The relative opsonizing power of various sera was found to be as follows:

| Rabbit No. | Route of Immunization. | |
|---|---|---|
| 328 | Intravenous | 2% to 8% |
| 329 | Intravenous | |
| 330 | Intratracheal | 10% to 20% |
| 331 | Intratracheal | |
| 332 | Subcutaneous | 2% to 4% |
| 333 | Subcutaneous | |
| 334 | Intrapleural | 10% to 20% |
| 335 | Intrapleural | |
| 336 | Normal (control) | below 1% |
| 337 | Normal (control) | |

In the test for protection three series of mice received intraperitoneally 1/2 c.c. of the respective sera each. Immediately following the serum mice of respective series received intraperitoneally virulent culture in the amount representing from 12,500 to 50,000 M.L.D.

| Route of Immunization. | Number of M.L.D. of Pneumococcus. | | |
|---|---|---|---|
| | 12,500 | 25,000 | 50,000 |
| Intravenous | living | living | + 24 hrs. |
| Intratracheal | living | living | living |
| Subcutaneous | + 24 hrs. | + 24 hrs. | + 24 hrs. |
| Intrapleural | living | living | living |
| Normal (control) | + 24 hrs. | + 24 hrs. | + 24 hrs. |

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## Racial variations in Blepharisma undulans.

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Studies on *Blepharisma undulans* and *Blepharisma lateritia* Stein, have emphasized the impossibility or great difficulty of observing the micronuclei, and also the inevitable death of exconjugants without dividing. Thus Bütschli[1] was unable to identify micronuclei in vegetative specimens of *B. lateritia* though he found them in conjugants. Exconjugants invariably died. Calkins[2] did not find micronuclei in non-dividing *B. undulans*, but

[1] Bütschli, *Abhandl. d. Senckenb. naturf. Gesellsch. Frankfurt a/M.*, 1876, Bd. x.

[2] Calkins, *Journ. Morph.*, 1912, xxiii.

discovered them during division within the macronuclear membrane, and described their emergence and activities during conjugation. He likewise was unsuccessful in obtaining a single viable exconjugant.

During the past five months we have had under observation a pedigree culture of *Blepharisma undulans* which emphasizes racial differences within the species. The animals of this race possess from four to fourteen relatively conspicuous micronuclei, all of which are free in the cytoplasm during every stage of the life of the cell; and all the exconjugants thus far secured proved to be viable.

The main culture has attained one hundred and fifty generations to date, an average of about one division per day, in the standard beef extract culture medium used in this laboratory. At intervals, epidemics of conjugation have appeared. Exconjugants have been isolated and new lines established from their progeny. Studies are in progress similar to those which have been conducted on *Spathidiums*.[1]

The wide experience of such observers as Bütschli and Calkins precludes the assumption that they were in error in regard to the micronuclear condition of the animals which they studied and the only reasonable conclusion is that there are races of *Blepharisma* which differ in regard to the vegetative position of the micronuclei; in some it is intramacronuclear and others extramacronuclear—the present pedigree race of *Blepharisma undulans* representing the latter and therefore agreeing with the marine species, *Blepharisma clarissima*, as described by Anigstein.[2]

The results of all previous workers are consistent in regard to to the non-viability of exconjugants. Whether the intramacronuclear position of the micronuclei bears any causal relation to non-viability it is impossible to decide. Certainly there are no obvious differences between the chief nuclear phenomena described by Calkins in his non-viable conjugants and those which occur in the viable conjugants of the pedigree race which we are conducting.

[1] Woodruff and Spencer, PROC. SOC. EXP. BIOL. AND MED., 1921, xviii, 180, 240 303.

[2] Anigstein, *Archiv. f. Protistenk.*, 1912, Bd. xxiv.