

# SCIENCE AND CIVILISATION IN CHINA

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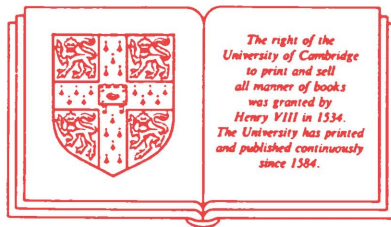
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Part 7: MILITARY TECHNOLOGY;  
THE GUNPOWDER EPIC



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Thus the automatic lighting of the second-stage rockets is clearly stated.<sup>a</sup> Although strangely prefiguring submarine-launched weapons of 'Polaris' type,<sup>b</sup> it was not in fact fired from under water, but rather from near the water-level on shipboard, and its trajectory was evidently kept very flat.<sup>c</sup> Fig. 214 shows the illustration from the *Huo Lung Ching*; those in later books simply re-draw it.<sup>d</sup> This invention has been noted by a few writers,<sup>e</sup> but its full significance has hardly ever been appreciated.

(vi) *The rise and fall, and rise again, of military rockets*

For reasons which have already been explained (p. 472), the origin and development of the rocket is an exceptionally difficult study in technological history. We must unravel it as best we can, but a definitive account will have to await further research.<sup>f</sup>

To begin with, we have two fixed points, +1264 when an empress was frightened by the 'ground-rats' or 'earth-rats' at a firework display (p. 135 above);<sup>g</sup> and the neighbourhood of +1280 when al-Rammāh in Syria described rocket-arrows as *sahm al-Khiṭāi*, 'arrows of China' (p. 41 above). Equally, in spite of arguments to the contrary, we do not believe that rockets were described in the *Wu Ching Tsung Yao* of +1044 (pp. 226 above); while on the other hand they were prominent among the fireworks mentioned by Fêng Ying-Ching and Shen Pang in +1592 (p. 134 above).<sup>h</sup> The details in the *Huo Lung Ching* affirm rockets clearly

<sup>a</sup> The same principle was even applied to fire-crackers in traditional China; cf. Ball (1), p. 282.

<sup>b</sup> Cf. Taylor (1), pp. 76-7. In Oct. 1982 the Chinese navy successfully tested a submarine-launched ballistic missile.

<sup>c</sup> It was thus the very model of a modern 'Exocet' missile (named from the flying fish *Exocetus*), so prominent in the Falklands campaign, as Dr Christopher Cullen remarked to us at Louvain.

<sup>d</sup> We also give in Fig. 215 the reconstruction made by Chiang Chêng-Lin for the National Historical Military Museum in Peking. Cf. Anon. (209).

<sup>e</sup> E.g. Hsi Tsé-Tsung (6); Hsü Hui-Lin (1); Chiang Chêng-Lin (1); Sandermann (1), p. 171.

<sup>f</sup> One meets from time to time in the Western literature with dubious stories about Chinese rocketry. For example, Hokeš (1) has written about 'Wan Hoo', a supposed official of the Ming period, who invented a kite-like monoplane powered by about 30 rockets, but perished in its first experimental flight. There is a whole series of uncritical references to this, as in Ley (2), pp. 84-5; Gibbs-Smith (10); Zim (1), etc. and it has even been entertained by Chinese writers such as Hsü Hui-Lin (1). But in spite of much correspondence, as with A. T. Philp in Australia, we have never been able to get any firm reference to Wan Hoo, and we suspect that he is a myth invented probably during or after the Chinoiserie period. The matter is reminiscent of a similar story about a dirigible airship ascribed to the Yuan (Vol. 4 pt. 2, p. 598) and probably equally without foundation.

The application of rocket-propulsion to land vehicles has never in fact been of much practical use (Taylor (1), pp. 18 ff.) except for test-track sleds (Humphries (1), p. 179, fig. 113), because although rocket thrust is so high per unit weight, and realisable with extreme rapidity, its fuel consumption is extremely great. But rocket-assisted take-off for aeroplanes has become commonplace (cf. Humphries (1), pp. 163 ff., fig. 100), and a glider like that ascribed to Wan Hoo was successfully flown by Fritz von Opel in 1928.

One can even find Wan Hoo in Norwegian; cf. Holmesland *et al.* (1), vol. 16, p. 508.

<sup>g</sup> Of course it does not follow that the ground-rats were a new invention of that year, nor that civil fireworks were their only employment. They may well have been a century or more old at the time. We have suggested (p. 474 above) that the incorporation of these mini-rockets in cavalry-confusing bombs was the most primitive form of the use of rockets in warfare.

<sup>h</sup> Their 'ascending fires' (*chhi huo*<sup>1</sup>) were undoubtedly rockets, and they also knew of the ground-rats (*ti lao shu*<sup>2</sup>) and the similar toys that whizzed about on water surfaces (*shui shu*<sup>3</sup>). Something like this last is in al-Rammāh (Partington (5), p. 203).

<sup>1</sup> 起火

<sup>2</sup> 地老鼠

<sup>3</sup> 水鼠

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