The solution of (2) can be obtained by successive application of l'Hopital's rule or by Laplace transforms, and the result can be expressed in terms of the familiar sum of exponentials as

$$c_n(t) = c_1(0)(k_1 k_2 \ldots k_{n-1}) \sum_{i=1}^{n} A_i e^{-k_i t} \quad (3)$$

The constants A_i are of the form $1/(k_i - k_j)(k_i - k_k)\ldots$ with all permutations $i,j,k,\ldots$ represented, so that if any two or more rate constants are identical the equations are indeterminate.

However, when the rate constants are all identical, the initial description (2) simplifies to

$$dc_n/dt = k(c_{n-1} - c_n) \qquad 1 \leqslant n \leqslant N-1 \quad (4)$$

and integration yields the set of equations

$$c_n(t) = c_1(0)(kt)^{n-1} e^{-kt}/(n-1)! \quad (5)$$

This expression is the desired time-dependent concentration of any species except the last in a system of reactions connected by identical rate constants. The concentration of the final reaction species is most easily found as the difference

$$c_N(t) = c_1(0) - \sum_{N=1}^{N-1} c_n(t) \quad (6)$$

The set of concentrations represented by equations (5) can also be written in terms of the probabilities of occurrence of the individual species $P_n(t) = c_n(t)/c_1(0)$ by dividing through by $c_1(0)$, and the results are recognizable as the so-called backward equations of a Poisson process[4]. Thus it appears that all of the important properties of the Poisson process can be used directly in the analysis of successive kinetic reactions connected by identical rate constants. The more widely known forward equations

$$P_n(t) = (kt)^n e^{-kt}/n! \quad (7)$$

are obtained if the individual species in scheme (1) are numbered starting with $n = 0$ rather than with $n = 1$.

One of the most interesting and important problems in modern biology concerns the mechanism by which living cells are activated to perform a given task, and blood platelets are being increasingly utilized as models in stimulus-response studies designed to help elucidate this process. These important cells are not only responsible for the maintenence of normal hemostasis, but are also implicated in thrombosis and perhaps in other vascular disorders as well. They undergo characteristic changes in shape when activated; at least one intermediate species is present in the classical 'disc to spiny sphere' shape change, and at least two intermediates are present when the reaction is stimulated under conditions which result additionally in the release of cellular material into the external medium. Preliminary evidence obtained in our laboratory supports the conclusion that the morphological species resulting from stimulation of platelets with (saturating levels of) adenosine diphosphate are formed consecutively and with identical velocities[5]. The Poisson model is clearly applicable to this system, and while there is no evidence to suggest that this finding applies to other stimuli or to other cellular systems, it would be interesting indeed if this were the case.

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Naturally occurring translocation dicentric chromosomes and somatic reduction in *Lathyrus sativus* L.

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Summary. A naturally-occurring case of terminal translocation resulting into end-to-end association of somatic chromosomes, and mitotic anaphase movement without chromatid separation in a variety of *Lathyrus sativus* is reported.

Variability in chromosome number and morphology in somatic cells cultivated in vitro is a general fact[1-3]. The translocation of a whole chromosome or chromosome arms have been reported in both normal and abnormal liveborns[4]. In the plants reproducing either principally or obligatorily through vegetative means, the somatic tissues represent a mosaic of chromosome complements wherein the normal chromosomal complement occurs in maximum frequency. In some such cases the variation in chromosome number and/or morphology is caused by reciprocal translocation[5].

In a normal looking diploid *Lathyrus sativus* (2n = 14) var. LSD-1 (obtained from IARI, New Delhi), polymorphism for pollen grain size and shape was noticed. On cytological examination, this variety exhibited intraindividual chromosomal instability in root- and shoot-tip mitoses, representing a wide range of chromosome numbers, between 14 and 3. The analysis of somatic chromosome behaviour in this variety for 2 consecutive generations revealed that the intraindividual instability of chromosome behaviour and number in somatic tissues is possibly controlled by genetic factors, which result in spindle abnormalities, chromosome degradation and minute chromosomes. The details are published elsewhere[6].

In this variety, some cells which had a reduced chromosome number also showed terminal translocation resulting in end-to-end fusion and also the anaphase separation of somatic chromosomes without chromatid separation, which resulted in somatic reduction.

The observations were recorded in well-spread chromosome preparations of root tip mitosis obtained after pretreatment in a saturated aqueous solution of para-dichlorobenzene for 3.5 h at 12–14 °C and staining in a 2% aceto-orcein + N · HCl mixture (9:1). The terminal translocation

resulting in end-to-end association of somatic chromosomes mainly involves homologous chromosomes (figs 1–3). The intact end-to-end attachments during cell division may result in reduction in chromosome number and change of chromosome morphology, forming dicentric chromosomes. Similarly, the anaphase movement of somatic chromosomes without chromatid separation (fig. 3) may lead to somatic reduction.

