ON THE EVOLUTION OF THE CHINESE MODEL OF AGRARIAN TECHNOLOGY

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I. THE CHARACTER OF THE TRADITIONAL MODEL OF AGRARIAN TECHNOLOGY

—Toward a Critique of Wittfogel's Theory of "Horticultural Husbandry" (*Gartenbau*)—

IT HAS BECOME commonplace to take Wittfogel's *Wirtschaft und Gesellschaft Chinas* [18] as the pioneering work in the scientific study of the character of the traditional "model" of farming technology in China. For Wittfogel, the traditional "Chinese" model of agrarian technology represented a kind of "horticultural husbandry" (*Gartenbau*), a variety unseen in European or Indian agriculture:

> der landwirtschaftliche Produktionsprozess in China in dermassen hohem Grade von Arbeitszeit durchsetzt ist, dass hier die wachsende Quantität in eine neue Qualität umschlägt, die sowohl vom Feldbau des feudalen und spätfeudalen Europa wie auch von der Agrikultur Indiens wesentlich verschieden ist. [18, p. 337]

The traditional model of Chinese agriculture, in other words, is seen as characterized by a unique intensity in application of labor resources, a kind of hyper-intensification of labor input.[1] Up to this point, most scholars are in agreement with Wittfogel's analysis.

In accounting for the development of this peculiarly "Chinese" model of agrarian technology, Wittfogel catalogues four determinant elements.

(1) The widespread use of irrigation techniques, both of the "furrow-contained" (*furchenmässige*) variety common in northern China and of the "flooded-field" (*flächen-*) species practiced in southern Chinese rice husbandry, which absorb enormous labor inputs.

> So ist denn die künstliche Bewässerung ein wesentliches Moment der chinesischen Agrikultur, ohne das diese niemals ihre spezifischen intensiven Formen hätte annehmen können. . . . [18, p. 229]

[1] In this connection, Ferdinand von Richthofen, who had a most profound influence on K. A. Wittfogel, summarizes the characteristics of Chinese agriculture as follows:

> Kleine, aber wirksame Werkzeuge werden verwandt, die Bebauung des Bodens geschieht in kleinen Parzellen. Die höchste Sorgfalt ist auf das einzelne gerichtet, bis zur Pflege der einzelnen Pflanzen hinab. Wir können das als Gartenkultur bezeichnen. Tierische Kraft wird unter Umständen als Hilfskraft benutzt, aber nur nebenbei . . . Bei dieser Methode finden wir jedenfalls die höchste Produktion auf die Bodeneinheit. (cited from K. A. Wittfogel [18, p. 342])

(2) The resort to individually-applied manuring techniques for fertilizing.

> Unterscheidet die künstliche Bewässerung ganz „Asien" von den Gebieten abendländisch extensiver Landwirtschaft, so ist die individuelle Düngung mit organischer Materie im grossen und ganzen auf den Fernen Osten beschränkt. [18, p. 338]

Individually-applied manuring—or *Kopfdüngung*, as Wittfogel calls it—is seen as inevitably leading to an intensification of labor input in the fertilizing process.

(3) The development of "combined-cropping" (*Fruchtkombination*) technology. Wittfogel saw crop-rotation agriculture as having attained currency in the West only at the turn of the nineteenth century. In China, on the other hand,

> die Fruchtwechselwirtschaft ist im Abendlande erst um die Wende des 19. Jahrhunderts zur Geltung gekommen. . . . Der aus der Furchenrieselung hervorgewachsene Reihenbau hat in China zu einer unendlichen Fülle von Kombinations-, Boden- und Wetterausnutzungsmöglichkeiten geführt, die in Europa nur die Gärtnerei kannte. Die nochmalige Dehnung der Benötigten Arbeitsmenge ist evident. [18, p. 338]

(4) The development in China of a preference for "hoe" over "plow" technology—in Wittfogel's words, of *Hackbau* agriculture. Wittfogel saw "hoe husbandry" as developing from *Reihenbau*, and the double-function of the hoe (i.e., as a tool both for weeding and for turning over sod to keep a steady level of moisture in the soil) was regarded by him as being an obvious source of demand for increased intensivity of labor.[2]

For Wittfogel, the above-mentioned four determinants interacted in organic fashion to bring about an unique intensification of labor demands in Chinese agriculture. Here again, there has been little disagreement with his thesis, as far as it goes.

But Wittfogel's characterization of "horticultural husbandry" does not stop here. For Wittfogel, a key aspect of this model of agricultural technology was the atrophy of the role of "artificial means of production" (*produzierten Produktionsmitte*) and hyper-exploitation of "naturally provided instruments of production" (*naturwüchsigen Produktionsinstrumente*: land, water, etc.). Wittfogel saw this unbalance as resulting in the creation of a mode of husbandry characterized by an "unparallelled development" (*einzigartige Entwicklung*) of labor-input and a corollary "underdevelopment of labor-[saving] tools" (*Arbeitsgeräte dermassen unentwickelt*). "Der gartenbaumässige, intensive Ackerbau entwickelt die Arbeitskraft auf Kosten des Arbeitsmittels" [18, p. 158]. Thus, "der Grundzug der landwirtschaftlichen Arbeitsgeräte Chinas ist ihre Einfachheit" and "technological primitiveness" (*technische Primitivität*). As these aspects of Chinese agriculture are inevitable consequences of horticultural husbandry for Wittfogel, it is but logical for him to conclude that Chinese agriculture was foredoomed to stagnate after having attained a certain maximum level of productivity.

It should be clear from what has preceded that Wittfogel postulates "horticultural husbandry" (*Gartenbau*) as the dominant mode of agrarian production in China, and regards irrigation as its single most important feature. In so doing, however, he has underestimated the significance of arable husbandry technology.

2 Regarding the above-mentioned four factors in more details, see [18, pp. 337–40].

Concentrating as he does on "hoe-husbandry" agriculture, Wittfogel has, in my opinion, failed to afford adequate treatment to the arable husbandry context in which this *Hackbau* technology developed. Let us begin our rebuttal with this point.

The mouldboard-fitted plow (*fanchuanli*)—a step beyond the more primitive seedbed-plow that had preceded it—came into increasingly widespread use in China as early as the Three Kingdoms, Chin, and Northern and Southern Dynasties periods (A.D. 220–589). According to the work of Motonosuke Amano,

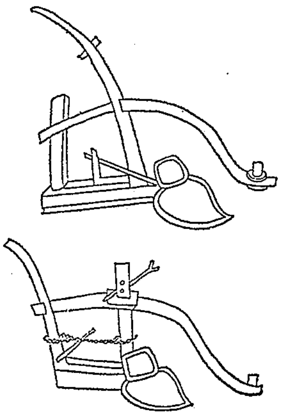
> The Wei dynasty [220–264] of the Three Kingdoms period saw the improvement of the traditional plow by the addition of a cast iron mouldboard attached to the coulter, the invention of an iron-tooth harrow *(p'a)* and knit harrow *(lao)* for harnessing animal power to the task of smoothing out the clods of soil turned over by the mouldboard; the development of a uniquely Chinese dry-field *(paoshang)* husbandry involving deep autumn plowing, shallow spring plowing, and the use of the iron-tooth harrow or knit harrow immediately after plowing; and the combination of plowing and seeding into one animal-powered operation in which a kind of wooden drill *(lou)* was used for sowing, and mulching and packing accomplished by means of the knit harrow or brush harrow *(ta)*. [1]

By the time of the T'ang Dynasty (618–907), we may observe the appearance of a mouldboard-fitted plow capable of adjustment to vary the depth of paddy plowing, and along with this new tool the perfection of a variety of new implements for the preparation of plowed soil for planting, including a new kind of iron-tooth harrow (*pa*), a sting roller (*liche*), and a rib roller (*lutu*); developments along these lines continued into the Sung (960–1279), with the appearance in that period of a comb harrow (*ch'ao*), and even as late as the Yüan (1280–1368), with the invention of a hand-held tooth harrow (*t'ang*) for use in cultivating and weeding. The T'ang period also witnessed the popularization of almost all of the farming implements known to Chinese agriculture before the twentieth century, and a particularly conspicuous enrichment of the repertoire of irrigation pumping devices (generically, "dragon-bone" or tread-wheel pumps [*lungku-ch'ê*] and water wheel pumps [*t'ung-ch'ê*]) at the disposal of the southern Chinese farmer, including a manual irrigation pump (*pach'ê*), a foot-operated tread-wheel pump (*t'ach'ê*), and an ox-powered capstan type pump (*niuchuan fanch'ê*) [1].

