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SOME EFFECTS OF DEFORESTATION IN CHINA.

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At the present time there is probably no large country in the world that offers so many interesting sociological problems as the Chinese Empire. It is well known to students of this science that race development and characteristics are in the main influenced and moulded by the surrounding natural physical conditions. It is doubtful if these great fundamental problems can be better illustrated and studied than in contemporary China and Chinese. It is a curious and profoundly significant fact, that approximately one-third of the human race have gone on for many hundreds of years developing a civilization peculiar to themselves, and, if we except the introduction of Buddhism, very little if at all affected by outside influence. The great nations of antiquity have arisen, flourished and crumbled into dust, whilst the Chinese have gone on the even tenor of their way, that was much the same a thousand years ago as it is to-day.

Bounded on the east, southeast and south by the sea, on the west by the jungles of Burma, Siam and the tremendous mountains of Thibet, and on the north by the deserts of Mongolia, this great country is uniquely hedged in by natural barriers not to be overcome until steam navigation made the sea an easy and safe highway for mankind. Unlike Japan, China has resisted and shrunk from the touch of modern western civilization with its wheels, cranks and hissing steam. Culminating in the present crisis, the Chinese can resist no longer. The fiat has gone forth, take your place with the other nations of the earth, lest your national existence be extinguished forever!

We have now reached a time when it will be possible to study this interesting and peculiar people, to see in what manner they have used and abused their birthright. How have they lived in and cared for this beautiful and fruitful country; have they utilized its resources in a proper manner? As yet we possess relatively very little knowledge of the interior of this huge empire, but judging from the observations so far recorded, we would say the Chinese have abused their natural resources without check or stint. We need not, for our present purpose, inquire into causes of such effects, further than is absolutely necessary in order to determine how to avoid making similar mistakes in the care and preservation of our own great and splendid fatherland.

The protestations from well informed organizations and individuals against the destruction of our forests in the United States have been so persistent and well sustained that general public interest has been now aroused to some sense of responsibility.

While it is obvious to every one that our timber resources are rapidly melting away, very few realize the dangers of this deforestation, or its effects upon the productive capacity of the country as our population becomes rapidly denser.

Droughts we have had, but famines never. Will famine be the concomitant of drought when our population numbers 400,000,000? is the natural and irresistible reflection in this connection.

If any doubts that drought, flood and famine follow deforestation as surely as night succeeds day, let him visit China and carefully study the writings of the few competent observers who have lived in and travelled through that little known country.

It is safe to say that drought, flood and famine are of annual occurrence in one or another portion of the Middle Kingdom, and that the famines are apt to be severe owing to the lack of efficient transportation from more favored sections of the Empire. It must not be assumed, however, that even a thoroughly good system of railways throughout China

would prevent famine, though undoubtedly it would check absolute starvation.

Russia, which is well provided with railways, seldom has a year without famine. Grinding poverty, filth and superstition are the common lot of the Chinese peasant and the Russian muzhik, and if there is any choice the Chinaman is probably the better off of the two. Similar causes have produced similar effects in both countries, deforestation has already ruined much of China and is beginning to spoil some sections of European Russia. There is a general tradition amongst the natives throughout the whole of the Middle Kingdom that the mountains and hillsides were once covered with forests and that the rains have decreased in frequency and increased in violence from generation to generation. In China as in some other countries the floods were formerly regular during successive years, whereas at later periods they have grown more irregular and violent. In mountainous regions torrential rains do not soak into the bare uncovered earth, the rapid run-off tears up the soil, fills the water courses and lakes with gravel and sand. Standing on the mountain tops of Eastern Shantung last summer, it was not difficult for the writer to picture in his mind those bare brown hills covered with primeval forests, the dry rocky gulleys filled with babbling brooks, and the deep valleys studded with beautiful lakes and streams now filled and choked with sand and gravel. The once deep-bayed indentations of this fine sea-girt province are deep no longer, but are now so silted that a good anchorage for deep-draft ships can only be obtained even in the best of the harbors, like Wei-hai-wei and Kiaochau by constant dredging. The celebrated geographer and geologist Baron von Richthofen, in speaking of Shansi province, remarks "that the traveller at every step has occasion to contrast the present poverty and inertness of the inhabitants, with the signs of a previously better condition. The large cities, even villages, the temples, the remains of magnificent public structures, as well as the history of China, give evidence that the northern provinces have been in a more prosperous state." The cause, aside from politi-

