with $BaSO_4$; the concentration of the original solutions were (in the case of methylene blue) 11·54; 17·00; 30·8; 51·4; 115·4; 218·4 and 308·0 mg/l.

The adsorption isotherms (Fig. 2) obtained were of the Langmuir type, except that in the cases of crystal violet and methylene blue there was a decrease of adsorption at the higher concentrations; we also plotted $1/x$ (quantity adsorbed) as a function of $1/c$ (equilibrium concentration) and obtained (apart from the exception just mentioned) straight lines which could be extrapolated to $1/c = 0$; this gave us x_∞; the results were:

Crystal violet: $x_\infty = 0{\cdot}10$ mg/g $BaSO_4 = 2{\cdot}5 \times 10^{-7}$ mole/g
Methylene blue: $x_\infty = 0{\cdot}066$ mg/g $BaSO_4 = 2{\cdot}2 \times 10^{-7}$ mole/g
Picric acid: $x_\infty = 0{\cdot}040$ mg/g $BaSO_4 = 1{\cdot}8 \times 10^{-7}$ mole/g

If we combine these Figures with our previous value for the surface area of 1 g of p.p. of $BaSO_4$ (= 5150 cm^2), we obtain the following values for the surface area occupied by 1 mole, 1 g or 1 molecule of our dye stuffs in the adsorbed state.

	m^2/mole	m^2/g	A^2/molecule
Crystal violet	206×10^4	5 150	343
Methylene blue	234×10^4	7 800	390
Picric acid	286×10^4	12 400	477

On the other hand, 100 A^2 seems to be a reasonable value for the surface area of a dyestuff molecule, if we consider the structure formula of the molecule and the lengths of bonds; hence the degree of occupation of the surface is found to be 30–22%.

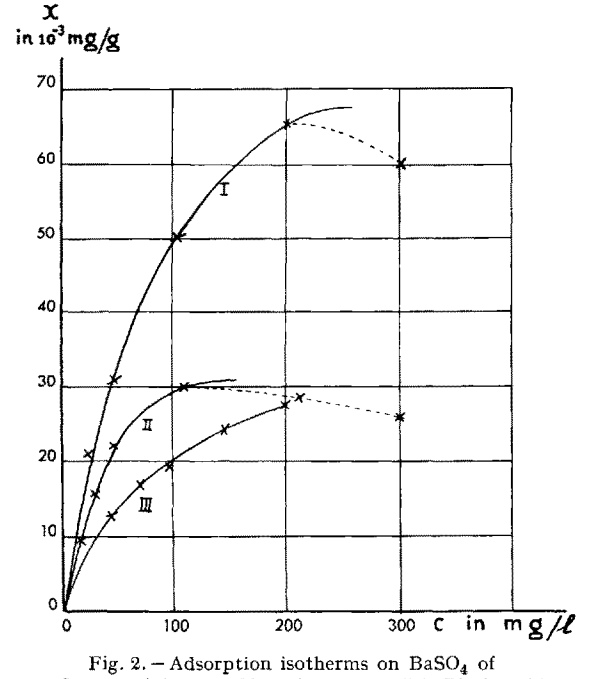

Fig. 2. – Adsorption isotherms on $BaSO_4$ of I.–Crystal violet; II.–Methylene blue; III.–Picric acid.

LANGMUIR[1] has treated the problem of surface occupation theoretically; his theory has empirical features (drawing from a pack of shuffled cards); the structure of the adsorbing surface is of great importance in his theory.

We decided to use the following empirical method for the determination of the maximum occupation of surface, where the influence of the structure of the adsorbing surface is neglected: we stamped a big piece of paper with a stamp in an arbitrary way, but we rejected every print covering partly an already existing print; our stamping ended with carefully stamping all places where there was still space for a print; we then counted the number of prints, and calculated the degree of occupation. This method gave a degree of occupation of 50% for a circular of moderately elliptic stamp, and 30% for a rectangular stamp (5 × 1·5 cm^2).

We think, therefore, that the degree of occupation ranging from 30–22% for our molecules of rather complicated shape is not unreasonable.

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Zusammenfassung

Die spezifische Oberfläche von $BaSO_4$-Niederschlägen wurde bestimmt durch Messung des Austausches von Oberflächen-Ba-Ionen mit γ-radioaktiven Ba^{131}-Ionen (spezifische Aktivität etwa 1 mc/g) einer gesättigten $BaSO_4$-Lösung. Die spezifische Oberfläche war 5150 cm^2/g.

Dann wurden die Adsorptionsisothermen von Farbstoffen (Kristallviolètt, Methylenblau und Pikrinsäure) an der Oberfläche von $BaSO_4$-Teilchen bestimmt. Unter der Annahme, dass jedes Farbstoffmolekül im adsorbierten Zustand eine Oberfläche von 100 A^2 einnimmt, ergab sich ein maximaler Besetzungsgrad von 22–30%.

Segregation of Bivalents in Meiosis Induced by Chemicals

Analysis of the effects of chemicals on grasshopper chromosomes made in this laboratory has shown that among the major changes induced by a variety of chemicals on meiosis is the remarkable phenomenon of the bodily movement of bivalents to the poles in anaphase 1, instead of their separation into univalents. An account of it was presented as seen in urethane affected meiosis[1]; but a more recent examination of material treated with a number of other chemicals has demonstrated this as a widespread phenomenon. In such clearly different chemicals as the nitrogen mustards and sodium ribose nucleate, meiosis is affected in such a manner as to present the appearance of a clear segregation of bivalents.