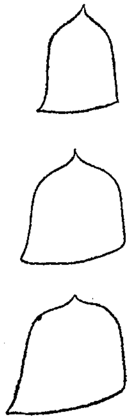
In fine, although the beast-powered dry-field arable husbandry that grew up in north China had become, for all practical purposes, technologically stagnant as early as the sixth century, the animal-drawn plowing techniques that originated in the north continued to be improved during the subsequent "later" dynasties of the T'ang, Sung, Yüan, and Ming (1368–1644) in the rice-planting areas of south China. If seen from this perspective, the much touted "inertia" of northern Chinese arable husbandry might well deserve reevaluation as a tribute to the very precocity of Yellow River agricultural civilization, and the standardization of dry-field farming methods in the sixth century *Ch'imin yaoshu* be regarded as an achievement in agricultural technology comparable in Chinese terms to the perfection of the Norfolk four-course system of crop rotation in late eighteenth century Europe.

Fig. 1. Agricultural Instruments Harnessing Animal Power

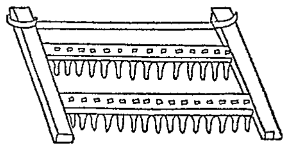
1. Plow (*li* 犂)



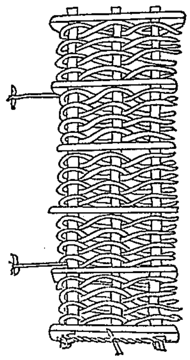
2. Mouldboard (鐴)



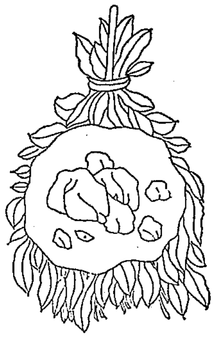
3. Square tooth-harrow (*fangp'a* 方耙)



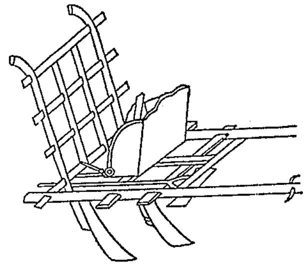
4. Knit harrow (*lao* 耮)



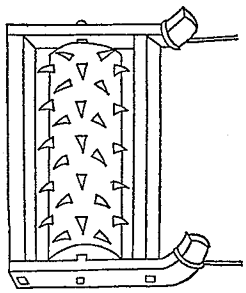
5. Brush harrow (*ta* 撻)



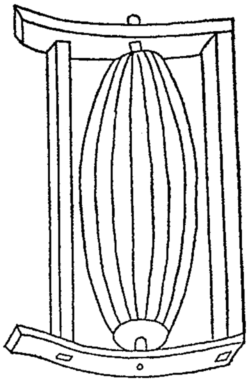
6. Drill cart (*louch'ê* 耬車)



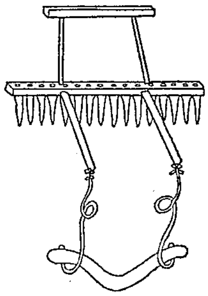
7. Wooden sting roller (*muliche* 木礰礋)



8. Rib roller (*lutu* 磟碡)



9. Comb harrow (*ch'ao* 耖)

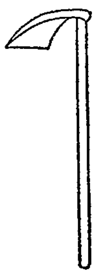


Source: Wang Chên, *Nungshu.*

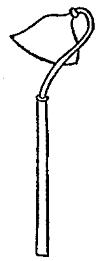
Of course, there are already visible in the *Ch'imin yaoshu* hints of certain uniquely Chinese patterns in arable technology, which were later on to become important factors in restricting the development of labor-saving devices to a level far below that shown by Western European agriculture in the eighteenth and nineteenth centuries. To be sure, the model farm in the *Ch'imin yaoshu* was "advanced" in that (1) fallow had been eliminated entirely; (2) seeding was by rows and performed with the wooden drill; and (3) inter-row hoeing seems to have been practiced, usually with the hoe (*ch'u*), sharp spade (*feng*), and weeding hoe (*nou*), but occasionally with the *lou* and *chiang* which permitted the applica-

Fig. 2.

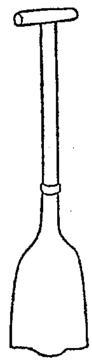
1. Weeding hoe (*nou* 耨)



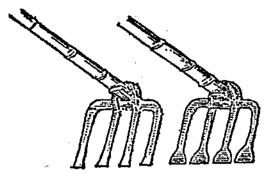
2. Hoe (*yuch'u* 钁鉏, *ch'u* 鋤)



3. Spade (*ch'iao* 臿, *ch'a* 鍬)

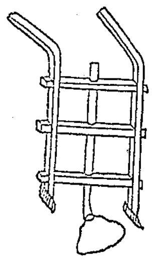


4. Potato hoe (*t'iehta* 鉄搭 [扒])



Left: dry field hoe; right: irrigated field hoe.

5. Duckfoot horse-hoe (*louch'u* 耬鋤)



Sources: Wang Chên, *Nungshu;* Ch'en Hêng-li, *Punungshu yenchiu.*

tion of animal (horse) power to the work. But evidence suggests that most hoeing in the kind of husbandry described in the *Ch'imin yaoshu* was still done with a hand-held hoe or weeding hoe, and that horse-hoeing was rare and its technology atrophied. Thus, while the introduction of crop-rotation agriculture in eighteenth century Europe was accompanied by a popularization of horse-hoeing, no such development was precipitated by the same advances in sixth century China, where animal power, while applied to plowing and sowing, did not replace human muscle in hoeing and cultivating work [9, p. 269]. With this critical stage behind it, Chinese husbandry in subsequent ages found itself lacking in incentive for perfecting plow and plow-related implements capable of use in hoeing and cultivating tasks, a condition which, ironically, was only worsened by the development of flooded-field rice agriculture in south China, which, by compensating for and replacing entirely some of the inadequate aspects of the older dry-field husbandry consequent upon the backward state of "plowing" techniques, gave even further impetus to the reliance on manual cultivation and traditional disregard for animal traction as a key to increasing productivity.

Our quarrel with Wittfogel's characterization of Chinese agricultural implements as "technically primitive" does not, it should be emphasized, concern the ultimate truth of his observations insofar as they reflect the viewpoint of a man struck by the atrophied condition of labor-saving technology in pre-Communist Chinese husbandry. Where we take issue with his scheme is over the matter of his refusal to recognize developments which, although perhaps not conspicuously, tended nevertheless to contradict the monolithically stagnant *Gartenbau* model he postulates. In calling our attention to the prominence of "hoe husbandry" (*Hackbau*) in traditional China's agriculture, Wittfogel has no doubt put his finger on the single most decisive aspect of that country's farming patterns in the pre-scientific age, and located a very important point of contrast with modern European agrarian technology. But even the most cursory review of the history of Chinese agriculture since the T'ang period—such as we have attempted above—will show that Wittfogel has overlooked a series of developments outside of the realm of "hoe husbandry." And, perhaps more seriously, it is evident that his conception of *Hackbau* agriculture carries with it an implied historical chronology which would place "hoe husbandry," and the implements used in its practice, at a stage prior to the perfection of "arable husbandry." The accuracy of such a chronology has, however, been called into question by at least one scholar of Chinese agricultural history, Yukio Kumashiro, whose opinion on the matter is that

> the basic implement in the hoeing technology we find overlapping with the arable husbandry described in the *Ch'imin yaoshu* was the perforated and sharp-angled hoe *(ch'u* or *nou),* and not the spade *(feng)* which belongs rather to the simpler "digging stick" *(i)* or *Grabstock* category of farming tool. Thus, while hoeing and plowing were still virtually undifferentiated in the technology described by the *Ch'imin yaoshu*, the "hoe-plowing" methods current at the time this work was written would be more properly considered as on a plane with the most sophisticated arable agriculture then known to human civilization, and at any rate must be distinguished from the much more primitive manual spade husbandry *(Grabstockbau)* of an earlier age. [9, p. 261]

Even though Kumashiro is prone to characterize ancient Chinese agriculture as backward in its application of animal-drawn plow technology and excessively dependent on the hand-held hoe for soil preparation, the very fact that he simultaneously classifies this "hoe husbandry" as "on a plane with the most sophisticated arable husbandry then known to civilization" certainly suggests that there was at least the possibility of future development of animal-powered arable farming techniques. By contrast, Wittfogel's *Gartenbau* schematization of traditional Chinese agriculture presents us with a virtually closed system, in which there would appear to be no internal impetus for further evolution. For Wittfogel, a failure to continue the development of labor-saving agricultural implements was not simply the price paid by the pre-modern Chinese farmer for his predilection for labor-intensive "horticultural husbandry," but was indeed made inevitable by the total absence of any necessity for such continued development.[3] The shortcomings of this kind of reasoning, it need not be elaborated, are manifold and serious, for Wittfogel's model makes it impossible to account for the transformations in crop-rotation husbandry precipitated by the replacement of the hand-hoeing technology of archaic Chinese agriculture with the horse-hoeing technology of that country's modern period.