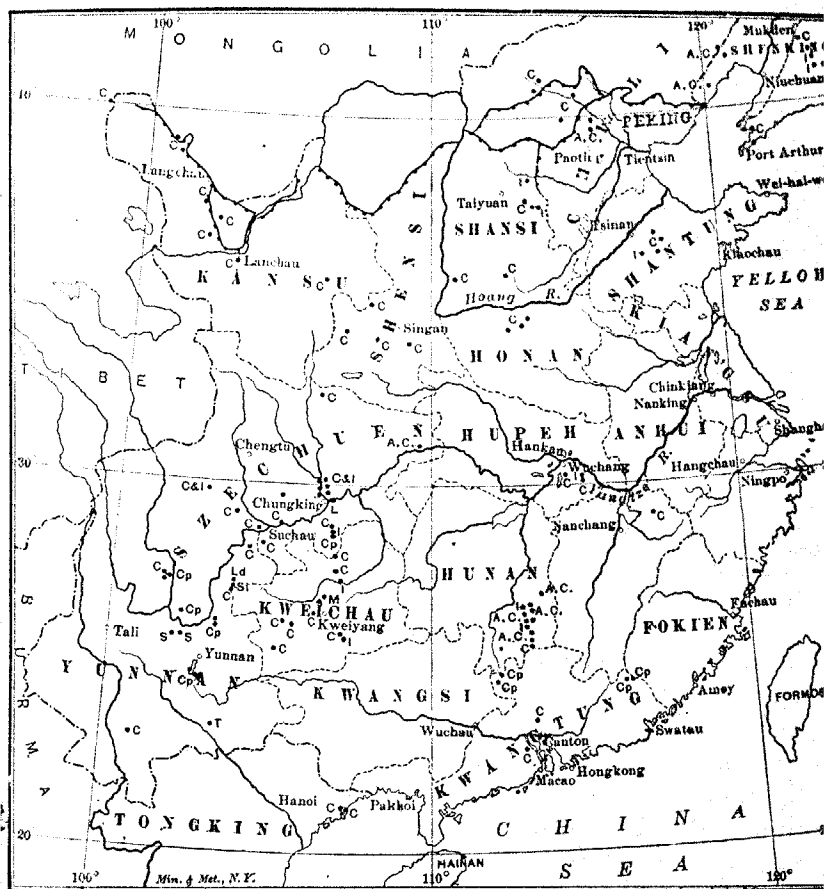
cal, that led to these conditions Richthofen believes is the deterioration of the climate, which is the probable consequence of the extermination of the forests. Throughout the whole country, from Hankow to Peking the mountain and hill sides are destitute of trees and shrubs and offer a most desolate aspect. The exceptions are the groves of trees at the villages and temples and parts of the Fu-niu-shan mountains where many hillsides are planted with oak trees for feeding wild silkworms. Richthofen thinks there are no positive proofs that these conditions had formerly been otherwise, but it is exceedingly probable and the people everywhere assert that their mountains were covered with trees in old times. He further states that besides this injurious effect of the destruction of the forests upon the climate in general, there is an immense amount of deterioration incessantly going on, which would not take place if the hills were wooded. The heavy rains wash off the soil from the rocks, and the water, instead of penetrating into the earth, and being stored up for feeding springs, runs off the hillsides and descends in torrents through gulches which were before perfectly dry. In the valleys, the rivers in overflowing their banks spread much fine sand or silt over the surface of the fertile alluvial soil, thus often rendering extensive regions unfit for agriculture. Instances of this kind are, according to Richthofen, numerous in Shansi, on the borders of the great plain. If it were not for the *löss* formation, he declares that northern China would already be a desert with some fertile valleys enclosed. Even this beneficial formation, which is the principal seat of agriculture and, more than other kinds of soil, capable of storing up moisture, is undergoing a rapid destruction.*

Archibald J. Little,† in writing of Szechuen province, remarks that at the present time in China wherever there is a stream that will float a log, there are no logs to float, and he might have added that in places where timber could not be in any way transported, it is converted into charcoal.

* "Richthofen Letters." Shanghai, 1870-1872, p. 37.

† "Mount Omi and Beyond." London, 1901, p. 257.

