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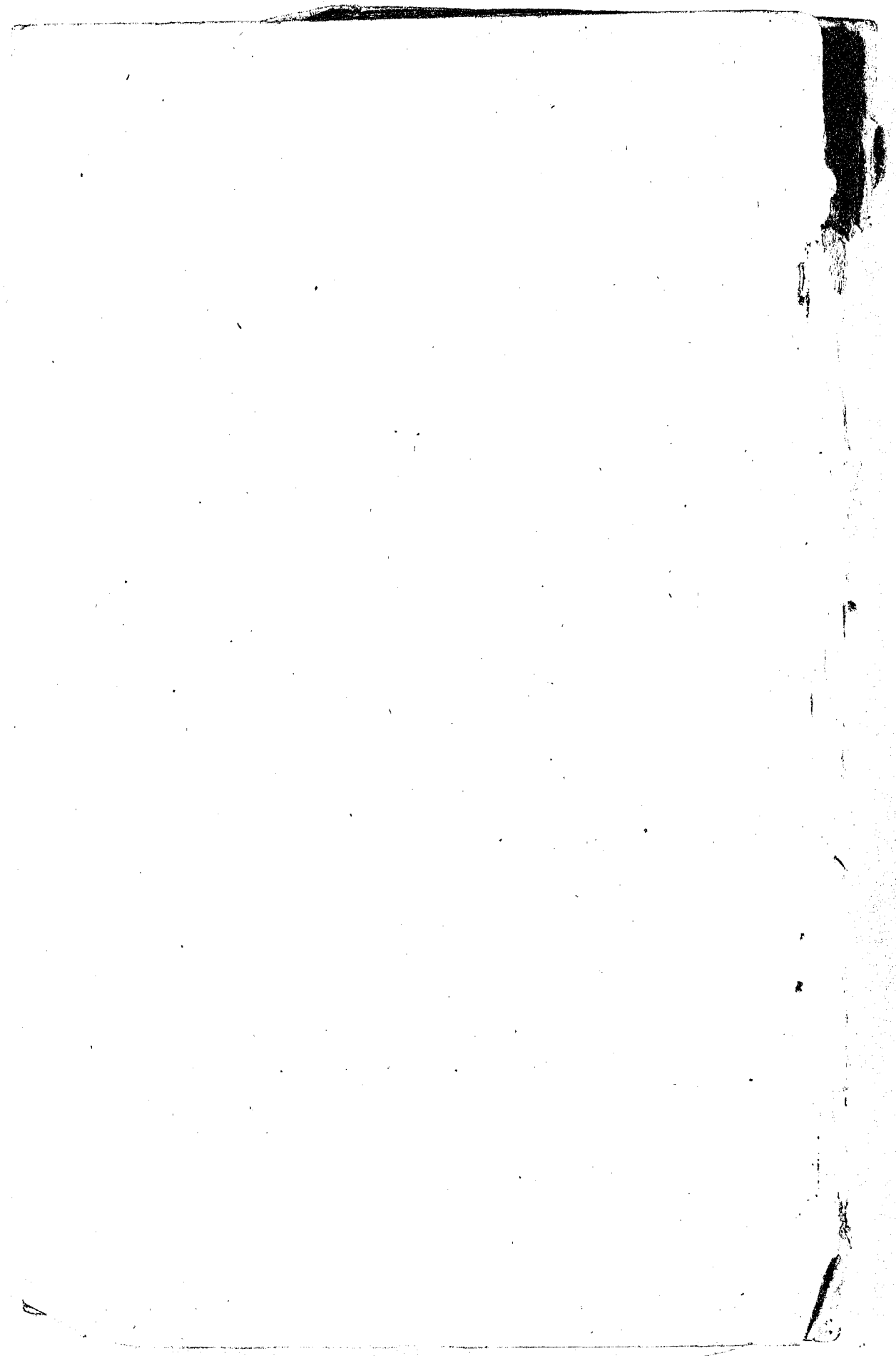
WEST CHINA BORDER

RESEARCH SOCIETY



1922-1923

WEST CHINA - Journal of West China Border - 1922-23
Research Society



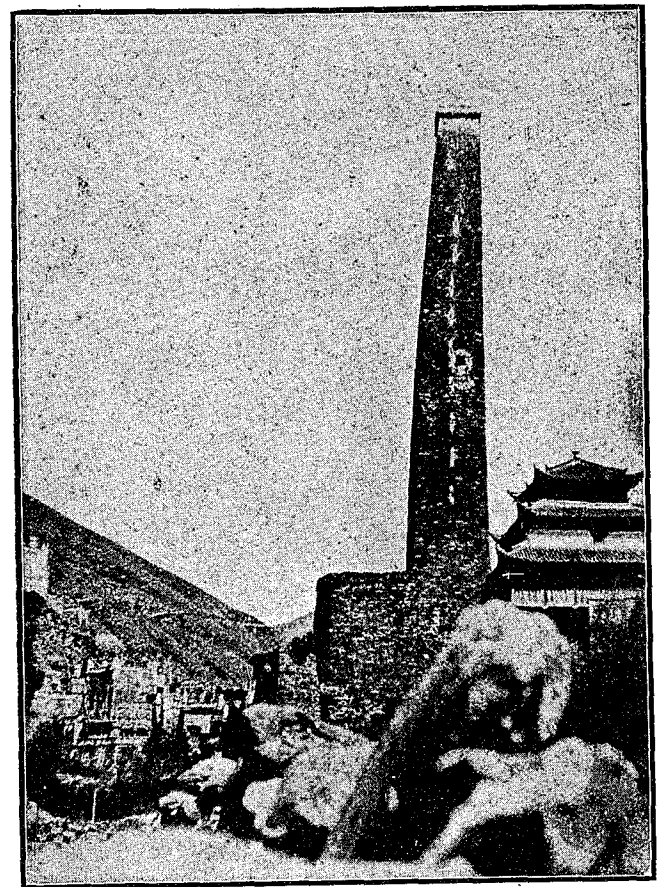
JOURNAL
of the
WEST CHINA BORDER
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TOWER AT TAWEI
ABOUT 20 MILES EAST OF MONGKONG

Organization and First Year's Program.

Looking toward the organization of a research society for work in the hill country and among the tribes of West China, a meeting of men interested was called at the home of Dr. W. R. Morse, Union University, Chengtu, March 24, 1922, at 3 p.m. The following were present:—Dr. W. R. Morse, D. S. Dye, A. E. Johns, C. W. Foster, E. Dome, H. N. Steptoe, A. J. Brace, J. R. Muir, G. B. Neumann, Dr. E. C. Wilford, Dr. S. H. Liljestrand, and T. E. Plewman.

At this meeting, as acting Chairman, Dr. Morse explained the object of the meeting and the wide field open for investigation. It was then resolved that an organization be effected, and that the name be, the "West China Border Research Society". A committee was appointed to draft Constitution and By-laws.

At the next meeting, April 21st, the Constitution was adopted, and the following elected officers: *President*, Dr. W. R. Morse; *Vice-President*, G. G. Helde; *Secretary*, E. Dome; *Treasurer*, D. L. Phelps; *Member Executive*, J. Hutson.

Mr. J. H. Edgar, F.R.G.S., was elected the first honorary member.

The first meeting of members took place Oct. 28th, 3 p.m., at the home of A. J. Brace. E. Dome read a paper on "The Black Lamasery at Badi", and T. E. Plewman read a paper, "A Journey into the Heofan Valley."

At the Executive meeting held Dec. 8, A. J. Brace was elected Secretary in place of E. Dome, returned home on furlough.

On Dec. 12th, a special meeting of members and friends was called to meet Dr. Smith of Upsala University, in the Biological Department, Hart College. Dr. Smith spoke informally on the "Flora of the Tribes Country" and exhibited his excellent photographs.

Jan. 27th, 1923, an open meeting of the Society was held in Hart College when the President, Dr. W. R. Morse, delivered his address on "Research", and by request, Mr. Plewman was asked to repeat his lecture on the "Heofan".

March 3rd, 1923, at the second regular meeting of the Society, Mr. G. G. Helde read his paper on "Four Passes over Fourteen Thousand feet", and Dr. S. H. Liljestrand on "Botanical Notes from Tatsienlu to Badi Bawang, with special reference to Medical Plants".

At Executive meeting, March 19, Dr. J. Beech was elected to serve on Executive in place of Mr. Hutson, resigned. Dr. Beech was also appointed to serve on the committee for editing and publishing the first Journal of the Society's proceedings.

The last meeting of the season was held April 7th, 1923. Mr. J. R. Muir read a paper on "Snow Mountains", and Mr. C. L. Foster delivered his lecture on "Geology of Szechwan".

The members of the Society are:—Dr. W. R. Morse, G. G. Helde, E. Dome, D. S. Dye, D. L. Phelps, C. L. Foster, H. N. Steptoe, A. J. Brace, J. R. Muir, J. H. Edgar, Dr. E. C. Wilford, T. E. Plewman, Dr. J. Beech, Dr. J. L. Stewart, D. C. Graham and G. B. Neumann.

Publishing Committee:—Dr. W. R. Morse, President; G. G. Helde, Dr. J. Beech, A. J. Brace, Secretary.

PRESIDENT'S ADDRESS

*Delivered at the first public meeting of The West China Border Research Society, at the Union University, Chengtu, Szechwan, West China, January 27, 1923.**

BY WILLIAM REGINALD MORSE, M.D., Dean of Faculty of Medicine, West China Union University.

The quality of this audience is proof that the Society under whose auspices you are invited here today did not gauge public opinion wrongly. No matter how necessary an association may be, there are times and occasions when an apologetic is necessary; so on this first public meeting of our West China Border Research Society I wish to explain to you our aims, and at the same time to make a plea for research. The chief obstacle in the way of progress in the direction of a very necessary and important matter in this university centre of Chengtu seems to lie in the fact that it is nobody's business to attend to it, and one object of this appeal, frankly, is to raise popular feeling in the matter to a sufficient extent that influential men and women will make it their business to investigate the matter, and devise ways and means of providing a plan to carry out in a scholarly way some scheme that will meet the emergency. Hence we do not feel any apology is needed for our existence; we feel we have attempted to fill a very real need; we ask your kindly consideration, and for a sympathetic hearing.

Our Constitution says: "I. The name of this society shall be the West China Border Research Society. II. The purpose of this society shall be the study of the country, peoples, customs and environment of West China, especially as they affect the non-Chinese. To this end, the Society shall promote study by the encouragement of investigation, loans of equipment, meetings, lectures, papers, the publication of a journal, and by any other means decided upon by members." The aims and purposes of this Society, then, are to encourage and promote and carry out exploration among the peoples of the Chino-Tibetan Border, especially that section which borders on Western and Southern Szechwan. The term research, as far as this talk is concerned, means investigation by exploring.

An academic statement is formal and cold and often a bit discouraging to folk of great modesty. The very words "research", "exploration", "investigation", to many educated people are inhibitory, due to the fact that so many belittle their worth and ability. The

*In the summer of 1922 six members of the Society took an eight weeks' expedition into the Tribes' Country of the Chino-Tibetan Border. The party consisted of Morse, Edgar, Helde, Liljestrand, Dome and Phelps.

promoters and members of this Society have no pretense to any other frame of mind other than an intense desire to promote as far as possible careful, truthful, accurate observation along any line which our natural abilities lead us; no other mental requisite is necessary for carrying on our research on this almost unknown border. Thus in a humble way we expect to succeed in adding something worth while to the storehouse of common knowledge.

The idea of forming this Society was born under the stress and excitement of the knowledge of the profound neglect of unknown peoples right at our doors; it was born under the strain of the prolonged exertion which one has to endure to investigate conditions under which these people live; it was born under the stimulation of the most wonderful scenery; it was born in the clean, pure air of the mountain passes of this strange and uninvestigated region; it was born in the brain of men who are yourselves, whilst their eyes were seeing some of the wonderful things the geography tells about. I hope you will feed this idea with the milk of human kindness; mother it; nurse it; train it; for if rightly nourished, we should develop knowledge of value to all mankind.

All science is advanced by observation, but we must remember Pasteur's remark, "In the field of observation chance favors only those who are prepared." Preparation always means continued hard work. Our whole life here in China is one of preparation; we have only to make the application. Huxley said, "Science is trained and organized common sense," so research might be defined as trained and organized observation through the exercise of common sense. Our principal armamenture, then, is *common sense*—is there one here lacking in the chief prerequisite for research? Common sense expressed in words written on paper. No matter how much we wander about, how much we see and experience, the final result will be local or lost altogether unless we make our contribution in a form which will be permanent to others.

Ideas always leak through from one people to another; will pass from one language to another. "Print and pictures will penetrate everywhere." Hence we intend to print and publish and circulate our own results; invariably careful to give accurate and true data and full credit to whom credit is due. "Let *not* him who seeketh cease from seeking until he hath found, and when he hath found he shall wonder."

Our aim is high, but unquestionably not so high that we cannot attain it by concentrated physical and mental effort. We must not only work physically, but we must conserve all the knowledge that is worthy of preservation and publication.

We need the chemist's laboratory, the astronomer's telescope, the mathematician's observations, the geologist's crowbar, the mineralogist's hammer, the anthropologist's measurements, the ornithologist's gun, the sinologue's translations, the traveler's explorations, the philosopher's deductions, the sociologist's and economist's researches, and all tinged by the truths of God's word; for the facilitation of the Brotherhood of Man is the groundwork of our labors. We need earnest men who are impressed by the importance of the matter and who will forego some comfort and ease, and undergo some hardship and exposure and much labor. As members of this Society there is no compulsion; we are joined by no

link that forces us through the will of any other member to continue in it or to do work. We are bound by the subtle and strong chain of honor. We are binding ourselves freely and voluntarily to study and work and sacrifice for the great cause of science, impelled to do so, it may be, by religious convictions. Behind the study and research we are impelled by a force demanding us to do our best for the brotherhood of man by as intensive study as is possible of the man himself and of the country in which he lives.

"China's wall of masonry was never a very efficient barrier." A wall of misinformation, or of no information, about our nearest neighbors is most difficult to tear down; for always life is desirable and human, a thing of intrinsic worth. It is our duty to know them and their country. It is a sacred trust. What we discover and perpetuate will influence the men of tomorrow, so we must have a clear-eyed vision of our responsibility.

Have we the "divine spark of creative ability which means new discovery and new understanding and new accomplishment" in the realm of peoples and nature? We must feel the compelling urge to know the why and the how of things; to discover truth and turn it to the betterment of our fellow men, "for none of us liveth to himself and no man dieth to himself." It is our duty to find out things; to utilize our tremendous opportunities here and keep the public posted with accurate information. Not only do we plead for science for its own sake, but for the practical use of our work, the economic and spiritual values of our task. To quote an author: "We come back to the cultivation of the emotions and perceptions: the interpretation of the soul of man; the interpretation of past experience, emotional, rational, etc.; elevation and refinement of taste; knowledge of human nature as revealed in literature and history; development of ideals; interpreting ideals of beauty, culture, etc." (Guger: *Scientific Monthly*, Dec., 1921, p. 541.) The same author says, "Learn to extract knowledge not only from the past, but also from things around us, and how to use such knowledge; to learn to weigh evidence, to deal with facts and evaluate the conclusions of others; to gain knowledge of the fundamental laws of nature and not fall a prey to them, to learn to express our thoughts clearly, forcibly and with a reasonable degree of grace; to form character and develop an intelligent appreciation of the things which enrich and refine life." We must not be bigoted or egotistical. The Israelite said to Moses, "Who made thee a prince and judge over us?" We must always in our work, whatever it may be, with stones, birds, animals, fossils, implements, paintings, mountains, climate, man, see "the struggle of the human mind towards new concepts of nature and to realize the place of such concepts in the fabric of civilization." We must not be solely collectors of facts. Someone said, "fact knowledge is the fool's paradise," and "an ounce of ability to turn facts into general ideas is worth tons of information." We must know each other's point of view, his facts and point of view and we must not misunderstand his motives and his accomplishments.

We want truth: it is a craving of the human mind. Buddha comes from a word which means "he to whom truth is known." More familiar to us is "Ye shall know the truth, and the truth shall make you free." All of us recognize that there is a God of an orderly universe.

Perhaps too many of us take too languid an interest in the golden age of antiquity; perhaps too many of us thoughtlessly do not realize the importance of our own and other's origins; perhaps we are too fixed in our racial prejudices to realize our debt to all races; perhaps we are too self-centred and self-complacent. We believe that life today is fuller, more interesting and more agreeable than at any previous time in the history of man. But is it?

It has been said that it is better not to know so much than to know so much that is not true. Should we praise our forebears less or praise them more? Should we emphasize our origins more, or more correctly evaluate them if we seek the actual truth?

Mr. Justice Holmes, of the United States Supreme Court, years ago in a Memorial Day address, said, "The joy of life is to put one's powers as far as they will go, and the measure of power is obstacles overcome, to ride boldly at what is in front of you, be it fence or enemy; to pray, not for comfort, but for combat; to keep the soldier's faith against the doubts of civil life, more besetting and harder to overcome than all the misgivings of the battlefield." "There are other sorts of combat more decent, more honorable, and more productive of better and more permanent results than physical combat." Why climb Mt. Everest? Why expedition after expedition to the North and South Poles? Why explorers, football players? Why fly over the Atlantic in an aeroplane? Why missionaries? Why this university?