But the riddle of traditional China's indisputably atrophied arable technology is not resolved merely by rejecting Wittfogel's tenuous arguments for the "inevitability" of this condition. The success of the current Chinese government in raising farm productivity by massive introduction of horse- and motor-powered hoeing would seem to prove that, Wittfogel's prognostications notwithstanding, the "system" was by no means doomed to stagnation by any internal causation. But why, then, did "hoe" husbandry remain so prominent a feature of China's agriculture for so long? Kumashiro offers a variety of rather narrow explanations for this phenomenon, including the following: (1) In traditional China, soil preparation for cormophyte crops as well as cereal crops required the use of the hoe; (2) The design of the traditional Chinese plow (the so-called "frame" or "square" plow), developed originally in response to the needs of northern Chinese agriculture, was not such that it could be easily improved by the addition of a *coulter* of furrow wheels. Its construction enabled it to plow rapidly and be turned easily, but these virtues were achieved only by severely limiting the depth to which soil could be turned and undercutting the rigidity of the assembly [9]. Rather than create a new type of plow, southern Chinese rice farmers preferred to supplement the traditional implement with such manual tools as the "potato hoe" (*t'iehta*), etc., when deeper working of the soil was called for. But perhaps an even more telling reason for the backwardness of China's arable technology as that nation entered the modern era was the failure of Chinese civilization to generate a counterpart to the revolutionary advances in the natural sciences that took place in Western Europe from the mid-seventeenth century onward.

It would be a mistake, however, to conclude from this catalogue of impeding factors that no attempts were made by the Chinese peasantry to create plow-related implements capable of compensating for the defects of the ancient "square" plow. Properly speaking, the term *li* or "plow" in Chinese continued to refer only to the old-fashioned long-chassis implement of northern pedigree, whereas all of the animal-drawn tools for soil preparation that came into existence during the late traditional era chiefly to supplement the inadequate "long-chassis plow" were of the no-chassis or "walking" plow variety, and were, accordingly, designated as sub-species of the hoe family. This semantic accident should by no means divert our attention from the fact that the improved "hoes" that came into use in the post-T'ang era were in reality animal-hauled plowing implements which

[3] "In der bisherigen intensiven Agrikultur Chinas waren kompliziertere Arbeitsgeräte z. T. nichtnötig . . ." [18, p. 155].

functioned, however imperfectly, to provide the Chinese peasant with more efficient means of harnessing ox- or horse-power to the tasks of soil preparation. Major developments in this category of implement included the "duckfoot horse-hoe" (*louch'u*), which came into prominence in the Sung and Yüan periods, and which continued to be used widely in Hopeh Province (under the name *huotzŭ*) until immediately after the Liberation; an animal-drawn cultivating tool known as the *yünch'u*, which might be regarded as a precursor of the three-bladed cultivator (*sanch'ih yünch'u*) that has been mass-produced since the Liberation by the North China Regional Agricultural Machinery Factory (Huapei nungyeh chich'ieh tsungch'ang) chiefly for use in the cotton fields of the North [11] [13].

From the above considerations, I think it will be agreed that Kumashiro's characterization of traditional China's agricultural technology as "manual-cultivating husbandry" or "atrophied arable husbandry" is considerably more appropriate than Wittfogel's *Gartenbau* schematization, if only because, as has been already mentioned, the latter postulation fails to suggest how the traditional mode of farming might become transformed into a more modernized one, while Kumashiro's model stresses the possibility of evolving a more up-to-date crop-rotation type of agriculture by substituting animal or mechanical power for human sinew in the cultivation phase of the farmer's work cycle. Again, Wittfogel's monotonous concern with the role of irrigation technology in shaping the past and future of China's agriculture is in keeping with his inclination to focus on stagnating rather than potentially transformable factors in that country's rural economy. A more forward-looking perspective, by contrast, is afforded by the Kumashiro thesis, which, in my opinion, correctly identifies the improvement of plow- and plow-related technology as the major hope for boosting China's agricultural output.

II. EXPANSION OF HYDRAULIC CONTROL AND FERTILIZER RESOURCES

Turning now to the more practical question of China's post-Liberation efforts to bolster the productivity of her highly problematic agricultural sector, it would probably be most appropriate to begin with the obvious point that—as has been adumbrated in the preceding section—no simple schedule of priorities for reform or expansion can be charted. Repeated setbacks have taught the current Chinese leadership that, within the agricultural sector itself, as well as for the national economy as a whole, China is in no position to toy with the classic Soviet formula of monolithic and mono-directional investments of labor or capital into any one pocket of productive activity. Very much the same kind of reverberating, dialectical model of development that crystallized in the late 1950s with the somewhat vague exhortation to "make agriculture the basis while making industry the leading factor" has found its counterpart within the former sector itself. Unlike Wittfogel, who was convinced that the condition of water control and irrigation was the decisive element in the Chinese countryside, Mao Tse-tung has preferred to afford hydraulic projects a less commanding status as "the essential basis" of the rural economy, holding that, while "irrigation . . . is the lifeblood of agriculture," "the fundamental way out for agriculture lies in mechanization." The immediate prospects for maintaining a healthy agricultural output are, in other words, acknowledged to depend very heavily on the rationalization of existing water-supply and flood-control systems and their elaboration to the greatest degree possible within the limits imposed by a largely decentralized hydraulic administrative network. At the same time, however, hopes for long-range and really significant increments in rural productivity are bound up with the success of mechanization programs, which alone are seen as capable of offering an alternative to the old-fashioned, labor-intensive cultivating methods of China's peasantry. Just how this "essential basis/leading factor" formula has come to regulate the distribution of labor and capital investment in hydraulic and mechanization projects is a question which we shall try to clarify in what remains of this paper. But before tackling the problem of the larger dialectic itself, it shall be necessary first to sketch the progress of programs undertaken in each of the subordinate realms delineated within it. Let us begin with hydraulic control and the "essential basis" arena.

From the outset, it should be emphasized that the availability of water was not the only major yield-influencing variable with which the pre-Liberation peasant concerned himself. Along with numerous variations on the proverbial "no water, no harvest" (*yushou wushou tsaiyüshui*), the northern Chinese farmer might just as frequently have been overheard until quite recently reminding his neighbors that "you can't get good yields with scanty fertilizer" (*shouto shoushao tsaiyüfei*). Even with the requisite water needs assured, considerable variations in productivity could be expected according to the adequacy of fertilizer at the farmer's disposal. Nevertheless, within the realm of traditional determinants of land productivity, water-works, with their relentlessly high maintenance costs, were clearly an "essential basis" type investment, while fertilizer input, exercising an influence upon yields very nearly in proportion to direct capital outlay, offered more potential for development as a "leading factor" in the reconstruction of China's agriculture. Nowhere was this more true than in the rice-producing valleys fo south China, where, even more than in the North, major agricultural disasters have almost always been caused by drought or flood. If a single most "essential basis" for stabilizing China's agricultural output must be identified, it shall certainly have to be regarded as the "prevention of droughts and protection against floods" (*fanghan paolao*), to borrow the post-Liberation phrase.

