the air. The influence of ultra-violet radiation is evident.

In the second type of test, the lamp was energized in the midst of an experimental run with the results given in Table 2. It should be noted in this connection

TABLE 2

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Elapsed minutes | 0 | 16 | 30 | 42 | 57 | 72 | 87 |
| *B. coli* recovered | 9,500 | 2,500 | 890 | 1 | 0 | 0 | 0 |
| Condition of lamp | off | off | off | on | on | on | on |

that maximum emission of ultra-violet radiation was not reached for several minutes after the lamp employed was first energized.

In the third type of test, the lamp was lighted but completely covered, leaving the room in darkness except for a brief period of time. A four-minute exposure of the room to light yielded the results given in Table 3.

TABLE 3

| | | | | | |
|---|---|---|---|---|---|
| Elapsed minutes | 0 | 15 | 30 | 45 | 60 |
| *B. coli* recovered | 4,300 | 890 | 0 | 1 | 0 |
| Condition of lamp | covered | covered | * | off | off |

* Lamp uncovered for 4 minutes prior to sampling.

In the fourth type of test (Table 4), the room air was irradiated for half an hour prior to inoculation of the darkened room with *B. coli*. This was done to determine the possibly masked effect of ozone and ions released by the lamp.

TABLE 4

| | | | | | |
|---|---|---|---|---|---|
| Elapsed minutes | 0 | 15 | 30 | 45 | 60 |
| *B. coli* recovered | 5,700 | 1,750 | 810 | 625 | 119 |

It should be apparent from these tests that the destructive power of ultra-violet light of itself is of a higher order of magnitude in air than in liquids or other environments not highly transparent to ultra-violet radiations.[3]

WILLIAM FIRTH WELLS
GORDON MASKEW FAIR

HARVARD UNIVERSITY

## STERILIZATION OF TRIBOLIUM BY HIGH TEMPERATURE[1]

IN order to obtain adult *Tribolium confusum* for experimental purposes some 500 eggs were recently placed in an incubator so that they might develop at a constant temperature of 28° C. As development proceeds and the pupal stage is reached the individuals are sexed: this is a necessary step, since the sex of *Tribolium* imagoes can not be determined by superficial characters. During the metamorphosis of these particular beetles, however, an accident inadvertently occurred to the incubator, which caused the temperature to rise from 28° C. to 39° C., in a period of about five hours. These temperature and time relationships were substantiated by a thermograph in the incubator. The *Tribolium*, at the time of this accident, had reached about the median of their metamorphosis. There are typically 7 or 8 larval instars in development, and most of these individuals were in the third and fourth larval stadium. Upon the discovery of this high temperature the larvae were immediately removed from the incubator and examined. It was obvious that the heat had increased their activity, since they were wriggling in the flour considerably more than is typical. As the temperature quickly sank, however, the larvae, to all intents and purposes, assumed their normal behavior. Not a single individual was killed outright by the heat. Since all the larvae seemed unaffected by their experience they were returned to another incubator and kept at 28° C. for the remainder of their metamorphosis. As pupae were formed they were sexed and isolated into male and female containers. The pupae emerged into imagoes without atypical mortality. A similar series of eggs from the same parental source had been placed previously in another incubator at 28° C., which fortunately maintained that temperature properly for the entire period of metamorphosis. This latter series furnishes a control for the former. Matings were made up of the "heated" *Tribolium* as follows: 50 bottles, each bottle containing 32 gm of flour and two pairs of *Tribolium confusum*. Every five days the flour of each bottle was sifted and examined for eggs. At the first five-day count only one bottle out of the 50 showed any egg production: this bottle produced three eggs. At the 10-day count the same bottle, again producing only three eggs, was the only productive one. No eggs were produced in any of the bottles for the fifteenth and twentieth day counts. The twenty-fifth day saw three bottles producing 18 eggs. Comparable experiments set up with the *Tribolium* reared at a constant 28° C. showed no such aborted fecundity. Here, for example, 30 of the 50 bottles were productive the first five days and yielded 305 eggs. The tenth day reading found 38 of the bottles productive with an egg count of 411. These data appear to be clear-cut evidence for the sterilization of *Tribolium* by high temperatures. The "heated" beetles seemed "normal" in every way as far as their activity was concerned. About 60 per cent. of the

[3] *Jour. Amer. Water Works Assn.*, VII: 3, 327–342, May, 1920.

