

It will be noted that the phrase 'an excessive amount of copper,' occurs in this document, as well as in F.I.D., 76, of June 18th, 1907. It is evidently desirable, to ascertain what constitutes an excessive amount of copper in vegetables. The decision quoted evidently conditions the total absence of copper, after January 1, 1909.

So high an authority as Dr. Tunncliffe (British Food Commission, 1899) holds that 'in a proportion not exceeding half a grain of metallic copper per pound, the presence of copper is quite harmless.' This corresponds to 71 parts per million, as a maximum. I am not aware of any other recognized authority having definitely stated a permissible limit for copper.

If we accept this limit, for purposes of comparison, it is found that 42 samples of the present collection exceed the amount named: i.e., 60 per cent of the collection.

The copper has been determined electrolytically, and is stated as parts by weight per million on the drained, but not dried vegetables.

All of these were found in good condition; and it is interesting to note that decided anti-putrescent effects are claimed for copper by Dr. Springer, (Journal of Industrial and Engineering Chemistry; 1909, p. 676).

The interior of the can was slightly rusted in two cases, but not to such a degree as to affect the colour of the contents. In the case of four samples, viz.: 40347, 40348, 40349 and 40350, the copper was determined separately in the drained vegetables and in the liquid content of the tin. The liquid contained no copper in solution, except in the case of No. 40348 where 30 parts copper per million were obtained.

I am unable, at present, to advise definitely as regards small amounts of copper in vegetables; but would respectfully recommend that medical opinions on the subject be obtained. The present report will serve the purpose of furnishing material for opinion; and I beg to recommend its publication as Bulletin No. 192.

I have the honour to be, sir,

Your obedient servant,

A. MCGILL,  
Chief Analyst.

NOTE.—While this bulletin is in press, a highly important article on the coppering of vegetables appears in the current number of the 'Zeitschrift für Untersuchung der Nahrungs- und Genussmittel.' From this article by Dr. G. Stein, the following is abstracted:—

It is particularly important to the keeping of tinned vegetables that they should be thoroughly sterilized. Sterilization under pressure at 120° C. destroys the chlorophyll, and the vegetables become yellow-brown unless previously treated with copper. Copper was formerly introduced by boiling in copper vessels, which yielded copper to solution in the acids naturally present in the vegetables; it is now introduced as salts of copper, mainly as the sulphate. The coppering of vegetables was first practised in France; but popular appreciation of the product has caused the innovation to be adopted by other countries. No other method of giving a desirable green to the preserved vegetable has proved a success; and although it is possible by using selected material and working with special care, to retain much of the natural green of peas in the preserved article, the process would be too costly to be worked profitably on the large scale.

It is recognized that certain copper salts are poisonous; but that copper may be present in harmless combinations would appear from the fact that many vegetables naturally contain copper. Tschirch has shown that in coppered peas the copper exists as *phytyoglyanate* (green) or as *legumininate*, which is colourless, and is only formed when the process of coppering is carried too far. Neither of these compounds is soluble in water; and the watery fluid in the tin (*Einbettungsflüssigkeit*) may be quite free from copper.

Well known investigators have shown that most copper compounds are either harmless, or cause vomiting and diarrhoea only, in quantities of 100 to 200 milligrams daily, even when continued for weeks. When excess of copper is employed in greening