Consistent with this identification of hydraulic projects with the "essential basis" side of the developmental model, the Chinese Communists at first pinned their hopes for improvement of water control facilities more on rationalization of the village social structure than on centrally planned capital or labor investment. As Wittfogel has emphasized—indeed over-emphasized—the upkeep of water-works was, throughout most all of China's imperial history, considered a responsibility incumbent upon all legitimate dynasts; and there is no doubt a measure of truth in Wittfogel's assertion that this particular obligation, to the extent it was actually fulfilled, served both to bring into existence and to justify a degree of paternalistic administrative centralization (Wittfogel's "Oriental despotism") rather surprising for an empire so miserably backward in its long-distance communications and transport infrastructure. But, as has proved to be the case with so many of his other generalizations, Wittfogel's portrait of a highly centralized system of water-control administration tends to disintegrate under closer analysis. In reality, the vast majority of water conservation and drainage resources in traditional China (excepting only such portions of the Yellow and Yangtze rivers as immediately affected the transport canal network or the select southern areas from which northern rulers extracted their regular rice supplies) were financed and supervised on a piecemeal and highly localized basis. Generally speaking, the largest practical unit of irrigation control was the village or a cluster of mutually adjoining villages; but the actual ownership of water-rights more often than not was in the hands, not of village corporations, but of private land-owners or clans, particularly in the rice-growing regions of central and southern China. Far from reinforcing the "despotic" structure of hydraulic administration, China's post-Liberation agrarian reformers found themselves in the position of having to struggle to replace a nearly chaotic diffusion of irrigation proprietary rights with a more rationalized system of coordinated control.

The uprooting of the landlord class in the land reforms of the early 1950s, followed soon after by the implementation of a rudimentary collectivization of land and irrigation rights, helped to a certain extent to lay the groundwork for a much needed reorganization of water control planning. But the Farming Production Cooperatives, which were the major units of collectivization until the Great Leap Forward, in many cases inherited the same highly parochial attitudes toward water rights that had been characteristic of the older village units they so often coincided with, with the result that a socialist education mass movement had to be initiated in the autumn of 1957 to discourage still frequent disputes over irrigation rights, and to prepare the way for the creation of the larger units of collectivization (People's Communes) ultimately necessary for a genuine rationalization of hydraulic management. Even after the launching of the communization movement, however, many obstacles stood in the way of a rapid improvement of water-control facilities. To begin with, the "three principles policy" adopted during the early stages of the movement, while identifying the "storage of water" as one of its triumvirate of priorities, also emphasized the need for "small-scale" projects and encouraged the use of voluntarily mobilized "mass-line" labor resources, rather than centralized capital investment, in the construction of hydraulic facilities. During the first three years of the existence of the People's Communes, the decentralized or "self-reliance" (*tzuli*) formula for hydraulic construction projects was instrumental in the realization of an unprecedenetd expansion of irrigated acreage, but the successes of this initial period stopped far short of accomplishing the irrigation of all potentially irrigatable lands. The really crucial period for the enlargement of water-control resources did not come until after the wave of natural disasters that continued from 1959 to 1962 had effectively dashed the hopes of the Chinese leadership in the People's Communes as a means of achieving a rapid solution to the problem of a lagging agricultural sector. In the wake of these disasters, it was soon realized that existing irrigation and flood-control facilities were still, in spite of significant post-Liberation augmentation, far from sufficient to permit complete reliance on Commune-mobilized voluntary labor as the sole means of maintenance and improvement. With this lesson learned, the focus of hydraulic resource improvement efforts switched to the rapid construction of large-scale, coordinated drainage and irrigation networks, and the modernization of the technology used in such drainage and irrigation facilities.

In the category of technological modernization perhaps the most striking advances came with the creation of master plans for long-term construction of integrated electrically powered drainage and irrigation systems in the Yangtze and Pearl River estuaries. By the end of 1963, work along these lines had progressed so far in the Pearl River delta area that electrified drainage and irrigation was making possible regular rice harvests even without regular rainfall in some 200 square kilometers of delta land and in more than 390,000 hectares (roughly 80 per cent) of the arable land in the twenty-five adjoining districts and townships [8, Oct. 25, 1964]. Following hard upon the heels of these two major projects, the construction of similar large-scale hydraulic projects (for the most part electrified) was begun in the drainage basins of such major inland reservoirs as Tungt'ing Lake (in Hunan), P'oyang Lake (in Kiangsi), and T'ai-hu (in Kiangsu); and, to the extent that these new drainage and irrigation facilities required the augmentation of existing electric power resources, rural electrification went forward with surprising speed, bringing electrically-powered threshing and crop-processing equipment, not to mention home appliances, into wider use, and culminating, in the period after the Cultural Revolution, in a boom in the construction of small-scale power plants at the Commune level.

Improvement of irrigation and drainage facilities by electrification has not, however, been confined to the rice-producing lowlands of the South. Advances in techniques for locating subsurface water and improvement of drilling methods have made deep-layer water tables as important a source of water for the well-supplied irrigation systems of the North as shallow-level water tables had been in the days when human and animal power were the only sources of energy for pumping. And in the mountainous interior sections of such southern provinces as Fukien, Kwangsi, Szechwan, Hunan, and Kweichow, electrically driven turbine pumps have largely replaced the old-fashioned water-wheel pump as a means of transferring rainwater pooled in natural reservoirs or streams to cultivated fields.[4]

An immediate benefit of the electrification and mechanization of hydraulic resources described above has been a considerable reduction in the human labor requirements absorbed by irrigation and flood-control tasks. A dramatic example

[4] This turbine pump was designed by the Fukien Institute of Agricultural Mechanization in 1954. After initial use in this province, it began to spread gradually to Kiangsi, Hunan, Szechwan, and Kwangsi provinces. This turbine pump is usable with a minimal amount of investment provided a minimal requisite water level and flux exist. It is usable not only for the expansion of irrigated land but also for the generation of electric power for the processing of farm products [8, Apr. 19, 1964].

of the degree to which labor conservation has been realized is shown by the experience of the Hsiaot'ang Commune of Nanhai County (Kwangtung Province). Since its creation during the Great Leap Forward, the Hsiaot'ang Commune has succeeded, not only in repairing and constructing a total of twenty-four upland waterways and two trunk canals, but also in fabricating, between 1960 and 1963, a coordinated network of electrically-pumped irrigation and drainage water courses on a commune-wide basis, with the result that more than 98 per cent of the rice paddies belonging to that commune are centrally drained and irrigated. Before the construction of this modernized hydraulic apparatus, water-control had depended mainly only human and animal power, applied through the traditional water-wheel pump. Needless to say, labor demands had been enormous, amounting, for the entire commune, to some 1.2 million man-days per annum (or, according to the current Chinese system of reckoning, 4,000 "labor units"[5]). By 1963, however, the number of man-days consumed in hydraulic labor had shrunk to a mere 90,000 for the entire commune (or 300 "labor units"), thereby liberating a total of 3,700 "labor units" for work in other, longer-term projects, such as the reclamation of waste lands and their conversion into rice paddies (no less than forty hectares of rice-producing arable have been added to the communes resources to date as a result) [17].

Investments in the enlargement and modernization of water-control capital such as have been noted above have been designed in rice-producing areas primarily to achieve a stabilization rather than expansion of rice output. But an important peripheral benefit has been the release of enormous quantities of raw human labor from pumping work, and in not a few instances this labor power has been transferred directly into other phases of the still painstaking and only semi-mechanizable rice production cycle (transplanting of seedlings, etc.), allowing in many cases the substitution of double- for single-cropping. In other instances, the conserved labor has been utilized for introducing a rotating- instead of mono-crop system, permitting commune production brigades to experiment with a variety of high-yield and advantageously priced crops.