Discovery, exploring the unknown, is the same spirit that brought us to China to pioneer amongst a strange people. There is a tremendous satisfaction in personally physically and successfully tackling a man's job that requires every effort of will, strength and spirit to accomplish; the influence of such experiences on character is tremendous. Exploration is "a superior kind of sport", for those weary of the cares and burdens of fixed customs—to triumph over obstacles reported as insurmountable. Experiments must be made, even though pioneers be killed, from airships to the inoculation of germs into one's self: some one must risk and possibly life be lost, so that in the long run civilization will gain.

"Intelligence, initiative, character, courage and the divine spark of the human soul" constitute practically the stock in trade of the explorer missionary. The end results of our stock in trade are colored and governed by impulse; these are varied in each individual and come from original instincts and acquired desires: Some of these are selfish, others are altruistic and are evoked by things of the spirit.

There is in us all a yearning for originality: to do something no one else has done, or find or see or make something new and different. Such a spirit coupled with altruism is behind investigation and research in the obscurer places of this old earth. A service for ourselves, for the Chinese, for the world.

It is silly and unnecessary to take chances. Surely; "but people who did that won the war. Who sailed over to America in a 2 by 4 fishing boat betting the world was round; not knowing they might drop off the edge?" Who risked life and died to test the theory about insect propagation of disease? Who died, and who won in attempting the North Pole? Who do impossible things? It is risky, but it is worthwhile to take a chance. It is not going through life building a little card house of useless, silly adventure. It is matching one's

physical, mental and spiritual self against which a man might momentarily flinch but never quail. It is worth while. There is risk, danger, work, fatigue; but there is peace, finality, and satisfaction in doing a man's job against real odds. It is not a romantic fantasy. It is not cutting capers, and playing to the gallery.

The utilitarian asks what things are to be accomplished by the conquest of Mt. Everest and these other adventures. The answer is that "there is something in the spirit of man that urges him to attain the all but unattainable, and that it is that more than gain, personal ambition and specific immediate results that animates discoverers", pioneers, inventors and missionaries.

Why explore? Don't you ever want to "live history"; experience the joy and benefit of realizing Robinson Crusoe? If you stand the test of the mountains you will stand any test. It shows the yellow streak. Don't you crave for something different? Don't you ever want to be a Sherlock Holmes? Don't you feel the fascination of the unknown? Don't you crave clean, pure adventure? Don't you want to combine all of these and at the same time do something of real use? Why explore? Is it a disease? I cannot answer the question fully, but there occurs to me: (1) People are interested in people. "The proper study of mankind is man" is trite and true and important. My reading and study has suggested to me the question as to whether or not the interest felt in Tibetans and the Tribes folk is due to the fact that they may well constitute as it were a root nationality: are they, or are they not, a parent stock? If the answer is affirmative it is one of the factors in the interpretation of their psychology. Thus the purely scientific desire to study the customs and country of these mysterious and unknown but fascinating people is a laudable reason: "The enjoyment of life just the sheer love of the thing". Most of us are young, and all should feel that way. We all should love to play and test our capacities. It is time to think of retiring when we have lost the thrill of adventure. It is not unworthy to pit oneself against real physical obstacles and overcome them. An element of danger, too, does not detract from the enjoyment. Perhaps the first appeal to us is that of a knowledge of the people and country which must be occupied by missionaries in the not distant future. (2) Another reason for our trips is study of these people anthropologically, and a study of the country from a scientific point of view. An addition to the world's knowledge of peoples and countries is no small aim. (3) Men enjoy seeing the best, and being at their best physically. One must be in the best physical condition, and possess some grit and determination. Moreover it is a test of nerves at higher altitudes and with prolonged physical exertion one tends to become nervous and irritable, but one must keep smiling and keep going,—a decided gain subconsciously. (4) The achievements of man like Edgar, who has surmounted well-nigh unsurmountable obstacles; borne up amidst every physical hardship from frozen feet to pangs of hunger, should hearten men in every occupation and stir them to rise over impediments which confront them. (5) "As men test and exercise and develop their capacities and raise the standards of achievement they will be more at home in the mountains, and enter more freely into their spirit." It is a privilege to enjoy the majesty of real mountain scenery. In this way is cultivated and developed a spiritual outlook and uplift that must benefit the traveler, and by his

added zeal benefit his coworkers, for on him lingers "the mysterious impressions of meetings with the gods face to face in solitary places."

The rewards are then, spiritual uplift, physical betterment, intellectual satisfaction, advancement of knowledge—and to some of us propagation of religion. Such a task well done is an inspiration. It is essentially God-given.

This institution, imbued with a spirit of scientific research, situated so uniquely with opportunities of tremendous significance and importance, will, if only we use our eyes, move our hands and feet and cultivate an open mind, not only impart knowledge but render a service to China and contribute not a little to the solution of problems of future missionaries. We will thus attain to the "consciousness that we have fulfilled our real functions of discovering truth, diffusing knowledge and developing ideals." The real spirit of the researcher is, to quote Kipling's "Explorer":

"Till a voice as bad as Conscience rang interminable changes—
On one everlasting whisper day and night repeated—so:
'Something hidden. Go and find it. Go and look behind the
Ranges—
Something lost behind the Ranges. Lost and waiting for you.
Go!'"

Four Passes Over Fourteen Thousand Feet

G. G. HELDE

One cannot travel far into the country to the north and west of Chengtu without being impressed by the steepness of the mountain sides, the torrential rivers, the narrow valleys, and the general instability of the surface. This is characteristic of a country which is geologically new, the forces of nature not having had time to soften the outlines of the landscape. By consulting any map of West China, one of the most noticeable features is that there is a series of rivers running from north to south, but separated from each other by high mountain ridges; and again, the branches of these main rivers are separated from each other by other ranges so that one cannot make many extensive trips into the country which we have set before ourselves to study without encountering high passes. True, one may follow up the Min River to Sungpan or leave the Min at Weichow and turn west to Lifan and Tsakulao and several days beyond without encountering these ranges, for the road is in the valley; or one may go to Tatsienlu, without encountering passes much over 9,000 feet high. But beyond any of these points, if one wishes to continue his investigations, he is very soon faced with the problem of getting himself, his party, and his equipment over mountain passes which may be from 14,000 to 16,000 feet high. In this paper, four of these passes are to be discussed. The first two are the better known, as they have been crossed by a number of travelers, but the latter two have been crossed but rarely.

The Ta Pao Pass lies north of Tatsienlu, and must be crossed when one wishes to reach Mongkong and the Ta Chin Valley from that side. Leaving Tatsienlu, the road follows up the river through three ten *li* stages, known as the Yi, Erh, and San Tao Ch'iao. Immediately upon leaving Tatsienlu, the altitude of which is 8350 feet, the ascent becomes noticeable, and in this thirty *li* stretch which is about six miles, an altitude of 9050 is reached. The direction from Tatsienlu is ten degrees west of north. There are only two or three houses along this stretch until Jui Shui T'ang is reached, a distance of 14 $\frac{1}{4}$ miles from San Tao Ch'iao. In this distance, a gain of altitude of 1500 feet is made, giving Jui Shui T'ang a height of 10,550 feet. As the name indicates, there is a hot spring here, with a water temperature of 134 degrees. A back bearing 20 degrees to the southwest from Jui Shui T'ang points to what is probably the highest peak this side of the great giants of the Everest group. Judgments of heights are notoriously incorrect, but bearing in mind the distance, and the height of the summit above the snow line, 26,000 feet ought to be a conservative estimate. After leaving Jui Shui T'ang, the road winds along through quite dense underbrush, largely prickly oak and dwarf juniper; the yaks are continually bumping into the brush

trying to get rid of their loads, and if one is riding, constant vigilance is necessary to keep from being pulled off by the low branches. The yak, or what is worse, the *zo*, a cross between the yak and the cow, is worthy of a special study, and if any member of the society is looking for a subject which will take all his patience, ingenuity, previous experience, and deep psychological insight to investigate, I commend this one to you.

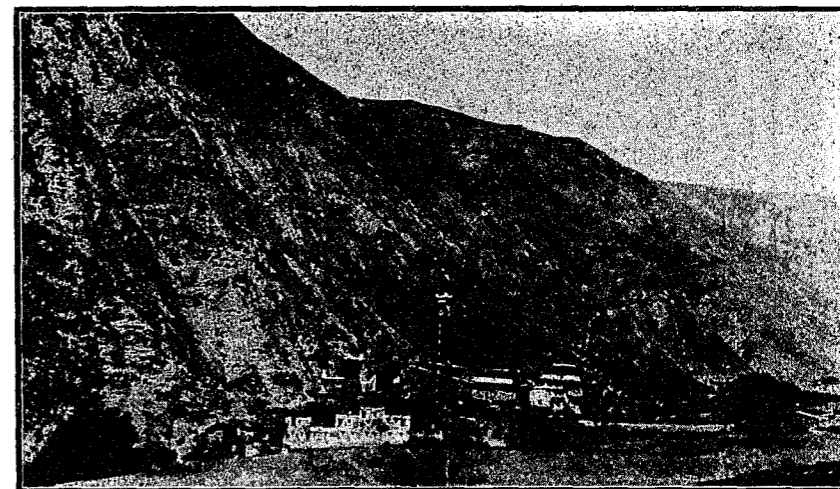
Looking forward, there seems to be no pass at all. At various points, there are high mountain ridges, but they all seem to be out of the general direction where the pass should lie. Directly forward there is only the same gradual slope that has been followed, with a slight incline right at the top. After passing around the foot of a spur over a very bad piece of road, the view widens out, but there is the same general aspect of the gradual slope. 7 $\frac{1}{2}$ miles from Jui Shui T'ang, there is a stopping point called Hsin Tien Tze, but never a place belied its name more. At some time in the past, there must have been several huts there, but now it is completely ruined, and the one or two miserable families who make their living by giving some sort of provision to the occasional traveler have merely roofed over two or three small rooms. But this is the last habitation until one goes over the top of the pass, and many miles down the other side. The altitude here was shown to be 11,590 feet by hypsometer, and 11,850 feet by the aneroid. The direction of the road forward is 35 degrees west of north. Five miles beyond Hsin Tien Tze, there is a fork in the road, the one to the left being the north road from Lhassa. It is now apparent why the pass seemed to have no difficulties, for while the outlook directly ahead shows the gentle slope, with the river gradually disappearing until only a small spring is seen, the road over the pass takes a sudden turn to the right and goes up the mountain side, at the foot of which the road has been leading. The bottom has an altitude of 12,800 feet, and the top by hypsometer an altitude of 14,500, and 300 feet higher by aneroid. The stone forming this slope and top is shale, with an occasional bit of limestone and marble showing. The strata dip 30 degrees to the southwest.

The day the writer went over this pass, the weather was most unfavorable, so that more than fleeting observations of the surrounding country as the clouds broke a bit was impossible. But for hardly more than an instant, the air to the southwest cleared somewhat, and there appeared a group of spirelike peaks, so steep that in many places the snow could find no resting place, but where a crevice or shelf held back the ice and snow, the contrast of color and the delicate weaving of the snow and ice outlines gave all the delicate tracery and fascinating lightness of a Gothic cathedral. The mists, now heavy, now light, now disappearing for an instant, threw over all an illusion of lightness and laciness. No heavy ponderous somber mountains here, immovable through the ages, but movement and lightness and illusion.

The descent from the Ta Pao Pass on the north side is first down a steep decline of broken stone to the head waters of a small stream flowing at the bottom of a rounded basin. Above the timber line, this basin and the mountain sides are covered with grass and flowers, typical of much of the Tibetan country of this altitude. At an altitude of 14,000 the first trees are found. These are the larch, scattered at first, but getting thicker and thicker, then an occasional

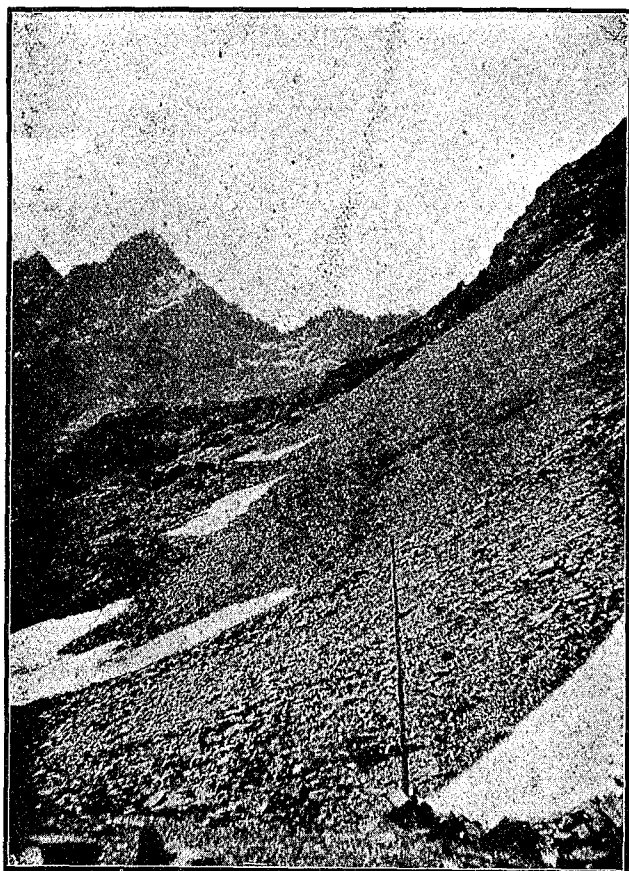
spruce or fir is found, and soon the traveler is in the midst of a dense forest, continuing almost monotonously until K'uei Yung, where there are two Tibetan houses, is reached. The altitude here is 10950 feet. The distance from Hsin Tien Tze is called 120 li, and my estimate of the distance horizontally is $17 \frac{3}{8}$ miles. This is after reductions to allow for turns and twists in the road are made. The distance from Tatsienlu is 45 miles, also allowing for these reductions. In actual distance traveled, my estimate is 55 miles, agreeing very closely with the estimate made by General Pereira. Following the road from K'uei Yung along the Mao Niu River to the point where it joins the Ta Chin River, Romi Chrango is reached. This pass, as is also true of the Hung Ch'iao, is not on a route over which the Chinese carry on trade, so that there are no inns, as there are on the Pa Lang and the Kung K'o Erh. The traveler must either be provided with tents, or depend upon making stops in K'uei Yung, the nearest houses to the pass on the north side and getting over to Hsin Tien Tze, in one day there to find shelter of the most abominable sort. It can be done if all goes well.

The Pa Lang Shan is on the main road west from Kwanhsien to Mongkung, which is the official and trading center of a large Tibetan district. A traffic of straw sandals, oil, and rice goes in, while medicines, hides and furs come out. The rainfall appears to be heavier than on the other three, and especially on the west approach, the soil is so saturated that one cannot get through without being soaked to the knees, except of course on horseback. With this excess of moisture goes a chill and depression, quite different from the softness and warmth of the Kung K'eo Erh. Leaving Mongkung, the road follows up the Ogszhi River to Jih Lung Kuan, with a rise in altitude from 8200 feet to 11,000 feet, in a distance of $41 \frac{1}{4}$ miles. Three streams join here, and the road follows up the ravine of the most easterly one in a general direction of 30 degrees south of east. The road is rough and steep and the numerous streams and boggy land make very uncomfortable traveling. $2 \frac{1}{4}$ miles from Jih Lung Kuan is an inn known as Kao Tien Tze, and at another stretch of the same distance, one called Sung Lin K'o. The highest inn about two miles from Sung Lin K'o is called Wan Jen Fen, "The Graves of Ten Thousand Men". The altitude is 13,800 ft. There seems to be a story of a battle which took place in here at one time, but whether true or not, the dreariness and desolation of this spot almost makes one willing to be added to the ten thousand who have gone before. The first mile from Wan Jen Fen continues on the same general slope, then the broken stone of the top is reached and the climb is very stiff. The formation is broken sandstone and limestone with considerable quartz in the veins. The writer has crossed this pass twice, both times in heavy rains and a wind that chilled to the bone. In order to take a hypsometer reading, a shelter was built of stones and the water boiled without undue difficulty, though the time in weather like this always seems interminable. There was considerable difference in the aneroid and hypsometer readings the former giving a reading of 15,000 feet and the latter 14,290. This latter figure agrees very closely with a hypsometer reading taken two years ago, which gave a height of 14,330 feet. At that time, the aneroid (not the same one with which this second observation was made) also read high by about six hundred feet.



KUANCHAI

ABOUT TEN MILES EAST OF MONGKONG



K'ONGK'ER PASS

FOUR PASSES OVER FOURTEEN THOUSAND FEET II

The top of the pass on the east side is also made up of broken stone, but upon leaving this, the road follows along the mountain side, high above the small stream to the right. There is much limestone through this section, and in the fertile soil, the grass and innumerable variety of flowers give a charm which is entirely missing on the west side of the pass. Some of the slopes are covered with dense timber, one of the curious features being that one slope will be densely wooded while the other will be barren of all wood except an occasional clump of underbrush. After following this slope for seven miles, the road drops down the point of the ridge with a sharp descent to Ten Sen Pa, a village on the left bank of the rushing P'i T'iao Ho, at an altitude of 9550 feet.

The Pa Lang Shan marks the boundary between Ogszhi and Wa Ssu, this latter being familiar to many, for it is governed by So Tu-si from his *chaitze* near Wen Ch'uan, where he has been visited often by foreigners. All of the carrying on this road is done by Chinese, and while for the entire distance from Mongkung to nearly Shuan K'o is in tribal country, the road itself is in Chinese control.

