become more complicated than triplets as well as some that are apparently unaffected; moreover the separation is very far from varying as the square of the wave-length, and recent work has shown that in some cases at least it is not proportional to the strength of the field.* In spite of these inconsistencies, however, we do not feel called upon to abandon the theory of electrified ions, for we must bear in mind that Lorentz's expression was deduced from assumptions which can hardly be realized in nature. He assumed a molecule of the simplest possible kind, consisting of a single positive or a negative ion acted upon by a central force proportional to its displacement and an electromagnetic force due to the external field equal in magnitude and direction to that which would act on a conductor carrying a current equal to the product of the velocity of the ion by the charge which it carries. Now it seems reasonable to suppose that the central force varies directly as the first power of the displacement because if it varied as any other power the period of vibration would change with the amplitude, and the spectral lines would change their position when the source of light became brighter, which has never been observed. The assumption that the same forces act on a particle carrying a charge e with a velocity v as would act on a conductor carrying a current of strength ev in the same direction is justified for comparatively low velocities by Rowland's experiment in Berlin in 1876. It seems utterly impossible, however, that a molecule should consist of a single ion, for in very few cases does the spectrum of an element contain less than twenty lines in the visible spectrum, and in the iron-spectrum there are thousands of them. A molecule which can vibrate in so many different periods must be exceedingly complicated. It is not surprising, then, that our simple theory is inadequate to account for the facts. Lorentz, in fact, knew this and instituted* a theoretical research on more general grounds before its insufficiency had been shown by the discovery of the quadruplet and other complications. He found that if the molecule naturally possessed more than three equivalent modes of vibration—that is, if it could vibrate in more than three ways with the same period—then the single spectral line corresponding to this period would become more than three-fold under the influence of magnetic force. Professor Lorentz does not regard this explanation as satisfactory, owing to the difficulty in conceiving a system having this property.

More recently Voigt† has proposed a theory which accounts for all the observed phenomena and is especially interesting in that by it he predicted cases of asymmetry found by Zeeman and others. Unfortunately the theory does not give any mechanical conception of the subject, merely consisting of the introduction into the equations of motion of terms of arbitrary form, which have no apparent justification.

It is comparatively easy to treat the case of a molecule composed of two ions carrying equal charges of opposite signs, and, in fact, Professor Rowland has lately given such a treatment before his students at Johns Hopkins University, but it leads to no new results as regards the Zeeman effect. Any case more general than this is very difficult. HERBERT M. REESE.

* Shedd, *Phys. Rev.*, July, 1899, p. 1; Aug., 1899, p. 86. Reese, J. H. U. Circulars, June, 1900.

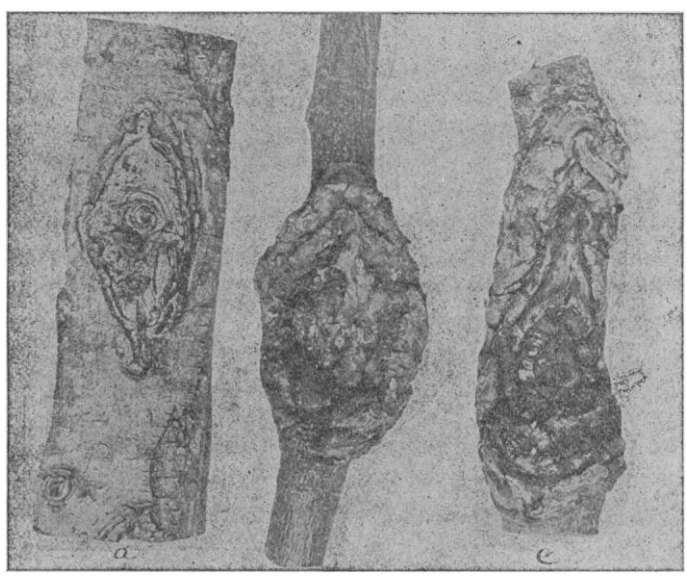
* *Wied. Annal.*, vol. 63, p. 278. *Astroph. Jour.*, vol. 9, p. 37.

† *Wied. Annalen*, No. 2, 1899, p. 345; No. 6, 1899, p. 352; No. 9, 1899, p. 290; No. 2, 1900, p. 376, and p. 389.

EUROPEAN APPLE TREE CANKER IN AMERICA.