Perhaps even more spectacular, however, have been the productivity increments achieved in the dry-farming North after the introduction of mechanized and electrified water-control techniques. As fertilizer and cultivating labor input are to rice yields, irrigation is to wheat and cotton output; water-starved wheat or cotton fields, that is to say, can be made to increase their yields almost in proportion to enhanced irrigation. That being the case, investments in the construction of dams and irrigation canals, as well as in the sinking by advanced methods of long-shaft wells in areas where (as is common in many parts of north China) the water-table lies well beneath the surface, have had a pronounced developmental ("leading factor"), and not merely stabilizing ("essential basis") influence upon northern Chinese agriculture, which has traditionally suffered from a distribution of rainfall distinctly disadvantageous for the wheat crop that is the

[5] A "labor unit" (*l'autungli*) is figured as the aggregate labor performed by one man working 300 days per annum.

mainstay of the region's economy. For the northern Chinese farmer of the pre-commune period, it was fatalistically assumed that "nine of every ten years shall be drought-years" (*shihnien chiuhan*); an adequate spring rainfall was considered "more valuable than oil." While the total annual rainfall in the central dry-farming areas of north China averages from 400 to 700mm, between 70 and 80 per cent of this rainfall generally occurs in the three summer months (July–September), while a meager 8–10 per cent comes in the crucial spring months immediately after sowing. The problem is particularly acute in the northeastern provinces of Hopeh, Honan, and Shantung, where the wheat crop is decisive, and where precipitation during the critical months of April and May is often so miniscule as be inadequate for the needs of the wheat seedlings [5]. The importance for the North's agriculture of expanding facilities for catching, storing, and distributing the summer rainfall can, under such circumstances, be safely said to be even greater than that attributable to the improvement of hydraulic resources in the rice-producing South.

The second major element in the "essential basis" sector of the Chinese rural economy is, as we have already mentioned, the matter of maintaining an adequate supply of fertilizer. Although the problem of a chronic shortage of fertilizers has tended to be less responsive to the therapy of social reorganization and rationalization of labor resource allocation than was the case with hydraulic facilities, and more dependent on centralized investments in the industrial sector for a long-term solution, there are several reasons for treating the fertilizer issue under the same rubric as water-control: firstly, because improved fertilization techniques, like modernized water-control facilities, serve chiefly to improve soil productivity rather than conserve human labor; and, secondly, because—as the following discussion will underwrite—there was, in the event, much room for bolstering fertilizer resources by rationalizing the production and distribution of traditional, organic (as opposed to manufactured or chemical) fertilizers. Then, too, efforts to improve low-yield alkali and laterite soils have often combined experiments with improved irrigation and increased fertilization. A brief discussion of the fertilizer problem is therefore in order before we turn to the "leading factor" side of agrarian reform efforts.

A major turning point in the campaign for improved fertilization techniques came in the latter half of 1964, with the launching of a drive aiming at the creation of "stable-*and*-high-yield fields" (*wênch'an-kaoch'ant'ien*), by which was meant fields producing consistent multi-crop harvests. What was most remarkable about this campaign is that it did not place maximum priority upon the quantitative increment of fertilizer impregnation, but rather relegated the matter of increased fertilizer application to a secondary position, along with the improvement of seed strains. The main emphasis in this program was given to the improvement of soils by enhanced irrigation and alteration of their chemical composition. Experimentation with alternate varieties of existing "natural" fertilizers accordingly played a role as or more important than the mere augmentation of fertilizer input, a clear rebuke to the prognostications of some scholars who have assumed, mainly from the conspicuous scarcity of manufactured fertilizers in China's pre-

Liberation agriculture, that the solution of the soil enrichment problem would turn upon the Communist's success in mass-producing synthetic or processed fertilizer materials.

In fact, a succession of experiments with various fertilization techniques has shown that, in general, a combination of old and new type fertilizing agents offers the best prospects for improving soil productivity. And that perhaps the foremost difficulty with traditional fertilizer technology was not so much its backwardness or inappropriateness as much as the lack of interest on the part of the authorities in coordinating and expanding such fertilizer resources as already existed. As early as the sixth century, if we may take the text of the *Ch'imin yaoshu* as evidence, the Chinese peasant was well acquainted with rationalized manuring techniques. By the seventeenth century a sophisticated method of soil enrichment had evolved in connection with the intensive rice agriculture of the South which involved the repeated application of fertilizer both before and after sowing. Yet, by the nineteenth century, primarily as a consequence of the lopsided market structure created by the penetration of the imperialist powers, China was exporting enormous quantities of soybean-cake (*tatoup'o*), one of her most precious sources of fertilizer material. Accordingly, there remained much room for reforming fertilizing technology simply by imposing a rational method of supervision and control over existing resources and techniques; the much-celebrated movement for developing the chemical sciences and popularizing the use of chemical fertilizers, pesticides, etc., has never served as more than an adjunct to the more important task of modernizing already available soil-enrichment practices.

Nevertheless, it was only by installments that the post-Liberation leadership came to realize the importance of combining the rationalization of traditional fertilizer techniques with the introduction of chemical fertilizing agents. During the first stage of scientific fertilizer experimentation—coinciding with the First Five-Year Plan (1953–57)—it was generally assumed that China's soil was, on the whole, nitrogen starved, but adequate in potassium content; and that a deficiency in phosphates was a more or less universal characteristic of the soils to be found in the Yangtze basin and in the regions south of it [14]. It was not until a series of experiments with multi-crop fields in various parts of China in 1958 showed that significant increments in soil productivity could be obtained by mixing in phosphate and potassium compounds with the basic nitrogenous fertilizing agents that this view came to be altered; since then numerous studies have been made of the advantages of phosphate fertilizers, as well as of the increases in productivity afforded by the supplementary use of manure and "green fertilizer" simultaneously with the primary nitrogen fertilizing materials. As a consequence of these and other developments, recent years have seen a favorable reassessment of traditional "green fertilizer" techniques as a means both of preventing soil depletion and of increasing its productivity, and a considerable amount of valuable chemical phosphate fertilizer is now being used, not for growing consumable produce, but rather for increasing the yields of "green fertilizer" crops, which, when plowed back into the earth, have proved themselves highly effective in increasing rice, wheat, and cotton outputs [3]. Increasing attention has come, in addition, to be focused on phosphorus-deficiency as China's major soil problem; by 1962, a nationwide estimate of phosphorus-deficient soil placed the total area in this category at more than 8 million hectares.[6]

The pattern of simultaneous and integrated employment of natural and chemical fertilizers continues up to the immediate present: along with frequent reports of construction of regional plants for manufacturing phosphate fertilizers for distribution to nearby communes we hear with equal frequency word of the steady increase of the nationwide production of "green fertilizer" crops, and of the efforts by various communes to expand pig-raising, not simply to improve meat supply, but as a means of providing cheap manure for fertilizer. At least in the foreseeable future, in other words, improvement of soil productivity can be expected to depend at least as much on the scientific and rationalized employment of old-fashioned fertilization techniques as upon the growth of a modern chemical plant for producing manufactured fertilizers.

III. ARABLE TECHNOLOGY: THE LEADING FACTOR

To a very large extent, China's climatic and soil conditions can be expected to make in the future, as they have in the past, water-control the "essential basis" of that country's agricultural development. But, as the "essential basis/leading factor" dichotomy dominant in post-Liberation planning circles so well expresses, the increases in agricultural productivity that might be expected from expansion of hydraulic resources are marginal in comparison to the increments that are possible once the traditional system of labor-intensive and implement-primitive cycle of cropping by means of the 'Chinese" plow and manual cultivating can be transcended. Really meaningful modernization of China's rural economy cannot be achieved without, in other words, a revolution in plowing and hoeing techniques, resulting in the mechanization of the entire production cycle, from soil preparation and hoeing, to harvesting and crop processing.

It is well known, however, that the mechanization of Chinese agriculture has been and will continue to be impeded by a whole range of problems which more or less unknown to the "extensive" husbandry of Europe at the stage when it underwent mechanization. Particularly problematic in this respect has been the pattern of technology that was developed in traditional China in connection with the hoeing and cultivating section of the crop-raising cycle, especially in the dry-farming and water-scarce areas of north China where careful and frequent hoeing with the *ch'u* and *nou* (vide supra, p. 453) was necessary not simply for weeding

[6] Chang K'ai-yen [2]. According to Chang K'ai-yen, the area planted with edible pulse crops and pulse crops for green manure amounted, at that time, to more than 20 million hectares, so that the amount of phosphorus fertilizers demanded per year was estimated at several million tons.

but, more importantly, for keeping the topsoil loose and moist so as to prevent the rapid evaporation of the at best barely adequate supply of subsurface water. It was perhaps inevitable that the northern Chinese peasant, forced by climate and soil conditions to invest so much time with hoe in hand, should seek to turn this time to maximum advantage by such intensive cropping techniques as *inter-planting* (*chientso*), companion seeding (*t'aochung*), and mixed-cropping (*huntso*), all of which rely heavily on manual hoeing and cultivating. Mechanization, under such circumstances, would accordingly conserve human labor only at the price of sharply reducing land productivity.