The K'ung K'eo Erh, meaning according to the Chinese, empty mouth, though most of the names in these parts are transliterations of the tribal names and can be taken as generally meaningless, lies between Tsung Hua on the Ta Chin Ho and Mongkung. The traveler can avoid it in making this journey by coming down the Ta Chin to Romi Chranjo and then up the Siao Chin to Mongkung, but in so doing, he travels around the two sides of the triangle instead of one. And any one who has experienced the delights of the K'ung K'eo Erh in beautiful weather will never be tempted to forego the pleasure of the ascent.

Leaving Tsung Hua, the road branches off from the road down the Ta Chin a short distance below the city, and follows a stream flowing from the southeast. The altitude of Tsung Hua is 7300 feet, and after traveling about eight miles to a point called Shan Ken Tze, a gain in elevation of only a thousand feet is made. But at this point, the approach to the pass differs from those of the others we are considering, for instead of following up near the small river, it leaves the bottom, and makes an exceedingly steep ascent to the rounded shoulder of a mountain spur, at the head of which lies the pass. One advantage in this method of approach is that a large gain is made in altitude by a steep climb before the difficulties of the rare atmosphere are reached. This sharp ascent continues until an altitude of 10,600 feet is reached, then the slope becomes more gradual, and finally as the summit of this long projecting spur is reached, the road becomes almost level, and again the traveler finds himself in the beautiful grass lands, with the landscape widening at every foot of advance. Here and there are groups of snow mountains, and to the west, the rolling undulations of the nomad country beyond the Ta Chin, with the setting sun bringing range after range into relief, makes the traveler, sitting by the road with the warm soft luxuriant atmosphere enveloping him sense something of the meaning of Nirvana. But he is rudely awakened by the chill air of the evening and the realization that he must sleep at Wu Li P'ai, the last stop before going over the pass. There can no more miserable inn in the world. The road from this point to the pass makes a gradual ascent for some two miles, then the scramble over the broken stone and the top is reached. There is

the inevitable pile of stones and prayer flags of the thankful travelers who have passed over before. The direction of the ridge is north and south, and the formation is largely slate, with the strata perpendicular. In August, there were some patches of snow in the protected spots. The hypsometer reading, taken under admirable conditions, gave the height as 15,678 feet. The aneroid was 300 feet higher. On the east side, there are the remains of inns which have been destroyed, and also the outlines of a barricade which a carrier said had been built by soldiers. The first inn is at Ta Shin Pao, and the first town of any consequence is called Tsung Tei, at an altitude of 10,650, and according to my estimate, fourteen miles from Wu Li P'ai. From there to Mongkung, the distance is some five miles.

I have left to the last, the Hung Ch'iao or Vermilion Bridge, for it is the highest and greatest of the four. It forms the water shed between the T'o River which flows past Tsakulao and Lifan into the Min, and the Siao Chin, though these waters finally unite at Kiating. The actual ascent of the pass may be said to begin at Mong Ku, a group of Tibetan houses on the east side of the range, lying at an altitude of 9760 feet.

The pass is visible from this point and already looks formidable. The road from Mongku is along a small stream and through much forest country, absolutely without habitation. This pass is not on the Chinese trade routes, the travelers and traders being Tibetans, who of course need no roofs. But in order to provide for the occasional Chinese, some one built a rest house called Tsoa Peng, but two years and a half ago all that remained of it was a piece of stone wall and a few shingles. The hut was just below the timber line, and from this point, a range of magnificent snow mountains can be seen in the northeast, somewhere north of Tsakulao. The timber line is at an altitude of about 12,000 feet, and at about a thousand feet higher, considerable masses of snow are encountered, for a great range of mountain peaks is just south of the road, and these hide the sun for much of each day. The road soon becomes more difficult, and from the time the snow is reached until the summit is passed, none of the other passes compares with it in difficulty. Not the least of the disturbing factors is the nearly continuous presence of robbers in the neighborhood, and at the time the writer crossed, the dead bodies at the roadside did not contribute to peace of mind. But when the top is reached, there is found the best view of the snow-covered peaks which join the pass on the south. They stand from two to four thousand feet higher than the pass itself, are covered solidly with snow and ice except where the precipice is too steep for the snow to hold. They appear so near, that one seems almost able to reach out and touch them; this illusion is intensified by the distant masses of snow peaks beyond them which can be seen. On the north and west other peaks are seen, but these are lower, and have no snow. In proportion and outline, they are as beautiful as the others, though they lose in color contrast and brilliancy by being without snow. The hypsometer observation was made under ideal conditions and gave the altitude of 16,279 feet.

In making observations as to the directions of some of the mountains, I found that upon taking the compass from my pocket, the needle instead of coming to rest spun rapidly for at least twenty revolutions, and did this several times when I held the needle, then

turned it east and west and released it. On the west side, the first possible stop is at a house called San Sung, some seven miles from the pass. The road soon follows along the stream draining from the pass, through the timber, and reaches Liang Ho K'eo, the junction with the Siao Chin.

If any members of the Society are interested in mountain climbing as such, I know of no more interesting spot than in the Hung Ch'iao region. Transport to the timber line can be made without difficulty where a permanent camp could be established, and the wait made for favorable weather conditions. It should be possible to reach the highest peak and return to camp in a day, and would give what we never have in our ordinary West China mountain climbing, true alpine conditions.

A Journey Into the Heofan Valley.

T. E. PLEWMAN.

The writer's intention was to traverse if possible the main valley of the Heh Shui, and failing that to at least attain the upper reaches of the Little Heh Shui known as the Heofan. In company with Messrs. Mao and Peng, two Chinese friends, we attempted to reach the Heh Shui from the Four States to the west, by way of Matang, but failed. Returning to Lifan, Messrs. Mao and Peng were already tired out, so the writer made a second and more successful attempt alone by way of the Ta Keo ("large valley") north-westerly from Lifan. However, I heard at Lifan that a band of robbers was operating at the upper end of the Ta Keo and had made up my mind to try the Siao Keo ("small valley") north from Lifan.

In company with my cook and two carriers, I left Lifan for the Heofan on July 30th. My guide was to catch up to us. There is a "Providence that shapes our ends rough hew them how we may," and though I had been over this part of the road twice before, I missed the entrance of the Siao Keo, some fifteen li north of Lifan, and continued up the Ta Keo towards Shangmengteng, quite oblivious of the fact that I was on the road that I had been warned against taking. After having travelled about 30 li, I knew I must have passed the entrance of the Siao Keo, and was somewhat dismayed to find out my mistake. I was reluctant to go back so far, and met some men coming out who stated that the robbers had left and that the road was momentarily open. Traders were going in again in little groups, travelling together for safety's sake. If they could, I could. I decided at once that I would stay with the Ta Keo route, which would take me into the Upper Heofan, go down the valley to Yahtu and return from the Lower Heofan by way of the Siao Keo to Lifanting. Knowing that the Heofan trip at best was rather risky, and that food was almost unprocurable there, we had purchased enough provisions to last us ten days, and only taken a few dollars in cash. No need to let the robbers have more than was necessary. That evening we stayed at the home of Hsia Sheopi, headman of Hsiamengteng. His large but rather dilapidated *gonggwan* (residence) is located on the top of a bluff overlooking the river, which flows south-easterly towards Lifan. A number of young women and some children were playing in the courtyard when I arrived, and not having seen me before, seemed afraid to have me enter. I gave them my card and asked one of them to convey it to Hsia Sheopi. He came out and gave me a warm invitation to stay with them for the night. I have known him for some years, but this was the first time I have stayed at his home. He is a well-meaning, but very weak man, and much addicted to opium. Every part of the house gave evidence of neglect and his fine large guest room was exceedingly



Photo by T. E. Plewman

GRASS COUNTRY NATIVES AT MATANG,
STATE OF SOMO

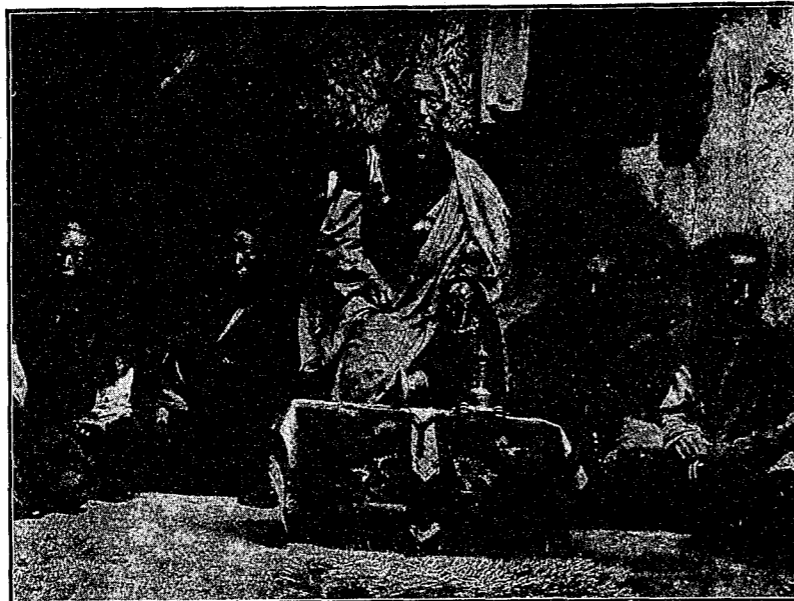


Photo by T. E. Flewman

ABBOT OF KANG KANG KIAI LAMASERY

dirty. However, he invited me to occupy a smaller but cleaner room upstairs, adjoining his own. After supper I accompanied him to his own room, where he invited me to enjoy a pipe with him. I declined, but had quite a long conversation while he indulged his "yin" for opium. I retired to my room about 10 p.m., but did not get much continuous sleep. Hsia Sheopi's wife, one of the young women I had seen at the gate, joined him, and from that time till 3 or 4 in the morning there was a procession of slave girls through my room to their apartments. Each time one of them came through carrying opium, midnight lunch, etc., they would also bear a flaming torch within an inch or two of my mosquito net. One time one of the slave girls did something that offended her master, for I heard a blow followed by the girl's cry, "Aba, Aba!" ("Father, Father"). The term seems to be synonymous with Lord or Master. An hour or two before daylight, quiet descended on the house. The master's craving for opium was satisfied for the time being.

July 31st.—Sent off my loads early in the morning, but delayed my own departure to take a picture of Hsia Sheopi's family. Ten *li* up the road came to the Shih Men Kwan Lamasery (yellow sect), where I renewed acquaintance with some of the lamas and caught up with my loads. Here also I was joined by our guide, who had followed us up from Lifan. Below Shih Men Kwan the river is rather turbid and the scenery while beautiful not so picturesque as from that place to Kangkangkiat Lamasery. We noticed the river water above Shih Men Kwan growing increasingly cold and clear. The path led through dense thickets of underbrush and occasionally through groves of trees, usually located close to a village. Most of these villages had good-sized red sect temples, with all the paraphernalia of prayer wheels, etc. We did not see any lamas attached to them, and walked through open doors into two of them which we looked over at our leisure. At Tasipa we met Tsang Sheopi, jun., who was visiting some of his relatives there, but turned and escorted us to his father's *gongguan* at Zr-pao-kiai. Alt. 7750. From him I learned that four or five Heh Shui robbers had remained after the main band left, and hearing this Tsang Sheopi had plucked up courage and surrounded them with 30 or 40 of his henchmen. After a brief skirmish, in which one of the robbers was wounded, they surrendered. Two of them had modern rifles and Tsang Sheopi was rejoicing in his acquisition of these. This occurred the day before my arrival. I also was glad, for it meant that the Ta Keo was probably free of robbers for the time being, and if I was wise I would take advantage of the going while it was good.

The next morning was beautifully clear, and I took a couple of landscape snaps from the roof of Tsang's house. The scene was entrancing. Great snow mountains in the distance, five or six villages in sight in the wooded valley, with several watch towers on the hillside and two beautiful streams lending variety to the view, Zr-pao-kiai has the finest outlook of all the native villages I have been in. Would that I could transport it a little nearer Kwanhsien. This morning I again sent my carriers on ahead and stayed behind for breakfast with Tsang. Five *li* beyond Zr-pao-kiai I stopped for a few minutes' rest with the Da Lama of the Kangkangkiat Lamasery (alt. 8000 ft.), whose picture I took several years ago and who at 78 years of age is

still hale and hearty. The lamasery belongs to the red sect and compared with the Tsakulao one is quite small. There are only about forty lamas. Tsang Sheopi is a devout adherent of the red sect and has rebuilt the lamasery at considerable cost to himself. On the top of his own house he has erected a private chapel or *kin leo*, where he also has a new set of Tibetan Scriptures that cost him over \$1000. But his piety does not help him to keep the favor of his parishioners, for not many years ago, enraged by his exactions from them, several thousand tribesmen surrounded his *kiatsu* and killed most of his family, Tsang himself escaping by the skin of his teeth. He also is a confirmed opium sot and his son bids fair to follow in his ways. Bidding farewell to the friendly lamas, we turned up the right branch of the river. From this point onward I was travelling through an unexplored section not previously traversed by a foreigner. For two or three *li* the path lay through a lightly wooded country and the grade was easy. Then the valley narrowed up, the path ascending the mountain by the side of a stream that was a continuous cascade. Great trees overshadowed us on every side. The scenery was magnificent beyond description. But we had to mind our step, for it was perilous to look too long at the towering crags on one side, or the rushing stream below us on the other. Bog holes and slippery tree roots lay in wait for the feet of careless travellers at every turn. I fell a victim to tree roots several times, and on one occasion had some difficulty recovering my helmet, which disappeared down a cliff into some brush. Fortunately I did not follow it. Everything seemed supersaturated with moisture. At noon that day my cook tried to kindle a fire to heat some water with, but spent nearly an hour in a vain attempt to get anything to burn. We had to carry a little kindling wood for use in such places. After rising three thousand feet the grade got slightly easier, the timber was noticeably stunted and small, and consisted largely of evergreen trees known as P'an-sien and Yang-go, the leaves of which are used by the Ch'iang exorcists (*dwan-gong*) in the worship of the white stone. In places the ground was quite swampy and fallen timber frequently provided a convenient way of crossing a soft section of the trail. We arrived at Niupeng—alt. 11900—about 5 p.m., not having seen a house or met a person during the day's stage. The name is derived from the fact that Tsang Sheopi has a cattle ranch in the vicinity, where he has 60 head of yak. The grazing being better a short distance away, his ranchers were now using another shelter, while the original one in which we were now resting was occupied by a number of families engaged in digging medicinal roots and sundry transients like ourselves desirous of getting into the Heofan. Arriving several hours before dark, most of the root diggers were still out on the mountain slope, and we had a chance to survey our surroundings and get settled down before the crowd got in. The shelter was about 45×25 feet, with bark roof. One side had three rooms partitioned off from the main part, branches of fir trees being tied to the framework of the shack to do duty as walls. As the branches were thinly distributed the protection was slight, and you could put your head through almost anywhere to see what was going on outside. A long trench at each end of the room held huge logs of wood, which burned merrily, and over which were suspended a large number of heavy iron saucepans and kettles. As darkness drew

nigh groups of young people kept straggling in with their pouches filled with roots and carrying their root-digging picks. The place was alive with activity. The huge fires were stirred up, edible greens picked on the mountainside were stewed to make soup, to which when boiling was added large lumps of cornmeal dough. Others toasted cornmeal or barley bannocks (*gokways*). Fire space was at a premium and the rootdiggers did not stand on ceremony in monopolizing the fire for themselves. Charity begins at home and the transients could wait till the first rush of supper was over, and then they could edge a pot or a pan in on the now slackening fire. The rootdiggers numbered about 35—men and women, boys and girls, together with seven or eight transients, so that there were about 45 people packed into the shack. The majority of them were natives (Rong) from the neighborhood of Kang Kang Kiai (Shangmengteng District), whole families coming up with about a week's provisions, digging roots for that length of time and then going out to Lifan to sell same, proceeds being reinvested in staple necessaries. Some claimed to be able to earn a dollar a day digging roots. The most sought after was the *peh muh*, a plant with a blue flower, the root of which was attached what looked like a small white bean. Freshly picked the latter fetch from 200 to 300 cash per ounce, or 500 to 600 if dry. They are valued as a tonic and supposed to give warmth to the body in wintertime. Amongst the rootdiggers we found a man who several weeks before had seen me in the chapel at Lifan when having some fun with my electric battery. He was quite friendly. After supper I gave two natives a little medicine, and some others who were not too tired started a dance. But every once in a while there would be a halt in the performance while the local fire brigade got busy extinguishing a blaze on the bark roof caused by sparks from the logs. A stalwart young man or woman would get up on the edge of one of the bunks round the side of the room and sling half a pail of water at the burning bark. It generally achieved its object—that is, put out the fire—but somewhat at the expense of the crowd below, who received the surplus water. Betwixt times I was informed that the Heh Shui robbers had visited them a few days before, but had not thought it worth while to tackle such a crowd for the sake of the small booty to be obtained. A mile or two away was the cowherds' shack occupied by two or three defenseless natives, and this they cleaned out to a finish. The evening drew on and the wind penetrated through the branch lining of the shack with ease. The heat from the log fire was comforting, but my back was chilled, and I thought it wise to retire before the atmosphere was too cold. A crowd has its advantages. I slipped into bed without hardly anyone noticing the fact. The families who occupied the partitioned-off sections retired therein. The rest of the natives—men and women—occupied bunks in the open part of the room, while the transients slept on pine boughs on the ground. A few lingered quite late into the night preparing *momo* and bannocks for the next day's bill of fare. My cook and carriers suffered quite a little from the cold, as they had no *pukais* (wadded quilts) with them and were only able to rent some very flimsy covering. No wonder that they frequently arose during the night to stir up the embers of the fire and toast themselves for a few minutes in preference to sleep. Towards morning we had a shower, and I had to cover my bed with an oil sheet. We were

