

## Bacteriophage-typing designations of *Salmonella typhimurium*\*

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### SUMMARY

The phage-typing scheme of Callow (1959) has been extended. The original number of types was 34; this has now risen to 207. Tables are presented which show the provisional type designations and the definitive designations now being introduced.

### THE NEW TYPING SCHEME

The phage-typing of *Salmonella typhimurium*, first devised by the late Miss B. R. Callow (Felix & Callow, 1943; Felix, 1956; Callow, 1959; Anderson, 1964) has established itself as the method of choice for the epidemiological study of *S. typhimurium* infection. The source of such infection in man is usually the livestock he eats, although epidemic cycling may occur in man, especially in hospitals, paediatric units and day nurseries. Even in such outbreaks, however, the ultimate infective source is animal.

Since certain phage types predominate in particular animal hosts, human infection with these types usually originates in those animals. Phage-typing can thus greatly shorten the time taken to trace the animal sources of human outbreaks of *S. typhimurium* infection (Anderson, Galbraith & Taylor, 1961; Anderson, 1964, 1968, 1969, 1971) as well as assisting in the control of infection in the animals themselves.

The first phage-typing scheme of Miss Callow distinguished 12 types of *S. typhimurium* with 11 phages. Her second and greatly improved scheme initially distinguished 34 types with 29 phages (Callow, 1959). Once the revised scheme was adopted for routine use in the Enteric Reference Laboratory in 1958, however, it rapidly showed that its sensitivity was of a high order, and since then it has progressively expanded until it now distinguishes 207 types with 34 phages.

As the first types studied in the evolution of this scheme were those of the original scheme, their new designations were allotted as numbers following in general the order of the original scheme. However, the new system subdivided certain types of the old scheme. Moreover, many *S. typhimurium* strains that were untypable with the old method yielded clear-cut typing patterns with the new, and these

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Table 1. *Salmonella typhimurium* phage typing designations

