposal was accepted by the TSC meeting in Manchester, 1986. The proposal was based on the results of a serological study of four strains designated as serovars *manhao* 1, 2, 3 and 4. Serovar *manhao* 4 and its reference strain Li 130 was apparently described by Luo Heng-sheng et al. in 1978. In a paper by Gao Ji-yuan et al. (1984) designations for the reference strains attached to serovars *manhao* 1, 2 and 3 are given as L70, L105 and L60 respectively.

The Manhao serogroup was further extended by the addition of serovar *lincang* with its reference strain, L14 which was described by Qin Jin-cai et al. in 1981.

These Chinese strains were investigated by Terpstra and his co-workers in Amsterdam. It was found that *manhao* 1, 2 and 3 were so closely related that they could be considered as belonging to the same serovar. In agreement with the Chinese workers serovar *manhao* 2 was chosen as the representative serovar with reference strain L 105.

The group now consists of the serovars *manhao* 4 and 3, both marked by i.d. because of incomplete documentation and serovar *lincang* marked by ++ because of controversial typing results.

Shermani serogroup - 1982

In the serovar list of 1967 this group consisted of only one serovar *shermani* with LT 821 as its reference strain, based on an unpublished reference. The relevant publication (Sulzer, 1982) refers to the strain as 1342 K, which replaces the previous designation in the Revised List of 1988. The group was extended by the addition of serovar *luis* that was thought at first to be a member of the Tarassovi serogroup. Further investigations however showed that strain M 6 of *luis* was serologically more closely related to *shermani* and consequently the TSC at their Manchester meeting in 1986 decided that it should be placed within the Shermani serogroup.

Three other strains, MW 4, CI 40, and 9160 were shown to represent three new serovars within the Shermani serogroup. Although their descriptions have not yet been published, they are listed in the Annex to the Revised (1988) - and attached lists under the proposed serovar names, *aguaruna*, *babudieri* and *carimagua* respectively.

4. HISTORY OF SEROVARS AND THEIR REFERENCE STRAINS

ITEROHAEMORRHAGIAE SEROGROUP - 1915

Serovar	Reference strain	Year of valid description
<i>icterohaemorrhagiae</i>	Ictero No. 1	1915
	RGA	1916
<i>copenhageni</i>	M 20	1938
<i>naam</i>	Naam	1940
<i>mwogolo</i>	Mwogolo	1946
<i>ndahambukuje</i>	Ndahambukuje	1946
<i>ndambari</i>	Ndambari	1946
<i>mankarso</i>	Mankarso	1953
<i>birkini</i>	Birkin	1957
<i>smithi</i>	Smith	1957
<i>dakota</i>	Grand River	1962
<i>lai</i>	Lai	1966
<i>tonkini</i>	LT 96-68	1971
<i>gem</i>	Simon	1972
<i>hongchon</i>	18 R	1991
<i>yeonchon</i>	HM 3	1991

<i>icterohaemorrhagiae</i>	Ictero No. 1	1915
	RGA	1916

The serovar* name *icterohaemorrhagiae* was first used by the Japanese workers Inada and Ido (1915, a and b), when they reported the isolation of the first leptospire from man in February, 1915. They called it *Spirochaeta icterohaemorrhagiae (japonica)*.

Since it was published earlier it takes priority over the name *icterogenes* that was used in the original publication of Uhlenhuth and Fromme (1916) in their description of the organism that they had isolated and believed to be aetiological agent of Weil's disease, which they called *Spirochaeta icterogenes*.

A Japanese and the German isolate were later designated Ictero No. 1 and RGA respectively. Both strains could have been attached to this serovar as reference strain. Because of doubt, on the authenticity of strain Ictero No. 1, strain RGA was designated many years as reference strain (TSC 1966 and 1986), notwithstanding the fact that the latter was published a year later.

Only after the recent detailed publication on the history of strain Ictero No. 1 (Yamamoto and Yanagawa, 1990) it was decided at the TSC meeting (Osaka 1990) to recognize the authenticity of this strain. Because Ictero No. 1 was isolated earlier than RGA the TSC agreed at the same meeting to replace RGA by Ictero No. 1 as reference strain of serovar *icterohaemorrhagiae* and as neotype strain of the species *L. interrogans*. A historical description of both strains will now be given.

* The word serovar was at that time designated as "serotype".

Naming:

In the original Japanese publications (Inada and Ido, 1915, a and b, and Inada et al, 1917) no mention is made of the strain name Ictero No. 1. The authors only recorded the isolation of four strains, Nishimura, Yamasaki, Matsumoto and Sakamoto, through serial guinea-pig passages.

In an other publication of 1915 (in Japanese) Inado and Ido use the notation "No. 1" in combination with the Yamasaki strain. However, they do so in one table only without any further explanation in the text.

The first publication with a more explicit reference to the name Ictero No. 1 is from Kitaoka (1937), who describes the strain as "Ictero. Nr 1" (in combination with "Menschlicher Stamm Nr 1"). He claims this strain to be the original decent of the Yamasaki strain. Much later (1968) Babudieri and Smith made the same reference to this strain but under the name "Ictero No 1".

Also in correspondence between Yamamoto and Borg-Petersen, dated May 3, 1968, this strain name is mentioned. In this correspondence and in the publication of Babudieri et al. (1968) it is stated that according to Yamamoto, strain Ictero No. 1 corresponds to the original Yamasaki strain that was recorded by Inada et al. (1915, a and b, and 1917).

History:

In the original Japanese publications (see above) it is stated that the Yamasaki strain was isolated from a guinea-pig inoculated on November 23, 1914, with blood from a sick 59 years old rice-handler, who was suffering from Weil's disease and admitted to the Kyushu University Hospital in Fukuoka. The strain was maintained by many serial guinea-pig passages (Inada et al., 1917). On May 13, 1915, after 24 passages through guinea-pigs, the strain was cultured in Noguchi's medium (Inado et al., 1916).

On the further history of the strain, different papers (correspondence between Borg-Petersen and Yamamoto, 1968, Babudieri et al., 1968, TSC report to ICNB, 1971, and Yamamoto et al., 1990) provide identical information, all based on the same source (Prof. Yamamoto). The papers indicate that Inada maintained the strain in the laboratory of Kyushu University until 1918. Then he moved to the Faculty of Medicine, Tokyo University, where the strain was maintained by him and by his successor Professor Sakaguchi. In 1940, Dr. Kubo, who worked in the same laboratory, sent a culture of the strain to Professor Yamamoto at the Tokyo Institute of Veterinary Pathology. He referred to it as Ictero No. 1 and stated that it corresponds to the strain Yamasaki, which Inada and Ido isolated from a patient of that name (Inada et al., 1917).

In 1945, this culture of strain Ictero No. 1 was found to be contaminated by fungi. Yamamoto purified the culture by intraperitoneal inoculation of splenectomized mice and by culturing their heart blood ten minutes later. Unfortunately, the mice were not examined on a concurrent leptospiral infection before the decontamination procedure was started. Nevertheless both before and after mouse passage the strain was found to be antigenically identical with another Japanese strain of human origin, Akasawa, isolated in 1933 by Numata in Ibaraki. "It seems therefore unlikely that the purified strain was other than the original strain Ictero No. 1" (Babudieri and Smith, 1968).

After World War II, no information was obtained on the existence of strain Ictero No. 1. According to the Report (1962-1966) of the TSC, Kitaoka informed the Subcommittee that he "understood that the original strain of Inada and Ido (Strain No. 1) had been lost". The same report mentions that as a result of a following circular letter "Yamamoto claimed to have a culture of strain No. 1" and subsequently he gives its history as from 1940 as mentioned above.

In the "Statements and Recommendations" of the TSC meeting - Moscow, 1966, it is reported that "Strain RGA was unanimously accepted as authentic and well documented. It was preferred to the Japanese strain because the authenticity of the strain is now doubtful".

This view continued until the recent review on the strain's history by Yamamoto and Yanagawa (1990).

The TSC then decided during its meeting in Osaka (1990) to recognize the authenticity of strain Ictero No. 1. As Ictero No. 1 is earlier isolated and published than strain RGA the TSC decided at the same meeting to replace RGA by Ictero No. 1 as reference strain of serovar *icterohaemorrhagiae* and as neotype strain of the species *interrogans*, notwithstanding its serological difference from strain RGA.

No comparative typing studies had been carried out on strains RGA and Ictero No. 1 until those of Babudieri and Smith (1968), which revealed serological differences. Lately this was confirmed by Yamamoto (1990). Borg-Petersen (1971) and Kmety (1972) considered these differences to be due to the presence in Ictero No. 1 of a thermolabile antigen, designated as Vi, which was not present in strain RGA. Kmety suggested subdividing serovar *icterohaemorrhagiae* into two varieties, Vi+ and Vi-, with Ictero No. 1 being the reference strain of Vi+ variety and RGA the reference strain of Vi- variety. However, over the years the stability of the Vi antigen became questionable.

icterohaemorrhagiae

RGA

1916

The designation RGA is an abbreviation of the Reichsgesundheitsamt in Berlin, where the strain was first cultured in vitro.

During World War I, in November 1915, strain RGA was isolated by Uhlenhuth and Fromme through guinea-pig inoculation with blood from a soldier in Belgium. They considered it to be the aethiological agent of Weil's disease. In the original publication (Uhlenhuth and Fromme, 1916) the organism is described as *Spirochaeta icterogenes*.

According to a letter of Borg-Petersen to the secretary of the TSC, dated January 1969, the infected guinea-pigs were sent to the Robert Koch Institute (Prof. Otto) and thence to the laboratory of the Reichsgesundheitsamt. There the strain was cultured in vivo in February 1916. The strain originally named "Berlin" and "original strain from Uhlenhuth and Fromme" was successfully maintained and in 1924 a subculture was sent by Manteufel from the Reichsgesundheitsamt to Schüffner in Amsterdam (Institute of Tropical Hygiene) under the designation RGA (Gispen and Schüffner, 1939).

Strain RGA appeared already on the list of Wolff and Broom (1954) as the reference strain of serovar *icterohaemorrhagiae* and still did when the last WHO list was published in 1967 (WHO, Tech. Rep. No. 380, 1967). This was in accordance with the recommendations of the TSC at the meeting in Moscow in 1966, reading that, "the oldest surviving authentic

strain, RGA should be accepted as the neotype strain of the species *interrogans*". This was approved again at the Manchester meeting of the TSC in 1986.

However after recognizing by the TSC (Osaka, 1990), the authenticity of the strain Ictero No. I, they consequently decided to replace RGA by Ictero No. 1 as reference strain of the serovar and as a neotype strain of the species *interrogans* in spite of the serological difference between the two strains (see Ictero No. 1).

copenhageni

M 20

1938, 1966

The strain M 20 was isolated by Borg-Petersen (1938) from a patient in Denmark. It was shown by agglutination-absorption tests to differ serologically from strain RGA. The strain M 20 is able to absorb nearly all antibodies from RGA antiserum whereas strain RGA only removes its homologous antibodies from M 20 antiserum. The strain was therefore considered to represent a 'subtype' of serovar *icterohaemorrhagiae*.

Gispen and Schüffner (1939) confirmed the serological results but they classified M 20 as the 'complete biotype' of *icterohaemorrhagiae*, and named it *icterohaemorrhagiae* AB. The strain was later considered to represent 'a subserotype' of *icterohaemorrhagiae* (WHO, 1965). Kmety (1966), who studied the antigenic structure of serovars of the *Icterohaemorrhagiae* serogroup, suggested abandoning the taxonomic rank of 'subserotypes' and proposed that M 20 should represent a 'serotype' named *copenhageni*. This suggestion was accepted by the TSC 1966 at their Moscow meeting in 1966 (TSC meeting, 1966: Statements and Recommendations, 1971).

naam

Naam

1940

The strain Naam was isolated by Wolff in 1936, from a fatal case of leptospirosis in a labourer in Medan, Sumatra, Indonesia (Walch-Sorgdrager et al., 1940).

The strain was later studied serologically and appears in Wolff and Broom's list (1954) as a separate serovar named *naam*. The separate serological status of the strain was confirmed by factor analysis (Kmety, 1967).

mwogolo

Mwogolo

1946

The strain Mwogolo was isolated from a patient in Zaire (formerly the Belgium Congo) in 1938 by van Riel (1946). The strain was studied and described as a new serovar of the *Icterohaemorrhagiae* serogroup by Kmety (1967).

ndahambukuje

Ndahambukuje

1946

The strain Ndahambukuje was isolated from a patient in Zaire (formerly the Belgium Congo) in 1938 by van Riel (1946). Although it is not mentioned in van Thiel's "The Leptospirosis", nor in Wolff and Broom's list of 1954, *ndahambukuje* appears in the WHO list of 1967 (WHO, Tech.Rep.Ser., No. 380) as a recognised serovar, after being studied by Kmety (1967), who confirmed its separate serological status.

The strain Ndambari was isolated from a patient in Zaire (formerly the Belgium Congo) in 1938 by van Riel (1946). It was first mentioned as representing a separate serovar in van Thiel's "The Leptospirosis" (1948), but it does not appear in Wolff and Broom's list of 1954.

The strain was studied by Kmety (1967) and included as a recognized serovar in the WHO list of 1967 (WHO, Tech. Rep. Ser., No. 380).

The strain Mankarso was isolated in Sumatra, Indonesia, in 1938 from a patient suffering from leptospirosis (Wolff, 1953). It first appeared as a separate serovar named *mankarso* in Wolff and Broom's list (1954). In his "Laboratory Diagnosis of Leptospirosis" (1954), page 82, Wolff states that "the strain Mankarso shows serologic affinity to *L. icterohaemorrhagiae* and *L. naam*, but absorption tests have revealed slight differences in antigenic constitution". The strain was submitted to factor analysis (Kmety, 1967), which proved its separate status.

The strain Birkin was isolated from a patient in Malaysia during 1953-1955 and described as a new serovar of the *Icterohaemorrhagiae* serogroup (Alexander et al., 1957).

The strain was studied by Kmety (1967), who confirmed its separate serological status.

The strain Smith was isolated from a patient in Malaysia during 1953-1955 and described as a new serovar of the *Icterohaemorrhagiae* serogroup by Alexander et al., (1957).

The strain was studied by Kmety (1967), who confirmed its separate serological status.

The strain Grand River was isolated in 1958 from surface water in the USA and described as a 'subserotype' of *L. naam* (Alexander et al, 1962).

At its meeting in Moscow in 1966, the TSC abolished the taxonomic range of 'subserotypes' and it was accepted as a separate serovar, named *dakota* with Grand River as its reference strain.

The strain Lai was isolated from a patient Lai An-hwa (or hua) during an explosive outbreak of leptospirosis in 1958 in the Wenjiang District of Sichuan province of China (Chen Ting-zuo et al., 1986). The strain was apparently described by Liu et al. in 1966. Its separate serological status was confirmed by a RL.

Because of lack of documentation at the time of the Manchester meeting in 1986 the TSC decided to record the serovar in the Annex to the Revised List (Kmety and Dikken, 1988).

Documentation which is now available is sufficient to permit the inclusion of *lai* as a separate serovar in the Icterohaemorrhagiae serogroup in the updated attached serovar list.

tonkini LT 96-68 1971

The strain LT 96-68 was isolated from a patient in South-Vietnam and described later as representing a new serovar of the Icterohaemorrhagiae serogroup named *tonkini* (Tsai and Sulzer, 1971).

gem Simon 1972

The strain Simon was isolated from a patient in Ceylon in 1966 (Nityananda, Sulzer, 1972), and designated as the reference strain of a new serovar in the Icterohaemorrhagiae serogroup named *gem*. The strain was studied at the CDC, Atlanta, under the strain designation LT 11-67. The published description of the strain is almost complete.

hongchon 18 R 1991

The strain 18 R was isolated in 1985 from a field mouse (*Apodemus agrarius*) in the Hongchon area, of the Kangwon Province of Korea.

The strain was submitted to cross-agglutination absorption tests, factor analysis, monoclonal antibodies, and restriction endonuclease analysis and was described by Hee-Bok Oh et al. (1991) as a new serovar in the Icterohaemorrhagiae serogroup named *hongchon*. Its serovar status has been confirmed by a RL. Therefore the strain is included unconditionally in the attached updated serovar list.

yeonchon HM 3 1991

The strain HM 3 was isolated in 1985 from a patient in the Yeonchon area of Kyunggi Province, Korea (Park et al., 1986).

The strain was submitted to cross-agglutination absorption test, factor analysis, monoclonal antibodies, and restriction endonuclease analysis and described by Hee-Bok Oh et al. (1991) as a new serovar named *yeonchon* in the Icterohaemorrhagiae serogroup.

Its serovar status has been confirmed by a RL. Therefore the strain is included unconditionally in the attached updated serovar list.

HEBDOMADIS SEROGROUP - 1918

Serovar	Refence strain	Year of valid description
<i>hebdomadis</i>	Hebdomadis	1918
<i>kabura</i>	Kabura	1952
<i>worsfoldi</i>	Worsfold	1957
<i>jules</i>	Jules	1958
<i>kremastos</i>	Kremastos	1958
<i>kambale</i>	Kambale	1960
<i>nona</i>	Nona	1960
<i>borincana</i>	HS 622	1963
<i>maru</i>	CZ 285	1966
<i>sanmartini</i>	CT 63	1979
<i>goiano</i>	Bovino 131	1980
<i>manzhuang</i>	A 23	1988

<i>hebdomadis</i>	Hebdomadis	1918
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The strain was isolated from the blood of a patient in Japan by serial passage through guinea-pigs in 1916 (Ido, Ito and Wani, 1918). In the original publication in Japanese in Nippon Naika Gakkai Zasshi, No. 5, 1917, the new leptospira is designated *Spirochaeta nanukayaami* (nanukayaami = seven day fever). In the publication of Ido et al. (1918) the designation *hebdomadis* appears for the first time, and was than generally adopted as the serovar name. As in neigther publication a strain name is mentioned, the serovar name was also used as the strain name. The strain was submitted to factor analysis by Kmety (1977), who suggested on the basis of the results that it should be placed in a subgroup to be named Hebdomadis.

