

has hitherto obtained. He first experimented with hypodermatic injections of cocaine and other drugs, finding that a 2 per cent. solution of cocaine was the weakest which would produce anæsthesia when introduced beneath the skin. A couple of syringefuls of this solution would be the toxic dose; and such an amount would be necessary in many trivial operations. It is well known that cocaine injection is dangerous to life, and even small quantities of the drug may give rise to very unpleasant symptoms.

Our investigator discovered that by injecting the solution into, but not under the skin in the surprisingly small quantity of .002 to 1.00, a practical anæsthesia would result throughout the whole thickness of the skin and insensibility more profound than that by hypodermatic injection of a solution one hundred times this strength could be obtained. The logical deduction followed that the drug itself could not be the main agent in causing the anæsthesia. Injections of distilled water were tried, and produced anæsthesia, but these were painful, *i.e.*, the infiltration of the water into the skin produced a burning pain which transcended that of a knife. Complete anæsthesia, however, followed the infiltration.

Could it be the infiltration alone that produced the pain of injection and later obtunded the sensibility? Injections of the normal salt solution (.6 per cent.) were made, but no anæsthesia followed, yet the injection itself was painless. The proposition to be solved then was as follows: If infiltration of water alone into the tissues produced pain followed by complete anæsthesia, while the injection of .6 per cent. sodium chloride was painless, but made no alteration in the sensibility of the nerve ends, there must be between these two extremes a salt solution of a certain strength which would at the same time be so similar to the normal fluid of the blood as to cause little or no pain in infiltration, and yet be sufficiently like water to produce anæsthesia of the parts so injected. Experiments proved that a .2 per cent. salt solution met these requirements. Solutions above or below these strengths were either painful to inject or produced no anæsthesia. Operations may be painlessly done by a .2 per cent. salt solution. I have personally experimented with various fluids. The ethers and alcohols are similar to water in that they cause burning pain on injection, followed later by anæsthesia. Ether, however, produces capillary hæmorrhage and alcohol coagulates the albumen of the tissues, and both substances, aside from this, are too irritative to be of use in this method. The various oils are not painful to inject, but afford no anæsthesia. They are usually absorbed without producing material change in the tissues.

Cocaine, .2 per cent.; morphine, .2 per cent.; ac. carbol, .2 per cent.; bromide of potassium, 3 per cent.; methyl violet, 1 per cent.; caffeine, 2 per cent.; sugar, 3 per cent., and other substances in