glad when daylight came, the rain ceased and we had the promise of a fine day. A long stage lay ahead of us and we were informed that there was no habitation *en route* till we got to our destination at Heh Kia Si Kiai, sixty or seventy *li* away. We had a hurried breakfast and my cook Lao Wei was much concerned when after five minutes' cooking I cracked a boiled egg to find it still raw. He did not understand it at all, but I laughed and told him to fry them the rest of the way—the altitude was too great. Niu Peng, as I have already noted, registered 11900 feet by my aneroid, but as it seemed consistently four to five hundred feet less than other aneroids, I am inclined to think that a hypsometer reading would have shown close to 12500 feet. Anyway, it was no use trying to boil eggs, and was the highest place at which I stopped overnight. Leaving the shack, we followed the stream up through a thicket. The sun came out, but the air was frosty, and the branches let down showers of ice-cold water as we passed through—the result of both dew and rain. We passed over a flat covered with slide rock and then came on to a long reach of meadowland covered with flowers. We were above the timber. One of my coolies who had once tried his hand at rootdigging pointed out a blue flower to me as the *peh muh* plant. I borrowed my guide's sword and dug the plant up by the root. Sure enough there was something like a white bean attached to it. I put the precious trophy in my pocket, but alas it was lost before I got back to civilization, and I am afraid I will have to buy some in the medicine shop if I wish to show you one. The valley narrowed up and on the slopes above us we could see several snow fields. Except in the valley bottom the whole country was devoid of vegetation. We seemed to be getting into a *cul de sac*, for on every side except the one we had come by were huge masses of slide rock surmounted by perpendicular precipices that towered up two and three thousand feet. I looked around uneasily and wondered where the path went to. Then it turned a corner and we saw in a hollow at the head of the valley a beautiful lake. It might be half a mile long and a quarter of a mile broad—a gem in a rough setting, for I could hardly appreciate its beauty. The terrible crags above me were overpowering, and my subconscious mind had ever before it the fact that I had to get over the pass somehow, and didn't like the look of things. The stream we had ascended drained the lower end of the lake, which in turn was fed by the water from a fall many hundreds, if not thousands, of feet in height. The head of the valley was shut in by several huge precipices in successive steps above each other, and my guide assured me that there was another lake as large or larger on one of the top-most ledges which was supplied from a snowfield. Near the summit of one huge precipice to the left was a natural tunnel through which, though a mile or two away, I could see the blue sky of the far side. The lake had doubtless been formed by mountain slides damming up the creek. For a few feet round the edge the water was crystal clear and the bottom easily seen. Then the color of the water rapidly changed from light green to deep green, and a few feet further from the bank it was blue black of the densest shade. I think it not unlikely that the lake is hundreds of feet deep and I regret that I had no time for further investigation. It would be interesting to find out whether or not there were any fish in it. The weather was ideal for photography—clear and sunny—and I made three careful exposures

of the beautiful scene, but hardly a trace of the view was visible on the film when developed. They were all over-exposed and the negative results I can only attribute to extremes of heat and cold, dryness and moisture that the roll was exposed to before I developed it in Chengtu. On the bank above the lake my aneroid registered 12600 feet, which I expect means an actual altitude of over 13,000 feet. The whole basin in which the lake reposed was full of slide rock and to my mind showed signs of much glacial action. The Dragon Lake above Iu-chee was doubtless formed under similar circumstances, but the Shangmengteng lake and surrounding mountains are on an infinitely grander scale and provide a fine opportunity for geological investigation. After slowly sipping a little ice water from the stream draining the lake, we turned up the mountainside to the right. The so-called road was barely visible, being mainly indicated by signs of dusty footprints across and up the rock-slide. One needed good eyesight to detect the way. It was very steep and we had to go carefully lest we precipitate a slide on the heads of those who followed us. Frequent rests were necessary, and my poor carriers were in constant distress, though they only had about forty *gin* (50 lbs.) each. A few wild poppies were in bloom alongside of the slide rock near the foot. Above this the mountainside was entirely bare. Towards the top we had to rest every few yards and our legs actually trembled with the constant strain of uncertain footholds. It was with a feeling of real thankfulness that we reached the top of the pass, to find a narrow ledge hardly big enough for the pile of stones surmounted by prayer flags built as a thankoffering by those who had safely made the ascent. Even my flippant friend the cook devoutly said *O-me-to-fu* several times and planted a stone on top of the others already bearing witness. The top of the ridge was so narrow that one could fairly straddle it, and the gulf on both sides was so deep and steep that you could not enjoy the scenery very much. I pined for lower ground and a less chilly blast. My aneroid registered 14120 feet, equivalent, I believe, to an actual 14500 feet. There was no snow on the summit, but one thousand feet below were numerous small snow fields in the gullies. Off to the west was an exceedingly high snow mountain, which I should take to be the same one I saw when going in to Matang. Looking northward, the range between the small and main Heh Shui rivers seemed comparatively low—not more than twelve thousand feet, so that when one gets over the Heofan pass the main physical difficulty of entering the Heh Shui proper has already been overcome. The top of the range marked the boundary between Shangmengteng and the Heofan. We had arrived at the summit at 10.15 a.m., and after a few minutes' rest started down over the rock slide. One thousand feet below came to a little flat with a stream running through it. Three or four snow fields were close by, but we were weary and had a long way to go, so were not tempted to do any wandering off the path. As we were thirsty, too, the surroundings suggested an early lunch. There were no trees near by—we were still above the timber line, but we collected some twigs and furze bush and tried to ignite them. However, it took over half an hour before we got a fire to burn and another half hour to boil water. It certainly was a trial to one's patience trying to heat anything on high ground. While preparing lunch some coolies coming out from the Heofan passed by. They were all taking out opium. Lunch over, we resumed

the descent into the valley, and soon began to get into timbered country again. I began to speculate on what kind of people we would find at Heh Kia Si Kiai, what language they would speak, whether they would be lamaists or white stone worshippers and whether they would prove friendly. Not far down the slope we passed a large stone platform or altar, on the top of which a white stone stood erect. The sight of this familiar symbol made me wonder if I was not once more in a land inhabited by Ch'iang, and I was quite excited at the prospect of finding them so far West. I was not exactly calmed down when my guide broke it to me gently that he had come away without Yang Sheopi's card, had not travelled this route before and was not acquainted with the people of the first village—Heh Kia Si Kiai—that we would come to. Perhaps he could speak the language of the Heofan, but as a guide he seemed of but slight value.

Two thousand feet down from the summit we got into very heavily wooded country and the temperature went up rapidly till we were uncomfortably warm. We passed through large patches of red and white wild strawberries, the latter being the largest I have ever seen. The cook and I lingered for a few minutes to pick a pailful, which was sufficient to last me several meals. (On the road to Matang we only saw the red variety.) Again we passed through groves of wild cherry trees, with tempting bright red berries, but the fruit was bitter to the taste. Still lower down we saw lots of large yellow raspberries. The slope was one long continuous descent—the most unbroken one that I have seen on my travels, and we arrived at the 10,000 foot level without having struck an up grade anywhere. We then slackened our pace, as it was still fairly early and we were getting close to Heh Kia Si Kiai. I called the guide and told him to go ahead and spy out the land. Incidentally to break the news to the inhabitants that a white man was coming and not to be alarmed. He asked for my card, but when obtained did not seem in a hurry to go on. We therefore purposely lingered, to give him a good start, and after resting a while followed on slowly. My worthy help did the same for me, believing discretion to be the better part of valor, and were a good five minutes behind. After walking slowly for several *li* lest I catch up to the guide, I arrived at an open glade, with a little rise at the far end, and there to my disgust not two hundred yards ahead, I saw him ascending the slope with feeble steps and slow. And not because of weariness, believe me, for he was a horse on the road when he wanted to be. I dropped in my tracks unseen, and let my valiant introducer get another start. Evidently he was afraid of a hostile reception himself, and felt more secure to have us close by. I wrote up my diary for fifteen minutes, and when my retinue arrived we resumed our march together. Soon after we came to two small houses with water wheels, but when we looked inside found that they were turning not millstones but prayer wheels. At this my anticipation of being in a land inhabited by Ch'iang suffered a rude jolt, for prayerwheels were not characteristic of the land of the sacred quartz-stone. It looked like Lamaism being predominant. The road we were travelling on was much more defined on the lower ground, where the subsoil was heavy, but as a result, was also much more susceptible to the effects of heavy rains, and in several places had been carried away by slides. There was no repair gang here and we had to do some careful edging to get across the forty and fifty feet gaps in the

road. The drop below was only one or two hundred feet, but that was quite enough to spoil my good looks, so I copied Agag, and "walked delicately." I never ceased in my admiration for my carriers in such places. True, they were mountain men, but how they could snake round a corner with my folding cot and other impedimenta on top of their loads and maintain their foothold was a marvel to me. We were now near the end of our stage and came to the first cultivated fields we had seen for two days. We were out of no-man's-land. We stopped our descent, and leaving the creek's rapid fall, angled round the side of the mountain. The main river at the bottom of the valley flowed eastward towards Maochow, while the stream we had been following flowed northward into it. We could now see quite clearly the northern side of the Heofan Valley, which was not nearly so precipitous as the one we were on, and having a southern aspect, was one long east and westerly reach of cultivated fields only broken here and there by large and populous *kiatziis* (villages). Hardly a tree could be seen on that side of the valley, while the southern side with a northern aspect was mainly a mass of crags and forest. Passing through some opium fields, we came in sight of the first village of the Heh Kia Si Kiai group of *kiatziis*. We could see our guide just arriving there. He had managed not to get far ahead, and was now interviewing a group of natives. Evidently he met with a satisfactory reception, for by the time we got on the scene he was ready to lead us to one of the houses at the near end of the village. The houses were high three and four storey structures, facing down the hill, and with no windows or doors on the rear side. We passed through the stables on the ground floor, up a ladder way into the living room with its big fireplace, then up another ladder way on to a lower roof or threshing floor, which was partly covered over. This was where I elected to sleep in order to get away from the smoke and the fleas. The ground floor of the house was built up from the steep mountain-side, and by the time you got to the third floor you were some distance up. I had stayed on many rooftops before; but these people seemed to be goats, for none of their houses had parapets round the edge of the roof, as was the rule in other districts. The stream we had followed down from the pass and left a mile or two back was now far below us—a silver thread of roaring rushing water. Standing as the village did on the promontory of two valleys, it enjoyed a splendid outlook. While surveying the situation, however, I kept well away from the unprotected roof edge. It did not accord with much dreaming. Found the elevation of the village to be 9750 feet and the main valley bottom was still 2000 feet below. Three other villages surrounded the one where I was staying and together comprised—as indicated by the name—the four villages of the Heh people. I made up my cot on the roof top, and had barely done so before the neighbors swarmed in on me—the men to the forefront, the women fetching up the rear. They proved to have the same speech as the Upper Heh Shui or Lu Hua district. They term themselves Krehchuh and their language while distinct from seems akin to the Ch'iang. They do not seem to be ardent religionists, for both lamas and *twankong* (exorcists as among the Ch'iang) are to be found, but lamaism seems to be predominant, as every village has its red sect temple and prayer wheels. Occasionally you would see a prayer flag on the roof top, but these were not general. On the other hand, apart from the white

stone I had seen on the mountain side, I saw practically no sign whatever of the white stone religion. I was quite disappointed in this, as I had hoped to find a Ch'iang settlement in this mountain recess perpetuating uncontaminated by Chinese or Tibetans the ancient rites of their mystic faith. Quite a number of the natives could speak Chinese, so I asked if any of them could read it, but in the whole village only found one youth who could recognize a few characters.

I found I was the guest of two widows—an old lady long bereft of her husband and more latterly bereft of her son, whose widow was now her only kin. They appeared to be as poor as church mice, but I was informed that the old lady had property and would have sufficient to live on had she any men folk to look after her fields. Getting practically nothing from her property, she was glad to take in any transients passing through the village. A quiet Rong native from Hsiamengteng had already been there for a few days when we arrived and seemed like one of the family. Our party numbered five. I occupied the roof top. The others with the trader and the two women occupied the living room below, which was not very large. In fact, rather congested quarters for seven adults.

One of the greatest drawbacks to residing on the rooftop is the fact that every time you want to go downstairs you have to run the gauntlet of the smoke. Arriving safely on the floor below, you find it much easier to breathe if you squat on the floor with the natives round the fire, as the air is comparatively pure close to the ground. In four days' stay in the Heofan, I did not see a single chair, little tiny stools about three inches high, such as Chinese cow coolies use, being the nearest approach to such. Usually there is a small aperture in the ceiling for the smoke to escape by, but it is also quite inadequate, so that by far the larger volume of smoke escapes by way of the ladder passage. On my coming into their midst the old lady kindly offered me her stool, but I sat on a small sack of grain instead. Some neighboring men and women came in and we talked together quite a time while the evening meal was being prepared. The young woman gave me a little of the soup she was stewing, which was made with greens from the mountainside. I found it quite appetising. After supper I sang for them, and taught them a verse of "Hark, I Hear a Voice," in English. They picked up the words and tune in no time, and would have kept me singing all night, but I suggested that it was their turn to provide some entertainment. So the neighbors who had dropped in and the young woman of the house all sang and danced. And while they rested twixt dances I had to sing again. There was more life in their dancing than any I had seen elsewhere. At ten o'clock I left them for my perch on the roof, somewhat to their disappointment, for they protested that the night was still young and the going still good. The neighbors came up on the roof with me and so close was the adjoining house that they could step across to it. Partly because of my eerie outlook over the moonlit valley, partly because it was my first night in a new country, I did not go off to sleep at once. My feet were toward the edge of the roof. My head was close to the door of a flat occupied by another family. I could hear the murmur of their voices inside. Dozing, I imagined that my cot was slipping down the slope of the roof, assisted towards the edge by the kindly ministrations of some of the natives. I would come to with a

jump to find that I was still quite safely anchored to the roof. But my seventy *li* tramp over the pass was a pretty good cure for restlessness, and despite an extra allowance of fleas, I got a fair night's sleep.

Next morning (Wednesday, August 3rd) while performing my ablutions and getting a shave, I had a most interested crowd of spectators, both men and women, who early found their way to my dressing room on the roof top. Among them was a red sect lama, from whom I found out that there was a lama temple close by. When leaving, I tried to secure a snap of two bright girls, the lama and a yak, but the girls took fright and ran away. On the way I visited the temple and found it to be a small square-shaped building, and typical of many others I saw in the Heofan. It was only one storey, with a bit of a loft above. The idols were of the ordinary Buddha type, but there was usually one or more of the objectionable kind. While the majority of the idols were inoffensive, the same could not be said of the paintings on the walls. Fully one-half of them could hardly be described in a mixed company. My observations have led me to conclude that the yellow sect lamaseries and temples are comparatively free of objectionable paintings and idols, in the red lamaseries and temples the conventional and objectionable are about half and half, while in the black sect lamaseries it is hard to find a respectable object of worship. After leaving the four villages of the Heh Kia, we rapidly descended over 2000 feet to the river bottom, which was said to be infested by robbers and devoid of regular inhabitants. Our path lay through dense underbrush, and when we heard some voices on the road below us, my guide handed one of his swords to the cook and held the other ready for action in his own hand. The travellers proved to be three Heh Shui men from Biao-oh Kiai, over the range from Chongkutzi. All were armed with swords but no rifles. One was quite friendly. The others were very suspicious, and it took our united urgings to persuade them to stand for a picture. It is hard to say whether they were robbers or peaceable citizens, but probably the latter for the time being, as there were not enough of them to be very formidable. To my regret this picture was amongst my spoiled films and for reasons hereafter mentioned, I did not attempt any further snaps of people in the Heofan. In general the Heh Shui and Heofan natives are of only average stature, sharp-featured, slight but wiry build, and of a truculent disposition. Their swords were always handy. A peculiarity of the Heh Shui men—in which they differ from other tribespeople, was their habit of drawing their hair into a knot (*Chu-chu*) at the back of the head. Arriving at the bottom of the valley we found a water mill, and a venturesome native miller who clung to his job despite the robbers, and cultivated a small garden patch on the side. His little shack was the only habitation that we could see in the valley bottom. The soil would naturally be richer there, yet all the population is found on the high ground, perhaps for safety's sake. Just beyond the mill was the bridge across the river. I took a snap of my loads crossing the bridge, the miller and his wife following me and watching me use the camera with the greatest of curiosity. We were warned to get away from the low ground as quickly as possible, so started the ascent of the far slope at once. The lower part was precipitous and devoid of timber, but covered with small undergrowth. (I forgot to mention that the

