



Daniel Sutton, a forgotten 18th century clinician scientist

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Introduction

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The 1760s saw an explosion in the numbers of individuals inoculated for smallpox. This was largely due to the innovations of the Sutton family, which made the procedure almost painless, much safer, and much more convenient. While Robert Sutton Senior modified inoculation technique so that it involved only a tiny stab just through the skin with a sharp lancet, it was the combination of skill and business genius of his son Daniel which really drove the expansion of inoculation. Daniel, with his brothers and several other partners, set up a chain of franchises across England and parts of Europe and North America which offered the now famous 'Suttonian Method'. Daniel himself inoculated 22,000 people between 1763 and 1766 with only 3 deaths and made a great deal of money from his practice. His contemporaries in the Royal College of Physicians struggled to emulate his approach and often condemned him and his family as 'men of confined abilities'. But Daniel Sutton was a great deal more than that.

In 1796, Daniel Sutton published a collection of his observations and ideas concerning inoculated smallpox in his autobiography, 'The Inoculator'.¹ He intended it as an instruction manual for young practitioners and hoped that they would benefit from his years of experience. He warned his readers that many of his practices appeared trifles but:

*Despise not trifles, tho they small appear:
Sands rise to mountains, moments make the year;
and trifles life. Your time to trifles give,
or you may die before you learn to live.*

Clinical experiments

Despite his lack of formal education, Daniel Sutton was an acute observer of the minute clinical details of his patients and an inveterate experimenter. While trying to understand why his father's simple puncture method was so successful, he explored the idea that the agent of smallpox required contact with the skin to infect a patient and he set up a series of experiments to test this idea.¹ In one study he made deep incisions down into the subcutaneous fat, where he laid a thread impregnated with 'pocky matter'. He bound the wound, being careful that the infected thread did not touch the true skin, and left it for two days before removing the thread. There was never a local inoculation reaction, while the conventional operation, which he had performed on the other arm, always progressed as expected, confirming his view that the infectious agent had to make contact with the skin. He attempted to transmit the disease by having a subject breathe through a special contraption connected to the mouth of an inoculated patient. Nothing happened, so he concluded that the disease was not transmitted by inhaling infected air. He collected blood from patients at various stages of natural smallpox and rubbed it into the skin of individuals that he was about to inoculate. Again nothing happened, confirming his belief that the state of the blood did not have anything to do with the infection. He took pus from suppurating lymph nodes and tried that. He collected material from early or late pocks and formed them into pills and gave them to his patients to swallow. He even took 'pocky matter', dissolved it in cold or hot water and gave it as enemas. Nothing happened. Smallpox was only transmitted when the 'variolous poison' made contact with the skin.¹

Sutton's views of the importance of the skin were reinforced when he discovered that pulling off a tightly applied bandage at just the right time, that is, just before the rash appeared, left the area of skin to which the bandage had adhered free of pocks, which developed normally elsewhere. He interpreted this as being due to pulling off the superficial layers of the skin along with the bandage.

In another experiment he observed that when he heated a patch of skin as the rash began to appear, more pocks formed there than on the rest of the body, a phenomenon that was demonstrated two centuries later in chickenpox.² Although he did not realize it, this was probably due to increased blood flow through the warm area at a time when the virus was present in the circulation. Greater blood flow led to a larger number of virus particles reaching the skin, offering an explanation for the face being the most severely affected part of the body, as it has the highest blood flow of any area of skin. Sutton concluded that Sydenham's cold method was beneficial in reducing the number of pocks that formed because it lowered the temperature of the skin.³ He also concluded that his practice of letting his patients have continuous exposure to fresh air probably worked for the same reason.

Sutton challenged another tenet of the 'Faculty', the Fellows of the Royal College of Physicians, who supported the idea that fatal smallpox involved the internal organs. One of the cardinal principles of treatment was to get the 'variolous poison' to come to the skin to prevent it 'going to the heart'. He obtained permission to perform an autopsy on a Negro who had died of confluent smallpox and showed that there were no pocks anywhere inside the corpse¹. The skin was the only part of the body affected.¹

Daniel Sutton's experiments are probably without parallel for the time. Despite his lack of formal education, he was a true clinician scientist. In modern terms we would say that he formulated a hypothesis and tested it in experiments that could have falsified that hypothesis. He had convinced himself that whatever caused smallpox, it was contact with the skin that triggered the disease.

