as a result of pseudorabies-virus infection. Finally, the DNA preparation was passed through DEAE-cellulose paper pulp: again no significant breakdown of cell DNA occurred. Once more, however, prior incubation of cell homogenates resulted in DNA breakdown: this assay indicated an increase in exonuclease activity after infection (Morrison, 1967).

Pseudorabies-virus DNA has been shown to incorporate thymine from pre-labelled host cells (Low, Mechie, & Hay, 1971). The present results indicate that, if this thymine is derived directly from cellular DNA and not from pools within the cell, it must arise from extremely limited, probably predominantly exonucleolytic, digestion.

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Induction of Deoxyribonucleic Acid Polymerase and Deoxyribonuclease Activities in Cells Infected with Herpes Simplex Virus Type II

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Herpes simplex viruses form one serologic group, but minor antigenic differences have resulted in a classification into two types (Plummer, Waner, Phuangsab & Goodheart, 1970): type I is associated with non-genital and type II with genital infections.

It has been shown that infection of exponentially growing BHK21/C13 cells‡ by herpes simplex virus type I leads to a rise in both DNA polymerase and deoxyribonuclease activities (Keir & Gold, 1963). The infected-cell DNA polymerase is considerably more heat stable than is the host-cell enzyme and is stimulated at salt concentrations that inhibit the host-cell enzyme (Keir, Hay, Morrison & Subak-Sharpe, 1966a). In addition, both DNA polymerase and deoxyribonuclease activities after type I virus infection have been shown to be immunologically distinct from the enzymes of the uninfected cell (Keir, Subak-Sharpe, Shedden, Watson & Wildy, 1966b; Morrison & Keir, 1968).

BHK21/C13 cells in exponential phase were infected with herpes simplex virus type I (strains

MP17 and McDonald) or type II (strains HG52 and MS) at a multiplicity of infection of about 10 plaque-forming units/cell. After 9h the cells were washed and harvested and soluble extracts were prepared by centrifuging at 105 000g.

DNA polymerase activity from both type I- and type II-infected cells was stimulated five- to six-fold over the cellular value and the 400% stimulation of type I activity by about 150mM-K⁺ or -NH₄⁺ (Keir *et al.* 1966b) was confirmed. Type II-infected cell activity was maximally increased at about 100mM-salt by about 50%. Host-cell activity was inhibited at these concentrations. Preincubation of these extracts at 50°C indicated that type II activity was considerably more heat-stable than was the cell enzyme but less so than was type I activity.

Type I and type II herpes simplex viruses induced a similar rise in alkaline deoxyribonuclease activity, but no increase of acid deoxyribonuclease activity was observed.

The results indicate: (1) that infection with herpes simplex type II leads to considerable increases in DNA polymerase and deoxyribonuclease activities; (2) that the DNA polymerase activity after type II virus infection has properties distinct from that of the host cell and, apparently, from that of the type I-infected cell.

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An Unusual Deoxyribonucleic Acid Species of Mammalian Cells

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During use of the technique described by Marmur (1961) for the extraction of ³H-labelled DNA from mammalian cells previously exposed to [³H]-thymidine, a problem encountered was the incomplete recovery of acid-insoluble radioactivity. It now appears, at least in mouse fibroblasts (strain L929), mouse ascites-tumour cells (Krebs 2), HeLa cells and horse lymphocytes, that 30–40% of the total nuclear DNA is difficult to recover because of its size and the fact that it is complexed to a carbohydrate-containing moiety. After lysis of the labelled cells with sodium dodecyl sulphate followed by emulsification with chloroform–3-

‡ Abbreviation: BHK cells, baby-hamster kidney cells.

methylbutan-1-ol and centrifugation to separate the emulsion, all the labelled DNA is precipitable from the resulting aqueous layer with ethanol. However, it was found that not all the DNA is subsequently recoverable by the classical 'spooling' technique and moreover a large proportion remained insoluble in 0.15M-sodium chloride. This is referred to as 'residual DNA'.

