finitely generated algebraic extensions

Let E/k be a finitely generated field extension of the form

$$E = k(\alpha_1, \cdots, \alpha_n).$$

Proposition

If each α_i is algebraic over k, then E/k is finite. In particular, it is algebraic.

Proof.

Let $E_0 = k$ and for $m \geq 1$ $E_m = k(\alpha_1, \alpha_2, \cdots, \alpha_m)$. Then, for each $i = 0, 1, \cdots, m-1$, $E_{i+1} = E_i(\alpha_{i+1})$ is finite. Thus, dimension of E/k is at most

$$\prod_{i=0}^{m-1} [E_{i+1}/E_i]$$

which is finite. $\square$

Question

Find an algebraic extension which is not finite.