SHORTLY after bulletin No. 163 of this station, entitled 'A New York Apple Tree

Canker,' was distributed, the writer received specimens of diseased apple limbs from various parts of the United States and Canada. Among the rest was a specimen from Nova Scotia which was noticeably different from any that I had yet seen. The injury was about six inches long on a limb two inches in diameter. Within the diseased area was a series of six ridges or convolutions in the wood surrounding a central starting point, each one of which evidently marked a year's growth of a parasitic fungus. The fungus, *Sphæropsis malorum* Peck., which has been shown to be the cause of the common New York apple tree canker, is more active in its growth. With this disease large areas of bark may be destroyed and the wood laid bare, or in other instances the bark may be much swollen and roughened, but the form of injury described above does not occur.



The appearance of the diseased limb, which was similar to that shown in Fig. 1 at *c*, strikingly resembled the work of *Nectria ditissima* as illustrated and described by European writers. However there was no fungus fruit in evidence, and as I was unsuccessful in obtaining more specimens the matter was dropped for a time.

In the latter part of May several specimens of diseased apple limbs were received from East Homer, Cortland County, N. Y., that were similar in appearance to the one from Nova Scotia, but in addition many portions of the dead bark and wood were thickly studded with the minute, deep red perithecia of a *Nectria*. Among the specimens were examples of recent infections as is shown at *a*, in the figure, as well as cankers of several years standing. The perithecia were abundant on all these specimens, so there seemed little doubt but that the *Nectria* was the cause of the diseased condition.

On visiting the locality it was found that the fungus was evidently confined to a small area and but few additional specimens were secured.

Through the kindness of Professor F. C. Sears, Wolfville, N. S., more specimens of the diseased apple limbs were obtained from that locality in June and the perithecia

of the *Nectria* were found to be abundant on them. Professor Sears writes that this form of canker is doing serious damage in some of the orchards of the Annapolis Valley.

Specimens of the diseased branches were sent to Dr. R. Hartig, Munich, Germany, for identification, who writes that the cankers are caused by the fungus *Nectria ditissima*.

So far as I know this fungus has not as yet been recorded as occurring on apple trees in America, and its appearance in our orchards is of great practical importance since it is a serious pest to European fruit growers.

W. PADDOCK.
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ZOOLOGY AT THE AMERICAN ASSOCIATION.

THE following papers were presented before Section F during the recent meeting at New York:

Sketch of the History of Statistical Inquiry of Evolution: By C. B. DAVENPORT, University of Chicago. The paper will appear in full in SCIENCE.

The Variation of Synapta: By C. L. EDWARDS, Trinity College. In the absence of the author this paper was read by title.

Variation among Hydromedusæ: By CHARLES W. HARGITT, Syracuse, N. Y. To be published in SCIENCE.

Variations in Jaws of Neries limbata: By MARIAN HEFFERAN, University of Chicago. Presented by C. B. DAVENPORT.

A quantitative study of variation made upon the species *Neries limbata*, collected at Cold Spring Harbor during the summer of 1899, gave the following results:

The character chosen for investigation was the number of teeth on the exsertile jaws. These number from 6–14 on each of the two jaws and were distinguished both for the sake of convenience and for purposes of comparison into definite teeth, those which occupy the distal half of the jaw and which are clearly separated from each other, and the indefinite teeth at the base of the jaw which are covered by a transparent horny layer.

The typical condition of the total number of teeth of 400 specimens of *Neries limbata* of Cold Spring Harbor is a curve of type I. or type IV., with a slight skewness in a negative direction from the mode 10. In case of the calculation of the right total teeth a transition from a curve of type IV. to an equally serviceable one of type I. could be made by dropping one extreme individual out of 400. The teeth on the right jaw appear to be slightly more variable than those on the left. The least variation is shown by the indefinite teeth. The degree of correlation between the two jaws is, on the whole, rather high, 0.820. Correlation is closer between the indefinite than between the definite teeth. A negative correlation exists between the definite and indefinite of the same jaw, that is, a small number of definite teeth is associated with a large number of indefinite and *vice versa*. An inverse relation also exists between the number of definite teeth and the age of the animal, older animals presenting fewer definite teeth.

This result as well as those of observation of many specimens showing many irregularities in the teeth, point to the conclusion that a process of erosion of the extreme teeth forms a large factor in the variation of the definite and perhaps indirectly of the indefinite teeth. A difference in the number of teeth in respect to the age of the animal has rarely been recognized in description heretofore and would be naturally overlooked unless a large number of specimens was examined. Little value can thus be placed upon the statements made in regard to the number of teeth in a large number of species where only a few specimens were found.