<i>kabura</i>	Kabura	1952
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The strain was isolated from a patient in Zaire (formerly Belgium Congo) between the years 1938-1946 by van Riel (1952). It is stated in this paper that no serological relationships with Congian, European, Indonesian or Australian strains could be found. Van Riel placed the strain in the Hebdomadis serogroup without suggesting a strain name.

Wolff and Bohlander (1958) confirmed the separate status of the strain and adopted the serovar name *kabura* with strain name Kabura.

The strain was submitted to factor analysis by Kmety (1977), who suggested that it should be placed in a subgroup to be named Borincana.

<i>worsfoldi</i>	Worsfold	1957
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The strain was isolated from a patient in Malaysia and described as a new serovar named *worsfoldi* (Alexander et al., 1957).

In the Second Report of a Joint WHO/FAO Expert Committee on Zoonoses (1959) the strain is listed as a recognised serovar.

The strain was submitted to factor analysis by Kmety (1977), who on the basis of the results suggested that it should be placed in a subgroup to be named Borincana.

<i>jules</i>	Jules	1958
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The strain was isolated from the blood of a patient in Zaire (formerly Belgium Congo) between the years 1952-1953 (van Riel et al., 1956).

Wolff and Bohlander (1958) studied the strain and found it to represent a new serovar which they named *jules*. The strain is mentioned in the Second Report of a joint WHO/FAO Expert Committee on Zoonoses (1959) with a note to indicate that it should be "provisionally classified pending further work".

The strain was submitted to factor analysis by Kmety (1977) who on the basis of the results suggested that it should be placed in a subgroup to be named Borincana.

<i>kremastos</i>	Kremastos	1958
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The strain was isolated in 1952 from a patient in North Queensland, Australia, by Smith et al. (1954). It was thought to represent a new serovar although no description of the serovar is given.

The strain was studied serologically by Wolff and Bohlander (1958), who confirmed its separate serovar status and suggested the name Kremastos for the strain, and also for the serovar designation.

The strain was submitted to factor analysis by Kmety (1977), who on the basis of the results suggested that it should be placed in a subgroup to be named Borincana.

<i>kambale</i>	Kambale	1960
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The strain was isolated from a patient in Zaire (formerly Belgium Congo) sometime during the years 1955-1956 by van Riel (1960) and described as a new serovar designated *kambale*. In the WHO list of 1967 it appears as a recognized serovar.

The strain was submitted to factor analysis by Kmety (1977), who suggested that it should be placed in a subgroup to be named as Hebdomadis.

<i>nona</i>	Nona	1960
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The strain was isolated from a patient in Zaire (formerly Belgium Congo) sometime during the years 1955-1956 by van Riel (1960) and described as a 'subserotype' of serovar *hebdomadis*.

After the abolition of the taxonomic range of 'subserotypes', it was upgraded to the rank of serovar and appears as such on the WHO list of 1967.

The strain was submitted to factor analysis by Kmety (1977) and placed in a subgroup to be named as Hebdomadis.

<i>borincana</i>	HS 622	1963
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The strain was isolated from a patient in Puerto Rico in 1951 and was first mentioned in a paper by Alexander et al. (1955) under the name *L. borincano*. It was subsequently given

a valid description by Alexander et al. (1963).

In the Second Report of a joint WHO/FAO Expert Committee on Zoonoses (1959) the strain is listed in Annex 6 under the serovar name *borincana* with the note "provisionally classified pending further work". In the WHO list of 1967 it appears as a recognized serovar.

The strain was submitted to factor analysis by Kmety (1977), who suggested that it should be placed in a subgroup to be named as *Borincana*.

maru

CZ 285

1966

The strain was isolated in 1962 in the Panama Canal Zone from surface water through hamster passage. It was described by Gale et al. (1966) as a new serovar named *maru*, reference strain CZ 285. (In Annex 1 and 2 of the list of 1967 (WHO, 1967) the strain is incorrectly designated as CZ 285 D and CZ 285 B respectively.)

The strain was submitted to factor analysis by Kmety (1977) and the results indicated that it should be placed in the subgroup to be named as *Hebdomadis*.

sanmartini

CT 63

1979

The strain was isolated by Hidalgo in September 1971 from a pig in the San Martini department of Peru. It was described by Agirre and Chernukha (1979) as a new serovar named *sanmartini*, closely related to serovars *hebdomadis* and *kremastos*.

The serovar was recognized by the TSC at their meeting in 1986 and was included in the Revised List of Leptospiral Serovars (Kmety and Dikken, 1988).

goiano

Bovino 131

1980

The strain was isolated from the kidney of a cow during a search for evidence of leptospirosis in apparently healthy Zebu cattle in Brasil during 1962-1968.

Santa Rosa et al. (1980) described the strain as representing a new serovar named *goiano*, with reference strain Bovino 131.

The strain was given provisional status by the TSC (1986) and is included in the Revised List of Serovars (Kmety and Dikken, 1988), marked +. Since then its serological status has been confirmed and it is included in the attached updated list unconditionally.

manzhuang

A 23

1988

The strain was isolated in 1962 from the blood of a patient in Mengla, Yunnan Province, China and was described as a new serovar of the *Hebdomadis* group by Zhang Fang-heng et al. (1988). It has been included in the attached updated list, but it has not yet been confirmed by a RL.

Therefore the serovar has been given provisional status (+).

AUTUMNALIS SEROGROUP - 1923

Serovar	Reference strain	Year of valid description
<i>rachmati</i>	Rachmat	1923
<i>autumnalis</i>	Akiyami A	1925
<i>bangkinang</i>	Bangkinang I	1932
<i>butembo</i>	Butembo	1946
<i>erinaceiauriti</i>	Erinaceus auritus 670	1951
<i>fortbragg</i>	Fort Bragg	1952
<i>mooris</i>	Moores	1957
<i>bulgarica</i>	Nicolaev	1958
<i>mujunkumi</i>	Yezsh 237	1971
<i>carlos</i>	C 3	1973
<i>srebarna</i>	1409/69	1974
<i>lambwe</i>	Lambwe	1981
<i>bim</i>	1051	1984
<i>nanla</i>	A 6	1989

<i>rachmati</i>	Rachmat	1923
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The strain was isolated in Sumatra, Indonesia, in 1923 by Baermann from the blood of a patient (Rachmat) suffering from "leptospirosis febrilis". Baermann (1923) differentiated it from other available strains. Subsequently Schüffner (1939) found that the strain behaved serologically as the 'incomplete biotype' of Akiyami A, and in his publication he named the strain Rachmat. Gispén et al. (1939) confirmed these findings.

In the list of 1959 (WHO, 1959) it is quoted as a 'subserotype' named *autumnalis* (A). As the taxon 'subserotype' was abolished in 1966, it appears in the list of 1967 (WHO, 1967) as a separate serovar named *rachmati*, with reference strain Rachmat.

<i>autumnalis</i>	Akiyami A	1925
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During an investigation in September-October, 1922, in the Shizuoka Province of Japan, several leptospiral strains were isolated from blood samples taken from patients suffering from autumn fever (akiyami). Serological studies revealed that the strain designed Akiyami type A, could be differentiated from *icterohaemorrhagiae*, *hebdomadis* and a strain known as Akiyami type B (Koshima et al., 1925).

Comparative studies by Schüffner on strains Akiyami A and Rachmat indicated that strain Akiyami A is the complete biotype of Rachmat (Schüffner, 1939 and Gispén et al., 1939). In the list of 1959 (WHO, 1959) the serovar appears as *autumnalis* "AB", but in the 1967 list (WHO, 1967), the serovar is named *autumnalis*, with reference strain Akiyami A.

<i>bangkinang</i>	Bangkinang I	1932
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The strain was isolated in Sumatra, Indonesia, in 1929 from the blood of a Chinese labourer thought to be suffering from undulant fever (Slot and van der Walle, 1932). They designated

the strain Bangkinang I. Walch Sorgdrager (1939) found the strain to be related to strain Rachmat with some agglutinogenic differences.

The strain was later studied by Wolff et al. (1952), who identified it as a separate serovar. The list of serotypes of 1967 (WHO, 1967) mentions the name *bangkinang* with reference strain Bangkinang I.

butembo

Butembo

1946

The strain was isolated from a human case during a study of leptospirosis in Zaire (formerly Belgium Congo) by van Riel (1946). It was found to be serologically distinct from other serovars available at that time. However, in the subsequent leptospiral classification scheme of Wolff and Broom (1954), it was not listed as a distinct serovar.

Later the strain was studied by Alexander et al. (1959), who described it as a new serovar named *butembo* and suggested it could be conveniently listed with *L. cynopteri* within the same serogroup. Wolff and Bohlander (1961) revised the status of the strain suggesting that it should be recognised as a distinct serovar unrelated to any of the other serovars known. Nevertheless, in the list of 1967 (WHO, 1967) the strain is placed within the *Cynopteri* group.

In Dikken and Kmety's paper (1978) the serovar *butembo* has been withdrawn from the *Cynopteri* serogroup and listed within the serogroup *Autumnalis*, to which it was found to be more closely related. At the TSC meeting in 1986 this arrangement was approved.

erinaceiauriti

Erinaceus auritus 670

1951

The strain was isolated from a hedgehog in the Soviet Union and considered to represent a new serovar. In the original publication of Ananyin (1951) the name of the strain is Yezsh 670 (the Russian word "Yezsh", means hedgehog).

The strain was later studied by Babudieri (1958), who confirmed its separate status. The list of 1967 (WHO, 1967) mentions the serovar name *erinacei-auriti* and its reference strain as *Erinaceus auritus* 670, which has been agreed by the TSC.

fortbragg

Fort Bragg

1952

The strain was isolated by Tatlock in 1944 from the blood of an acutely ill patient (Alexander et al, 1954) which subsequently was maintained in various laboratories by serial animal passages. The causal organism was believed to be a virus until Gochenour et al. (1952) recovered the leptospiral agent from the 259th. serial hamster passage. Preliminary serological studies by these workers indicated that the strain named Fort Bragg was related to strain Akiyami A.

Alexander et al. (1954) came to the conclusion that the strain Fort Bragg is the complete 'biotype' of serovar *autumnalis*. It was therefore considered to be a 'subserotype' of *L. autumnalis* named *fort-bragg*. When the taxon 'subserotype' was abandoned in 1966 (TSC Moscow, 1966), the strain was quoted in the WHO list of 1967 as representing a separate serovar named *fort-bragg*.

In Dikken and Kmety's publication (1978) the serovar *fortbragg* is placed in the subgroup Fort-Braggi.

The strain was isolated from a patient sometime during the years 1953-1955 in Malaysia (Alexander et al., 1957) and described as a new serovar of the *Autumnalis* group.

In the list of 1967 (WHO, 1967) it is quoted as a recognized serovar.

In Dikken and Kmety's publication (1978) the serovar is placed in the subgroup Fort-Braggi.

bulgarica

Nicolaev

1958

The strain was isolated in 1951 by Jankov in Bulgaria from a patient (Mitov, Jankov, Savov, 1955). The authors quote the strain as *Lept.gen.Nicolaev* with the note, that the strain was not definitively identified. Later Babudieri (1958) confirmed its separate serovar status and designated it as *bulgarica*, but later (1961) he considered it to be only a 'subserotype' of serovar *autumnalis*. The taxon 'subserotype' was subsequently abandoned (TSC Moscow, 1966). Therefore in the WHO list of 1967 it appears as serovar *bulgarica* with the reference strain Nicolaev.

In Dikken and Kmety's paper (1978) the serovar is placed in the subgroup Fort-Braggi.

mujunkumi

Yezsh 237

1971

The strain was isolated in 1966 from the kidney of a long-eared hedgehog (*Hemiechinus auritus*) in South Kazakhstan-Soviet Union and described by Chernukha et al. (1971) as a new serovar named *mujunkumi*, closely related to the serovar *erinaceaauriti*.

Because its serological status was confirmed after the Manchester meeting, it was included in the Revised List (1988) with an (o). As it has now been accepted by the TSC, Osaka (1990), it is included in the attached updated list unconditionally with the corrected transcription of the original Russian strain name Yezsh.

carlos

C 3

1973

The strain was isolated in 1970 from the kidney of a toad (*Bufo marinus*) captured near Suralah in the Philippines and described as a new serovar named *carlos*, ref. strain C 3 (Babudieri et al., 1973).

Because the strain did not reveal major serological relationship to any of the known serovars, it was suggested that it might represent a new serogroup named *Bufois*. However, being the only member of that group, the serovar was provisionally placed in the serogroup to which it was most closely related, viz *Autumnalis*.

srebarna

1409/69

1974

The strain was isolated from a shrew mouse (*Sorex araneus*) during 1969 in the game reserve Srebarna, Silistra district of Bulgaria (Mateev et al., 1971).

The strain was studied and described as a new serovar by Manev (1974) named *srebarna* with reference strain 1409/69.

The strain was isolated from an unstripped grass rat (*Arvicanthis niloticus*) in 1968 in the Lambwe Valley, Nyanza Province, Kenya, and described as a new serovar named *lambwe*, ref. strain Lambwe, by Dikken et al. (1981).

bim

1051

1984

The strain was isolated from a kidney of a febrile dog in Barbados and described as a new serovar named *bim*, ref. strain 1051 (Jones et al., 1984).

nanla

A 6

1989

The strain was isolated from the blood of a patient in 1962 in Mengla county, Xishuangbana, Yunnan province, China and described by Zhang Fang-zheng et al. in 1989 as a new serovar in the Autumnalis group. Being not yet confirmed by a RL it is given provisional status (+) in the attached list of serovars.

alice

Alice

The strain was isolated in 1966 from a man in Sri Lanka and is mentioned by Chernukha in the Fifth Int.Exch.in Leptospirosis (WHO, 1968) as a new serovar *alice*, ref. strain Alice. Nityananda and Harvey (1971) considered the strain to represent a new serovar. However conflicting typing results have been reported. It therefore was placed in the Revised List 1988 with ++. Because of the subsequent realisation that no documentation and valid description was given, the serovar is now placed in the Annex of the attached updated serovar list.

weerasinghe

Weerasinghe

The strain was isolated from a patient in Sri Lanka during the period 1965-1966 and is mentioned by Chernukha et al. in the Fifth inf.Exch.in Lept. (WHO, 1968) as a separate serovar named *weerasinghe*.

Nityananda and Harvey (1971) considered the strain to be a new serovar. During the TSC meeting of 1986 the strain was recognized as representing a new serovar and was included in the Revised serovar list (1988). However it was subsequently realized that no typing results and valid description had been published. Consequently the serovar has now been placed in the Annex of the attached updated serovar list.

PYROGENES SEROGROUP - 1923

Serovar	Refence strain	Year of valid description
<i>pyrogenes</i>	Salinem	1923
<i>zanoni</i>	Zanoni	1937
<i>abramis</i>	Abraham	1957
<i>biggis</i>	Biggs	1957
<i>hamptoni</i>	Hampton	1957
<i>robinsoni</i>	Robinson	1962
<i>alexi</i>	HS 616	1963
<i>manilae</i>	LT 398	1963
<i>myocastoris</i>	LSU 1551	1963
<i>camlo</i>	LT 64-67	1971
<i>guaratuba</i>	An 7705	1975
<i>princestown</i>	TRVL 112499	1978
<i>kwale</i>	Julu	1979
<i>varela</i>	1019	1982
<i>menglian</i>	S 621	1988
<i>nigeria</i>	Vom	1989

<i>pyrogenes</i>	Salinem	1923
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The strain was isolated by Baermann in 1924 from the blood of a patient in Sumatra, Indonesia (van Thiel, 1948). It was supposed that this strain is identical to an earlier strain isolated by Vervoort named *L. pyrogenes* (Vervoort, 1923), which is no longer available. The serovar name is therefore associated with the year 1923. Mochtar (1927) was the first investigator to study the strain and to differentiate Salinem from the strain Icterohaemorrhagiae, Hebdomadis, Rachmat, Sumatra, Deli B and saprophytic leptospire isolated from water.

The strain was submitted to factor analysis by Kmety (1967), who confirmed its present status. Later it was suggested that the serovar should be placed in subgroup Pyrogenes (Dikken, Kmety, 1978).

<i>zanoni</i>	Zanoni	1937
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The strain was isolated in 1933 from a patient in Australia by Cotter and Sawers (1934) and studied by Lumley (1937), who tentatively named the group represented by this strain Australis B.

Walch-Sorgdrager et al. (1938) studied the strain in more detail and found it to be closely related to Salinem.

In Wolff and Broom's list of 1954 the strain is placed already within the Pyrogenes group under the serovar name *australis B*, reference strain Zanoni/C 14.

The serovar name was changed later to *zanoni-australis B* (WHO, 1959), but in the 1965 list (WHO, 1965) only the name *zanoni* is given as both the serovar name and strain name. The strain was submitted to factor analysis by Kmety (1967), on the basis of which it was

suggested that the serovar should be placed in subgroup Zanoni (Dikken, Kmety, 1978).

abramis Abraham 1957

The strain was isolated from a patient in Malaysia sometime during the years 1953-1955 and described as a new serovar of the Pyrogenes group named *abramis*, ref. strain Abraham (Alexander et al., 1957).