The mechanism of whole chromosome unions, however, remains to be defined. One possibility may be the stickiness of telomeres of homologous chromosomes, resulting in dicentric chromosomes. In prophase cells, the end-to-end attachments of somatic chromosomes are frequently observed leading to chain-like interphase/prophase association[7], which helps to maintain the spatial relationship of mitotic chromosomes throughout the division cycle[8]. It is quite likely that the end-to-end terminal fusion of chromosomes giving rise to dicentric chromosomes possibly represents a relic of interphase associations which are more tightly held in this particular variety, either due to specific telomeric gene combinations in these chromosomes or representing a genetically-controlled translocation. The genetically-controlled disturbed polarity and spindle operation may cause the somatic reduction.

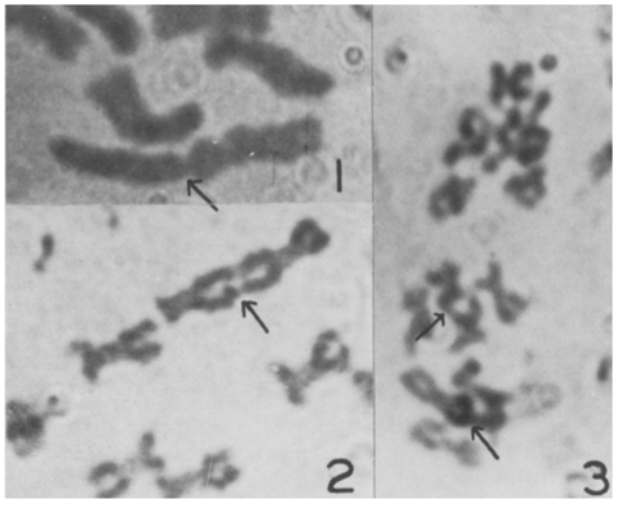

Figure 1 and 2. Chromosome spreads showing end-to-end attachment of somatic chromosomes.

Figure 3. Mitotic anaphase without chromatid separation. Arrows indicate the end-to-end attachment of chromosomes.

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Regulation of ppApp synthesis during sporulation of a conditionally asporogenous rifampin mutant of *Bacillus subtilis*[1]

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Summary. The intracellular synthesis of ppApp in a conditionally asporogenous rifampin-resistant mutant of *Bacillus subtilis* stimulated to sporulate in the Sterlini-Mandelstam (SM) medium supplemented with ppApp is negligible and comparable to that of the non-sporulating culture. The formic acid extract from the sporulating culture stimulates sporulation of the mutant in SM medium.

Bacterial sporulation is a simple model system for differentiation. A rifampin-resistant, conditionally asporogenous mutant of *B. subtilis* (Spo^c Rif^r) which sporulates poorly in Sterlini-Mandelstam[4] (SM) medium but sporulates normally in modified Difco medium[5] was found to regain its ability to sporulate in SM medium supplemented with arginine, methionine, valine and isoleucine[6]. Both the Spo^c and the Rif^r traits were mapped at the same gene. The Rif^r lesion has been shown to be located in the gene encoding RNA polymerase[6]. Several highly phosphorylated nucleotides (HPN) were found in sporulating cells of *B. subtilis*. Only ribosomes from sporulating but not vegetative cells are able to synthesize HPN[7,8]. Asporogenous mutants defective in the synthesis of HPN have been isolated[9]. The stimulation of sporulation by ppApp in the Spo^c Rif^r mutant[10] and the dependence of sporulation on the prior synthesis of pppAppp[11] seem to indicate that these HPN are involved in the initiation of sporulation in *B. subtilis*. This paper reports further evidence that the intracellular synthesis of ppApp is regulated by its exogenous supply during sporulation.

Experimental part. Bacterial strains used, conditions for sporulation, method of determining sporulation frequency have been previously reported[6]. The extraction and quantitation of HPN were done as previously reported[10]. Identification of HPN I was performed by scraping off the radioactive spots from the PEI-cellulose chromatogram. The radioactivities were eluted by 2 M triethylammonium bicarbonate prepared by bubbling CO_2 through a 2 M solution of triethylamine in ice until the pH was 7.5. The eluate was air dried and rechromatographed on PEI-cellulose TLC in 1.5 M KH_2PO_4 at pH of 3.4 for the 1st dimension and in 3.3 M ammonium formate, 4.2% boric acid at pH 7.0. ppApp (adenosine 3′-5′-bis-diphosphate, ICN Pharmaceuticals, Cleveland, Ohio, USA) was also chromatographed in exactly the same fashion on a separate TLC sheet. For ^{3}H-ATP incorporation studies, mutant culture resuspended in SM medium supplemented with amino acids were incubated with $H_3{}^{32}PO_4$ (carrier free, ICN Radiochemicals, Irvine, Cal., USA) or ^{3}H-ATP (adenosine 5′-triphosphate, tetrasodium salt [2,8-^{3}H], ICN Radiochemicals, Irvine, Cal., USA) with cells at final concentrations of 25 µCi/ml and 40 µCi/ml respectively at the time of resuspension. 40 µg/ml of unlabelled ATP was added to the