Little says the Chinese have a regular locust-like propensity to destroy every green thing wherever they penetrate; for when the trees are gone, comes the turn of the scrubs and bushes, then the grass and at last the roots, until finally the rain washes down the accumulated soil of ages and



C Coal A.C. Anthracite Cp Copper I Iron Ore L Lime M Mercury S Salt Si Silver T Tin Ld Lead
[By courtesy of "Mining and Metallurgy," New York.]

barren rocks remain. While this statement may be rather extreme, there is reason to believe the rainfall has considerably diminished in many portions, and is much more irregular and uncertain. All observers agree that the rivers have shrunk in volume and droughts occur where they

had been quite unknown. According to Little, in north-western Szechuen, in what is known as the "red basin" situated at the foot of the mountains, there have now been successive seasons of drought.*

On the Yellow River below Kai-fung-fu, after it has debouched into the "Great Plain," it is necessary to protect the surrounding flat country from inundations by the river with great embankments or dykes. These extensive and costly engineering works were formerly protected from the erosion of both water and wind, by a mantle of grass and bushes and at some points willows were carefully planted with excellent results. Neglected by the authorities, these embankments are now the prey of the peasants of that vicinity, who are so poor that they eagerly pull up every blade of grass and every root that can be found. The poverty-stricken condition of these poor people must be almost incredible; they are constantly subjected to inundations from the river by reason of the steady deterioration of the dykes; yet, it seems with a full knowledge of the consequences, they do nothing to preserve and much to accelerate the total destruction of these protective works. If something is not soon done by the authorities much of this country will become uninhabited and uninhabitable.

The Dutch hydraulic engineer Ryke, in his comments upon the improvement and defense of the Yellow River, remarks: "Stopping the abuse of nature committed by the people would be in the interest of everyone in the whole region, in the interest of every plain, valley and dale in the mountains, as well as the plains in Honan and Shantung now liable to dreadful inundations during every rainy season. By deforestation (deboisement) and all it entails, almost every mountain and hill stream has become torrential, and this means that the rainwater leaps downward in waves as soon as it falls; it means further, as a matter of course, the misery of a water famine in dry seasons." Ryke affirms that upon several occasions when it was neces-

* *Ibid.*, p. 257.

sary to examine a mountainous section of country for the sake of a stream, or for plains liable to inundation, he had only to look on the map of the district to know beforehand where to find the worst cases and they were invariably where the greatest number of villages and hamlets were indicated. He means of course by this that the evil results of deforestation are in a direct ratio with the number of habitations and density of population. Williamson, in his remarks on his journey through Shansi, states that on the roads leading through defiles stones are erected with inscriptions warning passengers against the sudden rush of waters in case of a rain storm. "*At this place beware of the mountain water,*" and "*travellers should not take shelter from the rain here,*" are the notices posted in many places.*

Some idea of the rapidity of the run-off in the mountainous sections of China can be obtained by gaugings at Chungking in Szechuen. According to Little, on July 6th, of one year, the Yangtse River stood 38 feet 6 inches above the mean winter level; in consequence of heavy rains in Yunnan it rose by the 13th of this month to 96 feet 8 inches, and fell again by August 3d to 28 feet above the winter level. It rose again on August 16th to 57 feet, this rise being due to the rains in the basins of the Ta and Tung Rivers in western Szechuen. After this date the river suffered comparatively slight fluctuations, steadily subsiding towards the lowest February level†.

If additional evidence is needed of the effects of deforestation in China, the indisputable fact of a steadily creeping southward of the Mongolian deserts might be cited. The once rich provinces of Shensi and Shansi appear to suffer most from this inroad of chronic desiccation with its resulting famines. Since about 1845 there has been a steady decrease in the population of the provinces bordering on the deserts, namely Shansi, Shensi, Kan-su and Chili. No doubt this has been due in some measure to other causes,

* Rev. A. Williamson, Journal North China Branch, Royal Asiatic Society. New Series.

† "Mount Omi and Beyond." A. J. Little. London, 1901. Pp. 119.

such as the Taiping rebellion and other political disorders. But the probabilities are that cultivatable area in these provinces is steadily shrinking, and has in a great degree been caused by the destruction of the protecting forests. In this connection we have some grounds for an interesting speculation as to whether or not certain well developed facts warrant the belief that much of the territory now desert was a habitable and fertile country in historic times. It is not possible to discuss the subject in this paper, save to say that unmistakable evidences of a comparatively high civilization have recently been discovered in the midst of what are now and apparently have long been hopelessly desert areas. It may, perhaps, be going too far to assume that the climatic changes which have brought about such results have been entirely due to deforestation. The probabilities are that other forces have been at work, but until the problem has been intelligently studied, it is hopeless to attempt its solution. Careful and scientific observations of rainfall, flow of streams, etc., have yet to be made in China. It is only at Shanghai and Hong-Kong that meteorological data covering any considerable period of years have been accumulated.

