AT a recent meeting of the Regents of the University of Nebraska, Dr. Frederic E. Clements was promoted from the position of assistant to that of instructor in botany. The following were elected fellows for the collegiate year 1898–9: In mathematics, C. C. Engberg and Alta Johnson; in chemistry, Mariel C. Gere, Benton Dales and Howard C. Parmelee; in pedagogy, William R. Hart; in zoology, Albert B. Lewis and Charles C. Morison; in geology, Cassius A. Fisher; in physics, Samuel R. Cook; in electrical engineering, Charles H. True, and in botany, Albert T. Bell and Cora F. Smith.

MISS AGNES MARY CLAYPOLE, instructor in Wellesley College, has been appointed assistant in the department of histology and comparative physiology in Cornell University.

DR. SOPHUS LIE, professor of mathematics in the University of Leipzig, has *angenommen* accepted a call to the University of Christiania.

DR. GISEVINUS has been appointed associate professor of agriculture in the University of Königsberg; and Dr. Richard Wachsmuth, of Göttingen, has been called to a professorship of physics in the University of Rostock.

DISCUSSION AND CORRESPONDENCE.

'A PRECISE CRITERION OF SPECIES.'

THE papers by Professor C. B. Davenport and J. W. Blankinship, suggesting the determination of species by means of statistical methods, are welcome signs that the appreciation of the value of these methods is rapidly increasing among biologists. Heretofore they have been applied most extensively by anthropologists; consequently the inherent difficulties have become familiar to them, and their experiences will be useful to biologists who pursue these methods.

Statistical data are generally represented in the form of curves; and experience show that most curves, if the number of cases is sufficiently large, approximately conform to the probability curve. When the number of cases is small the curves tend to become more and more irregular, and the question arises: How large must the number of cases be in order to be significant, that is to say, in order to justify us in assuming that the few selected individuals represent a curve which deviates from the probability curve? All the curves given by Professor Davenport and Professor Blankinship in their paper are based on material not sufficiently extensive to compel us to assume that the distribution differs from the law of probability. For example, the data contained in Fig. 9, which is one of the best of Professor Davenport's examples, are not of such a character that we must necessarily assume a curve deviating from the normal probability curve. If a thousand individuals had been measured instead of forty-six only, irregularities of the curve would probably disappear. The same is true of Professor Blankinship's measurements. The secondary maximum in his best table (No. VI., Fig. 17) is so uncertain that, until further data are forthcoming, we must assume that with an increased number of measurements the secondary maximum will disappear entirely.

Furthermore, it must be considered that under certain conditions the distribution of measurements cannot conform to the probability curve. Such is the case in conditions like those exemplified in Table VII. of Professor Blankinship's paper. Here the greatest relative frequency is that of the value zero. Smaller values are not possible; consequently all the variations must be on the positive side. The same is true wherever the measured value is very near zero. In these cases the distribution must be a symmetrical.

But granted the supposition that curves exist which have more than one maximum, the question arises whether we are justified in assuming that the two maxima represent two species inhabiting the same area. First of all, it must be mentioned that, assuming equal frequency and equal variability of the two species, two maxima will occur only when the distance between the two types is greater than the standard deviation of either type. When the difference is less, the result is apparently an increased variability. When two maxima exist, the biological problem resolves itself into a mathematical analysis of the given curve. Owing to the impossibility of obtaining sufficiently extensive material, and to the consequent inaccuracies of the results of

observations, as well as on account of the complexity of the curve, such an analysis must always be based on certain biological assumptions. Karl Pearson has shown how difficult an analysis of such curves is. If we assume that the composite curve results from measurements of two coexisting species we make one of many possible assumptions. Natural selection and mixture are two causes which may have effects of a similar character. When, for instance, two distinct types interbreed, and the offspring show a tendency to revert to either parental type, curves will result with two maxima, each representing one of the parental types; but this curve does not originate by addition of the two composing curves; it is much rather an unknown function of these curves. A case of this character was described by me when treating of the anthropometric characteristics of the descendants of Indian mothers and white fathers. On the other hand, when natural selection acts in such a way that a certain group of individuals is least favored, and if these individuals are not far removed from the average type, curves with two maxima may develop. It will, therefore, be seen that the mere existence of curves with two maxima does not by any means signify the existence of two distinct species.

The question of correlation, which has been well set forth by Professor Blankinship, seems a most interesting one, and has received very able treatment at the hands of Karl Pearson, who clearly set forth the theory of this subject. It does not seem likely that this method can be utilized for distinguishing between specific and individual characters. In the same species certain organs prove to be strongly correlated, while others are only slightly correlated; and according to this degree of correlation the proportions will change among various types, and it is probable that the degree of correlation will remain the same among all closely related types.

Since the application of statistical methods to zoology is still in its infancy, it is to be hoped that the study may be taken up according to strict methods, in order to avoid erroneous conclusions.

FRANZ BOAS.

SCIENTIFIC LITERATURE.

J. BOLYAI, *Scientia Spatii Absolute Vera.* With a Magyar translation by SUTÁK J., and a biography by FR. SCHMIDT. Budapest, Schmidt Ferencz. 1897. 8vo. Pp. xxviii + 143.

W. BOLYAI DE BOLYA, *Tentamen juventutem studiosam in elementa matheseos puræ elementaris ac sublimioris methods intuitiva evidentiaque huic propria introducendi, cum appendice triplici.* Budapestini, Sumptibus Academiæ Scientiarum Hungaricæ. 1897. Editio Secunda. Tomus I. 4to. Pp. xii + 679. Price, 50 francs.

Sixty-five years after its issue from the little provincial press of the 'Collegii Reformatorum' in Maros Vásárhely, why does the proud Hungarian Academy of Science reissue, in sumptuous quarto form, a magnificent *édition de luxe*, this strange Tentamen?

Bolyai Farkas (Wolfgang Bolyai) has two unimpeachable certificates of immortality. He was the father of Bolyai János, and he first publicly appreciated Lobachévski. The second of these two titles, though destined to bulk large in the final history of human thought, has never before been explicitly mentioned by any one, so far as I know. I here call attention to it for the first time. If any praise or appreciation of Lobachévski was ever published or printed before 1851, I have never heard of it. In Russia he found only such rude and offensive ironies as fill a criticism in one of the St. Petersburg journals, 'Son of the Fatherland,' 1834, or else complete indifference. The academician V. Bunyakovski in his work, 'Parallel Lines,' printed in 1853, does not even mention the investigations of Lobachévski. Among his own pupils not one worked at his ideas or appeared as their convinced defender.

Vasiliev, Engel and Staeckel give 1866 as the date of the beginning of the movement to recognize the non-Euclidean geometry. Vasiliev attributes the start to the Frenchman Hoüel, 'whom we must remember to-day with gratitude.' Engel in a note to this sentence of Vasiliev's Address traces back the initiative to Baltzer: "Hier haette Baltzer erwaehnt werden sollen, durch den Hoüel erst auf Lobatschefskij und Bolyai aufmerksam gemacht worden war." This was stated by Hoüel himself