

(a) The great resistance of small drops to coalescence with the bulk of the liquid cannot be explained by the usual interface tensions. A resistant film seems to coat the interface. Purely theoretical considerations lead to the conclusion that the tension of thin films is greater than the interface tension of the liquid in bulk. The particular properties of the film tension explain the stability of emulsions.

(b) The *pendant drop* can form only when the interface tensions stand in a definite relation to one another. Theory permits the derivation of three conditions for the interface tensions of the "pendant drop." The same conditions hold good also for the formation of the "wetting drop."

(c) In this connection the case of the "pendant bubble" is also treated theoretically, and is explained by interface tension.

III. From a few photographs of drops and bubbles the forces are calculated which are active in these formations. The results show that the tensions agree very well with the interface tensions, which confirms our theory.

RESEARCHES ON CHINESE MATERIA MEDICA.*

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While numerous noteworthy discoveries for the healing of the sick have been made during recent years, medical science still owes much to the people of the past for the accumulated knowledge of many remedies and cures. Primitive medicine almost always involves empiricism and sometimes superstition, but is often based on some keen observation. Such an observation, when confirmed and well appreciated, then becomes a sound principle in modern medicine. An example of this kind can be found in the prevention of smallpox in civilized communities. It is true that Edward Jenner (1796) was the first person to introduce vaccination, but the observation that inoculation of cowpox *débris* confers immunity against smallpox was previously known to the Orientals and Europeans, especially among milkmaids. It was from the latter that Jenner obtained the information, then conceived the idea of vaccination as a prophylactic measure against smallpox, and finally achieved his discovery.

We can recall another example in the introduction of the foxglove or digitalis for the treatment of heart diseases. The leaves of this plant were long known to diminish the body fluids in dropsy, but it was not until 1775 that William Withering actually initiated its use in medical practice. It was an old family recipe from which Withering derived his knowledge and which led him to investigate the therapeutic value of digitalis, which has now become an indispensable drug to relieve the symptoms of cardiac disorders.

Chinese civilization, like other ancient civilizations, is rich in curative measures. Its materia medica up to 1596 included 1871 drugs. Such drugs as camphor, cinnamon (*Cinnamomum cassia*), anise (*Illicium verum*) and rhubarb (*Rheum officinale*), which have been known in China for centuries have been admitted to modern pharmacopœias. There are, however, many other drugs that in China

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were believed to have unlimited therapeutic value, but have never been subjected to careful, critical, scientific investigations. And it is such investigations that may yield fruitful results. The recent introduction of Ma Huang into Western medicine is a good illustration.

Ma Huang, or botanically *Ephedra sinica* which is an herb and grows wild on the northern and western frontiers of China, has been known in Chinese medicine since antiquity. Some fifty centuries ago, Emperor Shen Nung tested this drug and admitted it to the legendary book entitled "Pentsao." The drug is believed to produce sweating, reduce fever, stimulate the circulation and relieve cough. It is an ingredient of several famous prescriptions. For example, in the treatment of Shan Han, which is a disease known to the Chinese physicians probably corresponding to fevers resulting from typhoid infection, pneumonia or other causes, pills made from the following prescription are considered to be of high value.

Ma Huang (<i>Ephedra sinica</i>) without nodes	10 catties
Apricot Kernels (<i>Prunus armeniaca</i>) blanched	4 shêng
Rhubarb (<i>Rheum officinale</i>)	1 ³ / ₄ catties
Snow Water	

Detailed instructions are given for making an extract of the above crude drugs, and finally dividing the mass into pills. The efficacy of this remedy is believed to depend on the diaphoretic action of Ma Huang, assuming that perspiration is a means of reducing fever. More commonly, Ma Huang is prescribed with other crude drugs and made into a decoction, and taken by the patient as such. This was the status of Ma Huang in Chinese medicine before any scientific investigation was begun.

In 1887 a pure principle, an alkaloid, was isolated by a Japanese chemist from the crude drug, and has since been called ephedrine. Other Japanese scientists soon discovered its mydriatic action, that is, its pupil-dilating effect. But this property has a limited clinical application and the drug did not attract much attention in the medical profession at large.

During the next three and a half decades, interest in ephedrine was almost wholly limited to the determination of its chemical composition. Its structural formula was established, and its synthesis repeatedly achieved.

Number of Publications on Ephedrine and Ma Huang

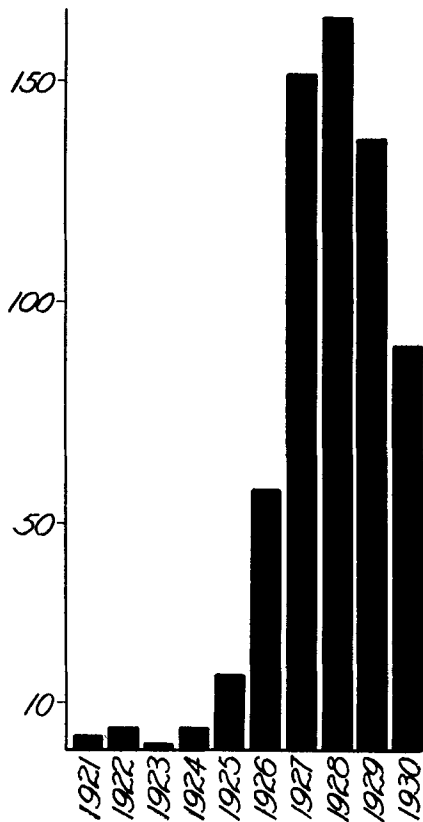


Fig. 1.

