and produced further exceptions. The control mothers, sisters of above, produced a total of 7,531 regular sons, 5 exceptional sons, 7,711 regular daughters and one exceptional daughter. The probability that the difference between the offspring produced by the X-rayed and control mothers was due to chance can best be calculated by a formula of K. Pearson[3] for the probable error of a difference, for reference to which the writer is indebted to Professor Pearl. Calculation shows that in the case of the exceptional daughters the difference between the number produced by the X-rayed mothers (8) and that which might be expected from the behavior of the control (mean = .46023) is 13.10 times the probable error of the difference, (.50751). The same quantity for the sons is 49.81 times the probable error of the difference. These numbers make it practically certain that the difference is not due to chance. Every cause for the difference except X-rays seems to have been eliminated from the experiments—the control and X-rayed females were sisters emerging at approximately the same time, were kept at the same temperature, etc.

In the fourth series of experiments all the mothers, both those which were X-rayed and those in the controls, were the daughters of one white-eyed female by two eosin-eyed, miniature-winged males. The 26 X-rayed females produced a total of 1,934 regular sons, 42 exceptional sons, 2,173 regular daughters and 8 exceptional daughters. Seven of the eight exceptional daughters were fertile and produced exceptional offspring. The 19 control females produced a total of 5,109 regular sons, three exceptional sons, 4,985 regular daughters and one exceptional daughter. The difference between the number of exceptional daughters produced by the X-rayed females and those produced by the control females is 9.425 times the probable error of the difference. The same quantity for the exceptional sons is 41.00 times the probable error of the difference. The fourth series of experiments therefore confirms the findings of the third series. The results of the two series of experiments may be added together. In this case we find that the difference between the number of exceptional daughters (16) produced by the X-rayed females and the expected mean (.9354) is 20.17 times the probable error of the difference.

The exceptional daughters of the X-rayed females were of two kinds. Four of those in the third series were homozygous for both of the sex linked characters and were therefore formed by equational non-disjunction. Three of those in the third series and seven of those in the fourth series were heterozygous and therefore formed by reductional non-disjunction. Two of the exceptional daughters not included in the above two kinds were homozygous for one sex linked character and heterozygous for the other. Their constitution and the explanation of their occurrence will be discussed at a future date. It is clear from the results of the experiments described that X-rays may cause non-disjunction during either the first or the second of the maturation divisions and that the exceptional condition of the females produced by it, consisting in the possession of two X chromosomes and one Y chromosome, is transmitted to a proportion of their offspring. There is therefore in this effect of X-rays on the germ cells a very clear case of an external agent which modifies the mechanism of inheritance in such a way that a permanent effect is produced on the germ cells.

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[3] On the influence of past experience on future expectation, *Phil. Mag.*, Sixth Series, Vol. XIII, page 365.

OKLAHOMA ACADEMY OF SCIENCE

THE eleventh annual meeting of the Oklahoma Academy of Science was held in Oklahoma City on February 9, and at the University of Oklahoma, Norman, on February 10. The following papers were read:

Responses of bruchus to modified environments: J. K. BREITENBECHER.

The Isleta Indians: ALBERT B. REAGAN.

Some birds of the Oklahoma Panhandle: R. C. TATE.

Additional evidence on the possibility of the redemption of the great plains from its semi-arid condition: J. B. THOBURN.

The possible contribution of the motion picture in the effective teaching of history: J. W. SHEPHERD.

Present-day objectives in physics: HOMER L. DODGE.

Present-day objectives in zoology: A. RICHARDS.

Observations on the removal of the semi-circular canals from baby chicks: L. B. NICE AND C. L. FURROW.

Buried mountain ranges in Oklahoma: CHARLES N. GOULD.

Sources and uses of direct current in high school laboratories: B. C. BROUSE.

An interesting problem in bird study: R. O. WHITENTON.

Nesting records for 1920 to 1922 at Norman, Oklahoma: MARGARET M. NICE.

The identification and ecology of an epiphytic fern included in the Oklahoma cryptogamic flora: M. M. WICKHAM.