| Type designation |                  |            | Type designation |                  |            |
|------------------|------------------|------------|------------------|------------------|------------|
| Definitive (DT)  | Provisional (PT) |            | Definitive (DT)  | Provisional (PT) |            |
|                  | Old scheme       | New scheme |                  | Old scheme       | New scheme |
| 1                | 1                | A.D.       | 50               | 3 var. 1         | U159       |
| 2                | 1a               | A.D.       | 51               | 5                | U51        |
| 3 an*            | 1a var. 1        | A.D.       | 52               | 1b var. 2        | U59        |
| 3 aer*           | 1a var. 2        | A.D.       | 53               | 2b var. 1        | U128       |
| 4                | 1b               | A.D.       | 54               | 1b var. 1        | 4a         |
| 5                | 3                | A.D.       | 55               | 1b var. 5        | U171       |
| 6                | 3a               | A.D.       | 56               | 1b var. 3        | U20        |
| 7                | 2d               | A.D.       | 57               | 3a var. 2        | U85        |
| 8                | 4                | A.D.       | 58               | 2c               | U56        |
| 9                |                  |            | 59               | 2d               | U134       |
| 10               |                  |            | 60               | 2                | U87        |
| 11               | 2                | A.D.       | 61               | 2                | U111       |
| 12               |                  |            | 62               | 2b               | U115       |
| 12a              |                  |            | 63               | 2b               | U139       |
| 13               | 2a               | A.D.       | 64               | 4                | U38        |
| 14               |                  |            | 65†              |                  |            |
| 15               | 2c               | A.D.       | 66               | U                | U101       |
| 15a              |                  |            | 67               | 2                | U103       |
| 16               |                  |            | 68               | 2b               | U162       |
| 17               | 2b               | A.D.       | 69               | U                | U158       |
| 18               |                  |            | 70               | 2c               | U154       |
| 19               |                  |            | 71               | 2c               | 14c        |
| 20               |                  |            | 72               | 2c               | U131       |
| 20a              | 2d               | A.D.       | 73               | 2                | U45        |
| 21               | U                | A.D.       | 74               | 2                | U71        |
| 22               |                  |            | 75               | 2                | U136       |
| 23               | 5                | A.D.       | 76               | 2                | U182       |
| 24               |                  |            | 77               | 2                | U6         |
| 25               |                  |            | 78               | 2                | U141       |
| 26               | U                | A.D.       | 79               | 2                | U113       |
| 27               |                  |            | 80               | U                | U17        |
| 28               | 2c               | A.D.       | 81               | U                | U96        |
| 29               | 2b or U          | A.D.       | 82               | 2a               | U55        |
| 30               | 4                | A.D.       | 83               | 2b               | U102       |
| 31               |                  |            | 84               | 2a               | U100       |
| 32               | U                | A.D.       | 85               | 2c               | 14b        |
| 33†              |                  |            | 86               | 2b               | 14d        |
| 34†              |                  |            | 87               | 2a               | U84        |
| 35               | U                | A.D.       | 88               | 2b var. 2        | U39        |
| 36               | 1 var. 11        | A.D.       | 89               | 2b               | U15        |
| 37               | 1 var. 6         | U86        | 90               | 2b               | U164       |
| 38               | 1 var. 9         | U156       | 91               | U                | U30        |
| 39               | 1 var. 12        | U178       | 92               | 2b               | U180       |
| 40               | 1 var. 10        | U165       | 93               | 2b               | 14a        |
| 41               | 1 var. 2         | U41        | 94               | 2b               | U148       |
| 42               | 1 var. 8         | U153       | 95               | U                | U163       |
| 43               | 1 var. 1         | U35        | 96               | U                | U24        |
| 44               | 1 var. 5         | U9         | 97               | U                | U64        |
| 45               | 1a var. 7        | U168       | 98               | U                | U25        |
| 46               | 1a               | U149       | 99               | U                | U40        |
| 47               | 1a var. 6        | U105       | 100              | 2                | U137       |
| 48†              |                  |            | 101              | 2                | U80        |
| 49               | 1a               | U57        | 102              | 2                | U70        |

A.D. = As definitive.

Table 1 (cont)