Although perhaps in not so extreme a form, a similar incompatibility between extensive mechanization and maintaining high yields exists throughout all parts of the Chinese countryside, largely because, unlike his European counterpart, the traditional Chinese peasant was accustomed to spend long hours in hoeing and weeding not just of cormophyte or garden crops, but of cereal crops as well. "Intensive" husbandry, in fact, seems to be both the dominant and distinguishing characteristic of Chinese agriculture, as the current leadership has recognized in its practical as well as chauvinistic encouragement of the "careful plowing and painstaking cultivation" (*chingkêng hsitso*) habits of the rural population. A go-slow policy with regard to the introduction of farm machinery, while in some respects attributable to industrial underdevelopment and a nationalist reluctance to discard a technology that is the fruit of so many centuries of tradition, has at the same time been to a very much greater degree forced upon the Chinese Communists by the harsh reality of their being no simple way to mechanize agriculture without making concessions to the needs of the older "intensive" style of farming with its enormous labor demands and correspondingly high area yields. Just how difficult progress in improving farm machinery resources has been will be made clearer by the following brief account of post-Liberation trends in implement design and manufacture.

Immediately after the rise to power of the present government there was much talk of improving the performance of existing farm tools and introducing machinery of entirely modern design. At least with respect to the latter expectation, results were disappointing, for even such modest "modern-design" implements as the two-wheeled double- or single-share plow have not found their way into common use except in some parts of the Northeast, and have certainly not even begun to replace the traditional "square" plow as the predominant tool for turning the soil. A further setback to the "new implement" program came in 1960 and 1961, when natural disasters and accordingly poor harvests set commune work brigades scurrying to the tool sheds in search of much needed older type tools such as the sickle, hoe, shovel (*hsien*), and mattock, and compelled handicrafts production cooperatives to devote all of their energies to the production of these traditional farming implements. (By October 1962, the total output of iron spades, mattocks, hoes, sickles, etc., had reached an astonishing 320 million [8, Dec. 24, 1962].)

Perhaps the most hopeful developments have come in the area of medium-sized, animal-drawn farm machinery, the demand for which has escalated rapidly since 1962. The key reason for the success in improving this category of implement has been that no attempt was made to achieve full mechanization, the novelty in most cases being simply the replacement of human by animal power, and the object of its introduction being at least partially the psychological preparation of the farmer for a more thoroughgoing mechanization that will eventually have to replace the "intensive" method of cultivation. Older medium-sized implements modified along these lines include the plow, wooden drill, harrow, water-wheel pump, windmill, and transport skiff (used in rural areas where waterways are the chief means of communication); more-or-less new devices in this same category include the "Liberation water-wheel pump" (*chiehfangshih shuich'ê*), the three-bladed cultivator (*sanch'ih yünch'u*), a kind of *ridging plow* (*ch'ant'angchi*), the "seven-inch walking plow" (*ch'its'unpu-li*), the hill plow (for plowing inclined fields) (*shantili*), and the "two-wheeled double-share plow" (*shuanglun shuanghua li*). But by far the most important of these improved medium-scale tools are of the former sort, the three-bladed cultivator (which has come to play a major role as a hoeing and weeding implement in the cotton-cropping areas of Hupeh [10] [4]) being a direct descendant of the traditional duckfoot hoe (vide supra), while the tractor-drawn ridging plow (*lungtsoli*)—which has achieved prominence in the Northeast after its standardization in 1964—is described as a remodelled version of the older *ch'ant'angchi.*

Of course it must not be forgotten that a major factor behind the very deliberate pace of mechanization of farming implements has been the persistent inadequacy of China's powered farm machinery production resources. It was not until 1958, for example, that a pioneering tractor-production facility (Tractor Factory No. 1) was established at Loyang. Previous to this initial step toward self-reliance in the production of heavy-duty farm machinery, the Chinese were completely dependent on Russian-built tractors which had, because of their high purchase and maintenance costs, to be operated either on state-run farms, or by state-owned tractor stations leasing tractor services to cooperatives or communes. Even by 1964, China's entire supply of tractors of fifteen- or more horsepower capacity was still only a meager 120,000–130,000. At least until that year, it is superfluous to observe, there could have been no thought of attempting large-scale full mechanization of soil-preparation and cultivation, even had all other conditions been propitious.

Another consideration that has been important in the development of mechanized agriculture has been the differential appropriateness of mechanization to varied topographical configurations (dry plain farms, upland farms, flooded lowland paddy fields, etc.). Certainly the most promising application of tractor power so far has been in the flat dry-farming areas of the Yellow River basin, where the development of the "Tungfanghung Model 28 Multi-purpose Cultivation Tractor" in 1964 opened new prospects for the expansion of cotton production in that part of China. Work on this machine began in earnest after the publication, in August 1963, of a "Proposal for Several Important Technical Measures Designed to Boost Cotton Production in the Coming Year" by the Technology Dissemination Exemplary Labor Group of the National Cotton Production Conference of Intensive Cotton-producing Districts, which gave the following advice.

> At present, sowing is accomplished manually in most of the cotton-growing districts of north China, making control of this operation very difficult. It is consequently necessary that animal-power should be harnessed to this task. To this end, the training of personnel specialized in drill-sowing must be undertaken, and the techniques used in this operation itself perfected. And, where conditions are favorable for mechanized plowing, the mechanization of sowing as well should be positively encouraged. . . . We also recommend that animal-drawn cultivating tools be brought into use as the most advantageous means of increasing the efficiency of cultivating and weeding operations, since animal-powered cultivation is five or six times as effective as human-powered cultivation, guarantees a schedule of operations more adaptable to varying seasonal conditions, and raises the quality of the cultivation accomplished. [16]

Although the proposal quoted above focused on the introduction of animal power into the cotton-growing process (probably intending that the major implement for accomplishing this should be the three-bladed cultivator mentioned previously), the multi-purpose cultivating tractor which made its appearance in the following year has made it possible for virtually all of the work stages in the cotton raising cycle (sowing, cultivating, post-sowing fertilizer application, banking, drainage furrowing, pest- and blight-proofing, and stalk-extraction) to be mechanized, providing a rare but important example of labor-saving machinery which increases rather than reduces land productivity.

Yet even with the aforementioned successes in mechanization of the production of cotton, it by no means follows that the way has been opened for total mechanization of cotton farming, or that, were this possible, the gains in labor productivity registered thereby would in themselves justify the investment in machinery. A case in point is the experience of the state-managed cotton farms in the Sinkiang Uighur Autonomous District. Comparing figures for yield per unit of cultivated area, it was found that the highest levels were achieved by semi-mechanized farms (i.e., farms where both machinery and human labor were used to produce the crop), and that production brigades relying on manual "intensive" cultivation techniques were able to bring in much higher yields than those possible in totally mechanized areas. Even in terms of yield per man-day of labor input, it was discovered that semi-mechanized farms were able to achieve comparable or perhaps slightly superior outputs in comparison to totally mechanized farms. In short, the availability of the Tungfanghung Multi-purpose Tractor-cultivator notwithstanding, it is clear that Chinese cotton farming shall continue to require significant investments of raw human labor, and that such investments of "intensive" labor are not only necessary to prevent slips in land productivity, but to achieve maximal returns on human labor resources as well.[7] As long, in other words, as a surplus of labor and shortage of land continues to exist in rural China, labor-saving mechanization shall have to be held within such limits as are compatible with increased surface yields, and shall have to be coordinated with, rather than displace, the older labor-intensive technology.