The strain was submitted to factor analysis by Kmety (1967), who confirmed its separate status and suggested that the serovar should be placed in the subgroup Zanoni (Dikken, Kmety, 1978).

biggis Biggs 1957

The strain was isolated from a patient in Malaysia sometime during the years 1953-1955 and described as a new serovar of the Pyrogenes group named *biggis*, ref. strain Biggs (Alexander et al., 1957).

The strain was submitted to factor analysis by Kmety (1967), who confirmed its separate status. Later it was suggested that the serovar should be placed in the subgroup Zanoni (Dikken, Kmety, 1978).

hamptoni Hampton 1957

The strain was isolated from a patient in Malaysia sometime during the years 1953-1955 and described as a new serovar of the Pyrogenes group named *hamptoni*, ref. strain Hampton (Alexander et al., 1957).

The strain was submitted to factor analysis by Kmety (1967), who confirmed its separate status. Later it was suggested that the serovar should be placed in the subgroup Pyrogenes (Dikken, Kmety, 1978).

robinsoni Robinson 1962

The strain was isolated from a sick canefield worker in North Queensland in 1951 by Smith et al. (1954), who found the strain to be antigenically different from strain Zanoni. The strain was forwarded for further investigation to Broom, who reported that the strain "has a specific antigen which differs from *L. pyrogenes* and *L. australis* B (= *L. zanoni*)" (Alexander, Smith, 1962).

The strain was then studied by Alexander and Smith (1962) and described as a new serovar named *robinsoni*, with ref. strain Robinson.

The strain was later submitted to factor analysis by Kmety (1967), who confirmed its separate serological status. Later it was suggested that the serovar should be placed in the subgroup Pyrogenes (Dikken, Kmety, 1978).

alexi HS 616 1963

The strain was isolated from a patient in Puerto Rico in 1951 and described, after comparison with serovars *pyrogenes* and *zanoni*, as a new serovar named *alexi*, with ref. strain HS 616 (Alexander et al., 1963). The new serovar first appears in the list of 1965

(WHO, 1965). The strain was submitted to factor analysis by Kmety (1967), who confirmed its status. Later it was suggested that the serovar should be placed in the subgroup Pyrogenes (Dikken, Kmety, 1978).

manilae LT 398 1963

The strain was isolated from a rat (*Rattus norvegicus*) in Manila sometime during the years 1957-1959 and described as a new serovar named *manilae*, ref. strain LT 398 (Galton et al., 1963). The new serovar first appears in the list of 1965 (WHO, 1965) with the footnote "Provisional classification pending further work". In the list of 1967 (WHO, 1967) it is included as a recognized serovar.

myocastoris LSU 1551 1963

The strain was isolated from a nutria (*Myocastor coypus*) in the USA in 1962 by Roth et al. (1963), who described it as a new subserovar of *L. zanoni* named *L. zanoni myocastoris*. In the list of 1965 (WHO, 1965) it appears under provisional status and in the list of 1967 (WHO, 1967) as a recognized serovar named *myocastoris*, with ref. strain LSU 1551. The strain was submitted to factor analysis by Kmety (1967) who confirmed its separate status. Later it was suggested that the serovar should be placed in the subgroup Zononi (Dikken, Kmety, 1978).

camlo LT 64-67 1971

The strain was isolated in 1967 from an American marine participating in operations in the Camlo area of South Vietnam and was described by Che-Chung Tsai (1971) as a new serovar of the Pyrogenes group named *camlo*, ref. strain LT 64-67. Discrepant typing results have been recently reported. Therefore the serovar is marked ++ in the Revised List of 1988 (Kmety, Dikken, 1988) and in the attached updated list.

guaratuba An 7705 1975

The strain was isolated from an opossum (*Philander opossum*) in Brazil and described as a new serovar named *guaratuba*, ref. strain An 7705, of the Pyrogenes group (Santa Rosa et al., 1975).

As it has not yet been confirmed by a RL, it is given provisional status (+) in the Revised List of 1988 and in the attached updated list.

princestown TRVL 112499 1978

The strain was isolated in 1971 from the blood of a 15 year old boy from Princetown, Trinidad, West Indies, and described as a new serovar named *princestown*, ref. strain TRVL 112499, in the Pyrogenes group (Green et al., 1978).

As its serovar status was not yet confirmed by a RL, it is marked (+) in the Revised List of 1988. It was subsequently confirmed by a RL, and accepted at the TSC meeting in Osaka, 1990. Therefore it is included unconditionally in the attached updated list of serovars.

Strain Julu was isolated from a schoolboy in the Coast Province of Kenya in 1968 (de Geus, 1971). The isolate appeared to be a member of the *Pyrogenes* group (de Geus, 1977) and was described by Dikken et al. (1979) as a new serovar *kwale*, with reference strain Julu. Its serovar status has been confirmed by a RL.

The strain was isolated in 1964 from an opossum in Nicaragua (Clark, 1966) and published by Sulzer et al. (1982) as a new serovar of the *Pyrogenes* group named *varela*, ref. strain 1019.

Being not yet confirmed by a RL, it is given provisional status (+) on the Revised List (1988) and the attached updated list.

The strain was isolated in 1981 from a man in Yunnan province of China and described by Li Cui-zhi et al. (1988). Its separate serovar status was confirmed by a RL. Not being published at the time of the TSC meeting (Manchester, 1986), the serovar was not included in the Revised List of 1988, but is included in the attached updated list.

The strain was isolated from a bovine kidney obtained from the abattoir in Jos, Nigeria, and described by Ezech et al. (1989) as a new serovar in the *Pyrogenes* group. However in this publication no serovar name is given. Only the laboratory code number of the strain is given as vv 3 JA. But in the following paper by Ezech et al. (1990) the serovar name *nigeria* is proposed. In this paper the strain name Vom is suggested, which should replace the laboratory code. The status of the strain has been confirmed by a RL. It is included in the attached updated list of serovars.

BATAVIAE SEROGROUP - 1926

Serovar	Reference strain	Year of valid description
<i>bataviae</i>	Swart	1926
<i>paidjan</i>	Paidjan	1953
<i>djatzi</i>	HS 26	1963
<i>kobbe</i>	CZ 320	1966
<i>argentinensis</i>	Peludo	1967
<i>brasiliensis</i>	An 776	1972
<i>balboa</i>	735 U	1982
<i>claytoni</i>	1348 U	1982
<i>rioja</i>	MR 12	1984

<i>bataviae</i>	Swart	1926
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Strain Swart was isolated in 1925 by Walch in Weltevreden near Jakarta, Indonesia, from the blood of a patient (Walch, 1926). Walch and Soesilo (1927) described the first serological experiments which distinguished the strain from "Icterohaemorrhagiae and Baerman" (Pyrogenes). At that time no investigations were carried out with hebdomadis and autumnalis strains. The strain was named *L. bataviae* by Esseveld and Collier (1938). In 1932 another strain named van Tienen was isolated from a patient in Indonesia (Dinger, 1933). This strain was examined serologically by the MAT against strains "Icterohaemorrhagiae, Bindjei (Canicola), Bangkinang (Autumnalis) and Swart". High cross-agglutination reactions were noted only against Swart (Dinger, 1943).

Wolff (1954) believed that the original strain Swart (Walch) was lost. Consequently strain van Tienen became the reference strain and is first mentioned in the list of Wolff and Broom (1954). However at that time it was not realised that Mochtar had forwarded the strain Swart (Walch) on May 19, 1942, to Prof. Yamamoto, who kept it for many years. In 1976 he sent the strain to the Amsterdam laboratory. Investigations subsequently performed, confirmed the serological identity of the strains Swart and van Tienen (personal communication, Dikken).

Being earlier isolated and published, strain Swart takes priority over strain van Tienen. During the TSC meeting in Boston (1982) it was decided that strain Swart should replace strain van Tienen as the reference strain of serovar *bataviae*.

<i>paidjan</i>	Paidjan	1953
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The strain was isolated in 1939 in Sumatra, Indonesia, from a human case of leptospirosis and was considered to represent a new serovar of the *Bataviae* group (Wolff, 1953). The strain appeared for the first time in Wolff and Broom's list of 1954 as a separate serovar.

<i>djatzi</i>	HS 26	1963
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The strain was isolated in 1950 from the blood of a patient in Puerto Rico and described as a new serovar named *djatzi* by Alexander et al. (1963).

The strain appears in the list of serovars of 1967 (WHO, 1967).

<i>kobbe</i>	CZ 320	1966
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The strain was isolated from a spiny rat (*Proechimys semispinosus*) in the Panama Canal Zone in 1962 and described as a new serovar of the Bataviae group by Gale et al. (1966). The new serovar appeared for the first time in the list of 1967 (WHO, 1967), with the strain designation CZ 320 K, which has since been corrected to the original CZ 320.

<i>argentiniensis</i>	Peludo	1967
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The strain was isolated from an armadillo (*Choetophractus villosus*) in Argentina in 1963 and was described as a new serovar of the Bataviae group by Szyfres et al. (1967). The serovar represented by this strain was included in the list of recognized serovars of 1967 (WHO, 1967), under the strain designation LT 1019 (laboratory code number). This has now been replaced by the name Peludo as given in the original publication.

<i>brasiliensis</i>	An 776	1972
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The strain was isolated in 1961 from an opossum (*Didelphis marsupialis*) in Brazil and described as a new serovar named *brasiliensis*, ref. strain An 776 (Santa Rosa et al., 1972). The strain had already been studied by Galton under the laboratory code LT 966, which was the strain designation given in the list of 1967 (WHO, 1967). This has now been corrected to the original An 776.

<i>balboa</i>	735 U	1982
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The strain was isolated from the urine of a spiny rat (*Proechimys semispinosus*) in the Panama Canal Zone by Gale (1966) and typed by Galton (WHO, 1967).

It was included in the serovar list of 1967 as a recognized new serovar *balboa*, reference strain LT 761, although no description had been published at that time.

The isolation and the description of the strain was not published until 1982 (Sulzer et al., 1982). In that publication the strain name is designated 735 U, which therefore takes precedence over the laboratory code LT 761.

<i>claytoni</i>	1348 U	1982
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The strain was isolated from the urine of a spiny rat (*Proechimys semispinosus*) caught in the Panama Canal Zone by Gale (1966) and typed by Galton (WHO, 1967).

It was included in the serovar list of 1967 as a recognized new serovar *claytoni*, reference strain LT 818, although no description had been published at that time.

The isolation and the description of the strain first appeared in 1982 (Sulzer et al., 1982). In this publication the name of the strain is given as 1348 U, which therefore replaces the previous designation LT 818.

The strain was isolated in 1970 from an opossum (*Philander opossum*) trapped in the Rioja location in the Peruvian jungle and published as a new serovar named *rioja* (Liceras de Hidalgo et al., 1984). It was recognized at the TSC meeting in Manchester in 1986 as a new serovar of the Bataviae group (Kmety, Dikken, 1988). Its serovar status was confirmed by a RL after that meeting. Therefore it is marked by (o) in the Revised List of 1988. In the updated attached list it is included unconditionally.

GRIPPOTYPHOSA SEROGROUP - 1928

Serovar	Refence strain	Year of valid description
<i>grippotyphosa</i>	Moskva V	1928
<i>valbuzzi</i>	Valbuzzi	1955
<i>canalzonae</i>	CZ 188	1966
<i>vanderhoedeni</i>	Kipod 179	1969
<i>ratnapura</i>	Wumalasena	1970
<i>muelleri</i>	RM 2	1973
<i>huanuco</i>	M 4	1979

<i>grippotyphosa</i>	Moskva V	1928
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Tarassov and Epstein isolated strains from patients with "water-fever" in the Moscow region of the Soviet-Union, studied them serologically and denominated them as *L. grippotyphosa*. No names of strains are mentioned in the original paper (Tarassov, Epstein, 1928).

According to Chernukha (personal communication), Terskikh isolated in 1929 a strain from a patient which was sent to Amsterdam under the designation "Moskva Y". The strain was studied by Dinger (1930), who found it serologically distinct from *Icterohaemorrhagiae* and other strains. This is apparently the strain known today as Moskva V. It is considered to be the reference strain of serovar *grippotyphosa*.

The strain was later submitted to factor analysis (Kmety, Lataste-Dorolle, 1973), which revealed its antigenic structure.

Using monoclonal antibodies strains of this serovar can be further subdivided (Kmety et al. and Ananyina et al., Leptospirosis Research Conference Moskou, 1991).

<i>valbuzzi</i>	Valbuzzi	1955
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The strain was isolated from a patient in North Queensland and described as a new serovar named *valbuzzi* (Smith, Brown, 1955).

The serovar represented by strain Valbuzzi is included in the list of 1967 (WHO, 1967) with the footnote: provisional classification pending further work.

Babudieri considered the strain to be identical to Moskva V. However Dikken found certain differences which were supported by Kokovin (1970).

The strain was submitted to factor analysis which confirmed its separate status (Kmety, Lataste-Dorolle, 1973).

canalzonae

CZ 188

1966

The strain was isolated in 1964 from the kidney of a spiny rat (*Proechimys semispinosus*) in the Panama Canal Zone and described as a new serovar of the Cynopteri group named *canalzoni*, reference strain CZ 188 (Gale et al., 1966).

The serovar was recognized by the TSC and is included in the list of 1967 (WHO, 1967) as a member of the Cynopteri group under the corrected designation *canalzonae*, but with the strain name CZ 188 K. This has now been corrected according the original description to CZ 188.

The strain was submitted to factor analysis by Kmety and Lataste-Dorolle (1973), who on the basis of the results proposed that the serovar should be placed within the Grippotyphosa serogroup, which was accepted by the TSC meeting in Manchester (1986).

vanderhoedeni

Kipod 179

1969

The strain was isolated from the kidney of a long-eared hedgehog (*Hemiechinus auritus*) in Israel and described as a new serovar named *L. van der Hoeden*, ref. strain Kipod 179 (van der Hoeden, Shenberg, Torten, 1969).

The strain was submitted to factor analysis by Kmety and Lataste-Dorolle (1973), who, on the basis of the results, proposed that the strain should be placed only provisionally within the serogroup Grippotyphosa, since it does not share any common main antigen with the other serovars of that group. The name of the serovar was changed to *vanderhoedeni* to accored to the IC.

ratnapura

Wumalasena

1970

The strain was isolated during the period 1965-1966 from a patient in the Ratnapura district of Shri Lanka (Ceylon).

The strain is mentioned in the Fifth Information Exchange in Leptospirosis (1968) by Chernukha et al..

The strain was described by Kokovin and Chernukha (1970), who proposed the serovar name *ratnapura*, with ref. strain Wumalasena.

muelleri

RM 2

1973

The strain was isolated in Malaysia from a rat (*Rattus muelleri*) by Wisseman et al. (1955) and described by Alexander et al. (1955) as a complete biotype of *L. grippotyphosa*, with ref. strain RM 2, although small differences (3-6% residual titre) were found.

Kokovin (1970) mentions the strain as a separate serovar under the name *rattus*.

The strain was submitted to factor analysis by Kmety and Lataste-Dorolle (1973), who found it to represent a new serovar for which the name *muelleri* was proposed. As this last publication gives a valid description of the serovar, the name *muelleri* was accepted by the TSC (Manchester, 1986).

The strain was isolated by Hidalgo in November 1974 from an opossum (*Philander opossum*) trapped in the Huanuco department of Peru. In 1975 the strain was sent to Chernukha in Moscow for further serological identification. On the basis of those results it was described as a new serovar named *huanuco*, with reference strain M 4 and was proposed to belong to a new serogroup Huanuco (Agirre et al., 1979).

Because the strain shows some serological relationship with certain strains of the Grippotyphosa serogroup, especially with Kipod 179, it was tentatively placed in the Grippotyphosa group.

As it was not yet confirmed by a RL the TSC (Manchester, 1986) accepted it on a provisional basis and the serovar was therefore marked (+) in the Revised List of Serovars of 1988. It has since been fully confirmed and appears in the attached updated list unconditionally (TSC, Osaka, 1990).

CANICOLA SEROGROUP - 1933

Serovar	Refence strain	Year of valid description
<i>canicola</i>	Hond Utrecht IV	1933
<i>schueffneri</i>	Vleermuis 90 C	1938
<i>kamituga</i>	Kamituga	1939
<i>benjamini</i>	Benjamin	1940
<i>bafani</i>	Bafani	1946
<i>malaya</i>	H 6	1955
<i>jonsis</i>	Jones	1957
<i>sumneri</i>	Sumner	1957
<i>bindjei</i>	Bindjei	1960
<i>broomi</i>	Patane	1960
<i>galtoni</i>	LT 1014	1969
<i>portlandvere</i>	MY 1039	1982
<i>kuwait</i>	136/2/2	1983

<i>canicola</i>	Hond Utrecht IV	1933
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The strain was isolated from the urine of a sick dog in 1931 in the Netherlands by Klarenbeek and Schüffner (1933). The strain was found to differ from *L. icterohaemorrhagiae* and Schüffner (1934) denominated it "*Leptospira canicola*".

The strain was submitted to factor analysis by Kmety (1967).

<i>schueffneri</i>	Vleermuis 90 C	1938
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The strain was isolated in Indonesia from the brain of a species of a bat (*Cynopterus*) by Collier and Esseveld (1938), who described it as strain 90 C, with agglutination characteristics

different from other known strains. Collier and Mochtar (1939) denominated it "*Leptospira schüffneri*".

The correct transcription of the name "*schueffneri*" appears firstly in 1959 (WHO, 1959). The strain was submitted to factor analysis and it was suggested that it should be placed in the subgroup Schueffneri (Kmety, 1967).

kamituga

Kamituga

1939

The strain was isolated in 1939 from a sick field worker in Kivu, Zaire (former Belgian Congo) by van Riel (van den Berghe, van Riel, 1939). In van Riel's paper (1946) the strain was differentiated by absorption tests from many other strains.