river crossing altitude was 7,500 feet. We had come down 7,000 feet since the previous morning.) After travelling two or three *li* of a zigzag path we came to a couple of houses that seemed to be deserted. We had probably climbed a thousand feet in that distance. Our path then lay through cultivated fields, but we went another couple of *li* before we met anyone. We were then halted with a call from behind us, and turning saw two natives who had apparently come off a side road. They had swords in their hands and demanded what our business in the Heofan was. They halted about six feet from us and kept up the conversation at that distance. Both of them seemed very suspicious of us and were ready for an offensive at a moment's notice. One of them had a long scar across his forehead that did not add to his beauty. Eventually, to our relief, we shook them off. Some distance above us we could see a village, on the outskirts of which a group of people stood watching us. We also heard a succession of deep horn blasts that would have done credit to a steamer's foghorn. Was it a warning that strangers were approaching? Arrived at last at the village of Chongkutzi (alt. 9600) to find all doors shut. However, our guide found his way to the largest house in the *kjaitzi*, belonging to a man named Ch'en, and after some parleying procured admission for us. What story he told the people about me, I do not know. I rather think he told some of the communities that the Lifanting official had appointed me to enquire into the woes of the Heofan people and suggest ways and means of redressing same. We prepared our dinner in this house. It was full of people, some smoking opium, some gambling, some having a violent quarrel in an adjoining room, some watching me eat my meal. The men of any consequence all had heavy ivory bracelets, and some of the women had belts made of large ivory buttons. They told me that it was all brought in by traders from Yunnan, probably en route from Burmah. It was a commentary on the adaptability of the Chinese traders to the needs of all sections that the demand of the Heh Shui and Heofan for ivory should be met from such a distance. I priced one huge bracelet and was informed that it cost over fifty taels. Not everybody is starving in the Heofan! The village of Chongkutzi is the largest and most centrally located in the Upper Heofan. It is difficult to get to, but once there it is probably the safest place to stay in the district, as only a very large band of robbers would dare to attack it. Had we not been bent on going as far down the valley as possible, and returning to Lifan by the way of the Siao Keo, it would have paid us to make Chongkutzi our headquarters and study the people from there. After dinner we noticed the large square roof of a big lama temple and walked over to it. It was the only one of any size we saw in the Heofan, and as usual belonged to the red sect. It had quite a library of Tibetan scriptures and a resident lama or two. But there is not a lamasery in the whole of the Heofan and nowhere have I seen Lamaism so nominal as there. Only occasionally did I see a prayer flag on the roof or an idol in the house. My own opinion is that the people of the Heofan do not trouble themselves very much about religion of any sort. It doesn't enter into their everyday life like it does in other sections of the Tribes country. A large proportion of the fields were in opium. The harvest was in full swing and gangs of natives, together with a few Chinese,

were engaged in scratching the pods and scraping off the exudate. Just how an opium tax can be collected here I don't know, for the Lifan official has not a rifle in the country, and dare not send a soldier in, but I met a young Chinese in the Ch'en house who assured me that he was opium tax collector for the district. I don't fancy that he would wax wealthy on what he collected in the Heofan, but it may be that he superintends the sending of the opium into Chinese governed districts, where it is only received if it has his chop with the amount of money to be paid at destination. Or it may be—and I think this is more likely—he is simply purchasing agent for the Chinese officials and tries to secure that the bulk of the crop is delivered to them. He would not have the worry of collecting an impossible tax then.

As there were villages every few *li* on this side of the valley and a network of roads, I decided to head down towards Yahtu and get as far as I could before evening. Leaving Chongkutzi about 2.30 p.m., we passed Ch'ienkutzi half an hour later. Was somewhat perturbed to hear that robbers were in the Siao Keo that I was hoping to return by. Nearing Ngeoker we turned a sharp corner, and found that the road was crossed by a deep gulch, that we would have to descend and reascend before we could get to the village that looked so tantalizingly close. Just round the corner of the road, where the cliff was sheer to the bottom of the gulch 500 feet below, I found my four worthy henchmen stopped by a band of five armed men. One had a rifle; the others had swords. I had my camera case under my arm and came up hastily to see what was the matter. I put on a bold face and asked to see the rifle. The owner still held it at the ready, but let me look at it, and I found it to be a cavalry carbine manufactured at the arsenal in Chengtu. My coolies moved on again, and I waited till they were well started and then followed them with as much composure as I could muster. I looked back a couple of times to see whether we were followed or not and then caught up to my cook and asked him why they had not gone on. He was greatly excited and said that the five men, who were from Shih Diao Leo in the Lower Heh Shui, had stopped them and demanded to know what was in the loads. They were preparing to go through them when I appeared round the corner with my camera case. The man with the rifle immediately inquired what the foreigner was carrying. My guide replied that it was an automatic ten-shot pistol. The robbers were immediately quite respectful, and when I came along were willing to respect the truce if I would. Apparently they preferred to wait till they could find an easier prey than a foreigner with a ten-shooter who might hurt someone before he was tamed. A narrow road, a precipice above and below, it was an ideal spot for bandits, and I hastened on towards the bottom of the gulch, where were several water mills, wondering how much longer my good fortune would follow me. Only one mill was occupied by a family of scared natives, who were undecided as to who they were most afraid of—the foreigner or the Heh Shui men. A heavy shower started, and we were tempted to seek shelter in one of the mills, but the natives were so afraid of us and we also were uncertain whether there might not be more robbers up the gulch, that we decided to go on a little further before seeking refuge from the storm. When we had gotten about two-thirds of the way up the far side of the gulch we came to an overhanging rock, and as the rain was now coming down in torrents took shelter there—

under. We could command a view of the gulch for some distance, so did not think we could be caught unawares from that direction. After fifteen or twenty minutes the rain abated, and we sallied forth to find the road up the hill exceedingly slippery. Fortunately the village of Ngeoker was only a few yards away. Arriving at the outskirts, we came across one man. No one else was in sight. He said to us in a surprised voice, "Didn't you meet the robbers?" We said, Yes, but they had not harmed us. Meantime some heads began to show above the parapets of the roofs, and men, women and children stared at us from a safe distance. Our guide appealed to them to let us into one of the houses, as we did not want to go any further. They replied that they had no room, and that there was an inn in a village close by. We went to the place where the inn was supposed to be, but every house there was also locked. Came back to the first place, and our guide again appealed to them to take us in out of the wet, and told them that we had our own food and would not need anything from them. I believe that the very fact that we had got past the robbers without hurt made them think that we might be in league with them, and if they let us in the enemy would be within their gates. However, at last one family agreed to take us in and the man of the house came down and unbolted the door. The buildings were very high—regular fortresses, with only notched logs from floor to floor, and these could be pulled up behind them and isolate every floor from the one below. I was on the third storey roof, but there was still another roof above me, where the women and children were located, and though the men crowded around me to see my pictures the rest of the family never ventured down from the topmost shelter, and when none of the men were using it, the ladder was drawn up to the top. The women and children did not come down while we were in the house—they just crowded to the edge of the parapet about ten feet above me and watched me from there. The people of this village seemed so afraid that they were suspicious of everybody they did not recognize and were probably a little nervous about us as long as we were there. They told us that the robbers had gone right through the village, but they had all taken refuge in their houses and the marauders had gone on without molesting them. An interesting matter to us was the fact that Ngeoker was the dividing line between Upper and Lower Heofan, the people of the next village speaking Ch'iang while the people of Ngeoker spoke Krehchuh, the language of the Upper Heh Shui. The people in this village were also quite curious about my camera case, and later my guide asked me not to destroy the illusion that it was a deadly weapon. I at no time gave any one to believe that it was such, but the fact remains that I profited by the ruse of my companions and did not think it advisable to take any further pictures of natives lest I expose the deception. One or two bands of robbers were now behind me; according to all accounts there were still more ahead, and how I was going to get back to civilization was somewhat of a problem. So I kept my camera close at hand, and did not allow any of my Ngeoker friends to see the terrible ten-shooter. Another matter for anxiety was the fact that while I was amply provided for, my coolies had practically exhausted the food they had brought with them, and no more could be obtained except at famine prices. They got one thousand cash a day from me, and it was insufficient to give them two good meals of even the cheapest

food—potatoes and *ch'in k'o meitzi* (a kind of barley). My men were going on short rations and could not stand that very long. Thursday morning, August 4th, we were up betimes still heading towards Yahtu. Our guide did not seem very familiar with the country and we kept to the lower road whenever we came to a fork. Passed a large village by the name of Gaygee. On still further went through another *kiatzi* by the name of Hsihsi-haha. In conversation with some of the Ch'iang inhabitants we were directed to a village in sight far down the valley, and quite close to the river, as the settlement of Yahtu. This encouraged us to go onward, and we pressed on down the lower road till we got right down by the river side. It was surprising in a populous country how few people you would meet on the road between places. No-one dared travel. Apart from the robbers, we had not seen half a dozen people on the road in two days. This morning in twenty or thirty *li* down the Heofan Valley the only person we saw on the road was a solitary girl whom we found esconsed on a high rock watching a flock of goats. On the other side of the valley far below us, we saw the entrance of the Siao Keo, the bridge leading to it, and five or six water mills on the stream nearby. We also saw several men and a horse or two cross the bridge as if entering the *keo*. Who would they be? Probably Heh Shui robbers, for hardly anyone else was travelling. A little further on, our road slanted down the bank towards the large village by the riverside which had been previously pointed out to us as Yahtu. It was now about eleven o'clock, the sun was very hot and arriving at the the river bottom we began to look around for a cool spot to get lunch. We were only a few yards away from the village when we met a native collecting wood. He seemed surprised to see us and said, "Where are you going? I would advise you not to go on, as there is a band of robbers right ahead." We said we were going to Yahtu. He informed us that we were on the wrong road, and were now 15 *li* beyond Yahtu. We should have taken the high road instead of coming down to the river. My cook and two coolies were exceedingly wroth and panicky into the bargain. Robbers ahead and behind, and a guide who did not know the road. They reviled him in no uncertain terms and he retaliated in kind, till they almost came to blows. A Chinese came limping up the road emptyhanded. His face was battered up. We asked him where he was coming from. He told us he was a small trader, and that the robbers ahead of us had taken everything he possessed and without food or money he was trying to get back to Lifan. I doubted if he would ever get over the pass alive, for the people of the Heofan are not given to charity and the man who is without goes to the wall. We ourselves were also short in both money and food and could not proffer any help. We were in a fix. The only direction in which we did not know of robbers blocking the road was northward and away from home. Yahtu was previously the seat of a Chinese *fen ch'isi* (official), who had charge of the Heofan, but there was no one there now and the natives were a law unto themselves. So I told the guide he had better get busy and hasten up hill to Yahtu. He was to see if he could find any headman who would provide us with an escort through the Siao Keo. The guide himself was badly frightened, and I was afraid the whole crowd would bolt at the first favorable opportunity. Our being so far out of the way was the combined result of having a poor guide,

being falsely directed at Hsihsi-haha, and not meeting any one en route to put us right till we got to the river bottom. The village by the river bank was Lehtukiai, not Yahtu. Altitude Lehtukiai about 7200. We had not eaten and were tired and hot, but we did not dare stay any longer, so thanking our informant, we turned up hill and followed our guide. The cook being also ahead, I decided to bring up the rear, lest something happen to my loads. My poor carriers cursed the guide and their luck both loud and deep as they sweated up the steep, steep hill. No food, no opium,—they were ready to drop. Coming to a fork in the road, I saw the cook a couple of hundred yards ahead on the lower and easier grade we had come down by. He was going full speed ahead, and as I was sure we should keep to the north road up the mountainside to reach Yahtu, I called after him. He turned, but apparently did not hear what I said, for he kept on his way and was round a corner and out of sight in a moment. Feeling that the guide, if he had obeyed instructions to go to Yahtu, had taken the other road, and that I must keep the loads with the guide and not leave them for a moment, I urged them up the Yahtu road, and decided that the cook had bolted. For an hour and a half we toiled up the zigzag path, and then came in sight of three *kiatsis*, which we hoped were Yahtu. Nearing the first village we saw one woman in a field and asked her if a man answering the description of the guide, and carrying two swords, had passed up. She did not understand us very well, but intimated that a stranger had gone by. We knew that there was not much hope of getting into any of the houses without someone who could speak the native language, so the two carriers and I rested on a bluff about quarter of a mile from the village, where we could see the guide and he could see us if he emerged. The minutes passed and no sign of cook or guide. My coolies frankly said that they thought both had bolted, and that we would have to get back as best we could without them. It was the bluest moment of my trip, for I seemed to have put my head into a noose from which there was no escape. I was glad I had some life insurance. We ate a bit of *gokway* (Chinese hardtack). A thousand feet below us was the other path that we had gone down by, and which the cook had also taken to return by. I scanned it carefully, but saw no sign of him, and my carriers said he must be far up the valley by then. Then I suddenly saw what looked like the cook's figure emerge slowly from behind a corner in the road. If it were he, he must have waited for us further up the road, and now was slowly going on again. We all yelled together, and after a minute or two, thanks to the still air, he heard and looked upward. We gesticulated and beckoned. If he went back to the fork and followed up the road we had travelled by he would have to go quite a distance, so he elected to climb over the bluffs and through the brush that separated us. He certainly paid for not coming back when I called him in the first place, for the short cut was not easily negotiated. He would be out of sight for ten minutes at a time, and we would wonder whether he would be able to make it, and then we would see his head show up over a crag again. He would stop to get breath for a minute or two and then wearily clamber up the crags again, arriving at last exhausted to throw himself on the road by our side. When he got breath we asked him why he took that road. He said that he was suspicious that the guide would bolt, and determined to

keep him in sight. The last time he had seen the guide he thought he was speeding on the lower road, so himself had followed along that fork. After progressing a way, not seeing us behind, he had stopped, and was going on slowly again when he had heard our shouts above him. He was quite sure the guide had travelled that road, and that he had bolted. I was quite encouraged by the cook's reappearance, for it was a much easier job for two people to keep the carriers together than one person alone. When the cook was rested a little we went on to the village, and ate a lunch. Not a native came near us. They were all up on the housetops, and paid no attention to anything we called out in Chinese, so we decided to start back for Ngeo-ker and rest with the same people who had given us shelter the night before. Surely they would not turn us away now that we were acquainted. Down the road we went, I leading the way, and the cook fetching up the rear. As usual, not a soul did we see. The people were like frightened rabbits in a burrow. They did not dare come out of their fortified villages. We had travelled about 15 *li*, half way to Ngeo-ker, and it was about 4 p.m., when I heard a voice above me calling out to stop, stop! A man rushed excitedly down from a higher road. It was our worthy guide. He stormily declaimed that we had made him follow us all this way. Why didn't we stay at Yahtu? He had been the round of all the three *kiatsis* and had persuaded the headman to give us an escort on the morrow through the Siao Keo. I asked him if this was certain. We had now well started on the way back to the Ta Keo, by which we had come, but as the Siao Keo was new ground and the route we had planned to return by, we would retrace our steps once more if he could assure us of an escort. He was quite positive we would get the escort, so we ordered the carriers to face about and took the road the guide had come by. From Yahtu to Lifan by the Siao Keo was the last side of a triangle, and the quickest way out, so we were naturally not anxious to retrace our steps the two sides we had already done and return by the Ta Keo. By 5.30 p.m. we were back again at Yahtu (alt. 8650), having covered about 70 *li* since early morning, but not travelled more than 30 *li* in any one direction. We had traversed one section three times. We were billeted at the *ex-siangyoh's* house. Under the Chinese *régime*, every village had a native headman responsible to the authorities for the behaviour of his people. But during our trip down the Heofan valley we did not find a solitary village with an incumbent in office. They had all resigned, as the lawless condition of the country, with Heh Shui robber bands roving up and down at pleasure, made it impossible for them to assume any responsibility. These men were termed *siangyoh*. It was now eighteen months since the natives had ejected the Chinese official from Yahtu, and though nominally under Chinese rule, they were in effect independent. But their independence had not brought them any happiness. They had lost what protection the Chinese had been able to afford them and the Heofan now constituted a no-man's-land between independent Heh Shui and Chinese-governed territory in the Wu T'eng. The Heh Shui robbers tell the Heofan people that they are still Chinese subjects, and therefore their legitimate prey, so they rob and ravish at will. "If you aren't under the Chinese, come and join us and acknowledge the Heh Shui *t'usi* (chieftain) as your ruler." We had landed into

Yahtu at most inopportune time, for the ex-*siangyoh*, named Yang Ch'in Long, had troubles of his own. Several weeks before a marauding band of Heh Shui men had carried off his wife, who was still in their hands and probably held for ransom. He had called a gathering of the men of the district to consult with him as to the best way of recovering her. Now we turned up and wanted the protection that he had not been able to afford himself. I am afraid that my guide told the headman some cock and bull story about my being sent into the Heofan by the Lifan official to enquire into conditions there, for the poor chap came in and prostrated himself before me, and told me a long story of the woes of his people. If the cattle were taken out to graze, or the young people went to work in the fields, they were carried off by the Heh Shui men. Just three or four *li* away, by the bridge leading to the Siao Keo, were their water mills for grinding grain, but not one of the six was turning a wheel. They didn't dare go down. What were they to do? Their brethren in the Heh Shui, speaking the same language (Ch'iang), nevertheless harrassed them beyond measure. He could only see one way out of it. That, was to join up with their oppressors, and acknowledge the Heh Shui *t'usi* as their overlord instead of the Chinese, in the hope they would then be spared. The latter were apparently impotent to protect them. Would I tell the Lifan official for him how impossible the situation now was, how though he had been a *siangyoh* for many years under happier circumstances, he was now powerless to maintain order. He hoped that the Lifan official would allow them to transfer their allegiance to the Heh Shui, which seemed their only hope of getting peace. I was informed elsewhere that there are at least two thousand Russian rifles in the Heh Shui, exchanged mainly for opium, and brought down through Mongolia and Kansu. While there are a few rifles in the Heofan, the number is inconsiderable, and the arrogant Heh Shui men stalk through the land like lords of creation. The Heofan people can't withstand them. They can only retire into their *kiatsis* and wait till the intruders have left. But while they may save their persons from injury by such passive resistance, their crops and their live stock are being carried off and famine conditions prevail. What could I say to comfort the poor man? He told me that they had three rifles in the settlement, and that the owners of same had consented to see me to the summit of the range on the Siao Keo road on the morrow, for which service I was to pay them one dollar each. They did not think there were more than two or three robbers at present in the pass, and they would probably not attack a party of seven, when we had three rifles with us. One of the three who were to accompany us was a vigorous but weather-beaten man of 55 or 60 years of age. In a countryside full of turbulent spirits this old man was a delightful contrast. He told me that all respect for law was gone, but that he still was determined to follow the light of his conscience and would do what was right no matter what the cost. He and the ex-*siangyoh* both struck me as remarkable men.