Marco Polo speaks of the Yangtse River as being thickly wooded in places where a tree is not now to be seen for miles. According to the naturalist Pratt, there are now no trees worth felling in the Yangtse valley within any distance of a stream that might be used for logging.*

Another naturalist, Père Amand David, cannot believe this reckless destruction of the forests which characterizes the march of Chinese civilization to be altogether due to the need of firewood. He attributes it rather to the fear of wild beasts and a desire to destroy any cover for them. In Szechuen and in a number of other provinces of the Yangtse drainage area, the natives mine and use considerable quantities of coal. Where this is abundant and cheap, it is not likely they are under much stress for fuel, as is the case in the "Great Plain," and along the banks of the Yellow River

* "The Snows of Thibet and through China." A. E. Pratt.

below Kai fung-fu. The theory of Père David's may, therefore, be correct, for the Chinese, as a rule, certainly have great fear of the tigers that are usually found in the wilder parts of China.

It is rather remarkable that so practical a people as the Chinese should not have long ago recognized the many advantages of forest culture, that is, in the sense of raising trees as an agricultural product. It seems, however, in some localities, notably in Hunan province, attempts have been made at replanting the hillsides with ordinary timber trees. But this is quite exceptional, for, as a rule, only those trees are considered worth growing that yield a comparatively quick return or harvest. The yield of the varnish tree (*Rus vernicifera*) the camphor (*Cinnamomum camphora*), mulberry (*Morus alba*), mountain oak (*Quercus esculus*), and the bamboo (*Bambusa*) form a large portion of the natural products of China, the mulberry being, of course, used in silk culture as is likewise the mountain oak.

The usual Chinese system of cultivation by means of terraced fields rising one above the other up the side of a hill or even mountain, does certainly tend to check erosion. These systems of terraced paddy fields are generally placed where possible athwart the course of small streams.

The French use barriers of a similar kind especially constructed to check erosion, and enable the soil to accumulate on steep hillsides in sufficient quantity to give foothold and sustenance to trees. In China one often sees, especially in those provinces ravished by the Taiping rebellion, abandoned fields of this kind covered with small trees or bushes, showing thus that the hillsides could be easily planted with trees were it possible to give up their use for agriculture.

It has been estimated under normal conditions in well forested areas, that about one-sixth to one-third of the whole rainfall flows off into the sea, the five-sixths or two-thirds sinking into the earth, where it is conserved to supply springs and wells. It follows, therefore, when the protecting cover is removed, there is little less to hold the water from immediately running off, consequently less and less soaks into the earth and the level of the ground water

steadily decreases, drying up the springs, wells and ooze that is very beneficial to vegetation. This statement has been so well substantiated by careful observations in Europe and America it scarcely needs reiteration. The existence of forests probably increases the amount of rainfall, because fogs and clouds, saturated with aqueous vapor, which sweep over it, are condensed by contact with the leaves and branches. Furthermore, the temperature of the air in forests is considerably lower in daytime and higher at night than that over cleared areas; this condition presumes a local circulation of the air, which has the effect of driving fogs or clouds into its bosom and a consequent deposition of the contained moisture. But probably the most potent effect of trees in conserving rainfall is from the fact that much of the rain is temporarily held by the leaves and falls to the ground slowly, giving it a longer time to soak into the ground. Forests also render this process more easy by the roots, which spread out over a large area, forming channels through which the rainfall filters and sinks deeper and deeper into the earth. It has been estimated by experiment that the aqueous vapor which forms over cleared fields is at least four or five times as great as that over a wooded tract, and consequently that the water which has oozed into the soil of the latter does not vaporize so easily, but is retained and serves to feed the surface springs and rivers.

It seems most extraordinary that a practical, intelligent and observing people like the Chinese should have failed to recognize some of these facts, and that seeing their country becoming steadily more and more arid and difficult to cultivate, some effort should not be made to mitigate or check the evil.