The serovar represented by strain Kamituga first appears in the list of serovars of 1965 (WHO, 1965) under provisional status, but in the list of 1967 (WHO, 1967) it is a recognized serovar.

The strain was submitted to factor analysis and it was suggested that it should be placed in the subgroup Canicola (Kmety, 1967).

benjamini

Benjamin

1940

The strain was isolated from a blood sample of a patient on the east coast of Sumatra, Indonesia, by Wolff in 1937 and studied by agglutination and absorption tests against many strains available at that time, from all of which it was found to differ (Walch-Sorgdrager et al., 1940). They named the strain Benjamin. The serovar represented by strain Benjamin first appears in the list of serovars of 1959 (WHO, 1959), with the serovar name *benjamini*. The strain was submitted to factor analysis and it was suggested that it should be placed in the subgroup Schueffneri (Kmety, 1967).

bafani

Bafani

1946

The strain was isolated from a patient in Zaire (former Belgian Congo) by van Riel (1946). Van Thiel (1948) states that the strain was differentiated by the absorption test from many other strains available at that time.

The serovar represented by strain Bafani first appears in the list of serovars of 1965 (WHO, 1965) under the name *bafani*, with a provisional status, but in the list of 1967 (WHO, 1967) it is listed as a recognized serovar.

The strain was submitted to factor analysis and it was suggested that it should be placed in the subgroup Canicola (Kmety, 1967).

malaya

H 6

1955

The strain was isolated from a patient in Malaysia and described as a new serovar named *malaya*, ref. strain H 6 (Alexander et al., 1955). It appeared already in the list of 1965 (WHO, 1965) as a recognized serovar.

The strain was submitted to factor analysis and it was suggested that it should be placed in the subgroup Schueffneri (Kmety, 1967).

<i>jonsis</i>	Jones	1957
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<i>sumneri</i>	Sumner	1957
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Two identical descriptions. Both strains were isolated from patients in Malaysia and described as new serovars named *jonsis*, ref. strain Jones and *sumneri*, ref. strain Sumner respectively (Alexander et al., 1957). Both strains appear in the list of 1967 (WHO, 1967) as recognized serovars.

The strains were submitted to factor analysis and it was suggested that they should be placed in the subgroup *Canicola* (Kmety, 1967).

<i>bindjei</i>	Bindjei	1960
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The strain was isolated from a patient in Indonesia in the 1930's by Sarditjo and later studied by Addamiano (1959) and Addamiano, Babudieri and Smith (1960).

Addamiano described the strain as a 'complete biotype' of *L. canicola*, no serovar name is mentioned. Only the following study by Addamiano et al. (1960) suggested the serovar name *bindjei*, ref. strain Bindjei. It appears in the list of 1965 (WHO, 1965) as a recognized serovar.

The strain was submitted to factor analysis and it was suggested that it should be placed in the subgroup *Canicola* (Kmety, 1967).

<i>broomi</i>	Patane	1960
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The strain was isolated from a patient in Australia in 1954 and later studied and described as a new serovar named *broomi*, ref. strain Patane (Addamiano et al., 1960). It appears in the list of 1965 (WHO, 1965) as a recognized serovar.

The strain was submitted to factor analysis and it was suggested that it should be placed in the subgroup *Canicola* (Kmety, 1967).

<i>galtoni</i>	LT 1014	1969
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The strain was isolated in 1964 from the kidneys of a cow in Azul, Argentina and studied at C.D.C. Atlanta (WHO, 1967). The description of the strain was published by Tedesco et al. (1969). These authors suggested the name *galtoni*.

The strain appeared in the list of 1967 (WHO, 1967) with the serovar name "*azuli*". However the name *azuli* is now considered illegitimate being not validly published.

<i>portlandvere</i>	MY 1039	1982
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The strain was isolated from the blood of a human patient in Jamaica and published by Sulzer (1982) as a new serovar named *portlandvere*, with ref. strain MY 1039. Its serovar status was confirmed by a RL after the TSC meeting, Manchester 1986, and is therefore marked by (o) on the Revised List (1988). In the updated attached list it is included unconditionally.

The strain was isolated in 1979 from the kidneys of a brown rat (*Rattus norvegicus*) trapped near Kuwait City by Bezjak (1983), and described by Terpstra (1983) as a separate serovar named *kuwait*, ref. strain 136/2/2.

AUSTRALIS SEROGROUP - 1937

Serovar	Refence strain	Year of valid description
<i>australis</i>	Ballico	1937
<i>lora</i>	Lora	1942
<i>muenchen</i>	München C 90	1942
<i>fugis</i>	Fudge	1957
<i>bratislava</i>	Jez Bratislava	1960
<i>jalna</i>	Jaľná	1960
<i>hawain</i>	LT 62-68	1971
<i>peruviana</i>	V 42	1973
<i>soteropolitana</i>	R 93	1976
<i>ramisi</i>	Musa	1979
<i>nicaragua</i>	1011	1982
<i>rushan</i>	507	1984
<i>bajan</i>	Toad 60	1991

<i>australis</i>	Ballico	1937
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The strain was isolated by Cotter and Sawers from a patient in North Queensland during an outbreak of leptospirosis in 1934 (Cotter, Sawers, 1934). Lumley (1937) described the strain as representing a new serogroup named "Australis A". The new serovar first appeared in the list of Wolff and Broom (1954).

The strain was submitted to factor analysis by Kmety (1960), who confirmed its separate serological status. In Dikken and Kmety's publication (1978) the whole Australis group is subdivided into two subgroups: Australis and Jalna. Ballico is the representative strain of the subgroup Australis.

<i>lora</i>	Lora	1942
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The strain was isolated in 1941 from a patient in Italy by Mino (1942), who indicated its serological relationship with type "Australis B", but no names were mentioned. The strain was submitted to factor analysis by Kmety (1960) and found to represent a separate serovar. The serovar name *lora* was proposed. It appeared already in the list of 1965 (WHO, 1965) under provisional status. In the list of 1967 (WHO, 1967) it is quoted as a recognized serovar. In Dikken and Kmety's publication (1978) it is placed in the subgroup Australis.

The strain was isolated by Rimpau (1942) from a patient in Germany, who considered it to belong to the former Australis B group (later named Pyrogenes group). In this publication no name of the isolate is given. Wolff (1953) found the strain to be different from Ballico. It appears already in 1954 in the list of Wolff and Broom as a recognized serovar *muenchen* with strain name München C 90 in the Australis group.

The strain was submitted to factor analysis (Kmety, 1960) and later it was suggested that it should be placed in the subgroup Jalna (Dikken and Kmety, 1978).

fugis

Fudge

1957

The strain was isolated from a patient in Malaysia and described as a new serovar named *fugis*, ref. strain Fudge (Alexander et al., 1957).

The strain was submitted to factor analysis by Kmety (1960). Later it was suggested that it should be placed in the subgroup Australis (Dikken and Kmety, 1978).

bratislava

Jež Bratislava

1960

The strain was isolated in Czechoslovakia from the kidney of a hedgehog (*Erinaceus roumanicus*) in 1953 (Kmety, 1954). It was later submitted to factor analysis and described as a new serovar named *bratislava* (Kmety, 1960).

In Dikken and Kmety's publication (1978) it is placed in the subgroup Jalna.

A footnote in the list of serotypes of 1967 (WHO, 1967) states that the nomenclature of this serovar is being examined further. Doubts concerning the naming of this serovar occurred because both names *L. erinacei europaei* and *L. esposito* appeared in literature of 1954 (Ananyin), and 1955 (Smith and Brown) respectively, but neither publication contained a valid description of the serovar.

jalna

Jalná

1960

The strain was isolated in Czechoslovakia from the kidney of a yellow-necked field mouse (*Apodemus flavicollis*) in 1953 (Kmety, 1954). It was later submitted to factor analysis and described as a new serovar named *jalna*, ref. strain Jalná (Kmety, 1960).

In Dikken and Kmety's publication it represents the subgroup Jalná (Dikken, Kmety, 1978).

hawain

LT 62-68

1971

The strain was isolated from the urine of a bandicoot (*Echymipera kalabu*), which was trapped in the surroundings of Wewak, Sepik district of Papua New Guinea and described as a new serovar *hawain* in the Australis or Panama group (Morahan, 1971). Typing results were not given. Being confirmed by a RL the serovar was recognized by the TSC in 1986 (Manchester) as a separate serovar within the Australis serogroup (Kmety, Dikken, 1988).

The strain was isolated in 1962 from cattle in Peru by Hidalgo and Herrer and studied by Galton (WHO, 1967). Although an official description of the serovar was not published, it appeared in the list of serovars of 1967 (WHO, 1967), under provisional status, named *peruviana*, ref. strain LT 941 (CDC code number).

The strain was described by Hidalgo (1973), who gave the name of the strain as V 42 instead of LT 941. The strain was also submitted to factor analysis (Kmety, unpublished data), and is listed in Appendix V. of Dikken and Kmety's publication (1978) as a member of the *Australis* subgroup.

Strain R 93 was isolated from a cavia (*Cavia aperca azarae*) trapped near Salvador, Bahia state, and was described as a new serovar of the *Australis* group, named *soteropolitana* (Silva, 1976). As the separate serovar status had not yet been confirmed, it is listed under provisional status (+) in the Revised List (Kmety, Dikken, 1988) and the attached updated list. Strain R 93 is probably the strain sent out to the reference laboratories under the designation *Solteropolitana*. In the Instituto Superiore di Sanita in Rome the strain is maintained under the original name R 93.

The strain was isolated by de Geus (1971) from the blood sample of a 30 years old weeder working in the Ramisi sugar cane fields, Kwale district, Coast Province, Kenya, and described as a separate serovar named *ramisi*, ref. strain Musa by Dikken et al. (1979).

The strain was isolated from a weasel (*Mustela nivalis*) in Nicaragua by Clark and studied by Galton (WHO, 1967), who suggested the name *nicaragua*.

Although an official description of this serovar was not yet published, it was included in the list of serovars of 1967 (WHO, 1967), under provisional status, named *nicaragua*, ref. strain LT 990 (CDC laboratory code number).

The strain was submitted to factor analysis by Kmety (unpublished data), and is quoted in Appendix V. of Dikken and Kmety's publication (1978) as a member of the subgroup *Australis*.

The strain was published by Sulzer et al. (1982), who quoted the name of the reference strain as 1011. This designation replaces the former laboratory code LT 990.

The strain was isolated in 1980 from a *Bombina orientalis* in Rushan county, Shandong province, China, and described as a member of the *Australis* group in a paper "The taxonomy of *leptospira interrogans* in China" by Gao Ji-yuan et al. (1984) (in Chinese). The strain was recognized as representing a separate serovar by the TSC (Manchester, 1986). The original paper gives an incomplete documentation. The strain is therefore marked by i.d.

The strain was isolated in 1985 on the island of Barbados during an investigation on leptospirosis in toads, from the kidney of a (giant) marine toad (*Bufo marinus*) (Everard et al., 1988). The strain has been typed in 3 reference laboratories by cross-agglutinin absorption tests and was also studied by monoclonal antibodies and restriction endonuclease analysis (Gravekamp et al., 1991). On basis of the results of those investigations the strain was recognized as a separate serovar. They suggested the serovar name *bajan*, with strain name Toad 60. Bajan is the local word for Barbados.

The strain was not described at the time the Revised List (Kmety, Dikken, 1988) was published. As its separate serological status was confirmed by a RL, the strain was included in the Annex of that list.

As the serovar recently has been published, it is now removed from the Annex and placed as a member of the Australis group in the attached updated list.

POMONA SEROGROUP - 1937

Serovar	Reference strain	Year of valid description
<i>pomona</i>	Pomona	1937
<i>mozdok</i>	5621	1965
<i>tropica</i>	CZ 299	1966
<i>proechimys</i>	1161 U	1982
<i>tsaratsovo</i>	B 81/7	1982
<i>kunming</i>	K 5	1984

<i>pomona</i>	Pomona	1937
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During an outbreak of seven-day fever occurring in a dairy-farming community near Pomona in North Queensland (Australia), Clayton et al. (1937), isolated this strain in 1936 from the blood of a patient.

They found the strain antigenically distinct from other serovars known to them. Lumley (1937) and Johnson & Brown (1938) also compared the strain with other strains and confirmed the previous findings. Later Derrick (1942), after having studied 80 cases concluded that the strain Pomona represented a new serovar which he named *pomona*.

The serovar is already quoted in the list of Wolff & Broom of 1954.

<i>mozdok</i>	5621	1965
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The strain was isolated in 1961 from the kidney of a common field vole (*Microtus arvalis*), trapped in the Mozdok district of North Ossetica, Soviet Union, by Semenova (1965), who considered it to be a subserovar of *pomona*. Chernukha (1966) confirmed its separate status. However in comparative studies Kmety (1970) did not find sufficient serological differences between strain 5621 and Pomona to justify its separate status. Similar findings were reported by Borg-Petersen (1974). In contrast Nicolescu and Moldoveanu (1974) confirmed

again its separate status, which was supported by comparative factor analysis studies of Manev (1976).

Terpstra carried out studies with monoclonal antibodies and considered the strain to be a separate serovar (Terpstra et al., 1987). The strain was already included in the list of 1967 under provisional status, and was recognized as representing a separate serovar by the TSC in 1986.

<i>tropica</i>	CZ 299	1966
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The strain was isolated in 1962 from the urine of a Spiny rat (*Proechimys semispinosus*) in the Panama Canal Zone by Gale et al. (1966), who described it as a new serovar designated *tropica*, ref. strain CZ 299.

Results of factor analysis studies by Manev (1976) confirmed that *tropica* has a separate serovar status.

<i>proechimys</i>	1161 U	1982
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The strain was isolated in the Panama Canal Zone from a Spiny rat (*Proechimys semispinosus*) by Gale and typed by Galton (WHO, 1976).

It was included in the list of 1967 (WHO, 1967) under provisional status under the name *proechimys*, with reference strain LT 796. Its separate serovar status has been confirmed by Manev (1976), using factor analysis (Manev, 1976). Only in the publication of 1982 by Sulzer et al. are further details given including the name of the reference strain as 1161 U, which had to replace the former laboratory code LT 796.

<i>tsaratsovo</i>	B 81/7	1982
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The strains B 52 and B 81 were isolated from harvest mice (*Micromys minutus*), in the Plovdiv district of Bulgaria by Ivanov in 1962. They were considered to constitute a new serovar named *tsaratsovo* with type strain B 52 (Manev, 1974-1975).

However during further studies by Manev and others on subcultures and cloned cultures of the strain B 52, it was found that it changed its characteristics and appeared to be identical to these of serovar *mozdok* (Manev, 1982). The strain B 81 and its clone B 81/7 received by Bakoss, kept the original described antigenic characteristics.

Manev therefore proposed to consider the well studied clone B 81/7 as the new type strain of the *tsaratsovo* serovar (1982). Using the monoclonal antibody technique, Terpstra et al. (1987) considered the strain to represent a separate serovar. However Hathaway et al. (1985), using cross agglutinin absorption and restriction endonuclease analysis, did not reveal sufficient differences between the serovars *tsaratsovo* and *mozdok*. Therefore the strain is listed as giving controversial typing results (++) (Kmety, Dikken, 1988).

<i>kunming</i>	K 5	1984
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Strain K 5 was isolated from a mouse (*Apodemus chevrieri*) in Kunming City in Yunnan province (China) and was described by Gao Ji-yuan et al. (1984) as a new serovar *kunming* with reference strain K 5 in the serogroup Pomona. Its serovar status was confirmed by a RL. The strain was recognized as representing a separate serovar by the TSC (Manchester, 1986).

Because of incomplete documentation the strain is listed with i.d. (Kmety, Dikken, 1988).

JAVANICA SEROGROUP - 1938

Serovar	Reference strain	Year of valid description
<i>javanica</i>	Veldrat Batavia 46	1938
<i>poi</i>	Poi	1942
<i>sorexjalna</i>	Sorex Jalná	1955
<i>coxi</i>	Cox	1957
<i>sofia</i>	Sofia 874	1961
<i>ceylonica</i>	Piyasena	1969
<i>menoni</i>	Kerala	1981
<i>fluminense</i>	Aa 3	1981
<i>A 85</i>	A 85	1984
<i>dehong</i>	De 10	1984
<i>menrun</i>	A 102	1984
<i>yaan</i>	80-27	1984
<i>mengma</i>	S 590	1988
<i>zhenkang</i>	L 82	1988

<i>javanica</i>	Veldrat Batavia 46	1938
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Twelve of the strains isolated in 1938 from fieldrats (*Rattus rattus brevicaudatus*) trapped near Ambarawa, Indonesia, (Sardjito et al., 1937) were studied by Esseveld et al. (1938). Eleven were found to represent a new serovar *javanica* with type strain R. Ambawara 94 (RA 94).

Previously in 1937 Esseveld had isolated in Jakarta (Batavia), Java, Indonesia, leptospiral strains from cats, among them the well studied strain K 49, which gave similar agglutination reactions to RA 94. Therefore Esseveld and Collier (1938) concluded that strain K 49 belonged to the recently described serovar *javanica*.

During that period Esseveld, Collier and Mochtar investigated about 3000 trapped animals near Jakarta (Batavia), Java (Gispen 1939). During that investigation strain Veldrat Batavia 46 was probably isolated. In a previous publication Esseveld (1938) quoted this strain as the reference strain for serovar *javanica*. The strain was submitted to factor analysis by Kmety (1963), who confirmed its serological status.