[1] From the Department of Biology, School of Hygiene and Public Health, the Johns Hopkins University.

eggs which were produced by these "heated" beetles were fertile and developed into larvae. A 60 per cent. egg fertility is not unusual for "normal" *Tribolium* and suggests that it is the fecundity of the *Tribolium* which is affected by the high temperatures and not the fertility. This general conclusion is in accord with a recent one of Park[2] who found that fecundity was drastically lowered by conditioned flour, while fertility was not significantly altered.

THOMAS PARK,
*National Research Council Fellow in the Biological Sciences*

## THE OSTRACODERM ORDER OSTEOSTRACI

THIS order, including the Cephalaspidae, Trematas-pidae, Dartmuthiidae and Oeselaspidae, has attracted considerable attention of recent years. Probably the greatest single factor in this renewal of interest was the publication of Stensio's monograph on the Cephal-aspidae of Spitsbergen in 1927.[1] New methods of study enabled him to work out many details of struc-ture in these early vertebrates which had not pre-viously been known. The beautiful preservation of the material allowed study of the brain case, many of the cranial nerves and important features of the vascular channels. The excellence of this monograph recalled to attention a group which has the natural attraction of being among the earliest known verte-brates and thus likely to throw some light on the early evolution of the phylum.

During the 1800's a number of outstanding paleon-tologists contributed to knowledge of these forms. Then, except for occasional papers, little was written of them. A few men with special problems in mind kept at work on the Ostracoderms. Among these was the late Dr. William Patten, of Dartmouth College.

Early in his career Dr. Patten discovered what he thought was a significant resemblance between certain embryological stages in some of the Arthropods and the Vertebrates. Moreover, he saw in the Ostraco-derms what he conceived to be homology of structure with some of the aquatic Arachnids of the same geological formations. He set himself the task of working out the implications of these observations, evolving a theory of the Arthropod ancestry of the Vertebrates. In the course of his study he gathered together a large amount of fossil material, that of the genus Trematapis being especially rich. During the summer of 1932 he made his last expedition to the island of Oesel, bringing home a large quantity of material, especially of Trematapis, Dartmuthia, Oeselaspis and Cephalaspis. His death in October of the same year cut short his research on his collection.

Dr. Patten had paid relatively little attention to the taxonomic aspects of his material. His own spe-cial problem consumed all his working time, and to have become involved in what would have been from that view-point irrelevant problems would have meant time lost from his main work. Thus most of his pub-lications are less concerned with taxonomic descrip-tion than with anatomical studies and theoretical implications drawn from these studies. In 1931 he published a short paper in SCIENCE[2] describing very briefly one new family, the Dartmuthiidae, two new species of Trematapis, *T. milleri* and *T. mammillata,* and another new species which he assigned to Lankes-ter's genus Didymaspis, calling it *Didymaspis pus-tulata.*

Since the publication of this paper Stensio[3] has redescribed the Didymaspis material on which the genus was founded, and as the Patten species differs from Didymaspis as thus characterized in important respects I have made it the type of a new genus, Oeselaspis.[4] This new genus does not fit any of the three families, Cephalaspidae, Trematapidae and Dartmuthiidae, and thus I believe forms the type of another family, the Oeselaspidae.

If the new families based on the material of the Patten collection are valid the Osteostraci as at pres-ent constituted would contain the following:

Family Cephalaspidae Agassiz 1844
  Sub-family Cephalaspinae Stensio 1932
  Sub-family Kiaeraspinae Stensio 1932
Family Trematapidae Woodward 1891
Family Dartmuthiidae Patten 1931
Family Oeselaspidae Robertson 1935

The following key may be useful in characterizing the families:

I. Pectoral sinuses present
  A. Lateral fields single: Cephalaspidae.
    1. Lateral fields with a postero-median angle: Kiaeraspinae.
    2. Lateral fields without a postero-median angle:
      a. Two anterior nerves to lateral field united for some distance anterior to orbit; Trige-minus running down anterior or posterior to combined anterior nerves: Kiaeraspinae.
      b. Two anterior nerves to lateral fields not united much anterior to orbit; Trigeminus running down between the two anterior nerves: Cephalaspinae.
  B. Lateral fields paired: Oeselaspidae.

[1] E. A. Stensio, "The Downtonian and Devonian Ver-tebrates of Spitsbergen." Part I, "The Cephalaspidae." 1927.

[2] Thomas Park, *Physiol. Zool.*, viii; 1; pp. 91–115, 1935.

[2] W. Patten, SCIENCE, 73: 1903, 1931.

[3] E. A. Stensio, "Cephalaspids of Great Britain." 1932.

[4] G. M. Robertson, *Amer. Jour. Science,* 29: May, 1935.