ALLEGED POISONING BY POTATOES.

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THE shoots, haulms, and leaves of the potato contain appreciable amounts of an alkaloidal glucoside, solanine; under certain conditions this alkaloidal glucoside may accumulate in the tubers themselves, and may be present in sprouting potatoes in quantity sufficient to cause serious poisoning.

Numerous cases of poisoning have occurred on the Continent. The symptoms of five epidemics in which 716 individuals were involved are recorded by Dixon Mann (Brend, "Handbook of Medical Jurisprudence and Toxicology," p. 252). Speaking generally, the symptoms were those of gastro-enteritis—namely, vomiting, diarrhoea, colicky pains, headache, depression, etc. The majority of the cases were serious, although all the people affected ultimately recovered. It is to be noted that the potatoes which acted in this way presented no abnormal appearance.

Pfuhl (*Deutsche Medicinische Wochenschrift*, 1899, p. 753) records the poisoning by potatoes in May and June, 1899, of fifty-six men of the Berlin Garrison. The symptoms were similar to the above, whilst jaundice and partial paralysis were noticed in a few cases. A rise of temperature was generally observed, accompanied by a feeling of irritation of the throat. No dilation of the pupil was noticed. The suspected potatoes, comparatively few of which had sprouted, were large, white, round, and normal in appearance. As mentioned later, the potatoes were examined chemically, and the proportion of solanine found to be much above the normal.

Mass poisoning by potatoes seems to be comparatively rare in Great Britain. The only case, and that a doubtful one, is reported in Taylor's "Medical Jurisprudence and Toxicology," sixth edition, vol. ii., p. 780. The opinion that death (which occurred with two boys who were affected) was due to solanine was based on

the fact that in the bowel were found some small pieces of potato peelings which possessed eyes, showing evidence of sprouting. No analysis of the potatoes used appears to have been made.

Towards the end of November, 1917, numerous cases of poisoning occurred in the Eastern District of Glasgow; the particulars are shown in the following table, for which we are indebted to Dr. Wright, Assistant Medical Officer of Health for Glasgow :

<i>Household.</i>	<i>Number of Persons Ill.</i>	<i>Number who ate Potatoes.</i>	<i>Number who did not eat Potatoes.</i>	<i>Date Eaten.</i>	<i>Onset of Symptoms.</i>	<i>Duration of Illness.</i>
A	1	1	7	November— 27, 1 p.m.	November— 27, 2.15 p.m.	Died 31 hours
B	8	8	None	24, 1 p.m.	24, 2.3 p.m.	Few hours
C	2	2	1	25, 1 p.m.	25, immediately after	" "
D	2	3 (1 ate little)	None	26, 5 p.m.	26, 5.30 p.m.	1 to 2 days
E	2	2	1	26, 5 p.m.	26, 8 p.m.	2 hours to 1 day
F	4	4	1	23, 6 p.m.	23, 24, 25, 5 hours to 2 days	2 to 3 days
G	7	7	None	24, 2 p.m.	24, 3 p.m.	Few hours
H	3	3	1	24, 12.30 p.m.	24, 2 to 3 p.m.	" "
I	2	2	6	24 and 25, 3 p.m.	25, 5.30 p.m.	" "
J	6	6	None	23, 1 p.m.	23, 3 p.m.	" "
K	3	—	—	24, 1 p.m.	24, 2 p.m.	" "
L	1	—	—	23	23, soon after	" "
M	5	—	1	24	24, "	" "
N	4	—	—	23	23, "	" "
O	2	4	—	23	23, "	" "
P	4	—	—	24	24, "	" "
Q	3	—	2	23	24, "	" "
R	2	—	—	24	24, "	" "
Total	61					

The symptoms in the above epidemic corresponded closely to those exhibited in the Continental cases—namely, headache, vomiting, diarrhoea, and debility—one case, that of a boy of five years, terminating fatally. A post-mortem examination showed that death was due to strangulation of the bowel, a condition which, in the opinion of the medical men who conducted the post-mortem, might have been caused by extreme retching and vomiting. The viscera gave no indication of irritant poisoning,

and no dilation of the pupil was noticed. Investigation showed conclusively that all the persons affected had partaken of potatoes obtained from one source. In some households those persons who did not partake of the potatoes were unaffected, whilst those who did subsequently became ill. The potatoes were purchased in various branches of a Co-operative Society in the district, and were part of a consignment of thirteen truck-loads which had been supplied to the shops in question.

A sample of the potatoes which had been in use in the household in which the fatal case occurred was procured, and also samples purporting to belong to the same consignment from the shop. As, previous to the post-mortem, it was considered that the circumstances pointed to an irritant poison, these potatoes were examined for mineral poisons, but with entirely negative results. The stomach contents, viscera, etc., from the fatal case were also shown to be free from mineral poisons on examination.

The potatoes were normal in appearance, firm and solid, but some on being cut into sections possessed a brownish indefinite line near the periphery. On standing for a short time the sections of the potatoes developed a much more decided pink colour than other samples similarly treated.

As the buds on quite a number of the potatoes showed evidence of sprouting, being about $\frac{1}{4}$ inch in length, it was decided to determine the quantity of solanine they contained.

The method of G. Meyer (*Archiv für Exper. Path. und Pharmacol.*, 1895, p. 361) was employed for the isolation of the solanine, and is outlined below.

500 grms. of the pared potatoes were finely divided by means of a grater, and the liquid portion separated by pressing in a muslin cloth, the grater being washed with small quantities of distilled water. After standing for some time the liquid was decanted from the separated starch, which was washed with small quantities of distilled water, the washings being added to the original liquid.

