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THE AUTUMN MINERAL

In 1927 two gynaecologists, Dr Selmar Ascheim and Dr Bernhard Zondek, became the first Europeans to publish the discovery that the urine of pregnant women was rich in sex hormones. But the roots of endocrinology actually extend much deeper into the past

Often mistaken for lamps, elegant gilt bronze objects such as the one shown here are actually considered to be single-tube subliming vessels once used for chemical and alchemical purposes. This vessel (ca 113 BC) formed part of the dowry of Princess Tou Wan, and was found in her husband's tomb

Text
Robert Temple

After Ascheim and Zondek's discovery that the urine of pregnant women was rich in sex hormones, it was determined that these sex hormones were composed of androgens and estrogens, as well as of gonadotrophins from the pituitary gland, which stimulate the gonads. Officially, this is how the science of endocrinology began. However, the existence of sex hormones in human urine had been known for over two millenia in China. What is even more surprising is that, beginning in the second century BC, these hormones were actually extracted from human urine, and purified and used in the treatment of a variety of ailments.

The precise date when the extraction of hormones from urine actually began is uncertain. The first printed reference to this process, however, occurred in 125 BC when the Prince of Huai-Nan coined the phrase "autumn mineral" to describe the hormone crystals. An adept pseudo-scientist, philosopher and Taoist, the Prince was famous for carrying out countless early scientific experiments, including causing eggshells to fly by means of hot air.

A more detailed reference to these hormones appeared in 25 BC when a high official named Ku Yung made a savage speech against alchemists and magicians. According to a text preserved from the early Han Dynasty, he complained during his tirade that "the Taoists say that by fusing cinnabar they can transform it and make yellow gold, and that from dark and muddy [that is, concentrated] urine they can make a hard white ice-like substance."

This crystallisation technique was kept secret for many centuries, until a literary reference to the "autumn mineral" was made in a poem entitled "Thinking of Old Friendships", by the renowned poet Pai Chü-I (772-846). In the poem, he mentions another poet, his friend Yuan Chen (779-831), and states that he had "prepared the 'autumn mineral' drug/Yet while still young encountered sudden death." Thus in the ninth century, the preparation of this "autumn mineral" was proceeding apace, although its recipe was a secret known only to the adepts and the process was evidently looked upon with considerable awe.

It was not until the eleventh century that an explicit account of the method for the preparation of the "autumn mineral" actually appeared in print. The earliest account was found in *Valuable Tried and Tested Prescriptions*, a book written by Chang Sheng-Tao which was published in 1025. Between 1025 and 1833, at least 10 different methods of obtaining sex and pituitary hormones from human urine were published in no less than 39 different books.

The quantities involved in these experiments were most impressive. On the occasion of each preparation, hundreds of gallons of human urine were used, while countless thousands of doses of hormones were prepared for medical use throughout China. Beginning in the second century BC, these experiments took place on an increasing scale, so much so that by the time the last traditional recipe appeared in print in 1833, the process had been going for at least 2,000 years.

On the occasion of each preparation of the "autumn mineral", hundreds of gallons of human urine were used

It has only been in recent years that Dr Joseph Needham of Cambridge University discovered the existence, identity and history of the so-called "autumn mineral" in China. Until then, no one in the West knew that it had even existed, much less that it had been used on such a vast scale for so long.

The best way to describe the ancient Chinese process for the extraction of hormones from human urine is to quote from the recipe published in 1025: "Collect ten tan [over 150 gallons] of male urine and set up a large evaporating pan in an empty room. Fix on top of it a deep earthenware still, luting the edges together with paper-pulp and lime so that when it has dried no steam can escape. Fill the evaporating basin 70 to 80 per cent full with urine, and heat strongly from below, setting a man to watch it. If it froths over, add small amounts of cold urine. It must not be allowed to overflow. The dry residue is *jen chung pai*. Put some of this, finely powdered, into a good earthenware jar and proceed according to the method of sealing and subliming by placing the whole in a stove and heating with charcoal. About two or three ounces [of sublimate] will be obtained. Grind this into a powder, and mix with date-flesh to make pills the size of a mung bean. For each dose take five to seven pills with warm wine or soup before breakfast."[1]

Simple evaporation of the urine left dried solids which then had to be further processed to rid them of the urea, salts and so on. Since the process of sublimation was so widely used in alchemy, this was adopted for the purification of the urine solids. A beautiful gilt bronze sublimatory, in which such experiments were carried out, was excavated from a prince's tomb in China in 1968. Dated to 113 BC, this alchemist's sublimatory was probably used for the extraction of camphor as well as in processes connected with mercury. This type of vessel is called *teng*, or rainbow vessel. Although the urine sublimatories would have been much larger, this early vessel shows the extreme sophistication of such equipment at very early dates. Something closer to what would have been used in the urine processes may be seen in a painting from a book entitled *Essentials of the Pharmacopeia Ranked According to Nature and Efficacy*, edited by Liu Wen-T'ai in 1505 and deposited in the Imperial Library.