| Type designation   |                  |            | Type designation   |                  |            |
|--------------------|------------------|------------|--------------------|------------------|------------|
| Definitive<br>(DT) | Provisional (PT) |            | Definitive<br>(DT) | Provisional (PT) |            |
|                    | Old scheme       | New scheme |                    | Old scheme       | New scheme |
| 103                | 2                | U18        | 157                | 2c               | U225       |
| 104                | 2c               | U129       | 158                | 2                | U147       |
| 105                | 2                | U121       | 159                | 2a               | U217       |
| 106                | 2e               | U75        | 160                | 2a               | U218       |
| 107                | 2                | U114       | 161                | 2b               | U19        |
| 108                | 2                | U36        | 162                | 5                | U133       |
| 109                | 2                | U135       | 163                | 5                | U251       |
| 110                | 2c               | U130       | 164                | U                | U212       |
| 111                | 2                | U11        | 165                | 2                | U216       |
| 112                | 2b               | U126       | 166                | U                | U254       |
| 113                | 2b               | U89        | 167                | 2                | U201       |
| 114                | U                | U142       | 168                | 2                | U193       |
| 115                | U                | U173       | 169                | 2                | U213       |
| 116                | U                | U68        | 170                | 2                | U206       |
| 117                | U                | U119       | 171                | 2e               | U242       |
| 118                | U                | U138       | 172                | 2e               | U120       |
| 119                | U                | U167       | 173                | 2c               | U219       |
| 120                | U                | U42        | 174                | 3a var. 3        | U208       |
| 121                | 2b               | U152       | 175                | 2b               | U227       |
| 122                | U                | U122       | 176                | 2b               | U221       |
| 123                | 2c               | U151       | 177                | 2b               | U189       |
| 124                | U                | U104       | 178                | U                | U191       |
| 125                | 1 var. 17        | U214       | 179                | U                | U246       |
| 126                | 1 var. 18        | U223       | 180                | U                | U250       |
| 127                | 1a var. 9        | U230       | 181                | 2                | U249       |
| 128                | 1 var. 13        | U187       | 182                | U                | U253       |
| 129                | 1 var. 20        | U239       | 183†               |                  |            |
| 130                | 1 var. 15        | U207       | 184                | 2b               | U228       |
| 131                | 1 var. 21        | U240       | 185                | 2                | U226       |
| 132                | 1a var. 5        | U157       | 186                | 2b               | U166       |
| 133                | 1 var. 19        | U233       | 187                | U                | U197       |
| 134                | 1 var. 16        | U209       | 188                | U                | U232       |
| 135                | 1a               | U211       | 189                | 1a var. 11       | U255       |
| 136                | 1b var. 6        | U234       | 190                | 2c var. 1        | U93        |
| 137                | 1b               | U252       | 191                | 1 var. 22        | U256       |
| 138                | 1b               | U243       | 192                | U                | U257       |
| 139                | 1b               | U247       | 193                | U                | U258       |
| 140                | 1b               | U224       | 194                | U                | U259       |
| 141                | 1b var. 4        | U65        | 195                | U                | U260       |
| 142                | 1a var. 10       | U184       | 196                | 1b               | U261       |
| 143                | 1a               | U241       | 197                | 1 var. 23        | U262       |
| 144                | 3a               | U248       | 198                | 1 var. 24        | U263       |
| 145                | 3a var. 1        | U108       | 199                | 2b               | U231       |
| 146                | 2b               | U222       | 200                | U                | U264       |
| 147                | 2e               | U169       | 201                | 2                | U265       |
| 148                | 2b               | U236       | 202                | 3 var. 2         | U266       |
| 149                | 2                | U235       | 203                | U                | U267       |
| 150                | 2                | U229       | 204                | U                | U268       |
| 151                | 2                | U244       | 205                | 1 var. 25        | U269       |
| 152†               |                  |            | 206                | 1 var. 26        | U270       |
| 153                | 2                | U73        | 207                | U                | U271       |
| 154                | 2c               | U26        | 208                | U                | U272       |
| 155                | 2c               | U203       | 209                | 2d               | U273       |
| 156                | 2c               | U204       |                    |                  |            |

\* an, anaerogenic, aer. aerogenic.

† These types have been abandoned.

NOTE. The first 36 definitive types have no provisional designation in the new scheme as they were directly allocated definitive numbers.

were allotted new typing designations. Since it was evident, because of the rapidly growing number of types, that it would be an error prematurely to finalize the designations, these were allotted provisional numbers, preceded by the letter U (= untypable): an indication that they did not correspond to any of the 34 basic types of the new Callow scheme.

It was clear that definitive numerical designations must eventually be given to the many types of the new scheme. This has now been done, and for some time we have been reporting the definitive type designations (DT) in addition to the provisional designations (PT) that have been used for a numbers of years.

The purpose of this article is to present the complete list of definitive phage type designations together with those that have been in provisional use, in order that equivalents can be apparent. The types are shown in Table 1.

The table shows the greatly superior discriminatory capacity of the new *S. typhimurium* phage-typing scheme over the original scheme. For example, strains identified simply as type 2 by the old scheme can be divided into no less than 37 distinct types by the new; 2b is divided into 27 types; and 2c into 17 types. Types designated as 'variants' of main types in the old scheme are allotted specific designations in the new. Thus, type 1 var 11 becomes type 36; type 1 var 6, type 37; type 1 var 9, type 38; type 1 var 12, type 39; and type 1 var 10, type 40.

As we have indicated above, these tables are published only as a key to the identification of the new type designations in terms of the old. Full details of the new typing scheme, together with information on the frequency distribution of types, will be given in a later paper.

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