It can be concluded that strain K 49 is one of the original isolates which was used as the reference strain during the early investigations to represent this serovar. It was believed that this strain was lost during the Second World War. Later it was found that strain K 49 was kept in the Eykman Institute, Jakarta (Batavia) and sent by Mochtar to Prof. Yamamoto during May 1942. In 1976 Prof. Yamamoto forwarded the strain to the reference laboratory in Amsterdam, where it was typed and found to belong to the same serovar as Veldrat Batavia 46.

Since strain K 49 and Veldrat Batavia 46 were isolated and described during the same period in 1938, both strains could have been considered as reference strains. However Veldrat

Batavia 46 has for long been used as such and therefore takes precedence.

<i>poi</i>	Poi	1942
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The strain was isolated in 1941 by Mino (1942) from a patient suffering from leptospirosis in Italy and designated as Poi. By comparative serological studies Wolff (1953) found that the strain showed a strong serological relationship with Veldrat Batavia 46. Preliminary absorption tests proved the close affinity between those strains. The strain already appeared in the list of 1954 (Wolff and Broom) as a separate serovar. This was confirmed by Kmety (1963), who studied the strain by factor analysis.

<i>sorexjalna</i>	Sorex Jalná	1955
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The strain was isolated by Kmety in 1953 from a common shrew mouse (*Sorex araneus*) trapped near Jalná in Czechoslovakia. Comparative agglutination tests (Kmety, 1955) differentiated the strain as a possible new serovar. Factor analysis studies (Kmety, 1963) confirmed its separate serological status. The strain appeared for the first time in the list of 1967 (WHO) as a separate serovar.

<i>coxi</i>	Cox	1957
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The strain was isolated between 1953 and 1956 from a patient in Malaysia. Alexander (1957) studied the strain and described it as a new serovar named *coxus*. Under this name it appears in the WHO list of 1965. The strain was further studied by Kmety (1963), who confirmed its separate serological status and corrected the name in *coxi*, which is in accord with the IC. In the WHO list of 1967 it is listed as *coxi*.

<i>sofia</i>	Sofia 874	1961
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This Bulgarian strain was isolated in 1958 by Mateev from a patient in Sofia. It was described by Babudieri (1961) as a new serovar of the Javanica serogroup. He designated the serovar name as *sofia*. The strain is included in the WHO list of 1967 as a separate serovar.

<i>ceylonica</i>	Piyasena	1969
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The strain was isolated in 1964 by Nityananda from a baker living near Colombo, Sri Lanka (Ceylon), and was included in Annex 2 of the list of 1967 (WHO, 1967) although not yet published. In this list the strain name is given as Dyananda of serovar *ceylonica*. Nityananda and Sulzer described the strain in 1969 and designated it Piyasena, which takes precedence over Dyananda.

<i>menoni</i>	Kerala	1981
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The strain was isolated in 1970 from the kidney of a bandicoot (*Bandicota bengalensis*) trapped in Mannuthy, India, and described by Dikken et al. (1981) as a new serovar named *menoni* with reference strain Kerala.

The strain was isolated in 1970 from the kidney of a field mouse (*Akodon arviculoides*) trapped in the district of Seropédica, State of Rio de Janeiro by Cordeiro et al. (1981, a and b), who studied the strain and described it as a new serovar named *fluminense*, with reference strain Aa 3. Its serovar status has not yet been confirmed by a RL and it is consequently listed under "provisional" status (+) in the Revised List of 1988 (Kmety, Dikken, 1988), and in the attached updated list.

A 85

A 85

1984

The strain was isolated in 1970 from a patient in the province of Yunnan, China, and described by Gao et al. (1984) as a new serovar named A 85, reference strain A 85. Its serovar status was confirmed by a RL. The TSC (Manchester, 1986) recognized the serovar in spite of its incorrect naming which is expected to be changed into *menгла* (Chen Ting-zuo: personal communication).

Because of incomplete documentation the strain is listed with i.d. in the Revised List of 1988 (Kmety, Dikken, 1988), and in the attached updated list.

dehong

De 10

1984

The strain was isolated from a rat in 1981 in the province of Yunnan and described by Gao et al. (1984) as a new serovar named *dehong*, reference strain De 10. Confirmed serologically by a RL, it was recognized by the TSC (Manchester, 1986). Because of incomplete documentation the strain is listed with i.d. in the Revised List of 1988 (Kmety, Dikken, 1988), and in the attached updated list.

menrun

A 102

1984

The strain was isolated in 1970 from a patient in the province of Yunnan, China, and described by Gao et al. (1984) as a new serovar named *menrun*, reference strain A 102. Its serovar status was confirmed by a RL, and it was therefore recognized by the TSC (Manchester, 1986). Because of incomplete documentation the strain is listed with i.d. in the Revised List of 1988 (Kmety, Dikken, 1988), and in the attached updated list.

yaan

80-27

1984

The strain was isolated in 1989 from a species of rat (*Crocidura platycephala*) in Ya'an county, Sichuan province, China, and described by Gao et al. (1984) as a new serovar named *yaan*, reference strain 80-27. Its serovar status was confirmed by a RL and it was therefore recognized by the TSC (Manchester, 1986). Because of incomplete documentation the strain is listed with i.d. in the Revised List of 1988 (Kmety, Dikken, 1988), and in the attached updated list.

The strain was isolated in 1986 from a man in Yunnan province of China and described as a new serovar named *mengma*, reference strain S 590, by Li Cui-zhi et al. (1988). Being not yet confirmed by a RL it is included in the attached updated list under provisional status (+).

zhenkang

L 82

1988

The strain was isolated from a house rat (*Rattus flavipectus*) in Yunnan province of China and described as a new serovar named *zhenkang*, reference strain L 82, by Li Cui-zhi et al. (1988). No confirmative typing results are known, and it is therefore included in the attached updated list under provisional status (+).

SEJROE SEROGROUP - 1938

Serovar	Refence strain	Year of valid description
<i>sejroe</i>	M 84	1938
<i>saxkoebing</i>	Mus 24	1944
<i>medanensis</i>	Hond HC	1948
<i>wolffi</i>	3705	1948
<i>hardjo</i>	Hardjoprajitno	1953
<i>haemolytica</i>	Marsh	1957
<i>ricardi</i>	Richardson	1957
<i>balcanica</i>	1627 Burgas	1961
<i>polonica</i>	493 Poland	1964
<i>geyaweera</i>	Geyaweera	1968
<i>gorgas</i>	1413 U	1977
<i>istrica</i>	Bratislava	1977
<i>recreo</i>	380	1977
<i>roumanica</i>	LM 294	1977
<i>trinidad</i>	TRVL 34056	1977
<i>caribe</i>	TRVL 61866	1978
<i>dikkeni</i>	Mannuthi	1978
<i>nyanza</i>	Kibos	1978
<i>guaricura</i>	Bov.G.	1980

sejroe

M 84

1938

The strain was isolated in 1937 from the kidney of a house mouse (*Mus musculus spicilegus*) in Denmark and described as a new serovar named *sejroe*, reference strain M 84 (Borg-Petersen, 1938). The strain appeared for the first time in the list of 1954 (Wolff and Broom) in the Hebdomadis serogroup. The strain was submitted to factor analysis by Kmety (1977), who confirmed its separate serological status and placed it in subgroup Sejroe.

The strain was isolated in 1942 from the kidney of a yellow necked field mouse (*Apodemus flavicollis*) in Denmark and described as a new serovar named *saxkoebing*, reference strain Mus 24 (Borg-Petersen, 1944). It appeared for the first time in the list of 1954 (Wolff and Broom) in the Hebdomadis serogroup.

The strain was submitted to factor analysis by Kmety (1977), who confirmed its separate serological status and placed it in subgroup Saxkoebing.

medanensis

Hond HC

1948

Hond HC is one of the strains isolated in 1929 from healthy dogs in Sumatra, Indonesia, by Kouwenaar and Wolff (1929). In the original publication no names of strains are given. The strain was later designated by Wolff as Hond HC (personal communication).

The strain was studied by Walch-Sorgdrager and Bohlander (1939) and later by Borg-Petersen (1944). The first authors treated the strain as a representative of a group of strains which they designated H.C. Borg-Petersen refers to "type hc strain HC" or "H.C.". Collier (1948) suggested the serovar name *medanensis*. The strain appears in the first serovar list of 1954 (Wolff, Broom, 1954) under the strain name H.C. In the WHO list of 1959 the name Hond HC is used officially for the first time. The strain was submitted to factor analysis by Kmety (1977), who, on the basis of the results, suggested that it should be placed in the subgroup Wolffi.

wolffi

3705

1948

The strain was isolated in 1937 from a human case of leptospirosis in Sumatra, Indonesia, by Wolff (1954). It had been previously mentioned by Schüffner (1938) as "L. 3705 (Wolff)" and later by Borg-Petersen (1944), who studied its serological properties. Collier (1948) suggested the serovar name *wolffi*. The strain name 3705 was used for the first time in the first serovar list of 1954 (Wolff, Broom, 1954). The strain was submitted to factor analysis by Kmety (1977) and placed in the subgroup Wolffi.

hardjo

Hardjoprajitno

1953

The strain was isolated in 1938 from a patient in Sumatra, Indonesia, by Wolff (1953), who quotes it under the serovar name *hardjo*. The serovar is first mentioned in the list of Wolff and Broom of 1954.

The strain was submitted to factor analysis by Kmety (1977), who, on the basis of the results, placed it in the subgroup Wolffi.

By DNA restriction endonuclease analysis differences among strains of this serovar were reported (Thiermann and Ellis, 1986). They suggest deviding the serovar into two different genotypes *hardjoprajitno* and *hardjobovis*.

The strain was isolated during the years 1953-1955 from a patient in Malaysia by Alexander et al. (1957), who described it as a new serovar named *haemolyticus*. In the serovar list of 1967 (WHO, 1967) the name was corrected in *haemolytica*.

The strain was submitted to factor analysis by Kmety (1977) and placed in the subgroup Saxkoebing.

ricardi

Richardson

1957

The strain was isolated in the years 1953-1955 from a patient in Malaysia by Alexander et al. (1957), who described it as a new sub-serovar named *ricardi*.

The strain appears for the first time in the list of 1959 (WHO, 1959) as a 'sub-serovar' of *haemolytica*. But in the 1967 list (WHO, 1967) it is given separate serovar status within the Hebdomadis serogroup. It was submitted to factor analysis by Kmety (1977) and placed in the newly established subgroup Saxkoebing of serogroup Sejroe.

balcanica

1627 Burgas

1961

The strain was isolated in 1958 by Janev from a patient in Bulgaria. Babudieri and Mateev (1961) studied the strain and described it as a 'subserotype' of *sejroe* named *balcanica*.

The strain appears for the first time as such in the list of 1965 (WHO, 1965). After the abolition of the taxon 'subserotype' it appears in the serovar list of 1967 (WHO, 1967) as a separate serovar within the Hebdomadis serogroup.

The strain was submitted to factor analysis by Kmety (1977), who placed it as a separate serovar in the subgroup Sejroe of the newly established serogroup Sejroe.

polonica

493 Poland

1964

The strain was isolated in Poland in 1957 from a hedgehog (*Erinaceus roumanicus*) by Parnas and Cybulska (1965), who described it as a new serovar named *polonica*. Wolff and Bohlander (1964) studied the strain and confirmed its separate serological status. This last paper appeared earlier than the publication in which the original findings were published. The description is therefore attached to the year 1964. The serovar appears for the first time in the list of 1965 (WHO, 1965).

The strain was submitted to factor analysis by Kmety (1977) and placed in the by him suggested subgroup Sejroe of serogroup Sejroe.

geyaweera

Geyaweera

1968

The strain was isolated in 1965 from a patient in Sri Lanka by Pura and described by Kokovin et al. (1968) as a new serovar of the Hebdomadis group named *geyaweera*. The new serovar was found by Wolff (personal communication) to be related to *sejroe*, *saxkoebing* and *haemolytica*. Therefore it was placed in the Revised List (1988) in the Sejroe group (Kmety, Dikken, 1988). It should be noted that in some papers the serovar name is quoted as *jeyaweera* (Nityananda et al., 1971).

The strain was isolated from the urine of a spiny rat (*Proechimys semispinosus*) in the Panama Canal Zone by Gale and studied by Galton (WHO, 1967). Before any description was published, the strain appeared in Annex 2 of the WHO list (1967) under the laboratory code LT 829 as the reference strain, with the serovar name *gorgas*.

The strain was submitted to factor analysis by Kmety (1977) and described as a new serovar of the subgroup Wolffi of the serogroup Sejroe. The first full report with confirmatory typing results was published by Sulzer et al. (1982). In this publication the strain designation 1413 U is given, which receives priority over the code number LT 829. The serovar *gorgas* was officially recognized by the TSC in 1986 and included in the Revised list of 1988 (Kmety, Dikken, 1988).

istrica

Bratislava

1977

The strain was isolated in 1954 from the kidney of a yellow necked fieldmouse (*Apodemus flavicollis*) in the Danube region of Czechoslovakia (Kmety, Pleško, 1956).

Factor analysis revealed its separate serological status (Kmety, 1977). The serovar name *istrica* was given, and it was suggested that it should be placed in the subgroup Sejroe of the Sejroe serogroup.

recreo

380

1977

The strain, isolated from an opossum (*Philander opossum*) in Nicaragua by Clark et al. (1966), was typed by Galton under the laboratory code LT 957 (WHO, 1967). Before any description was published, the strain appeared under provisional status in the serovar list of 1967 (WHO, 1967) with the serovar name *recreo*.

The strain was submitted to factor analysis and described as a new serovar (Kmety, 1977) and it was suggested that it should be placed in the subserogroup Wolffi of the serogroup Sejroe.

Confirmative typing results by agglutinin-absorption test method were not published until 1982 (Sulzer et al., 1982). In this publication the original strain designation 380 is given, which therefore takes priority over the code number.

roumanica

LM 294

1977

The strain was isolated in 1966 from a house mouse (*Mus musculus*) in Roumania by a working group of the Institute of Hygiene in Iasi (Nicolescu, 1976). In this paper the serovar name *iassy* is used although in the same paper there is a table summarising the results of factor analysis carried out by Kmety (submitted by correspondence) in which the name *roumanica* is given. The first complete valid description including the serovar name *roumanica* was given only in 1977 when Kmety published his results of his factor analysis studies of the Hebdomadis serogroup. Since this is considered as the first valid description, the serovar name *roumanica* with reference strain LM 294 has been accepted by the TSC (Manchester, 1986). In this paper Kmety suggests to place the serovar in the subgroup Wolffi of the newly established serogroup Sejroe.

The strain was isolated from a patient in Trinidad by Spence et al. (1972) and published as a new serovar *trinidad*, strain TVRL 34056. Galton (WHO, 1967) typed the strain and gave it the laboratory code LT 1098. The strain appeared under this code number in the official WHO list of 1967 with provisional status.

The strain was submitted to factor analysis and described as a new serovar of the subgroup Wolffi of the newly established serogroup Sejroe (Kmety, 1977). A full report with confirmative serotyping results was published by Sulzer et al. (1982). In this publication the strain designation TRVL 34056 is given, which receives priority over the code number LT 1098.

The strain was isolated in 1965 from the kidney of a brown rat (*Rattus norvegicus*), captured in the dockland area of Port of Spain-Trinidad. The strain was studied serologically and described as a new serovar *caribe* by Green et al. (1978). The serovar *caribe* was officially recognized by the TSC in 1986 and included in the Revised List of 1988 (Kmety, Dikken, 1988).

The strain was isolated by Adinarayanan in 1970 from the kidneys of a healthy looking bandicoot (*Bandicota bengalensis*) trapped in India, Kerala State. It was studied by Dikken et al. (1978) and found to be a new serovar of the subgroup Saxkoebing and was named *dikkeni*, reference strain Mannuthi. The serovar *dikkeni* was officially recognized by the TSC in 1986 and included in the Revised List of 1988 (Kmety, Dikken, 1988).

The strain was isolated in 1969 from a sick boy in Kenya by de Geus (1971) and studied by Dikken et al. (1978). The name *nyanza* was suggested for the new serovar, with reference strain Kibos. It conforms to the Saxkoebing subgroup. The serovar *nyanza* was officially recognized by the TSC in 1986 and is included in the Revised List of 1988 (Kmety, Dikken, 1988).

The strain was isolated from the kidney of a healthy cow during a survey for leptospirosis in Zebu cattle in Brazil from 1962 to 1968. The strain was designated as Bov.G. and described as a new serovar by Santa Rosa (1980). As the name should be treated adjectively in accordance with the IC, the suggested serovar name *guaricurus* was changed to *guaricura*. The serovar *guaricura* was officially recognized by the TSC in 1986 and included in the Revised List of 1988 (Kmety, Dikken, 1988).

CYNOPTERI SEROGROUP - 1939

Serovar	Refence strain	Year of valid description
<i>cynopteri</i>	3522 C	1939
<i>tingomaria</i>	M 13	1984

<i>cynopteri</i>	3522 C	1939
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The strain was isolated in 1938 by Collier and Mochtar from a kidney of a bat (*Cynopterus*), captured in Jakarta (Batavia), Java, Indonesia. The strain did not appear to be pathogenic for mice or guinea-pigs. Cross-agglutination tests carried out at the Eijkman Institute, Jakarta, showed that the strain was not related to any of the available serovars and therefore they considered it to be a new serovar (Collier et al., 1939). In the review article on "Leptospirosis in Indonesia" (Collier, 1948) the serovar was named *L. cynopteri*. The strain appears first in the list of serovars of 1959 (WHO, 1959) as a recognized serovar in the Cynopteri serogroup.