Here I had found several really delightful people in the very village where in the morning we had sat forlorn and hungry on the outside. Our guide was not much good in some respects, and he had led us on the wrong road several times, but he was certainly a help to us in introducing us to the people. Once inside we generally managed

to get on friendly terms with them. They were greatly interested in my snapshots, and none of them seemed to have seen a watch, for it excited them greatly. The women were also attracted by the sight of a collapsible manicure scissors, which could be folded up and opened at will.

That night we went to sleep dead tired. We had had to talk with our friends till late, but we retired thinking that the worst was over, and that on the morrow we would make a dash for liberty through the Siao Keo. Next morning we were up bright and early. Alas, the first thing we heard was that someone the previous night reconnoitring in the neighborhood of the bridge across the river, had seen 25 more robbers armed with rifles enter the Keo. The Heh Shui band in the pass would now be far too large to risk conclusions with them with only three rifles. Even odds they didn't mind, but there was no use their throwing away their weapons, and that was what venturing out now would mean. We were bitterly disappointed, for we had lost a valuable day in the vain hope of being able to return via the Siao Keo. There was nothing to do but change our plans once more, and head back the way we came, round two-thirds of the triangle. The good old man who was one of the three who were to have accompanied us, was quite agitated because the other two did not return the money they had received right away, and went out and collected it himself. He personally returned the three dollars to us. Our guide had again lost a certain amount of face, for we had all returned to Yahtu on his assurance that an escort was certain, and now we were about to traverse the Ngeo-ker section of the road for the fourth time, and dependent only on a kind Providence for protection. Food, money and time were all short, so we could not afford to linger. The big band of robbers at the entrance of the Siao Keo, of whom the horsemen we had seen at the bridge the previous day were probably the advance guard, would likely split up, and some of them following up the creek would likely enter the Ta Keo. If we wished to head them off, and get in ahead of them the quicker we started the better. Forced marches were the order of the day. With regret we bade our friends farewell, hoping that the next time we saw them it would be under happier auspices. We passed four or five *kiatsis* along the way, but did not meet a solitary traveller. Arrived at Chongkutzi by noon, forty *li* away. Our reception here was not very friendly, and I began to think that our guide's zeal was not tempered with discretion. I had heard him say a number of times, when asked our business, that we were there to "K'an di-tu" (see the land). If he had said to see the scenery and the people, his statement would likely have been harmless, but now coming back over our tracks, we heard murmurings against anyone who would receive us, for were we not there by our own confession to "spy out their land," and take any that was any good. So I told the guide not to use that expression any more. It was said that I could see three feet into the ground (why three feet and not one hundred, I don't know), and some of the baser sort who thought to profit by my magic eyesight, wanted me to tip them privily as to where was good land and what I had seen of precious things therein. I think my guide also made me out to be just what he thought would impress his hearers the most, and for "conscience sake" I dare hardly enquire what rôles I was supposed to have filled.

After dinner at Chongkutzi, we descended with all haste to the river bottom, watching for robbers all the time. Found the imperturbable miller still at his work, but he had had some interesting experiences since we had seen him. The five Heh Shui robbers that we had met near Ngeo-ker several days previously had gone right on down to the river bottom, avoiding the big villages near Chongkutzi. They had stopped at the mill, but not molested the miller. Behind us that day were two Chinese traders laden with bacon and salt that they expected to sell to the natives. They had accompanied us over the pass, but had lingered behind, so that we crossed the bridge several hours before they did. The robbers met them at the bridge and carried away both the men and their loads. They may now be working as slaves in the Heh Shui. This was just two or three hours after my innocent camera case had passed as a ten-shot pistol. None of the big band of robbers down the valley had as yet arrived at the bridge, so we were apparently ahead of them, and were much encouraged. We purchased a few potatoes from the worthy miller and struck up hill for Heh Kia Si Kiai with all speed. After a stiff climb of 2250 feet we passed through the opium fields surrounding the four villages. Arriving at the first village, found the people much more friendly than at Chongkutzi, and one family insisted on my going to the top storey and drinking tea while the loads caught up. They were full of stories of women and cattle being carried off by the Heh Shui people. Then left them for the next village, where we had stayed previously. There was a noise of weeping at one end of the street, and I was informed that a young man of 28, the only son of his mother, had fallen off one of the parapetless roofs the previous day and had been killed instantly. My forebodings had been justified by someone else. He had just been buried. I enquired as to the funeral rites, and was told that in the absence of any lama at the village just then, they had only held a sort of "wake" and taken the corpse to the burial place without any further ceremony. They inferred that the body was interred in the ground, but as I saw no graves in the Heofan, I think it just as likely that the remains were cremated or the corpse thrown in the river.

The same family took us in again. Had supper and went to bed early, as we had a long stage ahead of us the next day, with a 5000 foot climb in rather thin atmosphere. My guide and the Rong trader previously mentioned as stopping with the family, were having a merry time below with the young widow and a girl from the neighboring house. I could hear them talking and laughing for a long time. The moon rose over the mountain and the roof of the house was almost as light as day. I heard some steps coming up the ladderway, and the two damsels stood in the bright light of the moon. One of them had a little musical instrument like a jewsharp and proceeded to serenade me. The little tune was very primitive and simple, but the surroundings were certainly romantic enough and rather embarrassing. Politeness forbade me to abruptly dismiss them, so after listening for a minute or two to the zim-zim refrain, I complimented them on the music, suggested that it was late and I was tired, and they, taking the hint, retired the way they came. In Somo and the Four States it is customary for a girl's family to take the initiative in securing a husband. I think the same custom prevails

in the Upper Heofan. Who knows? Perhaps these ladies thought I was still unattached!

Next morning, I rose an hour before daybreak, got an early breakfast, and bade the family goodbye. The four villages of the Heh Kia had certainly treated us pretty well. It was 5.10 when we sallied forth, with 120 *li* to the next village over the range in Shangmenteng, and in all that stretch of country, the shack of the root diggers was the only shelter. It was possible that we might find a band of Heh Shui robbers in any part of this section, but we were hopeful that we had got the start of them and intended to maintain it. As we ascended the slope towards the pass we wondered if we would ever return again. Certainly the conditions of the country were not such as to encourage us, but we had met a few kindly souls and upright men who were as lights in gross darkness, for never have I been in a more God-forsaken or hopeless country than the Heofan. Our two coolies and the cook had an extra hard time returning over the pass. The cumulative effect of much travelling and lately also of short rations was having its effect, and though the loads were now down to about 50 lbs. each, it was with the utmost difficulty that they made the last two thousand feet to the summit. One thousand feet below the pass we stopped for an early lunch and a rest. We had carried up some sticks from several thousand feet below to assist us in lighting a fire, but our efforts were in vain, we could not get one started, so eventually gave it up and had a cold meal. Then on again up the last steep bit. I brought up the rear, for I was afraid that some one might give out entirely. The cook had to lie down every few yards. Arriving at the summit, with the exception of the guide, I was the freshest of the party. Descending the southern slope, we passed the beautiful lake for the second time, and arrived at Niu Peng quite early. I urged my men to go on a little further, and we would camp in the bush, but they were exhausted, so I let them stay there on the understanding that we would get up before light and start at daybreak for Lifanting. I offered them two days' pay if they could make the 130 *li* to Lifan in the one day. We had taken two and a half days coming up. My men had a good rest, as we had gotten in about 4 o'clock. That evening we had the usual shower. Heard some animals lumbering about after dark, so investigated, and in the dim light was able to see that several of Ts'ang Sheopi's herd of p'ien-niu (a type of yak) had wandered down to our shelter. Was sorry that I did not have a chance to see them in a good light. Up again next morning an hour before daylight and with the first signs of dawn started for Kang Kiai Lamasery, 60 *li* away. By 11 o'clock we were at the lamasery. Forging a stream got my feet wet, and shortly afterwards noticed that they were hurting, so investigated. Found that the *ts'ao-hai* (hemp sandals) which I wore over my boots, and which were small to start with, had contracted with the soaking they had received, and the withes had cut right through the leather of my boots and taken the skin off several toes. I had to change both shoes and sandals.

Arrived at Lifanting at 7.30, just after darkness set in. My men got in about ten o'clock. We had descended 7000 feet in one day, and travelled 130 *li*. The last part of the stage the heat made us feel very limp, for we had gotten accustomed to higher altitude and cooler weather. The balance of my journey to Kwanhsien was uneventful, so will not take time with further narrative.

Language of the Heofan. The language of the Upper Heofan is the same as that of the Upper Heh Shui. It is termed Krehchuh. It is spoken down the Heofan valley as far as the village of Ngeo-ker. Below Ngeo-ker the language is Ch'iang. At Yahtu I was surprised to find that the language was almost identical with the Kiutzeteng Ch'iang. Yet the Tunghua Ch'iang, adjoining Kiutzeteng, has many variations, and it is usual to find a new dialect every few miles. It would appear as though the Yahtu Ch'iang represent a migration from Kiutzeteng, or vice versa. But with the language identical one would expect the religion to be likewise, yet the Kiutzeteng Ch'iang follow the ancient cult of the white stone while the Heofan Ch'iang are all lamaists, as far down as we went, at least. In respect to the Krehchuh or Luhua language, the fact that it has so many words somewhat similar to the Ch'iang would indicate to us that though the natives now consider themselves quite separate and the Krehchuh have no dealings with the Ch'iang of the adjoining village across the boundary line—despite these present-day conditions, they may be of common origin. The passing of the centuries has developed two languages from the parent stock. A comparison is given below of five sections.

	Kiutzeteng Chiang	Tunghua Chiang	Yahtu Chiang	Krehchuh	Kiarong
One	arguh	ngaiguh	arguh	aow	gaychoh
two	nerguh	neguh	nerguh	i-yü	gayness
three	cheeguh	cheeguh	ksurguh	k'siu	gayswom
four	gurguh	zrerguh	gurguh	griu	gogee
five	warrguh	hwayguh	warrguh	oh-wu	gemngoh
six	strughguh	strughguh	strughguh	strugh	gaydroh
seven	schnerguh	hsinguh	schnerguh	shiu	geshniss
eight	creguh	bihguh	zrerguh	cra-ow	waherryih
nine	ihgwerguh	ihgwillee	ingwerguh	erguh	gengoo
ten	hadruogo	haluguh	hajugo	hao-jiu	sjay

The Krehchuh language is quite different from either Kiarong or Tibetan, but there are similarities to be noted above that indicate it is related to the Ch'iang. Note especially the Krehchuh equivalents of four, six, eight, nine and ten. Note also the strange fact that the Tunghua and Kiutzeteng Ch'iang have many variations though living side by side, while the Yahtu Ch'iang several days away is practically the same as Kiutzeteng. Though I saw none of the white stone worship in the Heofan, I had some indirect reminders of it. The village where we were misdirected to Yahtu was called Hsihsi-haha. This is rather an odd name. On top of the mountain near Tunghua is a white stone temple, with two sacred stones, the names of which are the Peh Hsihsi and the Peh Haha, or Hsihsi-haha. So the Ch'iang village in the Heofan went by the same name as the sacred white stones of the Tunghua Ch'iang. The rites of the white stone religion are handed down by *dwankong* (exorcists) from father to son. Amongst the Krehchuh there were said to be a few of these exorcists, but the Yahtu pure stock Ch'iang, where you would expect to find them, denied having any. I am therefore afraid that the investigator of the white stone religion will have to go elsewhere than to the Heofan to get much new light on the *lopre* (white stone) and *Apa Lowoxi* (Father God).

Opium in the Heofan. Ten years ago the Heofan opium trade was probably a gold mine to the Chinese officials of Lifu, Maochow, Weichow and Kwanhsien. The writer remembers that Yang Wei, one of our local politicians, years ago was credited with keeping a big guard at the Niangtzeling Pass, above Kwanhsien, because of the opium revenue he derived there. The price then was over ten dollars an ounce. Now, however, with opium being cultivated north of Kienchow and other places quite close to Chengtu, the price has dropped to \$1.30 an ounce, and the writer believes that very little Heofan opium comes out to the plain. Their best markets are in the Chinese towns close by, and perhaps in Kansu to the north. Opium is just as cheap in Chengtu as in Weichow, so there is not much object in smuggling it out, with all the attendant risks, when no profit can be realized. Though the Chengtu market is lost to them, the Heofan is still a large producer of opium. The natives themselves do not cultivate a large quantity. But Chinese and Rong from the Wu Teng who perhaps are in direct touch with the Chinese officials, if not acting on their instructions, go into the Heofan and rent land from the natives for opium cultivation. These speculators, however, have come upon hard times. While there was a Chinese official in the Heofan, they would enjoy his particular favor and protection. The natives got strong enough to eject him, however, and for eighteen months there has been no law in the land. I met a native from Shangmengteng, who had a little rented farm near Yahtu, and he bitterly complained that the only rule in the Heofan was the rule of the sword, and that no redress was possible if a Chinese or Rong had a difference with a Heofan man. This in conjunction with the cheapness of opium has made their lot not an enviable one. How to market their crop when once harvested is another problem, for that is the time the Heh Shui bands love to rove up and down the land intercepting the opium caravans and making huge hauls for their own profit. Despite all these handicaps, however, there is a constant procession of haggard opium sots over the Heofan pass. They go there to work in the opium fields near harvest time, when they receive 50 cents and found per day. Perhaps they are allowed a smoke between times, too, and when returning hope to fetch out a stock of opium with them. Returning from the Heofan, near the summit of the pass, with the temperature close to freezing, we came across several men prone on the ground having their smoke. Empty-handed, no food, no bedding, but the inevitable opium outfit with each one of them. Such wretched looking specimens. Some might never come back over the pass again, but what cared they! Was not the opium paradise just ahead! Generally speaking, the immediate result of cheap opium in the Tribes Country is an immense increase in its use. All along the high roads are opium dens and you can hardly go into a house without seeing some one smoking. The valiant appearance of opium suppression that existed three years ago in Wenchow, Weichow, Maochow and Lifu has now all disappeared and officially managed opium dens are the order of the day.

Currency of the Heofan. Lump silver is the usual financial medium, dollars being only valued in respect to their weight, and are chopped up into various fractions of the tael.

The Future of the Heofan. The problem of the Heofan is the problem of the Heh Shui. Geographically and racially they are one.

But it will be disastrous to China's prestige on the whole of the border if they actually surrender the Heofan to the Heh Shui tribesmen. The only other alternative seems to be a military expedition into the Heh Shui, and that would mean a large force, considerable skill and great expense. Kao Sheopi, of Tsakulao, who has personal knowledge of the Heh Shui, says that the reduction of that district will take a larger army than the one against the Goloks, and prove a more difficult task. The Goloks were robbers, and had had but little experience of real fighting. But the Heh Shui men have been engaged in civil war for six years. They have, according to Kao Sheopi, two thousand Russian rifles brought down across Mongolia and Kansu. They are inured to mountain fighting and would compose their differences in a second if their independence was threatened by the Chinese. Two years ago a force of several hundred Chinese soldiers essayed to enter the Heh Shui. Twenty-five hill men, occupying a position of advantage, ambushed them. The soldiers had no stomach for fighting a hidden foe, threw down their rifles and fled, leaving the Heh Shui men in full possession of the field. I heard stories in the Tribes country of the Heh Shui men's prowess with the rifle that were suggestive of William Tell. How one would hold an egg on his hand and let another shoot at it. Doubtless some of the tales are imaginative, but living as the Heh Shui men do with a rifle in their hand most of the time, it is natural that they should develop some marksmanship. Meantime the Heofan people in No-man's-land are ground between the upper and the lower millstone and long for peace. They wish to be on the winning side and just now lean to the side of the Heh Shui, to get relief from robber bands. But that the Heh Shui, or any part of the Tribes Country that is geographically and commercially dependent on China, can permanently effect its independence seems impossible. The lack of a centralized and authoritative government at Peking gives such sections of the country a chance to attain a temporary success, and it may take a century or two of gradual absorption on the part of the Chinese to regain what they may lose in the present period of unsettlement. Time is fighting on the side of the Chinese, but the immediate subjugation of the Heh Shui by military force does not seem in the range of present probabilities.

Regarding the possibilities of main Heh Shui exploration, the writer believes he would have had an easier time had he elected to go there instead of into the Heofan (small Heh Shui). The danger would not be from robbers, but would lie in the uncertainty as to what sort of a reception the people would give a foreigner. Once in and well received, you would have nothing to fear. We now know of several roads into the Upper Heh Shui—roads that are being travelled over every day, but whoever goes over them will have to run a certain risk and it is for the individual concerned to decide whether it is worth while or not to take it.