At the present time the normal annual rainfall at Peking is 16 inches and as the coast is approached it increases steadily. As far as I know no records have been kept in eastern Shantung; hence any estimate of the annual precipitation at say Chee-fu and Wei-hai-wei is a mere conjecture. Starting with 16 inches at Peking as a basis and studying carefully the conditions of the country between there and Chee-fu we may assume the rainfall in eastern Shantung

at 40 inches. According to Chinese historical records the climate of northern China has undoubtedly moderated considerably from what it was some centuries ago. This has been correctly attributed to the effects of deforestation. While the total annual precipitation has probably not greatly decreased, it is unevenly distributed, drought follows flood, and there are distinctive wet and dry seasons that are unusual in a temperate climate in much the same latitude as Philadelphia and surrounded on three sides by the sea.

At Hong-kong, Macao and Canton the annual rainfall is great, averaging 86 inches, and in 1891 was exceptionally high at 117 inches. In northern China the rainy season lasts about two months, July and August approximately. While the ill effects of deforestation in many portions of China are sufficiently obvious, it is not so easy to draw conclusions as to resulting influences upon the character of the people. Poor and unhappy they certainly are, overpopulation has stretched the food-supply about to its elastic limit. A failure of crops in any section entails starvation on the part of most of the inhabitants in that district, for transportation is usually so crude and costly, that supplies from other parts of the Empire cannot be delivered at a cost that will be within the ability of nine-tenths of the people to pay. Some sections are of course more fertile and favored than others, but it is evident in the best of them such dense populations cannot long continue to live by the soil alone. Unless therefore the Chinese encourage and extend their manufacturing industries and particularly develop their marvelous mineral resources, they cannot prosper, but will revert to savagery. The whole Chinese question, both political and religious, therefore, resolves itself into a purely industrial one. At the present time the Chinese nation is undoubtedly decadent, but the people as a whole certainly cannot be so considered. Political corruption, an absurd conservatism and self-conceit are the bane of the country. Yet political corruption is not unknown in other countries, and we regret to think even in those that supply the Chinese with most of their foreign moral and religious instructors. In a word, the Chinese house is worn out, it is filthy and rotten; place

its inhabitants in a clean new one and they will astonish the world with their prosperity and progress, moral, religious and industrial.

METALLURGY OF ALUMINUM.

The following item, gleaned from the "Digest" department of the *Electrical World*, may be classed as "highly important, if true," viz. :

Metallurgical processes which involve the use of calcium carbide as the reducing agent, possess an especial interest due to the fact that they are, in an indirect manner, electro-chemical, for the energy used for the reduction is as truly electrical as though the effect was produced directly by electrolysis instead of indirectly through the medium of the carbide furnace. Hence a discussion of such processes always involves the question of relative efficiencies as between fused bath electrolysis and electric furnace reduction—a question which generally solves in favor of the furnace. This question is raised but not answered by a patent recently issued (May 28) to Mr. Henry Spencer Blackmore, of Mount Vernon, N. Y., for the reduction of aluminum compounds by the reaction therewith of a carbide. Mr. Blackmore finds that aluminum oxide is reducible by aluminum carbide with liberation of the metal of both reacting bodies and in accordance with the equation $Al_2O_3 + Al_4C_3 = 6Al + 3CO$, the reaction being strictly analogous to that employed by M. Moissan some years ago for the preparation of metallic chromium. If, however, the oxide and carbide of aluminum be employed in the solid state it is found that the aluminum is either volatilized or so distributed through the residual charge as to render its collection impracticable, and accordingly it is proposed to suspend or dissolve the oxide and carbide in a molten bath, which remains inert with respect thereto, and which so reduces the temperature of the reaction and so alters the character of the medium as to permit the liquid metal to be tapped off. Two procedures are described : In the first, a mixture of cryolite and lithium fluoride is fused, and the oxide and carbide of aluminum are alternately added, the reaction occurring readily, it is said, and the aluminum separating freely. In the second, oxide of aluminum is added to the bath and calcium carbide then introduced, the effect being to produce aluminum carbide within the bath by reaction between the cryolite and the carbide of calcium, this aluminum carbide then reacting with the oxide present to yield the metal. The calcium fluoride formed interferes to no marked degree with the operation, and in the early stages serves to promote the fluidity of the metal. Eventually, however, the bath must be regenerated or renewed. Mr. Blackmore is authority for the statement that he has succeeded in producing aluminum by reduction by calcium carbide, on an experimental scale, at an expense not exceeding 7 cents per pound.

W.