<i>tingomaria</i>	M 13	1984
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The strain was isolated in 1970 from the kidney of an opossum (*Didelphis marsupialis*) in the Peruvian jungle. The strain is described by Licerias de Hidalgo et al. (1984) as a new serovar named *tingomaria* with reference strain M 13 in the serogroup Cynopteri. In this publication the serovar name *tingomariensis* is also mentioned, which may cause confusion. Since it was still not confirmed by a RL, the strain was included in the Revised List of 1988 (Kmety, Dikken, 1988) under "provisional" status. As its serovar status has been confirmed recently by a RL, it is now included unconditionally in the attached updated list.

DJASIMAN SEROGROUP - 1939

Serovar	Refence strain	Year of valid description
<i>djasiman</i>	Djasiman	1939
<i>sentot</i>	Sentot	1940
<i>gurungi</i>	Gurung	1957
<i>huallaga</i>	M 7	1984
<i>agogo</i>	Agogo	1986

<i>djasiman</i>	Djasiman	1939
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The strain was isolated by Kotter in 1938 from an acutely ill native in the Military Hospital of Koetaradja, Atjeh, Sumatra, Indonesia. The isolate was typed by Schüffner and described by Kotter (1939) as a new serovar named *djasiman*. It appears first in the list of 1954 (Wolff and Broom, 1954) as also representing a new serogroup Djasiman. In the list of 1967 (WHO,

1967) the serovar is listed in the Autumnalis group. In 1978 the serogroup Djasiman was reestablished by Dikken and Kmety (1978) containing the serovars *djasiman*, *sentot*, and *gurungi*. This rearrangement was accepted by the TSC (Manchester, 1986).

sentot

Sentot

1940

The strain was isolated in 1937 from a patient living in East-Sumatra, Indonesia, by the staff of the Laboratory for Pathology in Medan. The isolate was considered to be a separate serovar related to *djasiman* (Walch-Sorgdrager, 1940). The strain appears for the first time in the list of 1959 as representing a separate serogroup (WHO, 1959). In the WHO list of 1967 the strain was placed in the Autumnalis group. However, when Dikken and Kmety (1978) reestablished the serogroup Djasiman, they included *sentot* in it. The TSC (1986) accepted this proposal.

gurungi

Gurung

1957

The strain was isolated during 1953-1955 from the blood of a patient in Malaysia and described by Alexander et al. (1957) as a new serovar *gurungi*, reference strain Gurung. In the WHO list of 1967 the serovar was placed in the Autumnalis group. When Dikken and Kmety (1978) reestablished the serogroup Djasiman, they placed the serovar within that serogroup. The TSC (1986) accepted this proposal.

huallaga

M 7

1984

The strain was isolated in 1970 from the kidney of an opossum (*Didelphis marsupialis*) at Tingo Maria in the Peruvian jungle and published as a new serovar named *huallaga*, reference strain M 7 by Liceras de Hidalgo et al. (1984). The serovar was confirmed by a RL soon after the TSC Manchester meeting (1986) and is therefore marked in the Revised List of 1988 by (o) (Kmety, Dikken, 1988). It is now included unconditionally in the attached updated list.

agogo

Agogo

1986

The strain was isolated from the urine of a jaundiced boy of 12 years old admitted to the Agogo Presbyterian Hospital, Ghana. (Hogerzeil et al., 1986). The paper mentions that the strain was typed in the RL in Amsterdam and considered to be a new serovar closely related to *sentot*, serogroup Djasiman. The serovar name *agogo*, with reference strain Agogo is proposed.

As the serovar was not published at the time of the TSC meeting in Manchester (1986) but known to be typed as a separate serovar by a RL, it was placed in the Annex of the Revised List of 1988. Since then it has been published and is therefore now removed from the Annex to the main list. Since no typing results are given in Hogerzeil's paper, it is marked by i.t. in the attached updated list.

SARMIN SEROGROUP - 1939

Serovar	Refence strain	Year of valid description
<i>sarmin</i>	Sarmin	1939
<i>weaveri</i>	CZ 390	1966
<i>waskurin</i>	LT 63-68	1971
<i>rio</i>	Rr 5	1981
<i>machiguenga</i>	MMD 3	1984
<i>cuica</i>	RP 88	1991

<i>sarmin</i>	Sarmin	1939
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The strain was isolated by Kotter (1939) from a patient in Indonesia in 1930. The strain was later studied by Wolff (1953). In Wolff and Broom's list (1954) the strain is listed as representing a separate serogroup. Being the only member of that group it was tentatively attached to the Icterohaemorrhagiae group in the list of 1967 (WHO, 1967). In Dikken and Kmety's monograph (1978) the serovar *sarmin* is considered as member of a subgroup Sarmin of the Icterohaemorrhagiae serogroup. The TSC decided in 1986 to restore the separate st atus of serogroup Sarmin because related serovars had been described in the meantime.

<i>weaveri</i>	CZ 390	1966
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The strain was isolated from urine of a patient in the Panama Canal Zone in 1961 and described as a new serovar of the Icterohaemorrhagiae serogroup (Gale et al., 1966). In Dikken and Kmety's publication (1978) it was proposed that the strain should be listed as a member of the Sarmin subgroup of the Icterohaemorrhagiae serogroup. However, in the Revised List of 1988 it is included in the reestablished Sarmin serogroup (Kmety and Dikken, 1988).

<i>waskurin</i>	LT 63-68	1971
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The strain was isolated in 1967 from a bandicoot (*Echimidipera kalabu*) in New Guinea and was published as a new serovar of the Javanica or Celledoni group named *waskurin*, reference strain LT 63-68 (Morahan, 1971).

In a letter of 1973 to the TSC, Babudieri stated the strain's close affinity to *sarmin* and suggested that it should be placed in the Icterohaemorrhagiae group.

In Dikken and Kmety's publication of 1978 the strain is listed as a member of the Sarmin subgroup.

At the time of the TSC meeting in Manchester (1986) its serovar status had not yet been confirmed by a RL. It was therefore included in the Revised List (1988) under provisional status (+)(Kmety, Dikken, 1988). Later its serovar status was confirmed by a RL and therefore it was recognized by the TSC (Osaka, 1990) and is placed in the attached updated list unconditionally within the Sarmin group.

The strain was isolated in May 1973 from the kidney of a black rat (*Rattus rattus*) trapped alive in the district of Seropédica State of Rio de Janeiro (Cordeiro et al., 1981, a and b), who studied and described the strain as a new serovar within the Javanica serogroup. The serovar name *rio* was proposed. Being found to be serologically more related to members of the reestablished Sarmin group, it was placed in that group in the Revised List (1988), but under provisional status (Kmety, Dikken, 1988), as its serovar status had not yet been confirmed by a RL.

machiguenga

MMD 3

1984

The strain was isolated in 1970 from the kidney of an opossum (*Philander opossum*) trapped in the Peruvian jungle near Puerto Maldonado and was published by Licerias de Hidalgo et al. (1984) as a new serovar named *machiguenga*, reference strain MMD 3, in the Icterohaemorrhagiae serogroup. Being found to be serologically more related to members of the reestablished Sarmin group, it was placed in that group in the Revised List (1988), but still under provisional status (Kmety, Dikken, 1988). Later its serovar status was confirmed by a RL and recognized by the TSC (Osaka, 1990). It is therefore included in the attached updated list unconditionally.

cuica

RP 88

1991

The strain was isolated, during a search for leptospirosis in wild animals, from the urine or kidney of an Marsupial opossum (*Metachirus opossum*) trapped in a peri-urban area of Rio de Janeiro, Brazil, by Pereira et al. (1991), who studied and described the strain as closely related to serovar *weaveri*. Further studies by a RL confirmed its separate serovar status. The serovar name *cuica* has been proposed (personal communication Korver, 1991). Cuica is the local name for marsupial.

Because of incomplete description and documentation the serovar is listed with i.t. and i.d. in the attached updated serovar list.

MINI SEROGROUP - 1941

Serovar	Refence strain	Year of valid description
<i>mini</i>	Sari	1941
<i>szwajizak</i>	Szwajizak	1956
<i>georgia</i>	LT 117	1960
<i>perameles</i>	Bandicoot 343	1964
<i>beye</i>	1537 U	1977
<i>tabaquite</i>	TRVL 3214	1977
<i>ruparupae</i>	M 3	1984
<i>hekou</i>	H 27	1988
<i>yunnan</i>	A 10	1988

Sari is one of the strains isolated in 1940 from patients in Northern Italy by Mino (1941), who considered them to be closely related, but not identical to serovar *sejroe*. Babudieri (1956) studied the strain and described it as a new serovar which he named *mini*. The strain was submitted to factor analysis by Kmety (1977), who suggested that it should be placed in a new serogroup named Mini. The TSC accepted this suggestion during the Boston meeting in 1982, and consequently this serovar appears in the Revised List (1988) in the new serogroup Mini.

szwajizak

Szwajizak

1956

The strain was isolated in 1952 from a patient in North Queensland, Australia, by Smith et al. (1954). Babudieri (1956) studied the strain and described it as an incomplete biotype of *mini*.

Wolff and Bohlander (1958) checked the serological status of the strain and considered it to be a new serovar which they named *szwajizak*.

In the serovar list of 1959 (WHO, 1959) the strain is listed as a subserovar of *mini*, within the Hebdomadis group, but in the list of 1967 (WHO, 1967) serovar *szwajizak* is reported as a separate serovar.

The strain was submitted to factor analysis by Kmety (1977), who confirmed its separate serological status and proposed placing it in the new Mini serogroup. During the TSC Boston meeting of 1982) this proposal was accepted.

georgia

LT 117

1960

The strain was isolated in 1952 from a raccoon (*Procyon lotor*) in the United States and described as a new subserovar of *mini*, named *georgia* (Galton et al., 1960).

In the list of 1967 (WHO, 1967) the strain is reported as a separate serovar within the Hebdomadis group.

The strain was submitted to factor analysis by Kmety (1977), who confirmed its serovar status and suggested placing it in the proposed new Mini serogroup.

During the TSC Boston meeting of 1982 this proposal was accepted.

perameles

Bandicoot 343

1964

The strain was isolated in 1958 from a bandicoot (*Perameles nasuta*) in North Queensland, Australia, by Emanuel. It was studied by Wolff and Bohlander (1964), who described it as a new serovar named *paramelis* of the Hebdomadis serogroup. This name was later corrected to *perameles* (WHO, 1967). The strain was submitted to factor analysis by Kmety (1977), who confirmed its serovar status and suggested placing it in the proposed new Mini serogroup.

During the TSC Boston meeting of 1982 this proposal was accepted.

The strain was isolated during the years 1960-1962 from the urine of a spiny rat (*Proechimys semispinosus*) trapped in the Panama Canal Zone by Gale and typed by Galton (WHO, 1967). No typing results were published. The official serovar list of 1967 (Annex 1) does not contain this strain, however it is mentioned in Annex 2 of this list under the name *beye*, with strain code LT 844.

The strain was submitted to factor analysis by Kmety (1977), who described it as representing a new serovar of the proposed new Mini serogroup. Later Sulzer et al. (1982) confirmed its separate serological status by agglutinin-absorption test results, but designated the reference strain as 1537 U. The serovar *beye* was recognized by the TSC Manchester meeting of 1986 and the previous laboratory code number of the reference strain was replaced by the designation 1537 U in the Revised List of 1988.

tabaquite

TRVL 3214

1977

The strain was isolated in 1965 from a patient in Trinidad by Spence et al. (1972) and was considered to represent a new serovar named *tabaquite*, reference strain TVRL 3214. No typing results were given.

The strain was apparently typed by Galton (WHO, 1967), but no results were published. The Annex 1 of the official list of 1967 does not contain this strain, however in Annex 2 of this list the strain is mentioned under the incorrect designation TVRL 34056 (see also serovar *trinidad*).

The strain was submitted to factor analysis by Kmety (1977), who confirmed its serovar status and suggested placing it in the proposed new Mini serogroup. During the TSC Boston meeting of 1982 this proposal was accepted.

Its serovar status was finally confirmed by agglutinin-absorption test method by a RL after the TSC Manchester meeting of 1986. It was therefore listed by (o) in the Revised List (1988), but it is included in the attached updated list, unconditionally.

ruparupae

M 3

1984

The strain was isolated from the kidney of an opossum (*Didelphis marsupialis*) in 1970 at Tingo Maria in the Peruvian jungle and published as a new serovar of the Sejroe group, named *rupa rupa* - reference strain M 3 (Liceras de Hidalgo et al., 1984). In accordance with the rules of the code the serovar designation was contracted to one word *ruparupae*. Further investigations showed its closer relationship with the members of the Mini group. Serovar *ruparupae* was recognized by the TSC in 1986 and it was placed in the Mini serogroup in the Revised List (Kmety and Dikken, 1988), but marked by (o), since its serovar status was confirmed by a RL after the 1986 TSC meeting. It will be included in the attached updated list, unconditionally.

hekou

H 27

1988

The strain was isolated in 1964 from the blood of a patient in Hekou County, China, and described as a new serovar of the enlarged Hebdomadis group by Zhang Fang-zengh et al., 1988. Because of its close relationship with members of the Mini group, it was placed in that

group. The serovar got "provisional status" as it has not yet been confirmed by a RL (+). This was accepted by the TSC (Osaka, 1990).

yunnan A 10 1988

The strain was isolated in 1962 from the blood of a patient in Mengla County, China, and described as a new serovar of the enlarged Hebdomadis group by Zhang Fang-zheng et al., 1988. Because of its close relationship with members of the Mini group, it was placed in that group. The serovar got "provisional status" as it has not yet been confirmed by a RL (+). This was accepted by the TSC (Osaka, 1990).

TARASSOVI SEROGROUP - 1941

Serovar	Refence strain	Year of valid description
<i>tarassovi</i>	Perepelitsin	1941
<i>kisuba</i>	Kisuba	1956
<i>bakeri</i>	LT 79	1957
<i>atlantae</i>	LT 81	1960
<i>guidae</i>	RP 29	1960
<i>atchafalaya</i>	LSU 1013	1963
<i>bravo</i>	Bravo	1966
<i>rama</i>	316	1966
<i>tunis</i>	P 2/65	1969
<i>kaup</i>	LT 64-68	1971
<i>vughia</i>	LT 89-68	1971
<i>navet</i>	TRVL 109873	1978
<i>kanana</i>	Kanana	1981
<i>chagres</i>	1913 K	1982
<i>darien</i>	637 K	1982
<i>gatuni</i>	1473 K	1982
<i>banna</i>	A 31	1985
<i>gengma</i>	M 48	1985
<i>mengpeng</i>	A 82	1985
<i>mogdeni</i>	Compton 746	1987
<i>yunxian</i>	L 100	1988

tarassovi Perepelitsin 1941
(Previously named *mitis*, than *hyos*, with reference strain Mitis Johnson)

The strain named Mitis Johnson was isolated in Australia from the blood of a sick man (ox-driver) and described as a new serovar named *mitis* (Johnson, 1942).

Previously, however Mino (1938) had used the serovar name *mitis* to designate strains of leptospires isolated in Nothern Italy, which Gispén and Schüffner (1939) identified as *L.*

bataviae. The name *mitis* therefore was rejected for both the Australian and the Italian strains.

Savino and Renella (1944) isolated from man and pigs in Argentina leptospiral strains which they believed to constitute a new serovar for which they proposed the name *hyos*. Babudieri (1951) found *hyos* to be serologically identical with the strain Mitis Johnson. The name *hyos* was therefore considered to be the oldest legitimate epithet for the new serovar represented by that strain (Broom, 1952).

In 1938 Tarassov isolated, in the Primoria region of the Soviet Union, a strain from a patient named Perepelitsin. The clinical picture symptoms and signs of this infection was described by Terskikh et al. (1941). After the death of Tarassov the strain was studied by Kiktenko and Ananyin (1941), who found it to be different from other strains and designated it as L. DV-A. No strain name is mentioned in this publication. Varfolomeyeva compared the strain by cross-absorption tests with strain Mitis Johnson and suggested the serovar name *tarassovi* (1958).

DV-A is an abbreviation of "Dalnyj Vostok" (= Far East). As the use of abbreviations are not in accordance with Rule 14 of the Code, the TSC decided at the Moscow meeting (1966) to adopt the serovar name *tarassovi*. This name appeared already in the serovar list of 1967 (WHO, 1967) with Perepelicin as name of the reference strain. Because this strain was for many years not available to most laboratories it was decided, as an exception, to allow both strains, Perepelicin and Mitis Johnson, to act as reference strains until 1982, when alone Perepelicin was recognized as the reference strain of serovar *tarassovi*.

Since Perepelicin is an incorrect transcription of the in Russian written name of the patient, its correct transcription Perepelitsin is now introduced as strain name and used as such in the attached updated list of serovars.

<i>kisuba</i>	Kisuba	1956
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The strain was isolated from a patient in Zaire (former Belgian Congo) by Van Riel et al. (1956). In the list of 1965 (WHO, 1965) it is first mentioned as a separate serovar named *kisuba*, ref. strain Kisuba.

Wolff and Bohlander (1960) studied the strain and approved its separate serological status.

<i>bakeri</i>	LT 79	1957
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The strain was isolated in 1955 from the kidney of an opossum (*Didelphis marsupialis*) in the state Georgia, United States and described as a new serovar named *bakeri*, reference strain LT 79 (Galton et al., 1957).

The strain was studied by Wolff and Bohlander (1960), who considered it as a 'subserovar' of *L. tarassovi*. Since the taxon subserotype was abandoned in 1966 (TSC Moscow, 1966), *bakeri* appears as a separate serovar on the list of 1967 (WHO, 1967).