In 1923 my former colleague, Dr. Carl F. Schmidt, now at the University of Pennsylvania, and myself began to study a group of potent drugs suggested to us by a Chinese druggist. In the list Ma Huang was mentioned, and a small sample was purchased from a native drug store. We made a decoction of the drug and injected a portion of it into a narcotized dog left by a group of students after their exercise—and we at once observed a prolonged rise of blood pressure. The result of our first experiment aroused our enthusiasm and stimulated us to carry out an exhaustive investigation. Before long, we isolated an alkaloid and, as we were unaware of our predecessors' work, the nature and formula of the compound gave us considerable trouble. We almost decided to give a new name to this alkaloid, but we were cautious enough to search all the literature available in our small library in Peiping. Finally, we learned that we were dealing with a well-known chemical compound called ephedrine. Our attention was then chiefly devoted to the pharmacological action and possible therapeutic application. Thus we ob-

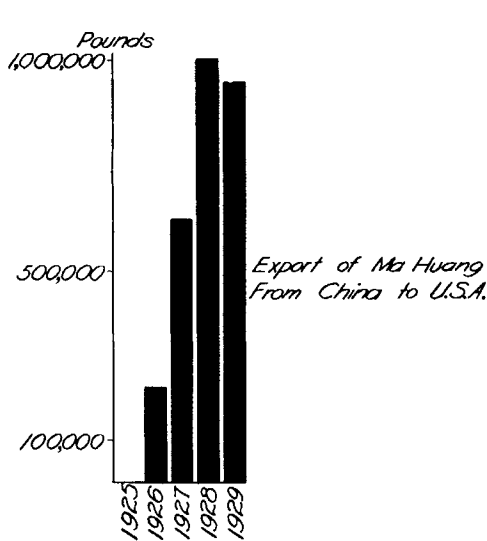


Fig. 2.

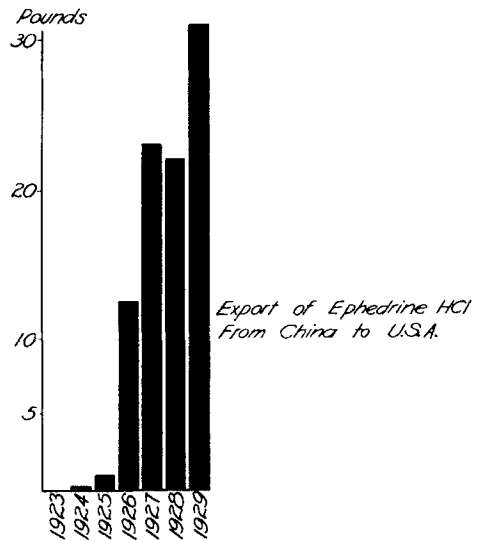


Fig. 3.

served, as stated above, a prolonged rise of blood pressure with the pure principle. This physiological property has now been utilized especially in spinal anesthesia for surgical operations. In animals, ephedrine dilates the bronchioles and in men the drug can similarly relieve asthmatic attacks. It was further demonstrated that ephedrine contracts the mucous membranes of the nose which led to its use in the treatment of rhinitis and hay fever. There are other conditions, such as whooping cough, bronchitis, postural hypotension, Adams-Stokes' syndrome, etc., in which ephedrine has been recommended. Most investigators agree that ephedrine has a real place in therapeutics.

Statistical records definitely indicate a rapid development of the interest in and use of ephedrine during the past few years. Figure 1 shows the number of publications on ephedrine and ephedra from 1921 to 1930. Figures 2 and 3 give the exports from China to the United States of Ma Huang and ephedrine

hydrochloride, respectively—each of which has only recently become a commercial article. It is obvious that the ancient drug Ma Huang has risen to prominence. Many men in China have found for themselves a new calling in the annual collection of Ma Huang (Figure 4). The crude drug is shipped in bales (Figure 5) from China to all parts of the world, for the manufacture of ephedrine. In addition, synthetic compounds have appeared on the market to supplement the supply of the natural product.

It can be safely said that the study of Ma Huang, and subsequently of ephedrine, is another example in medicine where a traditional belief has become a rational therapy. Furthermore, it represents "one of the most international forms of human endeavor" (Barger). The crude drug is of Chinese origin, but the active principle ephedrine was first isolated by a Japanese. The constitution of ephedrine



Fig. 4.



Fig. 5.

was explored and established by several Germans and Japanese, respectively. Its synthesis was first achieved by a Frenchman and by a Japanese, and later the synthetic isomers were resolved by an Austrian. The pharmacological investigation was initiated by several Japanese, but a thorough study was made by an American and a Chinese. Most of the clinical tests leading to the proper use of ephedrine were carried out by several Americans and a Canadian.

Space does not permit me to enumerate the researches of other Chinese drugs undertaken by different workers, but it suffices to say that a good beginning has been made by the Japanese scholars, and the recently published papers by H. P. Chu, T. Q. Chou, B. E. Read and J. C. Liu on several subjects along this line are of great importance. Continued investigations of the Chinese materia medica undoubtedly will add further interesting results.