After making alkaline with ammonia the liquid was evaporated almost to dryness, and the residue boiled with alcohol and filtered. This treatment with alcohol was repeated twice.

The pressed solid portion of the potatoes was also boiled with alcohol in two successive portions and filtered.

The united alcoholic solutions were evaporated to small bulk, allowed to stand overnight, filtered from any asparagin which had separated out, and the filter-paper washed with alcohol.

The filtrate was evaporated to dryness and digested overnight at the ordinary temperature with 250 c.c. of water containing about 3 c.c. concentrated sulphuric acid, in which the solanine is readily soluble. After filtration and washing the insoluble portion with water the solanine was precipitated with excess of ammonia, the solution raised to about 50° C., filtered and washed, and the solanine dissolved by pouring hot alcohol through the paper. The alcoholic solution was received in a weighed crystallising dish, the alcohol evaporated off, and the solanine weighed after treating with small quantities of ether and drying in the steam oven.

The sample of potatoes from the household in which the fatal case occurred showed

the presence of 0·41 part of solanine per 1,000 parts of potatoes, whilst a sample from the store, and supposed to be from the same consignment, gave 0·079 part per 1,000 parts. Wintgen (*Zeitsch. für Unters. der Nahr. und Genussm.*, 1906, p. 113) gives the normal content of solanine for potatoes in the month of November as 0·0892 and 0·0880 part per 1,000 parts potatoes. These latter results were obtained by a method which differs from that of Meyer in only a few details.

Meyer (*Archiv für Exper. Path. und Pharmacol.*, 1895, p. 361) found in pared, sound, unsprouted potatoes 0·024 part per 1,000, whilst in potatoes which had commenced to sprout, but were still sound, he found 0·040 to 0·066 part per 1,000.

The solanine was identified by the following tests :

(a) Its solution in hot amyl alcohol became, on cooling, a solid jelly ("Poisons," A. W. Blyth, fourth edition, p. 397).

(b) Dissolved in a drop of strong sulphuric acid containing a little Fröhde's reagent the colour changed to, first, light brown, then reddish, and, finally, a deep violet colour (*loc. cit.*).

(c) On heating a minute quantity with a solution of telluric acid in moderately strong sulphuric acid (2 water to 1 acid) an intense red colour developed (Baur, *Zeitsch. für Angew. Chemie.*, 1899, 99; ANALYST, 1899, **24**, 152).

(d) On gently heating a small quantity with strong nitric acid a brownish colour was at first developed, then became decided red, and passed suddenly into a pale yellow.

In the Berlin epidemic already mentioned Pfuhl states that the potatoes concerned contained solanine as below (*Deutsche Medicinische Wochenschrift*, 1899, p. 753) :

Pared and uncooked	...	...	0·38 part per 1,000.
Pared and cooked	...	...	0·24 " "

He gives as the normal content for May and June :

Pared and uncooked (May)	...	0·060 part per 1,000.
" " (June)	...	0·064 " "

These figures indicate that in both the Berlin and Glasgow cases the potatoes which caused the symptoms of poisoning contained at least five to six times the quantity of solanine which is found in normal, unsprouted potatoes.

An attempt to detect the presence of solanine in a quantity of the bowel contents of the fatal case was unsuccessful, but this is not surprising in view of the failure of Meyer to detect more than traces in the fæces and urine of a dog which had received 0·1 grm. of solanine for ten days.

The chemical data obtained in conjunction with the statistics compiled by Dr. Wright demonstrate conclusively, in our opinion, that the outbreak of poisoning was due to the eating of potatoes containing an excessively large quantity of solanine, and indicate the necessity for caution in the use of potatoes which have begun to sprout.

DISCUSSION.

Mr. A. E. PARKES remarked that possibly the potatoes referred to by the authors had been exposed to daylight, and had begun to go green. If that were the case, they might be expected to develop poisonous properties. Potatoes which have been stored in the dark and have commenced to sprout are frequently consumed without ill effects being experienced.

Professor K. C. BROWNING said that in Germany it was considered that potatoes grown in sandy soil, kept in the dark and allowed to sprout, would develop large quantities of solanine. A case of potato poisoning occurred in Germany in 1883, when a large number of cattle died as the result of eating distillery residue composed of potatoes, and he believed that it was in that case that solanine was first identified. Another well-known case occurred, also in Germany, about the year 1895, when about forty soldiers were taken seriously ill and a number died. In that case the potatoes had been stored in the dark and were all sprouting. He had never been able to be quite certain of the identification of solanine in poisoning cases, though he had identified what was almost certainly solanidine, the first decomposition product of solanine, by means of its property of gelatinising with amyl alcohol, which was very characteristic. On shaking out with ether (in which solanidine was soluble) a substance would be obtained which gelatinised, and also gave the characteristic reactions with Mandelin's reagent and with Brandt's reagent (sodium selenate), which latter he had used in place of telluric acid, as this happened not to be available. The difficulty of identifying solanine in cases of poisoning was due to the fact that in most cases, as there was violent sickness, very little would be left, and this would probably be converted into solanidine, the reactions of which were practically the same.

Mr. H. F. E. HULTON said that mere sprouting of the potatoes had not hitherto been associated with poisoning, but the development of chlorophyll was usually regarded as a danger-signal.

The PRESIDENT said that sprouting, even in the dark, meant that something was taking place in the body of the potato, and that the tubers became sweet was within his personal knowledge. Although, however, he had eaten sprouted potatoes without ill effect, he should not like to do so if they were green.