<i>atlantae</i>	LT 81	1960
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The strain was isolated in 1955 from the kidney of an opossum (*Didelphis marsupialis*) in the state Georgia, United States, by Galton et al. (1957). Although in this paper some serological differences from other members of the *Tarassovi* serogroup are reported, the

strain was not described as a new serovar. Only Wolff and Bohlander (1960) studied the strain and proved that it represents a new serovar which they named *atlantae*, with reference strain LT 81.

guidae RP 29 1960

The strain was isolated in 1948 from a pig in Brasil by Guida (1948), who also did some serological typing (Guida, 1952). However, Wolff and Bohlander (1960) described the strain as a new 'subserovar' of *L. tarassovi*, named *guidae*, ref. strain RP 29. The strain is first mentioned in the list of 1965 (WHO, 1965) as a separate serovar.

atchafalaya LSU 1013 1963

The strain was isolated from an opossum (*Didelphis marsupialis*) in the State of Louisiana, United States, and was described as a new serovar named *atchafalaya*, ref. strain LSU 1013, by Roth et al. (1963). It is already included in the list of 1967 (WHO, 1967) as a recognized serovar.

bravo Bravo 1966

The strain was isolated in 1961 from the urine of a patient in the Panama Canal Zone and described as a new serovar named *bravo*, ref. strain Bravo, by Gale et al. (1966). The strain is included in the list of 1967 (WHO, 1967) as a recognized serovar.

rama 316 1966

The strain was isolated from an opossum (*Philander opossum*) in 1962 in Nicaragua and described as a new serovar named *rama*, ref. strain 316, by Clark et al. (1966). The strain was studied and reported by Galton (WHO, 1967) and is first recorded in the serovar list of 1967 (WHO, 1967) under provisional status with the laboratory code LT 955. The serovar was finally recognized by the TSC in 1986, and is included in the Revised List of 1988 with the original reference strain designation 316 (Kmety, Dikken, 1988).

tunis P 2/65 1969

The strain was isolated in 1965 from the kidney of a pig in Tunis and described as a new serovar named *tunis*, ref. strain P 2/65, by Bakoss (1969). The new serovar was recognized by the TSC in 1986 and included in the Revised List of 1988 (Kmety, Dikken, 1988).

kaup LT 64-68 1971

The strain was isolated in 1967 from a bandicoot (*Echymipera kalabu*) in New Guinea and published to be a new serovar named *kaup*, ref. strain LT 64-68 by Morahan (1971). The serovar was recognized by the TSC in 1986 (Manchester, 1986). Because of incomplete documentation in the original publication, the strain is marked by i.d. in the Revised List of serovars of 1988 (Kmety, Dikken, 1988).

vughia

LT 89-68

1971

The strain was isolated from the blood of a patient in South Vietnam and described as a new serovar named *vughia*, ref. strain LT 89-68, by Tsai and Sulzer (1971). The new serovar was recognized by the TSC in 1986 and is included in the Revised List of 1988 (Kmety, Dikken, 1988).

navet

TRVL 109873

1978

The strain was isolated in 1971 from the blood of a 15 year old boy in the village of Navet, Trinidad, and described as a new serovar named *navet*, ref. strain TRVL 109873 (Green, 1978). The new serovar was recognized by the TSC 1986 and is included in the Revised List of 1988 (Kmety, Dikken, 1988).

kanana

Kanana

1981

The strain was isolated in 1967 from a gerbil (*Tatera robusta*) captured near Ramisi, Kwale District, Coast Province, Kenya by Njenga and described by Dikken et al. (1981) as a new serovar named *kanana* with reference strain Kwale. The new serovar was recognized by the TSC in 1986 and is included in the Revised List of 1988 (Kmety, Dikken, 1988).

chagres

1913 K

1982

The strain was isolated from a spiny rat (*Proechimys semispinosus*) in the Panama Canal Zone by Gale and reported as having been studied by Galton (WHO, 1967). The strain was included in the serovar list of 1967 (WHO, 1967) under provisional status, with the laboratory code LT 924. The isolation and description of the strain was first published in 1982 (Sulzer et al., 1982). In this publication the designation of the strain is given as 1913 K, which should receive priority over the former laboratory code number.

darien

637 K

1982

The strain was isolated from the kidney of an opossum (*Philander opossum*) in the Panama Canal Zone and published as a new serovar named *darien*, ref. strain 637 K, by Sulzer et al. (1982).

In the Revised List of Kmety and Dikken (1988) the strain is marked by i.t. indicating incomplete typing results.

gatuni

1473 K

1982

The strain was isolated from an opossum (*Didelphis marsupialis*) in the Panama Canal Zone by Gale and reported to have been studied by Galton (WHO, 1967). The strain was included in the serovar list of 1967 (WHO, 1967) under provisional status with the laboratory code LT 839. The isolation and description of the strain was first published in 1982 (Sulzer et al., 1982). In this publication the name of the reference strain is given as 1473K, which should receive priority over the former laboratory code LT 839.

The strain was isolated in 1962 from the blood of a patient in Mengla County, China, and described by Zhang Fang-zheng et al. (1985) as a new serovar of the Tarassovi or Shermani serogroup. Being not yet confirmed by a RL it is given provisional status (+) and is tentatively placed in the Tarassovi group in the attached updated list. This was accepted by the TSC (Osaka, 1990).

The strain was isolated in 1960 from the kidney of a pig in Gengma County, China, and described by Zhang Fang-zheng et al. (1985) as a new member of the Tarassovi serogroup. Being not confirmed by a RL, it is given provisional status (+) in the attached updated list. This was accepted by the TSC (Osaka, 1990).

The strain was isolated in 1970 from the blood of a patient in Mengla County, China, and described by Zhang Fang-zheng et al. (1985) as a new serovar of the Tarassovi or Shermani serogroup. Being not yet confirmed by a RL, it is given provisional status (+), and is tentatively placed in the Tarassovi group in the attached updated list. This was accepted by the TSC (Osaka, 1990).

The strain was isolated in England in 1977 from human sewage effluent (the liquid portion which after aeration is allowed to drain into the waterways) by the staff of the Microbiol. Dep. of the Inst. for Research in Animal Diseases at Compton-Berkshire (Cinco et al, 1980). It was found to be closely related to strains within the Tarassovi serogroup and described as a new serovar named *mogdeni*, reference strain Compton 746 (Coghlan et al, 1987).

The strain was isolated in 1986 from a pig in Yunnan province, China, and described by Li Cui-zhi et al. (1988). Its serovar status has not yet been confirmed. Therefore this serovar is listed under provisional status (+) in the attached updated list. This was accepted by the TSC (Osaka, 1988).

BALLUM SEROGROUP - 1944

Serovar	Refence strain	Year of valid description
<i>ballum</i>	Mus 127	1944
<i>castellonis</i>	Castellòn 3	1955
<i>arborea</i>	Arborea	1965
<i>kenya</i>	Njenga	1981
<i>ballum 3</i>	1853	1984

<i>ballum</i>	Mus 127	1944
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Borg-Petersen (1944) isolated the strain Mus 127 from the urine of a field-house mouse (*Mus musculus spicilegus*), and described it as a new serovar *ballum*. It appears in the serovar list of 1959 (WHO, 1959). The strain was submitted to factor analysis by Kmety (1967), which confirmed its separate serological status.

<i>castellonis</i>	Castellòn 3	1955
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The strain was isolated from a wood mouse (*Apodemus sylvaticus dicrurus*) in the East of Spain near Castellon de la Plana (between 1953-1955). It was described by Babudieri (1955) and named *castellonis*, strain Castellòn 3. The serovar is included in the serovar list of 1959 (WHO, 1959). The strain was submitted to factor analysis by Kmety (1967), which confirmed its separate serovar status.

<i>arborea</i>	Arborea	1965
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The strain was isolated in 1955 from a wood mouse (*Apodemus sylvaticus*), captured at Arborea-Sardegna, Italy (Babudieri and Moscovici, 1955), and was described by Thomakos and Babudieri (1965) as a new serovar named *arboreae*, reference strain Arborea. Because the suffix, -eae, is used for the designation of families, the serovar name was corrected to *arborea*. The strain was submitted to factor analysis by Kmety (1967), which confirmed its separate serovar status. The strain is included in the list of serovars of 1967 (WHO, 1967).

<i>kenya</i>	Njenga	1981
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The strain was isolated in April 1968 by Njenga from a pouched rat (*Saccostomys campestris*) in the Lambwe Valley, Nyanza Province, Kenya, and described by Dikken et al. (1981) as a new serovar named *kenya*. They considered the strain to represent a new serogroup named Kenya. However, being the only member of that group and having certain affinities to members of the Ballum group, the strain has been provisionally attached to this group.

<i>ballum 3</i>	1853	1984
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The strain was isolated in 1971 from a rat (*Rattus lesea*) captured in the province of Guangdong, China, and described by Gao et al. (1984) as a new serovar named *ballum 3*. The TSC

(Manchester, 1986) recognized the serovar, in spite of its incorrect naming, which is expected to change to *guangdong* (personal communication Chen Ting-Zuo, 1987). Because of incomplete documentation the strain is listed with i.d. in the Revised List (Kmety, Dikken, 1988).

CELLEDONI SEROGROUP - 1956

Serovar	Refence strain	Year of valid description
<i>celledoni</i>	Celledoni	1956
<i>whitcombi</i>	Whitcomb	1957
<i>anhoa</i>	LT 90-68	1971
<i>hainan-whitcombi</i>	6712	1984
<i>javanica 4</i>	M 6906	1984

<i>celledoni</i>	Celledoni	1956
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The strain was isolated in 1952 from the blood of a patient in North Queensland, Australia, by Smith et al. (1954) and described as a new serovar, named *celledoni*, reference strain Celledoni, by Broom and Smith (1956). It appears for the first time in the serovar list of 1959 (WHO, 1959) as representing a separate serogroup. The strain was submitted to factor analysis by Kmety (1963), which confirmed its serological status.

<i>whitcombi</i>	Whitcomb	1957
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The strain was isolated in 1953 from a patient in Malaysia and described as a new 'subserovar' of *celledoni*, named *whitcombi*, reference strain Whitcomb, by Alexander et al. (1957). It appears for the first time in the serovar list of 1959 (WHO, 1959) as a 'subserovar' of *celledoni*, but in the list of 1967 it is recorded as a recognized separate serovar. The strain was submitted to factor analysis by Kmety (1963), which confirmed its serological status.

<i>anhoa</i>	LT 90-68	1971
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The strain was isolated in 1968 from a patient in South Vietnam and described as a new serovar in the Javanica group named *anhoa*, reference strain LT 90-68 (Tsai, Sulzer, 1971). Because of its closer relationship with the members of the Celledoni group, it is listed in Dikken and Kmety's publication (1978) as a separate serovar of the Celledoni group. The new serovar was recognized by the TSC (1986) and is included in the list of 1988 as a member of the Celledoni group (Kmety and Dikken, 1988).

<i>hainan-whitcombi</i>	6712	1984
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The strain was isolated from a patient in Hainan province, China, in 1967 and described by Gao et al. (1984) as a new serovar named *hainan-whitcombi*. The serovar was recognized

by the TSC (Manchester, 1986) in spite of its incorrect naming, which it is expected to change to *hainan* (personal communication, Chen Ting-zuo, 1987). Because of incomplete documentation the serovar is listed with i.d. in the Revised List of 1988 (Kmety, Dikken, 1988). Recently some laboratories have reported controversial typing results. Therefore the serovar is now marked by ++ in the attached updated list.

javanica 4

M 6906

1984

The strain was isolated from a patient in the Yunnan province, China, in 1969 and described by Gao et al. (1984) as a new serovar named *javanica* 4. Its serological status has been confirmed by a RL. The serovar was recognized by the TSC (Manchester, 1986) in spite of its incorrect naming, which it is expected to change to *mengdeng* (personal communication, Chen Ting-Zuo, 1987). Because of incomplete documentation the serovar is listed with i.d. in the Revised List (Kmety, Dikken, 1988).

LOUISIANA SEROGROUP - 1964

Serovar	Refence strain	Year of valid description
<i>louisiana</i>	LSU 1945	1964
<i>orleans</i>	LSU 2580	1964
<i>lanka</i>	R 740	1971

louisiana

LSU 1945

1964

The strain was isolated from the kidney of an armadillo (*Dasypus novemcinctus*) in the state of Louisiana of the United States and described as a new serovar of the Autumnalis group named *louisiana*, reference strain LSU 1945 (Roth et al., 1964). It appears in the WHO "list of serotypes" (1967) within the Autumnalis serogroup. However, Dikken and Kmety (1978) considered that this serovar represents a new serogroup, which they named Louisiana. This proposal was accepted by the TSC in 1982 (Boston) and serovar *louisiana* is placed within the Louisiana serogroup in the Revised List of 1988 (Kmety and Dikken, 1988).

orleans

LSU 2580

1964

The strain was isolated from the kidney of a nutria (*Myocastor coypus*) in the state of Louisiana of the United States and described as a new serovar of the Autumnalis group named *orleans*, with reference strain LSU 2580, (Roth et al., 1964).

Dikken and Kmety (1978) suggested placing this serovar within the new serogroup Louisiana. Serovar *orleans* was recognized by the TSC in 1986 and was placed in the Louisiana serogroup. It appears as such in the Revised List of 1988 (Kmety and Dikken, 1988).

The strain was isolated in 1967 from a patient in Ceylon and described as a new serovar of the Autumnalis group named *lanka*, reference strain R 740 (Nityananda, Sulzer, 1971). Serovar *lanka* was recognized by the TSC in 1986 and was placed according to the suggestion of Dikken and Kmety (1978) within the new Louisiana serogroup. It appears as such in the Revised List of 1988 (Kmety, Dikken, 1988).

PANAMA SEROGROUP - 1966

Serovar	Refence strain	Year of valid description
<i>panama</i>	CZ 214	1966
<i>mangus</i>	TRVL/CAREC 137774	1978
<i>cristobali</i>	1996 K	1982

<i>panama</i>	CZ 214	1966
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The strain was isolated in 1962 from the kidney of an opossum (*Didelphis marsupialis*) trapped in the Panama Canal Zone and described by Gale et al. (1966) as a new serovar named *panama*, reference strain CZ 214 of an undetermined serogroup.

In the WHO list of 1967 the serovar appears as a member of a separate serogroup named Panama.

<i>mangus</i>	TRVL/CAREC 137774	1978
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The strain was isolated from a mongoose (*Herpestes auropunctatus*) caught in November 1973 at Chaguaramas, north-west Trinidad and described by Green et al. (1978) as a new serovar named *mangus*, reference strain TVRL/CAREC 137774, of the Panama group. As the strain still requires confirmation by a RL, it was included in the Revised List (Kmety and Dikken, 1988) under provisional status (+).

<i>cristobali</i>	1996 K	1982
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The strain was isolated about 1965 from the kidney of an opossum (*Didelphis marsupialis*) in the Panama Canal Zone by Gale and was typed by Galton (WHO, 1967). In the serovar list of 1967 (WHO, 1967) the strain appears only in Annex 2 with reference strain designation LT 940. The isolation and description of the strain was not published until 1982 (Sulzer et al. 1982). In this publication the designation of the strain is given as 1996 K, which takes priority as the first published strain designation over the previous laboratory code LT 940.

RANARUM SEROGROUP - 1972

Serovar	Reference strain	Year of valid description
<i>ranarum</i>	ICF	1972
<i>evansi</i>	267-1348	1975
<i>pingchang</i>	80-412	1984

<i>ranarum</i>	ICF	1972
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The strain was isolated from the kidney of a leopard frog (*Rana pipiens*) in 1964 in Iowa, United States, by Diesch et al. (1966). The strain did not show any serological relationship to any other leptospiral strain except a very low cross-reactivity with a strain of serovar *ballum*. Babudieri (1972) studied the strain, confirmed its separate status and considered it to represent a new serovar, which he named *ranarum*, with reference strain ICF. It did not show any pathogenic properties in laboratory animals. Cinco (personal communication, 1986) studied the strain and considered it to belong to the parasitic species *Leptospira interrogans*. The serovar was recognized by the TSC (Manchester, 1986), and along with serovar *evansi*, it was considered to form a separate serogroup known as Ranarum. Shortly after, its serovar status was confirmed by a RL and it is therefore marked by (o) in the Revised List of 1988 (Kmety and Dikken, 1988). In the attached updated list it is included unconditionally.

<i>evansi</i>	267-1348	1975
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The strain was isolated from Malaysian surface water in the state of Selangor during the years 1961-1966 by Alexander et al. (1975) and described as a new serovar serologically related to serovar *ranarum*. The name *evansi* was suggested with reference strain 267-1348. The TSC (Manchester, 1986) recognized the separate status of serovar *evansi* and placed it in the Ranarum serogroup (Kmety, Dikken, 1988). Since the serovar status was confirmed after the Manchester meeting (1986), it is marked by (o) in the Revised List (Kmety, Dikken, 1988). In the attached updated list it is included unconditionally.

<i>pingchang</i>	80-412	1984
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The strain was isolated from the kidney of a frog (*Rana nigromaculata*) in 1980 in the county of Pingchang, Sichuan province of China and described as a new serovar of the Ranarum serogroup by workers of the Sichuan Sanitary and Anti-Epidemic Station in 1984. The serovar status of this strain has been confirmed by a RL. Therefore the serovar is included in the attached updated list unconditionally.

MANHAO SEROGROUP - 1978

Serovar	Reference strain	Year of valid description
<i>manhao 4</i>	Li 130	1978
<i>manhao 2</i>	L 105	1979
<i>lincang</i>	L 14	1981

<i>manhao 4</i>	Li 130	1978
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The strain was isolated in 1973 from the blood of a patient in Lichuan County, Jiangxi province of China, and described by Luo Heng-sheng et al. (1978) as a new serovar named *manhao 4*, reference strain Li 130. Later the strain was studied by factor analysis by Qin Jin-cai et al., 1981, who confirmed its separate status. The serovar was recognized by the TSC (Manchester, 1986) in spite of its incorrect naming, which is expected to be changed to *lichuan* (personal communication, Zhang Fang-zheng, 1988). Its serovar status has been confirmed by a RL. Because of incomplete documentation the serovar is marked by i.d. in the Revised List (Kmety, Dikken, 1988), and the attached updated list.

