bovine serum albumin from buffer solution but quantitatively removed ovalbumin under the same conditions: that from the plague anti-serum, though it removed the toxin quantitatively under all conditions tested, also removed some other protein. As several other antigens are present in the protein fraction used as antigen and the anti-serum contains antibodies to several constituents of the plague organism, this is not surprising.

The preparations were subject to a more stringent test for specificity by comparing their behaviour with precisely similar 'resins' prepared from normal γ-globulin. In the case of the anti-ovalbumin 'resin', the same high specificity was shown. Under the same conditions that the anti-ovalbumin 'resin' removed ovalbumin quantitatively from solution the resin prepared from normal rabbit γ-globulin removed none. The latter 'resin' did, however, remove some protein from the protein fraction from *P. pestis* and, despite a number of attempts, we have not succeeded in reducing this non-specific absorption below 15–25 per cent in this case.

We have also succeeded in preparing cross-linked resins by direct mercuration of polystyrene and cross-linking the polymer chains via the sulphydryl group of the antibody protein. Their immunochemical properties are exactly similar to those of the diazo 'resins'. Anthrax antigen absorbed on the anti-anthrax 'resin' when injected into rabbits and guinea pigs confers active immunity, and the animals will survive the challenge of a lethal dose of anthrax organisms. This indicates that the antigen retains its biological activity when absorbed.

Full details of this work will be published elsewhere.

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Evidence for the Conversion of Quinic Acid to Shikimic Acid in Roses

The simultaneous occurrence of quinic and shikimic acids has been reported in several plants[1–3]. No definite role has been ascribed to either of these alicyclic acids in higher plants, except for participation of the former in the synthesis of chlorogenic acid[4].

In certain micro-organisms, shikimic acid has been demonstrated to be in the direct path to aromatic ring biosynthesis[5]. Microbial response to exogenous quinic acid has been reported in secondary mutants of *Aerobacter* which grew well when supplied with quinic acid[5]. Similar results have been reported for a mutant of *Neurospora*. A quinic dehydrogenase, which converts quinic acid to 5-dehydroquinic acid, has been demonstrated in *Aerobacter*[5], although the enzyme is not widely distributed. Davis[5] has concluded that quinic acid is not directly involved in aromatic ring biosynthesis in micro-organisms, and that where a requirement has been shown to exist, it is due to an adventitious quinic dehydrogenase.

The recent discovery of a high concentration of quinic acid in rose tissues[6] suggested the use of this plant for the biosynthesis of quinic acid labelled with carbon-14. This was accomplished by exposing actively growing plants of the variety 'Redbird' to $^{14}CO_2$ in light. Quinic acid labelled with carbon-14 was isolated by ion-exchange chromatography and crystallized. The labelled acid was fed into young blooms of 'Better Times' roses through cut stems and allowed to metabolize for 5, 23, 45 and 71 hr. before harvesting. The blooms were fractionated and radioactivity was determined in each of the non-volatile organic acids, free amino-acids, sugars and protein amino-acids.

More than 25 per cent of the carbon-14 in quinic acid fed to the roses could not be accounted for in any fraction and was presumably metabolized and lost as $^{14}CO_2$. This was confirmed in a subsequent experiment, where it was found that about 20 per cent of the radioactivity was evolved as $^{14}CO_2$ in 71 hr.

In petals, approximately 10 per cent of the incorporated carbon-14 could be accounted for in other compounds, and the remainder was present as quinic acid. About 25 per cent of the carbon-14 appearing in non-volatile organic acids was recovered as labelled shikimic acid. In petals of roses harvested after 71 hr., about 20 per cent of the carbon-14 in free amino-acids appeared in tyrosine and about 20 per cent appeared in phenylalanine.

The results show that quinic acid is metabolized by roses. This is borne out by other results indicating that quinic acid normally increases in concentration in rose blooms until they become about half open, after which the concentration decreases[7]. A similar development has been observed in apple fruits[2]. The evidence is clear that roses contain the enzymes necessary to reduce quinic to shikimic acid, although no evidence can be presented as to whether or not it follows the classical mechanism via quinic dehydrogenase, 5-dehydroquinase, and 5-dehydroshikimic reductase[5]. The possibility that the label in shikimic acid could arise from decarboxylation of quinic acid and its subsequent incorporation via a dark fixation mechanism has been ruled out since earlier experiments have shown no label to be incorporated into the quinic–shikimic fraction during dark fixation of $^{14}CO_2$.

A complete report of this work will be published in the *Contributions from Boyce Thompson Institute*.

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