Treatment of this insoluble fraction with α -amylase followed by mild alkali was sufficient to solubilize completely a fraction sensitive to the digestive actions of pancreatic deoxyribonuclease, snake-venom diesterase and spleen diesterase. Although sucrose-density-gradient analyses revealed this DNA species to be of low molecular weight (approx. 5S), the kinetics of its labelling before and after a 'chase' indicated it to be metabolically stable. Also, like the remainder of the nuclear DNA, it is replicated during the S-phase of the cell cycle.

Perhaps the most interesting feature of this 'residual DNA' species was revealed by chromatography on columns of hydroxyapatite. Despite the solubilization procedures, which involve alkali treatment, the 'residual DNA' still behaves in a fashion expected of a double-stranded molecule. Attempts to 'denature' the material either by heating at low ionic strength followed by rapid cooling, or by treatment with alkali followed by neutralization, were unsuccessful. One possible explanation of such behaviour is that the molecule is somehow cross-linked. So far only pretreatment with 2-mercaptoethanol has rendered the molecule 'denaturable'. Nevertheless after this treatment the DNA is still readily 'renatured' by incubation at high ionic strength, suggesting the presence of repetitious nucleotide sequences.

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Initiation of Deoxyribonucleic Acid Replication in Mammary-Gland Organ Cultures

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When explants from the mammary glands of mid-pregnant C3H mice are cultured in medium 199 with insulin the parenchymal cells are induced to replicate their DNA and divide (Stockdale, Juergens & Topper, 1966; Mayne & Barry, 1970). We have found that the same changes occur when medium 199 is replaced by a simpler medium containing only inorganic salts, glucose and amino acids. Withdrawal and replacement of the components of this medium have enabled us to study the substrates required for the initiation of DNA replication.

We conclude that the initiation and synthesis of DNA in organ culture, as measured by the incorporation of [3 H]thymidine, can be divided into three distinct periods. At 0–4h there is a lag period in which insulin, glucose and amino acids may be absent from the medium. At 4–12h there is a period in which these components must be present and that ends by the subsequent rise in DNA synthesis being insensitive to actinomycin D. At 12–22h there is the period in which parenchymal cells are in S-phase. DNA synthesis in this period is unaffected by the absence of insulin, glucose or amino acids from the medium or by inhibition of RNA synthesis, but it is immediately stopped when protein synthesis is inhibited by cycloheximide.

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Effect of Azaserine on Insulin Release *in vitro*

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Azaserine (O-diazoacetyl-L-serine), an analogue of glutamine, has been shown to act *in vivo* to inhibit markedly the synthesis of purine nucleotides *de novo* in various mammalian tissues (Moore & Le Page, 1957). It has been suggested (Mayhew, Wright & Ashmore, 1969) that purine nucleotides may be involved in the metabolic events leading to insulin release from the mammalian pancreas in response to various secretagogues. On this basis it was decided to determine whether azaserine could exert an effect *in vitro* on the release of insulin from isolated rat islets of Langerhans. A parallel study was undertaken with mouse islets of Langerhans in view of reported species differences in the effects of other inhibitors.

Islets of Langerhans were prepared by collagenase digestion of the pancreas (Howell & Taylor, 1968) and were preincubated for 30 min in a physiological medium containing 5 mM-glucose. After a further incubation for 30 min in the presence of glucose or 8 mM-glucose plus the agent under study the medium was sampled and the insulin content was determined by radioimmunoassay.

With rat islets of Langerhans no effect of 0.3 mM-azaserine was observed on the rate of insulin release in response to 20 mM-glucose or the release produced by 5 mM-leucine, 5 mM-theophylline or 1 mM-dibutyryl cyclic AMP (6-N,2'-O-dibutyryladenosine 3':5'-cyclic monophosphate. However, the