Poecilocera picta (Acrididae) was used as the animal for study. Specimens were injected with the following chemicals in normal saline: (a) ethyl urethane, 2%, (b) nitrogen mustard [di(2-chloroethyl)-methyl-amine-hydrochloride], 0·1%, and (c) sodium ribose nucleate (from yeast), 0·1%. In each case, 0·4 ml of the solution was injected into the posterior abdomen of the grasshopper. At various intervals after injection, the testes were removed and fixed in Carnoy's fluid and Feulgen squashes were made. Sections were also cut (10 μ thick) and stained in Feulgen-light green and Heidenhain's haematoxylin. With urethane, 6 h after injection, about half the number of meiotic anaphases showed bivalent

[1] I. LANGMUIR, J. chem. Soc. *1940*, 335.

[1] P. K. NAMBIAR, Cytologia (in press).

segregation. In nitrogen mustard treated forms, this phenomenon was first seen 8 h after treatment; but large numbers of affected anaphases showing clear bivalent segregation were seen much later, and up to 5 days after injection. Sodium nucleate treated forms also exhibit the same phenomenon. 12 h after injection a few nuclei show bivalent segregation. The number increases gradually until, by about 30 h, a very large percentage exhibits this peculiarity.

the poles. It seems more probable that the chemicals affect the centromere rather than the spindle. This view obtains additional support from the fact that occasionally a few bivalents occur on the spindle in a disorientated manner. The conclusion seems irresistible that the chemical has inactivated the centromeres or in some way rendered them ineffectual so that the bivalents are carried passively to the poles or are left behind on the spindle. An upset in the nucleic acid charge in the chromo-

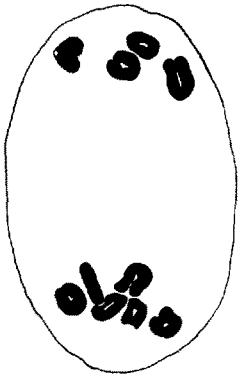

Fig. 1.–Segregation of bivalents. 6 h after injection with 2% urethane solution.

× 1600.

Fig. 2.–Segregation of bivalents; autosome lagging. 12 h after injection with 0·1% solution of sodium ribose nucleate.

× 1600.

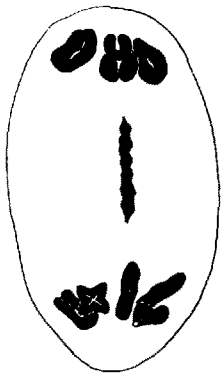

Fig. 3.–Segregation of bivalents. X-chromosome lagging 8 h after injection with 0·1% solution of nitrogen mustard.

× 1600.

The segregation might involve all nine bivalents so that they become distributed between the two poles, the X-chromosome also segregating as in normal anaphase (Fig. 1). Most often, the segregation ensures a distribution of 5 and 4 bivalents to the poles but occasionally a distribution of 6 and 3 is also found. In a number of instances, one bivalent (Fig. 2), and sometimes the X-chromosome (Fig. 3), is left behind on the spindle.

To our knowledge, this phenomenon of bivalent segregation has no parallel. The only comparable instance is that reported by AUERBACH[1] in *Drosophila* where, as a result of treatment with nitrogen mustard, the treated X-chromosome and untreated normal X-chromosome move to the same pole during oogenesis. In the present case, however, it must be presumed that all chromosomes in the cell are affected by the chemical. It seems difficult to account for this segregation except on the basis of a change brought about in the centromeres of the bivalent in their attraction-repulsion relationships with reference to the centrosomes. DARLINGTON'S[2] views that the formation of the spindle and the successful orientation and movement of the chromosomes on it depend on a balance in the strength and timing of the cycles and repulsion of the centromeres and centrosomes, lead one to conclude that in the present case the non-separation of the univalents and the bodily movement of the bivalents to the poles must be due to an upset of these relationships. That the spindle is acting more or less normally is clear from the movement of the bivalent to somes rendering the univalents unable to separate seems also possible.

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Zusammenfassung

Urethan, Senfgas und Ribose-Nukleat-Natrium scheinen alle die Meiose der Heuschrecke auf eine interessante Art und Weise zu beeinflussen. In Anaphase I verursachen sie eine Abspaltung von zweiwertigen Einheiten, die, anstatt sich in einwertige Einheiten zu teilen, als Ganze nach den Polen wandern.

[1] C. AUERBACH, Genetics *32*, 3 (1947).
[2] C. D. DARLINGTON, *Recent Advances in Cytology* (Churchill, London 1937), 2nd ed.

On the Multiple Sex Chromosome Mechanism in a Lygaeid, *Oxycarenus hyalinipennis* (Costa)

Multiple sex chromosome mechanisms have been described in numerous species of heteroptera belonging to at least ten different families[1] of which the families Reduviidae and Nepidae have afforded maximum evidence. In the family Lygaeidae, only few examples of such a mechanism have been reported from the subfamilies Lygaeinae[2,3] and Rhyparochrominae[3], the

[1] F. SCHRADER, Evolution *1*, 134 (1947).
[2] S. D. SCHACHOW, Anat. Anz. *75*, 1 (1932).
[3] E. VON PFALER-COLLANDER, Acta zool. Fenn. *30*, 1 (1941).