Clinical observations

Sutton's devoted clinical care led to surprising observations among his patients. One day he set

out to inoculate all seven hundred inhabitants of a town, and managed half before lunch and the rest after three-thirty in the afternoon. He was astounded when he noticed that those treated in the afternoon had about five times as many pocks as those treated in the morning. But when he consulted his notebooks, he realized that this almost always occurred, and then modified his approach by restricting his operations to the morning. By keeping copious and meticulous notes he also showed that inoculation never transmitted syphilis or scrofula, as some of its opponents had claimed.

Another of Sutton's observations was the discovery of a specific type of immune reaction that much later became known as 'the Arthus response' (or cutaneous hypersensitivity), after the French immunologist who described it more than a century after Sutton.⁴ Sutton found that he could distinguish patients who had had smallpox before, however slightly, and were consequently resistant to inoculation, by the skin's response on introducing the inoculum. In a susceptible individual the injection site was like a tiny red fleabite that only began to itch on the fourth day.

However, if there was an immediate small swelling expanding to the size of a shilling piece within an hour or so, accompanied by itching and a reddish ring around the site like an insect bite or sting, the recipient had already had smallpox. We now know that this was a reaction between the patient's antibodies and the smallpox virus in the injection site, indicating prior immunity. Such local immune reactions became widely used in the twentieth century as markers of immunity to a range of infections.

By continuously monitoring the progress of the inoculation wound, Sutton could forecast the patient's course, and take prophylactic measures when indicated. His treatment included laxatives, calculated to produce four stools a day in a favourable patient; but, if there was any doubt about the likely outcome, the dose would be increased to produce six motions a day. The appearance of the pustule on the seventh day was critical. In patients destined to have a mild course, there was a fully formed pustule with a domed top. If the pustule remained flat and failed to fill, then the patient was likely to develop convulsions and suffer from a high fever and severe back

pain. Enemas were judged to be essential to head-off the impending crisis. Although Sutton appears to have based his therapeutic decisions on experience, he does not give any details of the evidence that drew him to his conclusions on these elements of his method.

Another aspect of the Suttonian method that Daniel did not investigate was the special nostrum that he and his family prescribed for their patients. They kept the contents secret, but it was easy for experienced physicians to discover what the Suttons used because of the telltale symptoms of mercury poisoning. Many of the treatment protocols in use in the 1760s to prepare patients for inoculation combined mercury with antimony because they were thought to be antidotes to the 'variolous poison' that caused smallpox. William Watson, a contemporary of Daniel Sutton, did investigate whether mercury had a role in reducing the severity of inoculated smallpox and concluded that it did not.^{5,6}

Daniel Sutton: a brilliant, unrecognised 'mere empirick'

Daniel Sutton's book is a remarkable account of a clinician scientist at work. His many detailed observations and experiments may be unique in 18th century medicine. His investigation of the role of the skin in inoculation is one of the very first systematic studies of the pathogenesis of a disease process. Yet no one remembers him. Sutton made a serious mistake by publishing his book too late. He procrastinated. Every year some new little nuance persuaded him to delay publication until he could regard his system as perfect. If he had printed his book in the 1770s or 1780s his ideas might have attracted attention and debate. Even those who disagreed with his conclusions might have been stimulated to perform experiments of their own. But in 1796, inoculation was no longer a focus of scientific interest. Edward Jenner and vaccination had altered the intellectual environment.⁷

The Suttons were also victims of their own success. When numerous inoculators, many without any medical training at all, began to copy their methods, the price rapidly declined.

So many inoculators were available that the advantage of being a Sutton soon wore off. Everyone could do it, and most got results that were just as good as the innovators'.

Daniel Sutton lamented:

Whether from an interested or other sinister motive, I neither know, nor wish to enquire, but I find it has been circulated, That I am not the person who introduced the new system of inoculation:...In short That some other person, having assumed my name has proceeded to the exorbitant length of declaring that for many years I had quitted my profession and was long since dead".

His achievements were almost forgotten. But among all his accolades and financial rewards, the one thing that he valued above all was the fact that the King had granted him a family crest. He had asked that this be made retroactive so that his father and brothers were allowed to claim the same distinction. This mark of gentlemanly status meant more to him than anything else that had happened during his career. It seems a small reward for a man whose efforts resulted in a discovery of world shattering importance. If he had been a 'member of the Faculty', not a 'mere empirick', a knighthood or a financial reward from parliament might have been forthcoming.

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