<i>manhao 2</i>	L 105	1979
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The strain L105 was isolated from the blood of a patient during an investigation on leptospirosis (1964-1965) in the Manhao area of Mengzi County, Yunnan province of China, by a working group of the Institute of Military, Kunming (1979). The strain was described as a new serovar named *manhao 2*, reference strain L105 (laboratory code no. 56615). Later the strain was studied by factor analysis by Qin Jin-cai et al. (1981), who confirmed its separate status. The serovar was recognized by the TSC (Manchester, 1986) in spite of its incorrect naming, which is expected to be changed in *qingshui* (personal communication, Zhang Fang-zheng, 1988). Its serovar status has been confirmed by a RL. Because of incomplete documentation the serovar is marked by i.d. in the Revised List (Kmety, Dikken, 1988), and the attached updated list.

<i>lincang</i>	L 14	1981
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The strain was isolated in 1977 by Chen Ming-hua from a patient in Lincang, Yunnan province, China. The strain was studied by Qin Jin-cai et al. (1981) in Beijing by factor analysis and found to represent a new serovar named *lincang*, reference strain L 14, in the Manhao serogroup.

Because of controversial typing results the serovar is marked bij ++ in the Revised List of 1988 (Kmety, Dikken, 1988), and the attached updated list.

SHERMANI SEROGROUP - 1982

Serovar	Reference strain	Year of valid description
<i>shermani</i>	1342 K	1982
<i>luis</i>	M 6	1984

<i>shermani</i>	1342 K	1982
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The strain was isolated from a spiny rat (*Proechimys semispinosus*) in the Panama Canal Zone by Gale and typed by Galton (WHO, 1967). The strain is listed in the 1967 WHO list as a separate serovar named *shermani*, reference strain LT 821, within the new serogroup Shermani. The isolation and description of the strain was first published in 1982 (Sulzer et al., 1982). In this publication the designation of the strain is given as 1342 K, which therefore takes priority over the laboratory code LT 821 as name for the reference strain.

<i>luis</i>	M 6	1984
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The strain was isolated in 1970 from the kidney of an opossum (*Philander opossum*) at Tingo Maria in the Peruvian jungle and described as a new serovar of the Tarassovi group named *luis*, reference strain M 6, by Liceras de Hidalgo et al. (1984). The strain was later placed in the Shermani group because of its limited relationship to members of the Tarassovi group and its high reactivity with *shermani* antiserum (Kmety unpublished data). The TSC approved this suggestion in 1986 (Manchester meeting, 1986). Being not yet confirmed by a RL it was included in the list of 1988 under provisional status (+). As its serovar status has now been confirmed by a RL, it is included in the attached updated list, unconditionally.

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HEBDOMADIS - 1918-

<i>hebdomadis</i>	Hebdomadis	1918
<i>fabryi</i>	Fabrya	1952
<i>woolfordii</i>	Woolford	1957
<i>jules</i>	Jules	1958
<i>krongosai</i>	Krongosai	1958
<i>rambale</i>	Rambale	1960
<i>nova</i>	Nova	1961
<i>HS 622</i>	HS 622	1963
<i>CZ 285</i>	CZ 285	1966
<i>CT 61</i>	CT 61	1979
<i>Bovini 131</i>	Bovini 131	1980
<i>A-23</i>	A-23	1988

AUTUMNALIS - 1921

<i>Rachnai</i>	Rachnai	1921
<i>Akigami A</i>	Akigami A	1925
<i>Bangkhang 1</i>	Bangkhang 1	1932
<i>Butembo</i>	Butembo	1946
<i>Erinaceus auritus 670</i>	Erinaceus auritus 670	1951

NOTES TO THE UPDATED LIST OF SEROVAR.

The new list of serovars was prepared according the following lines:

The list contains only published serovars.

- + Provisional status; serovars validly described but not yet confirmed by serological typing results of a Reference (Ref.) Laboratory (Lab.) even as the original description was based on the typing results of a Ref. Lab.
- ++ Strains which have given rise to controversial typing results but which were validly described.
- i.t. Strains published without typing results or with incomplete typing results (i.t. means incomplete typing).
- i.d. Strains published without data on the history or adequate serovar name (i.d. means incomplete documentation).
- Annex. Strains, **not published** but studied in References Laboratories and considered to be new serovars, are listed in the Annex.

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**UPDATED LIST OF SEROVARS OF THE
SPECIES *L. INTERROGANS***

Serovar	Reference strain	Status	Year of publication
ICTEROHAEMORRHAGIAE - 1915			
<i>icterohaemorrhagiae</i>	Ictero No. 1		1915
	RGA		1916
<i>copenhageni</i>	M 20		1938
<i>naam</i>	Naam		1940
<i>mwogolo</i>	Mwogolo		1946
<i>ndahambukuje</i>	Ndahambukuje		1946
<i>ndambari</i>	Ndambari		1946
<i>mankarso</i>	Mankarso		1953
<i>birkini</i>	Birkin		1957
<i>smithi</i>	Smith		1957
<i>dakota</i>	Grand River		1962
<i>lai</i>	Lai		1966
<i>tonkini</i>	LT 96-68		1971
<i>gem</i>	Simon		1972
<i>hongchon</i>	18 R		1991
<i>yeonchon</i>	HM 3		1991
HEBDOMADIS - 1918			
<i>hebdomadis</i>	Hebdomadis		1918
<i>kabura</i>	Kabura		1952
<i>worsfoldi</i>	Worsfold		1957
<i>jules</i>	Jules		1958
<i>kremastos</i>	Kremastos		1958
<i>kambale</i>	Kambale		1960
<i>nona</i>	Nona		1960
<i>borincana</i>	HS 622		1963
<i>maru</i>	CZ 285		1966
<i>sanmartini</i>	CT 63		1979
<i>goiano</i>	Bovino 131		1980
<i>manzhuang</i>	A 23	+	1988
AUTUMNALIS - 1923			
<i>rachmati</i>	Rachmat		1923
<i>autumnalis</i>	Akiyami A		1925
<i>bangkinang</i>	Bangkinang I		1932
<i>butembo</i>	Butembo		1946
<i>erinaceiauriti</i>	Erinaceus auritus 670		1951

<i>fortbragg</i>	Fort Bragg	1952
<i>mooris</i>	Moores	1957
<i>bulgarica</i>	Nicolaev	1958
<i>mujunkumi</i>	Yezsh 237	1971
<i>carlos</i>	C 3	1973
<i>srebarna</i>	1409/69	1974
<i>lambwe</i>	Lambwe	1981
<i>bim</i>	1051	1984
<i>nanla</i>	A 6	1989

PYROGENES - 1923

<i>pyrogenes</i>	Salinem	1923
<i>zanoni</i>	Zanoni	1937
<i>abramis</i>	Abraham	1957
<i>biggis</i>	Biggs	1957
<i>hamptoni</i>	Hampton	1957
<i>robinsoni</i>	Robinson	1962
<i>alexi</i>	HS 616	1963
<i>manilae</i>	LT 398	1963
<i>myocastoris</i>	LSU 1551	1963
<i>camlo</i>	LT 64-67	++ 1971
<i>guaratuba</i>	An 7705	+ 1975
<i>princestown</i>	TRVL 112499	1978
<i>kwale</i>	Julu	1979
<i>varela</i>	1019	+ 1982
<i>menglian</i>	S 621	1988
<i>nigeria</i>	Vom	1989

BATAVIAE - 1926

<i>bataviae</i>	Swart	1926
<i>paidjan</i>	Paidjan	1953
<i>djatzi</i>	HS 26	1963
<i>kobbe</i>	CZ 320	1966
<i>argentiniensis</i>	Peludo	1967
<i>brasiliensis</i>	An 776	1972
<i>balboa</i>	735 U	1982
<i>claytoni</i>	1348 U	1982
<i>rioja</i>	MR 12	1984

GRIPPOTYPHOSA - 1928

<i>grippytyphosa</i>	Moskva V.	1928
<i>valbuzzi</i>	Valbuzzi	1955
<i>canalzonae</i>	CZ 188	1966
<i>vanderhoedeni</i>	Kipod 179	1969

<i>ratnapura</i>	Wumalasena	1970
<i>muelleri</i>	RM 2	1973
<i>huanuco</i>	M 4	1979

CANICOLA - 1933

<i>canicola</i>	Hond Utrecht IV	1933
<i>schueffneri</i>	Vleermuis 90 C	1938
<i>kamituga</i>	Kamituga	1939
<i>benjamini</i>	Benjamin	1940
<i>bafani</i>	Bafani	1946
<i>malaya</i>	H 6	1955
<i>jonsis</i>	Jones	1957
<i>sumneri</i>	Sumner	1957
<i>bindjei</i>	Bindjei	1960
<i>broomi</i>	Patane	1960
<i>galtoni</i>	LT 1014	1969
<i>portlandvere</i>	MY 1039	1982
<i>kuwait</i>	136/2/2	1983

AUSTRALIS - 1937

<i>australis</i>	Ballico		1937
<i>lora</i>	Lora		1942
<i>muenchen</i>	München C 90		1942
<i>fugis</i>	Fudge		1957
<i>bratislava</i>	Jež bratislava		1960
<i>jalna</i>	Jalná		1960
<i>hawain</i>	LT 62-68		1971
<i>peruviana</i>	V 42		1973
<i>soteropolitana</i>	R 93	+	1976
<i>ramisi</i>	Musa		1979
<i>nicaragua</i>	1011		1982
<i>rushan</i>	507	i.d.	1984
<i>bajan</i>	Toad 60		1991

POMONA - 1937

<i>pomona</i>	Pomona		1937
<i>mozdok</i>	5621		1965
<i>tropica</i>	CZ 299		1966
<i>proechimys</i>	1161 U		1982
<i>tsaratsovo</i>	B 81/7	++	1982
<i>kunming</i>	K 5	i.d.	1984

JAVANICA - 1938

<i>javanica</i>	Veldrat Batavia 46		1938
<i>poi</i>	Poi		1942
<i>sorexjalna</i>	Sorex Jalná		1955
<i>coxi</i>	Cox		1957
<i>sofia</i>	Sofia 874		1961
<i>ceylonica</i>	Piyasena		1969
<i>menoni</i>	Kerala		1981
<i>fluminense</i>	Aa 3	+	1981
<i>A 85</i>	A 85	i.d.	1984
<i>dehong</i>	De 10	i.d.	1984
<i>menrun</i>	A 102	i.d.	1984
<i>yaan</i>	80-27	i.d.	1984
<i>mengma</i>	S 590	+	1988
<i>zhenkang</i>	L 82	+	1988

SEJROE - 1938

<i>sejroe</i>	M 84		1938
<i>saxkoebing</i>	Mus 24		1944
<i>medanensis</i>	Hond HC		1948
<i>wolffi</i>	3705		1948
<i>hardjo</i>	Hardjoprajitno		1953
<i>haemolytica</i>	Marsh		1957
<i>ricardi</i>	Richardson		1957
<i>balcanica</i>	1627 Burgas		1961
<i>polonica</i>	493 Poland		1964
<i>geyaweera</i>	Geyaweera		1968
<i>gorgas</i>	1413 U		1977
<i>istrica</i>	Bratislava		1977
<i>recreo</i>	380		1977
<i>roumanica</i>	LM 294		1977
<i>trinidad</i>	TRVL 34056		1977
<i>caribe</i>	TRVL 61866		1978
<i>dikkeni</i>	Mannuthi		1978
<i>nyanza</i>	Kibos		1978
<i>guaricura</i>	Bov.G.		1980

CYNOPTERI - 1939

<i>cynopteri</i>	3522 C		1939
<i>tingomaria</i>	M 13		1984

DJASIMAN - 1939

<i>djasiman</i>	Djasiman		1939
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<i>sentot</i>	Sentot		1940
<i>gurungi</i>	Gurung		1957
<i>huallaga</i>	M 7		1984
<i>agogo</i>	Agogo	i.t.	1986

SARMIN - 1939

<i>sarmin</i>	Sarmin		1939
<i>weaveri</i>	CZ 390		1966
<i>waskurin</i>	LT 63-68		1971
<i>rio</i>	Rr 5	+	1981
<i>machiguenga</i>	MMD 3		1984
<i>cuica</i>	RP 88	i.t., i.d.	1991

MINI - 1941

<i>mini</i>	Sari		1941
<i>szwajizak</i>	Szwajizak		1956
<i>georgia</i>	LT 117		1960
<i>perameles</i>	Bandicoot 343		1964
<i>beye</i>	1537 U		1977
<i>tabaquite</i>	TRVL 3214		1977
<i>ruparupae</i>	M 3		1984
<i>hekou</i>	H 27	+	1988
<i>yunnan</i>	A 10	+	1988

TARASSOVI - 1941

<i>tarassovi</i>	Perepelitsin		1941
<i>kisuba</i>	Kisuba		1956
<i>bakeri</i>	LT 79		1957
<i>atlantae</i>	LT 81		1960
<i>guidae</i>	RP 29		1960
<i>atchafalaya</i>	LSU 1013		1963
<i>bravo</i>	Bravo		1966
<i>rama</i>	316		1966
<i>tunis</i>	P 2/65		1969
<i>kaup</i>	LT 64-68	i.d.	1971
<i>vughia</i>	LT 89-68		1971
<i>navet</i>	TRVL 109873		1978
<i>kanana</i>	Kanana		1981
<i>chagres</i>	1913 K	i.t.	1982
<i>darien</i>	637 K	i.t.	1982
<i>gatuni</i>	1473 K	i.t.	1982
<i>banna</i>	A 31	+	1985
<i>gengma</i>	M 48	+	1985

<i>mengpeng</i>	A 82	+	1985
<i>mogdeni</i>	Compton 746		1987
<i>yunxian</i>	L 100	+	1988

BALLUM - 1944

<i>ballum</i>	Mus 127		1944
<i>castellonis</i>	Castellòn 3		1955
<i>arborea</i>	Arborea		1965
<i>kenya</i>	Njenga		1981
<i>ballum 3</i>	1853	i.d.	1984

CELLEDONI - 1956

<i>celledoni</i>	Celledoni		1956
<i>whitcombi</i>	Whitcomb		1957
<i>anhoà</i>	LT 90-68		1971
<i>hainan-whitcombi</i>	6712	++	1984
<i>javanica 4</i>	M 6906	i.d.	1984

LOUISIANA - 1964

<i>louisiana</i>	LSU 1945		1964
<i>orleans</i>	LSU 2580		1964
<i>lanka</i>	R 740		1971

PANAMA - 1966

<i>panama</i>	CZ 214		1966
<i>mangus</i>	TRVL/CAREC 137774	+	1978
<i>crisobali</i>	1996 K		1982

RANARUM - 1972

<i>ranarum</i>	ICF		1972
<i>evansi</i>	267-1348		1975
<i>pingchang</i>	80-412		1984

MANHAO - 1978

<i>manhao 4</i>	Li 130	i.d.	1978
<i>manhao 2</i>	L105	i.d.	1979
<i>lincang</i>	L 14	++	1981

shermani 1342 K
luis M 6

10% criteria 1

evaluation 4

Akodon arica 48 90-00 T.J.

Annex 96

antigen (density) 4

Apodemus agrarius 22

Apodemus chevreuxi 22

Apodemus flavicollis 22

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Arvicola 22, 23

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Australia 2 31, 41

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- complete 20, 27, 37, 40 32

- incomplete 36, 38

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Bubo 22, 41

cattle 25, 40, 43, 59

Cavia 22, 41

Chactophorus 22, 41

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- general 1, 5, 8

- history 1, 2

- principles 3

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complex 22, 41

- pathogenic 1

- saprophytic 1

controversial typing

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cow (see cattle)

Crocidura platycephala 48

Cynopterus 38, 54

1982
1984

10% criteria 1

evaluation 4

Didelphis 48 90-00 T.J.

Annex 96

antigen (density) 4

Apodemus agrarius 22

Apodemus chevreuxi 22

Apodemus flavicollis 22

Apodemus sylvaticus 22

armadillo 35, 40

Arvicola 22, 23

Australia 2 31, 41

Australia 2 31, 41

Argentina 2 31, 41

basal 42, 47, 53, 56, 58, 62

Basilinna 47, 58, 62

bat 38, 4

biology V, 1

biotype

- complete 20, 27, 37, 40 32

- incomplete 36, 38

Bombus 22, 41

Bubo 22, 41

cattle 25, 40, 43, 59

Cavia 22, 41

Chactophorus 22, 41

classification

- general 1, 5, 8

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complex 22, 41

- pathogenic 1

- saprophytic 1

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cow (see cattle)

Crocidura platycephala 48

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ANNEX

Serovar	Reference strain
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ICTEROHAEMORRHAGIAE - 1915

<i>bogvere</i>	LT 60-69
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AUTUMNALIS - 1923

<i>alice</i>	Alice
<i>weerasinghe</i>	Weerasinghe

BATAVIAE - 1926

<i>losbanos</i>	LT 101-69
<i>santarosa</i>	LT 21-74

AUSTRALIS - 1937

<i>pina</i>	LT 932
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JAVANICA - 1938

<i>vargonicas</i>	24
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TARASSOVI - 1941

<i>langati</i>	M 39090
<i>sulzeriae</i>	LT 82

BALLUM - 1944

<i>peru</i>	MW 10
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SHERMANI - 1982

<i>aguaruna</i>	MW 4
<i>babudieri</i>	CI 40
<i>carimagua</i>	9160

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