Needless to say, the "careful plowing and painstaking cultivation" technology that we see surviving alongside of such machinery as the Chinese have been able to introduce into their agriculture has undergone considerable improvement and rationalization in the post-Liberation period, notably in the wake of the promulgation of Mao Tse-tung's famous "Eight-Point Charter" (*Patzu hsienfa*) in 1958 during the first stages of the Great Leap Forward. Of the eight basic injunctions included in this formula (improving soil [*t'u*], fertilization [*fei*], irrigation [*shui*], seed strains [*chung*], closer planting [*mi*], perfecting anti-blight techniques [*pao*], improving *field management* [*kuan*], and bettering farm implements [*kung*]), only the last touches upon labor-saving devices; in any event, the emphasis of the code is upon the simultaneous implementation of *all* of the desiderata catalogued therein, and the "bettering of farm implements" seems to have been meant more as a guideline for what we have above described as semi-mechanized than for genuinely mechanized agricultural technology. The primary object, in other words, of the rationalization of the older labor-intensive cropping methods appears to be the "horticulturization of husbandry," or the upping of land (not necessarily labor) productivity—a goal which is hardly compatible with open throttle mechanization of agricultural production. Whatever mechanization is possible under this scheme of priorities shall have to satisfy the twin requirements of labor economy *and* increased land productivity, or as one Chinese analyst put the matter in 1960, "modernization of our agricultural technique will be characterized by the integration of mechanization with garden-style farming" [15, p. 15]. A summary history of tractor production since the abandonment of the Great Leap Forward will reveal, I believe, just how difficult has been the introduction of power machinery under such a contradictory set of priorities for agricultural reform.

The six models of tractor machinery standardized in 1965 were as follows:

(1) The 54 hp Tungfanghung Model 54;

7 COMPARISON OF PRODUCTIVITY OF RAW COTTON BY TYPES OF CULTIVATION

	Requisite *Kung* per *Mu*	Yield per *Mu* (Seed Cotton) (*Chin*)	Yield per Labor Day (*Chin*)
Average concentrated cotton field typical in major cotton districts	18–22	140–220	8–10
Production involving "careful and intensive" cultivation on individual basis	20–25	280	12–14
Mechanized cotton raising district in Sinkiang	10–12	200–250	ca. 20
Partially-mechanized farms[a]	18–20	400	20–25

Source: [7].
[a] Farms where cultivation is both by machine and manual labor.

(2) The 100 hp Hungch'i Model 100;
(3) The 75 hp Tungfanghung Model 75;
(4) The 28 hp Tungfanghung Model 28 (multi-purpose cultivator tractor);
(5) The 35 hp Fêngshou Model 35 (for paddy use);
(6) The 7 hp Kungnung Model 7 (hand tractor).

Most widely used of the above is (4), the Model 28 Cultivator Tractor, which, in addition to cultivating, post-sowing fertilizer application, and transport, is capable of powering plowing, harrowing, and seeding operations for both cotton and corn cropping. The Tungfanghung Model 75, delivering about 35 per cent more efficiency in plowing operations than the smaller Model 54, has been found most useful in the dry-field agriculture of the North and Northwest. The Fêngshou Model 35 Tractor, by contrast, has been designed (to a great extent in imitation of foreign, especially Japanese, machinery) especially for use in the paddy fields of the South, where it is employed in plowing, spreading fertilizer, drainage, and irrigation operations. The most original of the six standard models, however, is the last-mentioned Kungnung Hand Tractor, which is serviceable, because of its small size, in garden plots, orchards, and terraced hill-fields. This light-weight implement, because of its relatively simple design and reduced scale, has lent itself to decentralized manufacture in commune farm-machinery workshops, as well, of course, as the more sophisticated facilities in Shanghai (where its production first began in 1966), and is now, along with a variety of other small-scale, semi-mechanized implements, being produced by local machine-shops in Kwangtung, Chekiang, Liaoning, and Shensi Provinces, in addition to centralized plants in such major industrial centers as Wuhan (Hupeh), Tientsin (Hopeh), Shenyang (Manchuria), and Lanchow (Kansu). It should perhaps be remarked, in passing, that this decentralization of production is the result of a deliberate policy with regard to rural mechanization that was introduced in 1966, according to which the atrophied but still important commune-level accounting unit (the so-called "collective economy") was specified as the principal source of financing mechanization of farm production, while local industry was allocated the primary role in developing the capacity for manufacturing the necessary farm machinery, and emphasis was placed on the increase of China's repertoire of small-scale farm machinery.[8]

The overall pattern of tractor manufacture and distribution, according to what we have so far seen, appears to be developing along two discreet lines: first, that of the heavy- and medium-tractor, for use primarily in the northern plains and southern lowlands; and second, that of small-scale hand tractors, for use in garden plots and orchards and (more important) the enormous areas of sloping upland arable previously innocent of even animal-powered machinery. With varying models now available for different terrains, the total tractor output has swelled sharply from the estimated 150,000 units produced in 1965, particularly in the years since the Cultural Revolution which have been marked by a rapidly in-

[8] This policy was said to have been presented by the Party's Central Committee and Chairman Mao [8, Oct. 18, 1966].

creasing popularity of the Kungnung hand tractor, a development which in turn has been hastened by the substitution (in accordance with the 1965 mechanization proposals mentioned above) of the commune for the agricultural machinery station, county, or province as the primary unit for the purchase and maintenance of motorized farm machinery. As is not uncommon in post-Liberation China, political developments have exercised an important influence in the decision to emphasize the development of the smaller, less expensive, and more adaptable kind of tractor; one of the many criticisms of previous agrarian policy that surfaced during the course of the Cultural Revolution disturbances was aimed at the more than two thousand agricultural machine stations that had come into existence by 1965 and which had been up till then intended not merely to service the mechanization needs of nearby communes but to act as centers for the ideological re-education of the rural populace [8, Aug. 31, 1965].[9] The anti-bureaucratic orientation of the Cultural Revolution made it perhaps inevitable that this policy of "mechanization from above" should come under fire. But the abandonment of machinery stations as the primary focal points for the advancement of mechanization and the assignment of highest priority to the meeting of the mechanical needs of the "lower and middle peasant" required that a larger proportion of agricultural machinery output would have to be occupied by smaller-scale tractors, etc., while the decentralization of manufacturing facilities for such machinery should have to be greatly accelerated. While such a revision of the overall planning of agricultural mechanization can be expected to have a damping effect on the production and distribution of heavy-duty farming machinery, it is hoped that this loss will be more than compensated by the added incentives offered the direct producer ("small and middle peasant") by immediate accessibility to the kind of modest and inexpensive machinery most compatible with the "careful plowing and painstaking cultivation" technology upon which he continues to be dependent.

IV. THE "NEW" OLD-FASHIONED HUSBANDRY: PROSPECTS FOR THE FUTURE

As the result of the many changes and innovations achieved since the Liberation, the lopsided predominance of "naturally provided instruments of production" (*naturwüchsigen Produktionsinstrumente*) over "artificial means of production" (*produzierten Produktionsmittel*) that Wittfogel saw as an ineradicable characteristic of China's agriculture has been altered to an impressive if perhaps not irreversible extent. Chinese husbandry has not been transformed at a stroke into a model of mechanized, or even semi-mechanized, farming—nor is there any prospect of such a transformation taking place within the foreseeable future. But an increasing arsenal of "artificial means of production"—even if limited, for the most part, to application in making the still crucial "naturally provided means

[9] There were in 1965 a total of 2,263 agricultural machine stations in China, scattered through over 1,300 district and urban centers.

of production" a more stable and fruitful basis for the rural economy—has already achieved a large enough impact to create a modest surplus labor force in the countryside and to gradually mitigate the hyper-intensivity with which human labor was tradition-exploited in the villages. The question with which we shall be preoccupied for the duration of this section concerns the prospects for the further paring of intensive production techniques from the rural economy as a whole.

To begin with, it is necessary to correct the impression probably given by the preceding remarks that labor utilization techniques have been growing steadily and uniformly less "intensive" and more "mechanical" in every subsection of the production process. Not only is there a pronounced unevenness in the degree to which the various "hyper-intensive" aspects of horticultural husbandry (irrigation, manuring, combined cropping, hoeing, etc.) have been rendered less labor expensive, but in certain sectors of the rural economy where mechanization or semi-mechanization have proved difficult to introduce or have not yet been carried out, we shall find not a few instances of a level of labor intensivity in excess of that required by traditional agriculture.