Unilateral inheritance in bruchus: J. K. BREITENBECHER.

The acceleration of fission rate in paramœcium: DIXIE YOUNG.

Concentric corpuscles of the palatine tonsils: J. M. THURINGER.

A note on the migration of miriapoda: J. M. THURINGER.

The parasites of dogs and cats in Oklahoma: JOHN E. GUBERLET.

Observations on the egg laying of the cow pea weevil: ALFRED BRAUER. Introduced by J. K. Breitenbecher.

The skeletal development of a 23-year old elephant compared with that of man: ED. CRABB.

The fall grasses of Cleveland County: C. W. PRIER.

Notes on the effect of urea on the diffusibility of MgSo4: ALMA J. NEILL.

Notes on biological survey: C. W. SHANNON.

A new geologic map of the Arbuckle Mountains of Oklahoma: C. E. DECKER.

A study of some conglomerates near the eastern limits of the redbeds of Oklahoma: F. O. EVANS.

Some phases of the Permian between the Arbuckle and Wichita Mountains, Oklahoma: E. R. BROCKWAY.

Phosphate rock in Oklahoma: A. C. SHEAD.

Chemical composition of Oklahoma sand barite rosettes: A. C. SHEAD.

The Osburn fault of northern Idaho: J. B. UMPLEBY.

An analysis of drillite and its bearing on the possible formation of igneous rocks from pre-existing sedimentaries: A. C. SHEAD.

Chemical composition of the Black Mesa: A. C. SHEAD.

Building materials of Oklahoma: M. C. OAKES.

An interpretation of certain peculiarities of the Canadian river basin of western Oklahoma: C. F. BOLLINGER.

Evidence of Permo-Pennsylvanian glaciation in the Wichita Mountains: S. WEIDMAN.

Outline of the structural geology of the Ouachita Mountains of Oklahoma: C. W. HONESS.

Notes on the paleontology of the Comanchean of Love County, Oklahoma: F. M. BULLARD.

Summarized data on the structural history of Oklahoma: BESS U. MILLS.

Some observations on the South Canadian River near Norman: O. F. EVANS.

An example of an Indian picture writing in the Wichita Mountains: S. WEIDMAN.

Present status of science work in Oklahoma: C. W. SHANNON.

Distribution of taxes in Oklahoma: F. F. BLACHLY.

The simple rigidity of a drawn tungsten wire at incandescent temperature: WILLIAM SCHRIEVER.

The cause of the optimum angle in a receiving conical horn: VICTOR A. HOERSCH.

An electrometer for measuring the radioactivity of gases from oil and gas wells: FORREST K. HARRIS.

A boy's vocabulary at eighteen months: GEORGE F. MILLER, MARGARET D. MILLER AND MARGARET M. NICE.

An experiment in automatic spelling: HERBERT PATTERSON.

The magnetism of the map: SOPHIE ALTSHILLER COURT.

Some problems in vocabulary testing: GEORGE F. MILLER.

A comparison of the sizes of the vocabularies of fifty children of the same age: MIRIAM OATMAN-BLACHLY.

A special feature of the program at the annual dinner, held on February 10, was the centennial celebration of the birth of Louis Pasteur and Gregor Mendel. The following program was presented:

Pasteur's contributions to chemistry: C. L. NICKOLLS.

Pasteur's contributions to bacteriology and pathology: GAYFREE ELLISON.

Louis Pasteur—the man: L. B. NICE.

Gregor Mendel: A. RICHARDS.

The following officers were elected for the ensuing year:

President, S. Weidman, Norman, Oklahoma; *first vice-president,* John E. Guberlet, Stillwater, Oklahoma; *second vice-president,* Frank G. Brooks, Oklahoma City, Oklahoma; *secretary,* L. B. Nice, Norman, Oklahoma; *treasurer,* J. K. Breitenbecher, Norman, Oklahoma; *curator,* Fred Bullard, Norman, Oklahoma.

L. B. NICE
Secretary

NORMAN, OKLAHOMA