Observations on the Medical Botany of the Szechuan-Thibetan Border, with notes on General Flora.

BY S. H. LILJESTRAND, PH.B., M.D.

I. In the first place I want to acknowledge my indebtedness to Mr. George Helde for his record of altitudes and for the use of his well worked out map. For the sympathetic help of Mr. J. Huston Edgar, who was the inspiration of the party in his unflagging attention to physical and psychical needs, and for the patient forbearance of the members of the party whose special missions made for speed, but who had daily to wait for the member dragging along behind, filling his portable presses by the way.

The trip may be divided into three sections:

- (1) Yachow to Tachienlu
- (2) Tachienlu to Mongkong, via Badi and Tsonghwa
- (3) Mongkong to Kuanhsien.

The first section represents a gradual transition from *Rainy* to semi-arid climate, and exhibits the phenomena of the Rainscreen effect of three mountain ranges.

The second section lies wholly in the hinterland and is characterized by much sunshine and high altitude, with semi-arid to arid climate.

The third section is the reverse of the first, with a difference in latitude, not sufficient to cause marked change in flora.

2. The writer, not being a professional botanist, started out with a fundamental knowledge considerably below par. This was in part made up by constant observation, consultation of books and people and an eager desire to find out what those mountains and valleys of mystery held in the way of plants for the healing of men. Both the search and the findings have well repaid the weariness of the tedious care of specimens that often had their natural freshness greatly increased by showers and mists. My faithful assistant and personal friend Mr. Lu Tseh Ren deserves unstinted praise for his persistent endurance of the most trying conditions, eating his monotonous fare of corn cakes for many days at a time and staying up late nights to dry the pressing papers over refractory fires.

A kind Providence also led a real Botanist, in the person of Prof. Harald Smith, of Upsala University, to our vicinity. He unlocked many closed doors and corrected mistakes I had made. He also furnished an example, in himself, of what blood and spirit must be put into a scientific study of Nature, in one or other of her phases. I am therefore indebted to Prof. Smith both for inspiration and

practical help in technic and classification. In view of this, and the fact that a two months' delay in Song Pan prevented Dr. Smith from getting across the passes north of Tachienlu before they lay deep in snow, I was glad to be able to furnish him with about two hundred specimens in flower of which he either had nothing, or only seeds, or leafstalk.

I. (1) The Rain-screen ranges.

TEA. Of historic interest is the TEA PLANTATION on the Min Shan, near the Hsien City of that name near Yachow. The tea from this mountain has been from ancient times prepared specially for the imperial household. Tea is grown in a scattered fashion on the hills west of Yachow. Crossing the Pheasant Pass, 80 li from Yachow, I found the tea fruits being dried in preparation for pressing oil out of them.

Yün King Hsien is a tea packing center, and from here on we found the road filled with carriers of tea, laden as heavily as 300 lbs., going westward to Tachienlu.

The second pass, the Tai Hsiang Ling, presented on its eastern aspect a fine floral display, but I was enjoying an attack of diarrhoea and was unable to get samples. The top gave a reading of 9250 ft. on the aneroid barometer. Buttercups and wild geranium gave a homelike look to the summit, descending from which we saw the startling transition from abundant rain to only enough to support a grass-land pasture. Jin Ji Hsien lies below the steep descent, its uplands being clothed with the buff and pink of extensive fields of Buckwheat. The picture now was one of marked dryness of climate. Solomon's seal: Polygonatum: Characterize Pass.

Crossing a low range we descended into the spacious valley of Er Lang River, tributary to the Tong R. White Wax trees in bloom filled the air with a nauseous odor. Some fine Chestnut trees relieved a dry landscape, barely supporting a sparse growth of corn (Maize). This valley presented only some fine persimmon trees, the road finally ascending to the town of 'Mud Head', where we had an elegant inn, and the next day crossed the Fei Yue Ling range. At 7800 ft I found a lonely specimen of Larkspur which offered hope of seeing more vigorous neighbors. Loads of Chinese medicine, reporting as from Yü Ho Tong, passed us.

We now entered the valley of the Tong River, which presents a characteristic flora. Coming down from Hwa Lin village, where we spent the night, and dispatched home-sick messages to the stranded mariners on Beh Lu Ting; we collected specimens of *Convolvulaceae*, species indeterminate as yet, but possibly closely related to *Scammonium Radix*. Also a red flowered plant esteemed by the Chinese (*Tong Dze*). The convolvulus may be *Exogonium purga*. At least, it is very similar. In this case the root gives *Jalap*.

(2) The Tong R. Valley, in brief, furnished the following:—

The Stinking Peach of the Chinese Pharm. Perhaps, as suggested by Prof Smith, one of the Euphorbiaceae. The French priests have decided it is a noteworthy "heart tonic".

Acacia. There are a number of varieties along the route. Dry. Datura Stramonium. This was just growing up as we entered the Tong and everytime we touched the Tong R. or its near tributary valleys we ran into *datura*, a good guide for lots wanderers.

Scoparius, broom corn.

Hyporicum, very oily, and aromatic, odor like citronella. Beautiful, shows polymorphism. High altitudes small unbranched, low shrub.

Marrubium, or white horehound, in great abundance. Thrives on dry banks size of plum trees.

Dwarf chrysanthemum. Below Hwa Lin, and other localities. Dry. Prickly Pear is a curious inhabitant. According to Edgar, they are employed as pets, taken out walking, etc. They roost unconcernedly on top of sunbaked mud walls. They were in fruit and I picked one, for six days I was occupied with picking the microscopic barbed needles out of my hands,—or rather wearing them out.

Xanthoxylum, familiar to Chinese feasts as Hwa Jiao, in favored places.

Turning from the Tong Valley up branch leading to Tachienlu, I found wild parsnip, cultivated rhubarb and anisum.

II. (1) In Tachienlu, we enjoyed *strawberries*, and rhubarb from 12,000 ft and higher on adjacent Alps.

Tame Digitalis, I found growing vigorously in Dr. Andrew's garden (Purpurea). It should do well on plantation.

Tsamba Tea, if denatured, would be a good article of diet. Its odor is borne on every wind in this largely Tibetan town.

Argot is said to exist on Grasses around Tachienlu. I saw none. Asafetida can be bought on the street in Tachienlu. Quite likely from Persia. A condiment in cooking. It may be that its herb *Conium Maculatum* is among the floral habitants of the region. There are certainly very similar plants in abundance.

(2) Leaving Tachienlu, northward we enjoyed the roses which Wilson describes, creamy, white and abundant. Red rose more sparse.

We here ate something like piecrust for bread. Officially = "GO KWEE", blessed, as a memory. It was excellent ballast, assisting equilibrium on yakback.

At 9000 ft Osier willows, white birch along the water course and its narrow verdant bottom where grain fields are tidily kept, after the fashion of river bottoms at home. Oats, barley grow well.

Water cress (= Nasturtium) occurs.

Chinese med. "San Hwa Sen" Mtn peanut in stone walls "Du Jo Lien"

"Ma Yü Dze" Poinsetta-like leaves, species Paris

"Ho Ma" Nettle, watery extract good for boils said rifleman. Use root.

"Chien Lin Gwang" watery extract for Scabies. Local anesthetic "like opium"

"Tseo Mao Dan" (Shu Yoh), Peony.

Fern on Mani stone piles = Polypodium "Niu Lai Tsao": "smell of leaves like milk".

Taraxacum officinale, and variations, in abundance.
 Ranunculaceae, Buttercups in the Ta R. Valley
 Wild geranium
 Peony

"Ho Tsao",— { Anaphalis Margaritacea?
 "Everlasting"?

Salix Populus (from which salicin), all thru Tachienlu region, called "Beh Yang Su"

"Yiu Song" terebinth (spruce?), more tamarisk-like in foliage.

Ba Yue Gwa of unknown classification. "Seeds cure children's colic after eating".

"Wild Pepper" shrub, in fruit.

San Dsao Go, an ACACIA (probably).

Hydrangeas, creamy colored. Sown horse peas in fields.

D. Phelps says "river bottom much like those in S. California".

Wilson's "Lady's Rose" much in evidence.

Red Rose 10 ft high single

Fruits: Gooseberry, Cherry, Currant.

Juniper

Fine blooming single Peonies in groves of "mountain willow" that look like olive groves.

Arum, "Jack in the Pulpit".

Laryx Botanique

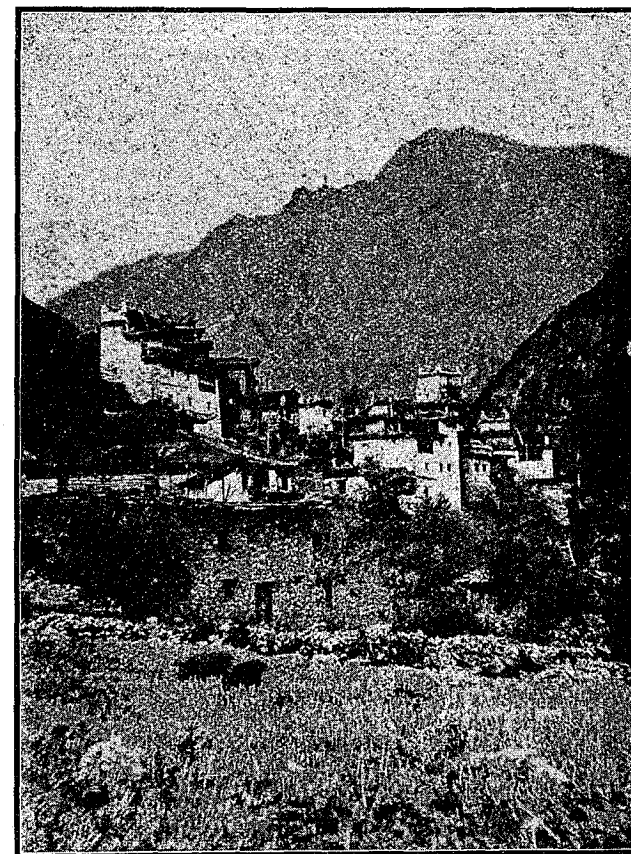
- (3) At 10 000 feet (Hsin Dien Dze) an angel entertained me unawares. This was a significant looking plant that was past its flowering, so I could not be sure, but I have since concluded that the robust family in the midst of which I pitched my tent was

Atropa Belladonna, whose tribe I, of course, was eagerly looking for. The calyx cup is unusually deep, but leaves and root are typical. I broke Geo. Helde's staff and my own, digging the great root of one plant. The root was large as my head. The next morning having gone a considerable distance, I inquired about the root. "Oh, it is back there at the camp".

The approach to the Dah Pao Pass showed a change of scene. Rank wet grass meadows over which stood sentinel the upright yellow-green seed stalks of

Rheum (? Alexandream) and watched us go by. Huge Yellow Meconopsis luxuriated here also. The others of the party were by this time on the way up the pass, and in my distraction I almost passed by; fortunately I waded into the meadow and got specimens which proved very difficult to dry, remaining wet for many days.

It is a cruel ascent, taking the life out of carriers and weak hearted travelers, to one of whom I loaned my mule, and did not see him again till the end of the stage 80 li over the Pass. This was a blessing "in disgust", however, as it gave me a good excuse for the time taken in collecting.



T'UNGKU

ABOUT 10 MILES SOUTH OF ROMI
 CHRANGO

I should here say that such an expedition is no occasion for good botanical work. Probably most of my specimens would be unacceptable in a first rate herbarium due to fading of colors caused by insufficient time for changing the presses. It is also to be said that botanizing is no summer day's picnic. It means many hours of work often late at night, changing paper and drying them over smoky fires that are usually either too hot or too cold.

We now re-entered the Tong R. Valley, the "Takin Ho," and encountered tomatoes, cultivated by French fathers, and potatoes.

We arrived opportunely to find the bloom at its best. On the west-southwest side of the pass the grassy steep is replaced, near the top, by shaly rock slides. On the border between these zones and for some distance down, the "purple poppy", so-called locally, gave us some brilliant specimens.

As we crossed over the wonderful vast sloping meadows of the other side (N. E.) altitude 14,000 feet, the Primulas, Yellow Meconopsis and Rheum were in their glory. Aconitum proved very scarce, but other members of the Crowsfoot are abundant, especially Trollius in the moist lush meadows of the great forest which one traverses for ten or fifteen miles, and which contains many gigantic trees, of which Betula, birch with red bark (otherwise just like white birch) interested me most. The larches and birches are hung with Spanish moss (usnea longissima), a striking spectacle.

K'ong K'eo Pass. Favored with brilliant weather we found a truly Elyssian display of flora in the vast meadows forming the West aspect of the Pass. The number of specimens was embarrassing with only one night to spend at the inn at Wu Li Pai well up toward the cross over.

The king of flowers here is Aconitum Napellus. He is attended by a good growth at a lower altitude of a curious black dusky aconite on a flower stalk bearing no leaves which all spring directly from the root. I have found no description of it in Strassburger or the Botany texts. This dusky type, so curious in comparison with the royal blue of the Napellum, but morphologically the same, may be the "Black Aconite" of the Thibetans.

3. Passing Mongkong we ascended Balang Shan. We here encountered heavy rains, and collecting was impeded. The Solanaceae were interesting, and the gigantic specimens of Rhubarb, with flowering stalks eight feet high, of which I got a good photograph. The Chinese corroborated the presence of Atropa—"dien chueh", specimens occurring in fruit.

Name	Altitude Place	Synonyms and use
Wintergreen	Yün Hwa Shan, 11000 ft	Gaultheria
Dipsaceae	Hwa Lin 6000	
Dang Gwei	Yün Jin 7200	
	Fei Yue Lin	Larkspur
Polypodium	Lu Ding Chiao	
Huan Huen Tsao	" " "	
Vicia		
Forget me not	Fei Yue Lin	
Fennel	Wa Sze Geo	
White Horehound	Tong Valley	Marrubium
Acacia	Tong Valley	

Name	Altitude Place	Synonyms and use
Currant, red	Fei Yue Lin	
Sedum (Beh Yeh)	" " "	
Polygonum viviparum	Ta R. Valley	Ran B'h
"Purple sage"		An aromatic
Lilium "tiger:"	Ta Valley	
Gnaphalium	Ta	
Xanthoxylum Piper	Ta	
Datura Stramonium	Tong R. Valley	Lao Lien Hwa, "poisonous"
Campanula		Pao sen, tonic, much used
Parsley	Tong R.	
Dentaria	Da Pao Shan	
Primula	" " "	
Tseo Tsao Hwa		
Peonia		Tseo Mu Dan
Tseo Tsao		With Deo Fu, for edema of legs
Usnea Longissima		"Spanish moss" Da Pao Forest
Incarvillea	Bawang	
Artemisia	" "	Tsen Ngai
Thyme	Dung Gu	Hemp
Man Orchid (Hsiang Shu) 9000	Mao Niu	Ngai Hwa
Clematis	" "	Incense
Thalictrum	" "	On dry side of mountains
"Citronella"		
Ni Bin Tsao	Mao Niu	"Jin Hwa" Hemoptysis extract hot alcohol
Chiang Ho (Yeh)		Umbellifera
"Cow Tail Medicine"		Niu Wei Chi
Bah Yue Gwa		
Sambucus Ebulus		
Malva		Dong Han Tsai
Epimedium		Yün Yang Hong: "den reo" for coughs
Tsai Fu		Nation wide use. Sze product for colds headache
Hypericum		Citronella-like odor, oily.
a Euphorbiacea?		Tseo Tao Dze, heart tonic
Convolvulus (jalap?)		
Tswei Gu	Hwa lin	Antipyret. Sedum? crassulacea
Gentian	Hsin Dien Dze	Chin Jiao
Asterias	" " "	
Ngai Tong Dze Su	Hwa lin	Tonic
Valeriana	Da Pao	
Aguilegia		
Anemone	Da Pao Forest	Wine, "5th month flower" Ague
Polygonum		Lumbago, "ran ba"
Arum	Hsin Dien Dze	"Jack in the Pulpit"
Labiatum	" & Mao Niu	Sage?