The urine processes were sophisticated in a number of other ways as well. Using a technique derived from the Chinese bean curd industries, gypsum (calcium sulphate) was sometimes used to precipitate the hormones out of the urine. The most impressive substance used for the purpose, however, was "the juice of soap beans", an extract from a saponin-containing plant, the beans of

Seaweed as depicted in the manuscript *Pên-ts'ao p'in-hui ching-yao (Essential of the Pharmacopeia Ranked according to Nature and Efficacy)*, by Lin Wen-T'ai, 1505. The same manuscript contains the image of two monks cleaning subliming vessels with a feather

Gleditschia sinensis. The saponins and the proteins of the soap-beans were remarkably successful in precipitating the hormone sediments out of the urine. The earliest printed account of this technique was published in 1100. In the West, however, it was not until 1909 that the physician Adolf Windaus, using digitonin, made the discovery that such substances can be precipitated by soaps.

An alternative method for extracting hormones from urine, which did not use forced evaporation by fire, was natural evaporation by the heat of the sun over a long period of time. In some cases, the sediment would not be sublimed but the unpurified hormone sediments would be diluted in distilled water. This yielded a liquid known as "autumn dew water" that could be swallowed. This was, no doubt, the poor man's "autumn mineral".

The Chinese were also very particular about whether the urine used in these experiments came from males or females. In the recipe quoted earlier, only male urine is specified. In fact, the Chinese used either male or female urine or a careful mixture of the two, depending on the effects they wished to achieve. Thus, some products consisted predominantly of androgens while others consisted predominantly of estrogens, with gonadotrophins being included in the extracts.

POWERFUL DRUGS

The pure crystals of absolutely pure hormones obtained by the traditional Chinese methods put the Chinese doctors in possession of powerful drugs. The surviving texts make clear that these drugs were indeed used to treat hypogonadism, impotence and sex reversals, in which males or females spontaneously were transformed into their opposites, apparently a common phenomenon in ancient China. Other conditions treated with the hormones included hermaphroditism, spermatorrhoea, dysmenorrhoea, leucorrhoea, and decreasing libido in ageing men. The hormones were even used to stimulate beard growth, as the Chinese had noted that men grew beards when they had testicles but ceased to grow beards when castrated.

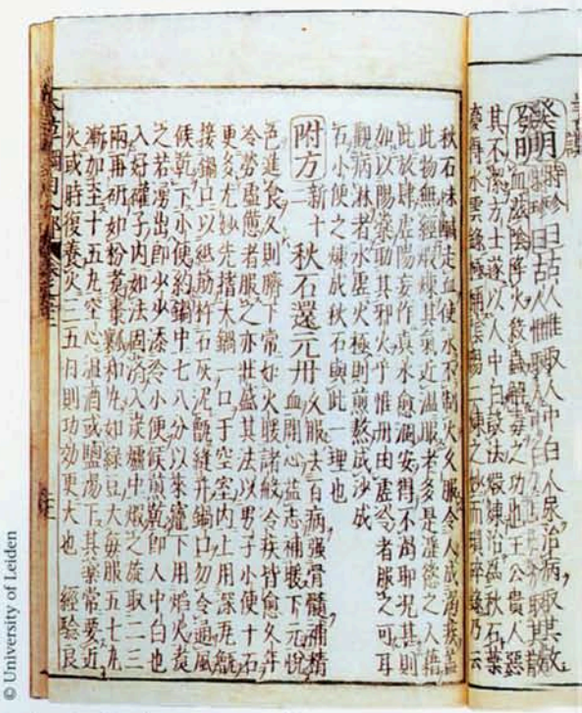
Although it has been suggested that the effect of ingesting these gonad hormones would have been rendered inactive by the liver, the Chinese seem to have used such large doses that oral consumption would have been effective.

Quite apart from urine processing, the Chinese were also using thyroid hormones to treat goitre in the seventh century, as first recorded by Chen Ch'uan in AD 643 in *Old and New Tried and Tested Prescriptions*. And in 1180, it was from China that Roger of Palermo received the information that the ashes of seaweed were a fine medicine for goitre. The Chinese had long recognised the connection between goitre and a lack of what we now call iodine, although in the West this only became clear with Chatin's work in 1860.

For millenia, there were two types of alchemy in China: the chemical side connected with the attempt to make elixirs of immortality (the *wai tan* alchemy) and the physiological side in which the body was treated as a laboratory (*nei tan* alchemy). In connection with the latter, sexual activity was viewed as fundamental. Chinese monks and nuns were anything but celibate; they specifically had sex together as often as possible in pursuit of their religious aims. An extraordinarily complex and bizarre theory existed concerning the sperm, and the production of as much sperm as possible was considered desirable. One must therefore conclude that the Chinese experiments with sex hormones were part of a larger context in which sexual activity was eagerly pursued and studied by the deepest-thinking philosophers. This is in stark contrast to the Western tradition in which sexual activity was regarded as base or animal. If someone in the West had even tried to extract hormone crystals from urine in the Middle Ages, for example, he or she would surely have been burnt at the stake for witchcraft. Thus, in considering the treatment of sexual dysfunction and other medical complaints with sex hormones, let us not forget the magnificent pioneering work of the Chinese, who for 2,000 years anticipated modern developments and demonstrated their remarkable ingenuity as endocrinologists. ■

Reference

1 Excerpted from *Valuable Tried and Tested Prescriptions* by Chang Sheng-Tao and quoted in *The Great Pharmacopeia* of Li Shih-Chen (Chapter 52), published in 1596.



A recipe for the extraction of hormones from human urine, as reprinted in a Japanese edition published in Kyoto (1714)