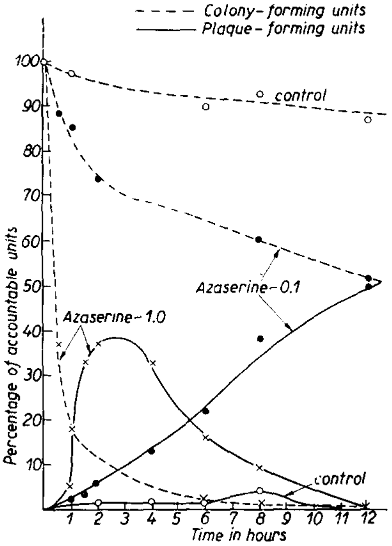

Fig. 1. Recovery of *Escherichia coli*, K-12 as either colony formers or plaque formers after exposure to azaserine. (Azaserine concentrations in μg/ml).

In salts-glucose or in broth media the spontaneous liberation of *lambda* phage parallels the rate of bacterial growth reaching an average of one free phage per 2–3000 bacteria in a saturated culture. In the presence of as little as 0.1 μg of azaserine per ml in the salts-glucose medium the phage yield after 5 hours was 400 times greater than that of the spontaneous control with a decrease in bacteria giving 23 phages per surviving bacteria (see Table I). In nutrient broth, greater concentrations of azaserine are required for both inhibition of bacterial growth and induction of phage formation. With 200 μmg of azaserine per ml of broth the bacterial count dropped precipitously and the phage count rose to over 500 times that of the growing control (Table I). With proper concentrations of cells and drug, mass lysis could also be demonstrated.

A more accurate measure of induction was obtained by exposing washed bacteria to azaserine in phosphate buffer. In this medium, neither growth of the bacteria nor maturation of induced phage occurs. Starting with a given population of bacteria, 100% of which are colony formers, the inducing action was measured by the conversion of colony formers to plaque formers or infectious centers when plated on the sensitive indicator, *Escherichia coli*, strain C. The proportion of the population which cannot be accounted for as either colony or plaque formers are apparently cytotoxic victims of the drug action. Though the percentage of plaque formers per accountable population increases rapidly with increased concentration of or exposure to the drug, the percentage of "unaccountables" lost by the cytotoxic action also increases. After a two hour exposure to 1.0 μg of azaserine per ml, 48% of the original population was recovered as either a colony former (11%) or a plaque former (37%). Fig. 1 also shows that further exposure resulted in a complete sterilization of all forms at 12 hours. The cytotoxic action at 0.1 μg/ml is nil allowing almost complete accountability with 49% plaque formers and 50% colony formers after a twelve hour exposure.

Thus azaserine joins the ranks of chemical inducers of prophage development. This is of particular interest, not only because of the antibiotic nature of azaserine, but because of its radiomimetic and anti-neoplastic properties.

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The application of mineralogical theories to the "mineral" phase of teeth and bones

For many years mineralogists have recognized that constant ratios of elementary constituents are not essential to the existence of a single phase having characteristic physical and optical properties. Thus, for example, one of the commonest rock-forming minerals is plagioclase feldspar, the composition of which might be: $Na_{0.68}Ca_{0.32}Al_{1.32}Si_{2.68}O_8$. This substance, called andesine, can be considered as an isomorphic intermediate between albite ($NaAlSi_3O_8$) and anorthite ($CaAl_2Si_2O_8$), being 68% of the former and 32% of the latter.

On the basis of the lack of constancy of certain elemental ratios, there is no evidence of a defective crystal lattice other than the proxy of Ca for Na and Al for Si. That is, there is no evidence of vacant positions in the lattice. Nevertheless, precisely this type of evidence (lack of constancy of Ca/P ratios) has been used by numerous non-mineralogists in order to demonstrate "defects" in the lattice of apatite when considering the mineral substance of tooth and bone. Thus, for example, the so-called "defect series" of apatites postulated by POSNER, FABRY AND DALLEMAGNE[1] is completely meaningless in the sense in which they have attempted to use it to describe these structures. That extensive isomorphic substitution does take place in the apatite structure was clearly demonstrated by the writer in 1938[2], and has been confirmed by numerous investigators[3,4,5].

There are two glaring omissions in their experimental results on the "defect" hydroxy-apatites with various ratios Ca/P, namely, (1) determination of the water content and (2) determination of the carbon dioxide. These omissions should be quickly recognizable in view of the isomorphic substitutions involving $PO_4^{3-} \longrightarrow H_4O_4^{4-}$, $[3PO_4]^{9-} \longrightarrow [4CO_3]^{8-}$ and $Ca^{2+} \longrightarrow H_3O^+$ or H_2O, as suggested[6,7]. Francolite from Staffel, it will be recalled, contains F, CO_2 and H_2O (above 300° C) in the amounts 4.11, 3.36 and 0.90 weight per cents, respectively[8]. The quantity of fluorine alone is slightly in excess of the amount required to fill all fluorine positions of the fluorapatite structure.

The question of how the carbonate ion occurs within the crystal lattice of mineral carbonate-apatites has not been demonstrated rigorously, but a hypothesis that qualitatively fits all of the experimental data has been presented[6,7]. Certainly it must be fully as obvious now as it was in 1937[8] that the carbonate group does not substitute for fluorine of fluorapatite and, whatever the structural formula for carbonate-apatite may be, it cannot be $Ca_{10}CO_3(PO_4)_6$. Furthermore, it should be obvious that constant ratios of C:P:Ca would not be expected, and the fact that they are not found does not demonstrate either a defect structure or the presence of more than one phase.

The question of the existence of a carbonate-apatite probably first arose in 1822, when HAÜY[9] questions the validity of WERNER's supposition that certain apatites were not merely mixtures. During the intervening 133 years, there has been no straightforward demonstration that small, water-clear crystals of francolite consist of more than a single phase. The conclusion of POSNER AND DUYCKAERTS[10], that two phases are indicated by their infrared absorption data is a *non sequitur*, and must be disregarded completely in view of the fact that such data as they present cannot possibly yield information concerning the configuration of other atoms in the vicinity of the CO_3 groups.

There have been many attempts to demonstrate the presence of two phases, but all have been completely unsuccessful in demonstrating even a trace of any solid form of $CaCO_3$. It must, furthermore, be recalled that the carbonate content of francolite is sufficient to require about 10 % of $CaCO_3$. In light of the fact that impurities amounting to less than 0.5 % are readily detectable in many clear, colorless crystals, it must be concluded that some of these persons are quite naive with regard to mineralogical matters. It should be emphasized, moreover, that the properties of francolite differ from those of fluorapatite in several important respects, and these differences cannot be explained by assuming the presence of a second phase. One of these differences is a distinctly smaller lattice periodicity for the *a* direction of francolite as compared with fluorapatite[6]. Optical differences have been reported by many mineralogists[5].

That certain non-mineralogists are likely to make fundamental contributions to knowledge on the mineral, francolite, through the complete disregard of well-established mineralogical concepts seems highly unlikely, although there appears to be no interruption in the output of their misleading interpretations on these matters.

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The participation of the oxidative pathway in the glucose metabolism of mouse tumors

Following the pioneer investigations of WARBURG AND DICKENS, the existence of an oxidative pathway in glucose metabolism as distinct from the glycolytic pathway, seems now well established for a number of normal animal tissues[1–5].