This latter development, puzzling as it might seem at first mention, nevertheless makes some sense when we consider the important changes that have been made since the Liberation in the organization of production in the countryside, and the specific ways in which this reorganization has facilitated technological improvements in the production process. On the most obvious level, the last two decades have seen the virtual disappearance of the dispersed and isolated small-scale paternalistically-controlled "family holding," and its replacement by larger, non-familial units of production (cooperatives, communes, production brigades, etc.). Rationalization of labor mobilization and application has been, of course, the key motivation for this transformation, but the character of the rationalization that has been achieved has been in many ways shaped by the pre-Liberation rural class structure the inequities and irrationalities of which collectivization has been designed to overcome. Unlike the social reforms that accompanied collectivization in the Soviet Union, the changes implemented by the Chinese leadership in the countryside have been aimed primarily at achieving a *downward* transfer of control over means of production; the dispossession of the Chinese *kulak* was seen as necessary, not to speed the flow of agrarian surplus into the cities, but to give the capital-starved lower and middle peasant as much access as possible to such crucial instruments of production as animal-drawn farming implements, draft animals, water-wheel pumps, and other capital goods the ownership of which had previously been monopolized by the landlord and rich peasant stratum in the villages. To the extent that the redistribution of existing capital resources has allowed these resources to be used more completely and productively, collectivization might well be said to have served an economically rational end: such phenomena as the rationalization of crop and income distribution among the producers and of crop rotation methods certainly merit such a description. But immediate economic gains have never been as important an aspect of collectivization in Chinese eyes as the increments in available human energy that have been made possible by the elevation of the overwhelming majority of poor and middle peasants to an economic and social status in every way equal to that of the humbled *kulak* and landlord classes.

It is for this reason that collectivization has so often been accompanied in China by the surprising phenomenon of labor resources being augmented even—indeed, especially—when the rationalization of labor organization has not been parallelled by any noticeable advances in labor-saving technology.[10] Insofar as collectivization has given the lower and lower-middle peasant a hitherto missing sense of his political and historical identity, and abated the demoralization that had haunted him in the intensely competitive and atomized society of the pre-Liberation countryside, reserves of highly-motivated *raw* labor have become available which were previously untapped, and it has been these *new* reserves which have supplied the vital increment in energy that, perhaps more than centrally deployed machinery of technology, have been instrumental in restoring and transforming China's agriculture in the post-Liberation years. As in other areas of the economy, a binary pattern of development of productive resources has come to characterize the various units of agrarian collectivization, the one emphasizing savings and re-investment in labor-saving capital goods, and the other—such as we have seen apotheosized in the nature-defying efforts of the farmers of the Tachai Commune in Shansi Province—featuring protracted outlays of ideologically-motivated labor in overcoming climatic and topographic obstances to production and in evolving, step by step, an improved folk technology for increasing yields and stabilizing output.

Hyper-intensive labor input, *après* the latter formula, will be immediately perceived to be of a distinctly different genre from that which had accompanied *Gartenbau* agriculture in its pre-Liberation visage. The latter, it should be stressed, was traditionally associated with rich- or middle-peasant households, which alone combined the access to capital and labor resources required for such hyper-intensive methods of labor application to be economically viable. The kind of heavy labor investment we observe in the Tachai model, however, is very much more akin to the model of labor mobilization that has come into existence in areas where semi-mechanized and mechanized hydraulic control and husbandry have been introduced, in that both feature a much enlarged scale of labor recruitment and deployment, and depend upon a successful diverting of the traditional peasant's family-centered concerns in favor of a larger collective interest.[11]

Another distinguishing feature of "hyper-intensive" labor input as it survives—or has been adapted—in the new China is that it has come in many cases to be associated with the organization of production in areas where hydraulic control

10 K. A. Wittfogel defines this order as "*general* (state) slavery" in his *Oriental Despotism* (1957), stating as follows:

> The rapid integration of the Chinese peasants into primitive collectives, called Producers' Cooperatives, indicates that Communist China is moving quickly from a semi-managerial to a total managerial order. [19, p. 443]

As stated above, however, this way of thinking has resulted from his unwillingness to understand the significance of land reform and collectivization revolution in China.

11 Regarding this, an editorial of *Jênmin jihpao* [8, July 12, 1964] reports in detail.

facilities have been most modernized. This apparently paradoxical situation will perhaps make more sense if we recall that in the two or three decades before the rise to power of the present Chinese government, "careful plowing and intensive cultivation" was drifting in many areas in the direction of "shallow plowing and sloppy cultivation" (*ch'ienkêng ts'utso*), and that the *Gartenbau* tradition of intensive agriculture was in a state of decline. Demoralization resulting from rising landlord absenteeism and political insecurity certainly contributed to this development, but an equally important reason for this stagnation was the decayed condition of water-control facilities, a condition which resulted in the diversion of much labor power from other key aspects of the *Gartenbau* production cycle. This being the case, it should not be surprising that the campaign to revive and improve the old-fashioned labor-intensive technology (announced in such slogans as "plow carefully and cultiviate painstakingly," "horticulturalize agriculture," and "plow deeply and cultivate painstakingly; conserve seed and increase harvests" [*shênkêng hsitso, shaochung toshou*]) did not get under way seriously until the movement for "stable-*and*-high-yield fields" (begun in 1964; vide supra, p. 461) had precipitated widespread mechanization and electrification of hydraulic control facilities, in turn creating a new source of raw labor, now freed from pumping work. As typified by the experience of the farmers of Hsinchou County in the Huangkang *chuanch'ü* (Hupeh Province), the portions of this new labor resource not re-directed into land reclamation and crop diversification projects were usually employed to re-introduce "careful plowing and painstaking cultivation" habits into the production process, achieving in the process significant increments in output. Even with large investments of labor poured into such capital-restorative or capital-creative activities as the repair and construction of mill-races, roads, and reservoirs and the development of forestry, stock-farming, and fishery resources, the modernization of irrigation and drainage facilities permitted the total number of work units (*kung*) of "careful plowing and painstaking cultivation" per *mu* of cultivated acreage to be upped as much as 400 per cent, from 20–30 to 70–80. The Hsinchou statistics probably are higher than those applicable to similar labor re-deployment programs elsewhere because, in addition to mechanized and electrified hydraulic control facilities, the availability of powered machinery for deep and time-flexible cultivation made possible significant economies in cultivating labor. But comparable transfers of labor resources from hydraulic maintenance and supply work have been achieved in many other areas, and the trend at the moment is toward more and more concentration on intensive or "horticultural" labor application techniques [6].[12]

[12] Other instances confirm a pattern of doubling or trebling the labor force available for extremely labor-intensive cultivating work as a result of implementing mechanization or semi-mechanization programs. The experience of the Tachai Labor Brigade in Shansi Province (vide supra), for example, showed that, as a result of collectivization and the expansion of productive resources (including large domestic animals, threshing machines, weeding machinery, chemical fertilizers, and crop sprays) which was thereby made possible, a 100 per cent increase in the size of the labor force employed in "careful and intensive cultivation" tasks was achieved, with the consequence that a several-fold increment in food-crop output was gained [12].

A final distinguishing characteristic of the "new" old husbandry is that it represents only a temporary stage in the long-term program for restoring and modernizing China's agriculture, and not merely a revival of or return to the fixed "habits" of the Chinese farmer. More than any other single factor, it is the over-supply of labor in the countryside (a phenomenon which has been problematic for the last century or so of China's history) that has forced the current Chinese government to retain so many aspects of the traditional labor-intensive agriculture. This labor surplus having come into existence chiefly as the result of the disruption and atrophy of the "horticultural husbandry" technology, with its impressive capacity for supporting large populations with scanty acreage, it was most likely unavoidable that the short-term agrarian policy of the post-Liberation government should place a great amount of emphasis on recovering the traditionally high levels of area productivity, and that the achievement of this goal should entail significant investments of "hyper-intensive" labor. But it is of the utmost significance that much of the labor reserve currently employed in "careful plowing and painstaking cultivation" tasks has been created by substituting machinery for men in hydraulic control and supply work, and that the ultimate aim of this revival of "intensive" labor techniques is to boost not only the gross production but also the area productivity of comestibles and other crops—an aim at least partially compatible with an expansion in the use of labor-conserving farm machinery. Furthermore, it seems likely that, as matters progress, more and more of the responsibility raising and maintaining stable and high yields will be borne by machines and not men, finally conferring upon the Chinese nation the key condition for her rapid industrialization: the ability to transfer the surplus rural population into commune industries without impairing the health or productivity of the agricultural sector. Only when that stage is reached, however, will the post-Liberation government's long-affirmed desire to close the gap between peasantry and proletariat be within sight of realization.

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