Annex C. Cholinesterase Measurements.

ChE is present in all mammalian tissues. Experiments with animals at Porton analysed ChE from many tissues: blood, brain and liver being the most common. Brain and liver ChE cannot be extracted from live mammals. So when it became apparent that ChE activity in people participating in experiments ought to be measured, blood was the obvious tissue to use as a source. Because nerve agents were known in 1945 to inhibit ChE activity[1], considerable interest was placed in finding out the normal lower limit of ChE activity in healthy humans.

Little information had been published about normal ChE limits by 1948 so Porton measured ChE in some Service volunteers[2]. Red Blood Cell (RBC) and plasma ChE were measured by the "Warburg Manometric method". A sample of blood was drawn from each man and then separated into plasma and red blood cells. ChE activity was then estimated by measuring the volume of carbon dioxide produced per minute by a millilitre of plasma (or red blood cells) at a temperature of 38^{o}C. The ChE measurements in 1949 produced the following information.

- The average level of RBC ChE activity found from a blood sample taken from each of 27 healthy Servicemen was 112 Warburg units. A statistical analysis of samples estimated that the normal range of RBC ChE activity was 84 - 140 units.

- The average level of plasma ChE activity from blood samples taken from 11 men was 91 Warburg units. A statistical analysis of the samples estimated that the normal range of plasma ChE activity was 55 - 127 units.

In 1950 a new method of measuring ChE was used in experiments with animals[3]. This was the "Michel Electrometric method". It was used in the animal experiments to measure whole blood ChE even though it was "not so satisfactory" as the Warburg method. Apparently measurements could be made faster with the Michel method.

The Michel method was used alongside the Warburg technique in work in 1953[4,5]. Later in the 1950s the Michel method, or a variation of it, became the usual way to measure ChE. The method used a different measurement technique to Warburg. Again a blood sample was taken but ChE activity was measured in terms of pH units. The numerical values representing lower normal limits found by the Michel method are different to those yielded by the Warburg method[6]:

- RBC ChE normal lower limit 52

- plasma ChE normal lower limit 59

- whole blood ChE normal lower limit[7] 109

---

1 Porton Report 2693. The toxicity, symptoms, pathology and treatment of T2104 poisoning in animals 16 August 1945.

2 WO189/322 Porton Technical Paper 135. Cholinesterase as an aid to early diagnosis of nerve gas poisoning. Part 1 Variations in the cholinesterases in the blood of humans 26 Sep 49.

3 WO189/578 Porton Technical Paper 233 The cumulative action of nerve gases. The effect of divided doses of GB upon animals 18 Apr 51.

4 WO189/712 Porton Technical Paper 378. Psychological effects of G agent on man - Second report 14 Sep 53.

5 WO189/733 Porton Technical Paper 399. Percutaneous Toxicity of G Compounds 11 Jan 54.

6 Porton Note 4. Frequency distribution of Blood ChE activity in man 27 Feb 58.

7 WO189/778 Porton Technical Paper 446. Field test for the Assay of Human Whole Blood ChE 12 Nov 54.