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.

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THE OSTRACODERM ORDER OSTEOSTRACI

THIS order, including the Cephalaspidae, Tremataspidae, 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 Cephalaspidae of Spitsbergen in 1927.[1] New methods of study enabled him to work out many details of structure in these early vertebrates which had not previously 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 vertebrates and thus likely to throw some light on the early evolution of the phylum.

During the 1800's a number of outstanding paleontologists 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 Ostracoderms 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 Tremataspis 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 Tremataspis, 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 special 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 publications are less concerned with taxonomic description 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 Tremataspis, *T. milleri* and *T. mammillata,* and another new species which he assigned to Lankester's genus Didymaspis, calling it *Didymaspis pustulata.*

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, Trematаspidae 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 present constituted would contain the following:

Family Cephalaspidae Agassiz 1844
 Sub-family Cephalaspinae Stensio 1932
 Sub-family Kiaeraspinae Stensio 1932
Family Trematаspidae 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; Trigeminus 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.

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

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

[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.

II. Pectoral sinuses absent
 A. Lateral fields single: Dartmuthiidae.
 B. Lateral fields paired: Tremataspidae.

This classification is provisional, as considerable work is being carried out on the members of the order at present. A considerable number of species of Cephalaspidae have been recognized, as well as several genera, whereas Tremataspidae includes only one genus with but four well-authenticated species, and Dartmuthiidae and Oeselaspidae include but one genus and species each. Further study may result in additions to these families or perhaps in reducing one or more to lesser rank. It has seemed desirable to publish this classification, however, since no general accounts of the order have been published which include the Dartmuthiidae or Oeselaspidae, forms which add to our knowledge of the order.

The writer is at present working through the Tremataspids in the Patten collection, material which, thanks to the excellent state of preservation, should yield much additional information regarding this group.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE ULTRA SONIC VIBRATIONS OF SMALL PLATES[1]

IN a previous communication,[2] it was shown that a triode valve could be made to vibrate a Chladni plate at frequencies up to twelve kilocycles and so produce very complicated sand figures. Since then we have been able to vibrate small glass plates and large brass plates as high as eighty kilocycles. In order to do this, it is necessary to use a nickel rod as the mechanical vibrator and to actuate the rod from the coil of a wireless sending set. The reason for this is that all audio amplifiers and all loud speakers are insensitive to these high vibrations. The ear is also unaffected by frequencies above twenty kilocycles (*circa*), so that no note is heard while these figures are being formed.

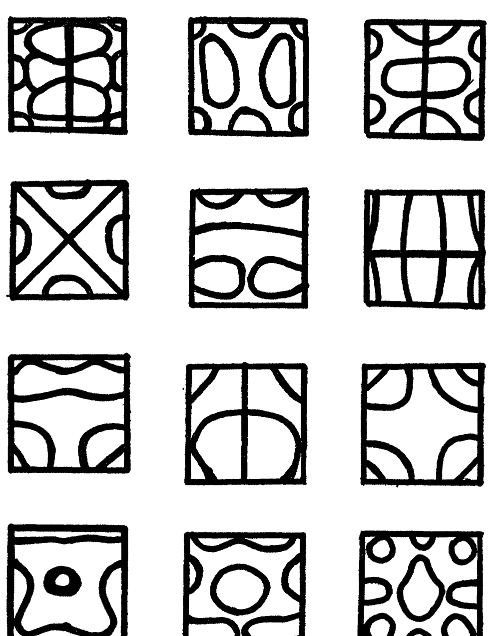

FIG. 1. Small brass plates vibrated at fifty kilocycles.

Fig. 1 shows the results upon small brass plates one inch across at fifty kilocycles. It will be noticed that some of these patterns are exactly similar to those upon large brass plates ten inches across vibrated at very much lower frequencies. The nodal lines in Fig. 2 were formed at a frequency of eighty kilocycles.

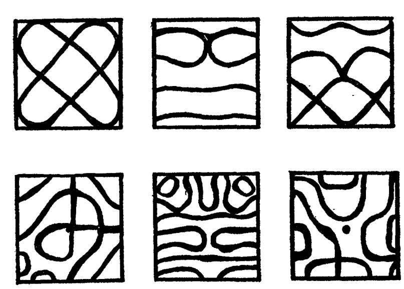

FIG. 2. Plates vibrated at eighty kilocycles. Upper row, glass; lower row, brass.

The upper row shows glass plates one inch across, while the lower row gives patterns on brass plates. It was much easier to make the sand dance up and down on the glass than on the brass, so that in the actual photographs from which the tracings were made, the figures on the glass were much better defined than the others.

We finally decided to vibrate large brass plates at eighty kilocycles. This proved to be very difficult. To make a brass plate ten inches across vibrate eighty thousand times a second with such regularity that the sand will move to the nodal lines and stay there demands a very careful adjustment of each vibrating part. The brass plates were polished brightly and given a wax finish. Each plate was clamped at a point on the periphery and the vibrating nickel rod applied at the opposite side.

The patterns are shown in Fig. 3. Incidentally the

[1] Contribution No. 107 of the Division of Industrial Sciences, West Virginia University.
[2] SCIENCE, 76: 1980, 547–548, December 9, 1932.