Name	Altitude Place	Synonyms and use
Juniper.		Marrubium?
Beh Hao Hao		Anti-febrile
Hwang Tsai		
Mountain Pepper	Ta R. valley	
Polypodium	Ta R. valley	
Salvia-like		Labiata, very aromatic, oily
Rheum (alexand-reum)	Ta R. valley	Da Pao meadows
Mountain peanut		Stachys?
Gnaphalium	Dapao south	
Cynoglossum	Ta R. Valley	Jin Gu
Stellaria	" " "	
Crissa	" " "	Crucifer, nasturtium
Artemisia		
Cherry	Hsin Dien Dze	Swan Pao
Arum	" " "	Ten-leaved, Ba Yue Gwa, red fruit
Corydalis		
Chu Dze Hwa		wine making ferment contained
Lao Hsiung Pao	Hsin "	
Heracleum	" "	Niu lai tsao
Pedicularis	Ta valley	
Pi Dze Hwa	" "	Clove shaped flower for cuts
Swei Hwang		San Bo Tsai, "Mountain mint"
Borage		Geh gwa hwa
Salvia		Mountain "ma liu" for gormands (leaf & root)
Sorbus		Tooth ache, anti-inflammation
Berberis		
Mecnopsis Botanini	Da pao meadows	
Iris yellow	" "	"RARE"
Primulas	" "	
Paris	" "	Du Jo Lien, for bruises
Deutzia		Beh Ji Gu teo, tonic
Aconite		Tall peaked cowl, "Pien teo hwa"
Salvia II		Large leaved
Soldanella	Da Pao Meadows	
Trolius	" " "	
Saxifraga		Tse Chien Hwa, eye med. Infusion
Epilobium	Ta R. Valley	Ma Yü Dze infusion: bruises
	Dsung Gu Valley	Yen San Fong, species Angustifolium
Gentian II	Dapao Forest 10,000	Small leaved
Long Dan Tsao	" "	Dragon Gall
Valeriana	" "	species "dioica"
Labiata Shrub.		Very aromatic
Cucurbitum	Mao Niu et al.	Chien Li Gwa, 1000 mile gourd
Cassia		

Name	Altitude Place	Synonyms and use
Acacia		
Acer		O Dsang
Salix Populus	Tong Valley	Beh Yang Liu
Valeriana 88		
Fennel		
Phaseolus		Yeh Deo Dze
Swei Beh Dze		Smallpox antiseptic
Spirea	Mao Niu	
Sedum		I Dze Jien for boils.
Primula 70.	Dung Gu	New? species. Leaf dentati- form
Lamium album	Tong Valley	
Viburnum		Chen Tsen Su
Vicia III		Fresh wounds, Dao Keo Yoh
Stachys		Mountain Peanut
Geranium		
Primula IV	Ta Valley	Dea Dsan Hwa
Medicago	" "	
Jiu Niu Tsao		8-ft tree, bruises poison
Orchid III	Mao Niu	Tsen Pan Tsao, wounds
Salvia		Hong Mi Hwa
Ma-T'i-o	Mao Niu	Tonic
Dipsacea	Romi	Cliff
Chrysanthemum		Dwarf, "hwa gwang"
Chu Dze Tsao		Lavandula?
Cuscuta		Parasite, "motherless vine"
Hwang Geo Jin	Chango	Incense
San Lin Go 167		Acacia-like
Tobacco? 165	Bawang	
Physalis		Solanacea, "hong gu niang"
Hippophae		"swan swan tsao", mountain willow
Polygonum	Bawang	vegetable
Leontopodium		134
Sticta		lichen on tree
Philadelphus		
Rosae	Ta valley	
Chelidonium	Tong valley	
Chalstephus		Sinensis Holly hock, Chi-pan-hwa Tonic
Orobanche		Catnip-like labiate
Solanum Tuber		Potato (cultivated)
Euphorbia Helioscopia		Ring worm
Du Ho		
Rheum IV 93	Dung gu	
Fagopyrum		Buckwheat red and white
Bitter Gourd		Yeh K'u Gwa
Orchid		
Hemp		Yeh Su Ma
Atropa bel.	Hsin Dien Dze	} Past flowering season. } Berries present.
" "	Ba Lang Shan	

Name	Altitude Place	Synonyms and use
Leguminosa	Kong Keo Erh	Large rotund leaf.
Dang Gwei		Tonic, costly
Alsine?		Hsueh Lin Dsi. Panacea genito-urinary
Meconopsis II		Tall flowering stem multi- flor.
Colchicum? 36		Fu Seo Sen. Tonic
Aster		Ban dao dsen. Cardalgia
Fritillaria		Roylei, first among Cough Cures (Bei mu)
Small Ma Tu O		Ligularia? Bruises
Arnica? 40		Incipient Boils. Di Din Tsao
Gao San (Aconite?)		Low, blue cluster
Veronica		
Pseudo-Lonicera, Leonurus S., Impatiens, "wild cotton", Anemone,		Repeat Valeriana, Gnaphalium, Hsiang hsiang tsao, 141, Ane- mone, Salvia, Borage, Swertia, Spiraea, 4, Thistle, Mu Hsiang, long narrow leaf Orchid, Sa Sen Tonic (Campanula), Primula V, Pedicularis, Allium (wild onion)
Aconitum Napellum in vigorous profusion at 15,000.		
Delphinium succeeds aconite at 12,000 to 10,000 feet, and this is suc- ceeded in turn by a large salvia like labiate. This order is followed faithfully on all the passes.		
Delphinium is called "Fu Tswang tsao" application for sores.		
Artemisia, Chiang Ho, Du Ho. LAVANDULA? or primula.		
Chiang Ho is brought out in enormous quantities as medicine, both for export and domestic consumption.		
Pao sen (campanula)		
Repeat Dentaria, Corydalis. Sedum. Sausuria. Polygonum. Spiraea		
Potentilla. Repeat "Buddha's Hand. Deutzia. Astragalus.		
Military Orchid, also Man Orchid. Repeat Gnaphalium		
Ribus, "Lao shiung pao" for bruises		
Hsuen tsan, "snow tea" for eye wash		
Euphorbia. Used for Boils.		
Incarvillea reappears at 8,000 and lower.		
Scutellaria Alpini. Repeat "Fu seo sen" = Buddha's Hand Tuber, Tonic (an Orchid)		
Parnassia, Lao Bin Yoh for phthisis,		
Sausuria is used as emmenagogue. (Hsueh hwa)		
Datura Stramonium reappears in neighborhood of Tong Valley		
Epipactis and Sibbaldia		
Campanulaceae vary from time to time.		
Wu Jia Pi 145		
Rheum II, grass meadows of Kong Keo Erh, deep-dentate 1-ft long leaf		
Rheum III, Smaller Leaf		
"Lao Bao Dze Yoh" very poisonous (corydalis)		
Tseh Lan for arthritis, alcoholic extract, much used		
Pedicularis shows fine large specimens		
Repeat Stachys, Physalis, Allium.		
Euphorbia Lactifer		Lapidium 8/5
Chenopodium		
Rhodeola		

ON THE BALANG SHAN:

Atropa at 15,000. Veratrum (Album?)
Rheum Gigans at 14,000-15,000. Flower stalk 8 ft high: leaves 2-ft
diameter.
Wu Bei Dze
Repeat Polygonatum, Hsueh Mu, Blood tonic, Du Ho, Umbellifer
Opium cultivated in large quantities west of Mong Kong.
Aruncus, Myosotism. Repeat Artemisia, and labiates. Aromatics.
Repeat Dentaria. Vicia. Triticum. Astragalus.
Dianthus Superbus.
Solanum.

ON THE NIU TEO SHAN:

Calama Grastis. Geranium Much Larger as others due to moisture
Repeat Viburnum, Berberis, Rubus, Prunus, Ribus, currant black
Carnus. and red
Henbane Burdock
Corydalis is of wonderfully wide distribution (Dr. H. Smith)
Salix (rotifolia) spectacular foliage
Euphorbia III. 157 Repeat: Salvia, Viciae abundant, Chrysanthemum,
Hyoscyamus Niger Repeat Dianthus. Thalictrum. Pedicularis
Solanum
Aster, candelabra-formed. Repeat Gnaphalium, Corydalis,
Delphinium
Arabis Crucifera, Ficus. Viburnum (prunifolium)

There are many unidentified plants, and the writer plans to
continue the survey. A Chinese assistant is engaged to gather
specimens during the two flowering seasons during furlough, after
which it is hoped to do intensive study of a given section.

Notes on Szechuan Geology.

C. L. FOSTER

We who have travelled thru the gorges of the Yangtse into Szechuan have seen striking evidences of the forces acting on, within and around this earthly home of ours. In the gorge region so much history in space of time is compressed into so little space in distance that we are likely to miss the inner significance, while admiring the outer charm of the scenes around us. In the Gorges the view is confined to a few hundred feet horizontally and about a mile upward. When we get beyond them we can see the mountain landscape unfolded before our vision and can appreciate a little more fully the work that has been wrought by the hand of Nature in fashioning the hills, carving the river channels, tilting and folding up the surface.

The geological history of Asia in general, and of China in particular has been outlined by Bailey Willis (Research in China, V. 2; Carnegie Institution, Washington, D. C.). The purpose of this paper is to outline in a general way the sequence of events in Central Szechuan. Data dealing with this area is limited at best, and for the most part is at this time inaccessible to the writer.

It has been the privilege of the writer to traverse the region surrounding Mt. Omei, sacred to Chinese Buddhism, in a more or less casual manner. Some of the resulting impressions are hazy and uncertain, but a few stand out strong and clear. Among the uncertainties is the question of the age of the strata under consideration. One of the strong impressions is that crustal movements of considerable magnitude were in progress at times during the deposition of the 10,000 to 12,000 feet of sediment in the district immediately surrounding Mt. Omei.

It may be well to begin with the section of the mountain as observed on one occasion. Lying at the base is a series of rocks of igneous origin. The eroded surface of this formation dips in a general southwest direction at about 15 to 25 degrees. One of these rocks is a coarse gray biotite granite. It lies exposed in a stream cut some 200 feet deep just North and East of a small ravine known to the local foreign community as "Granite Gorge". It is seen again in the lower and intermediate slopes of an eastern spur of Mt. Omei known as Si Chi P'in. The rock weathers readily, and the small streams from the mountain have cut it out to a width of several hundred feet where they come together. It is not found as large boulders far from its source of origin, but small fragments are carried for some distance by the streams. It seems to have been intruded into an older mass of porphyry, the groundmass of which is heavily impregnated with hematite. The phenocrysts are evidently of feldspar, and range from $\frac{1}{4}$ to $\frac{1}{2}$ inch in length, and are about $\frac{1}{8}$ inch wide. This porphyry

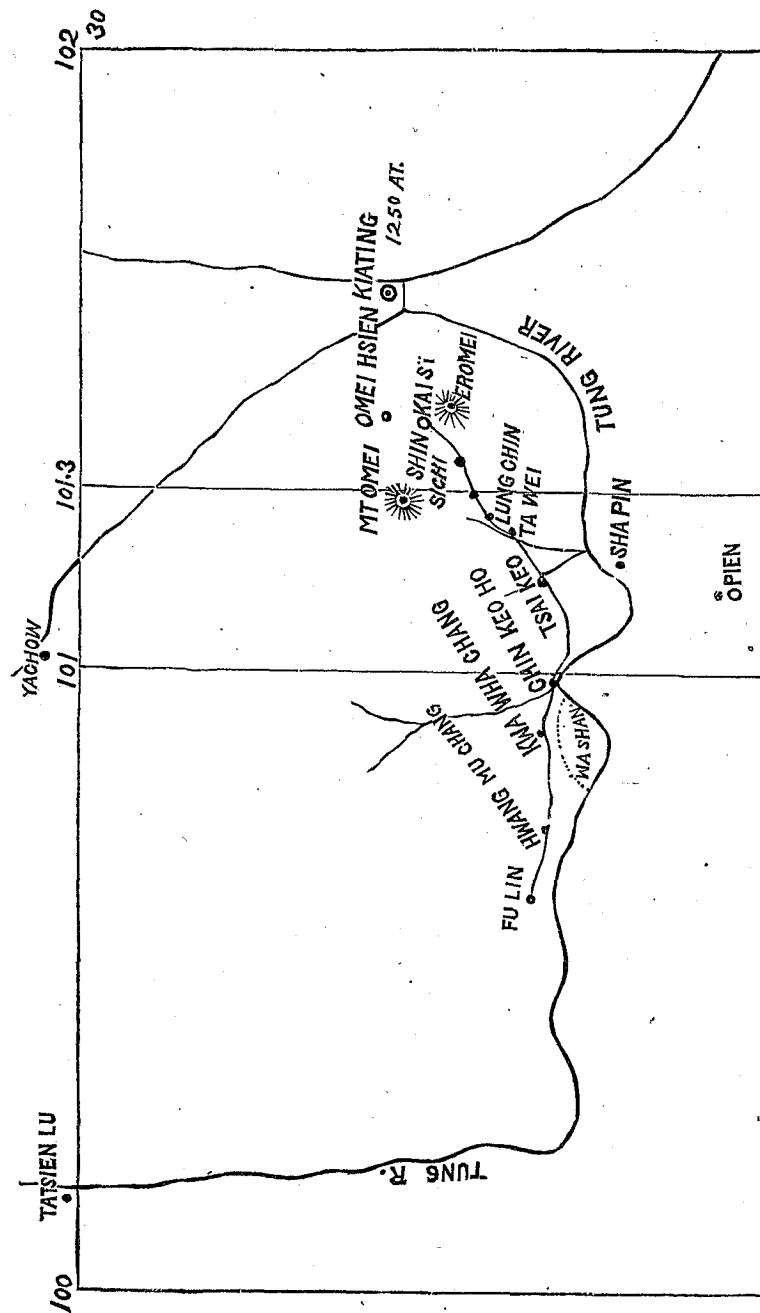


FIG. 3.—SKETCH OF ROUTE SHIN KAI SI TO WA SHAN

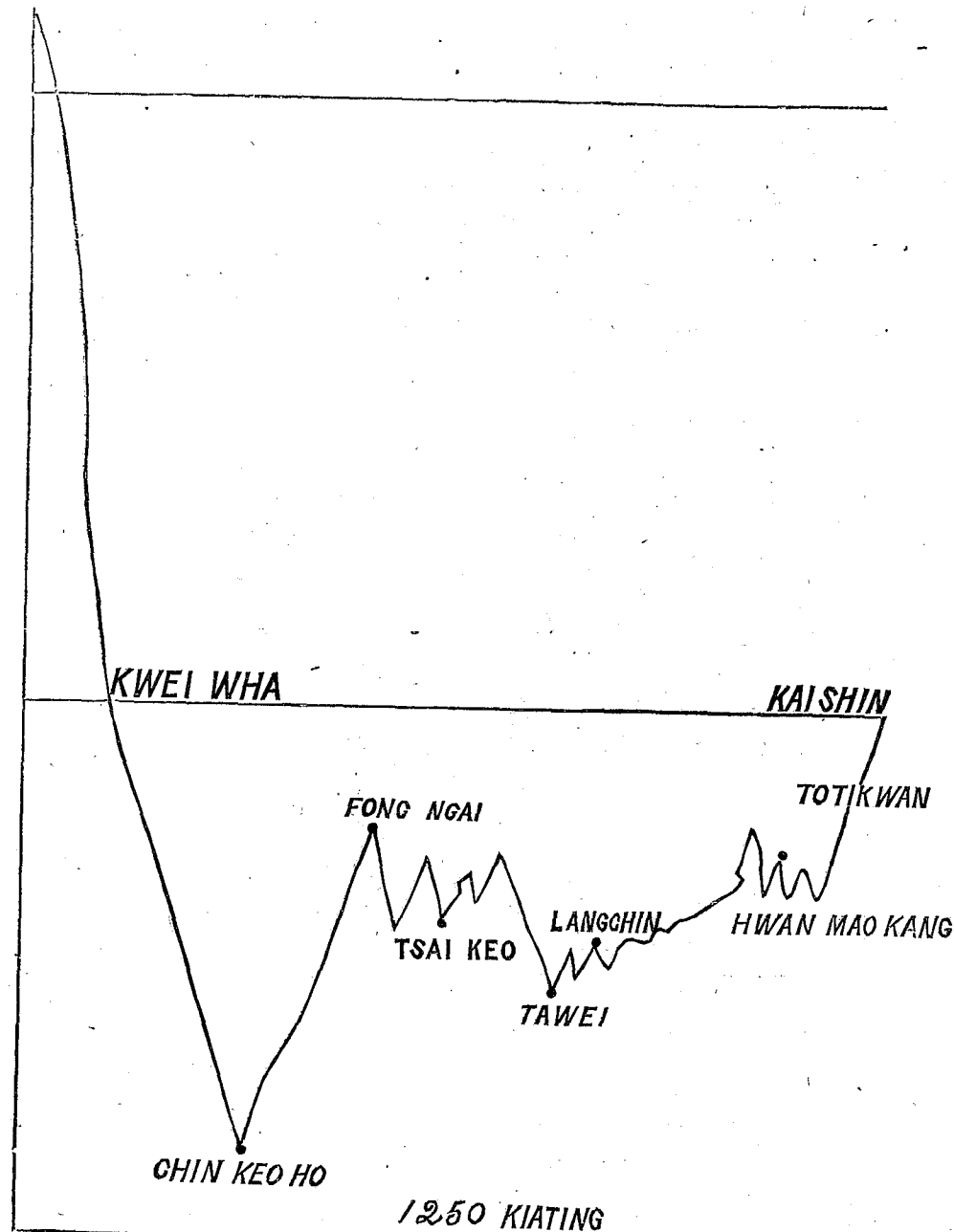


FIG. 2.—ROUTE PROFILE WITH ELEVATIONS

outer surface of the phenocrysts is, as a rule, stained a malachite green or an azurite blue. Above this coarse porphyry there is one with smaller phenocrysts, and having a large proportion of hematite, as mentioned in a preceding paragraph. This brings us to the top of the great cliff of Omei, near the Chin Tin Temple. A little to the south of the temple there is a small exposure of columnar basalt, very dark and fine grained. These two top-most formations evidently belong to a surface flow, the more deeply buried mass forming the larger phenocrysts and that cooling nearer the surface being finer grained. The lower part referred to as porphyry would perhaps better be called amygdaloidal, while the top portion is so fine-grained as to be microscopic. The whole seems to have been part of a great surface flow, the extent of which has not been determined.

Basalt of similar character occurs at the foot of Er Omei, some 9,000 feet below, and it has the same relation to the amygdaloidal porphyry as at the top of Omei. The fracturing of the crust in this region has permitted vertical movements of some size to take place, and the basalt and porphyry at the foot of Er Omei are in juxtaposition with limestones and shales. 1,500 or 2,000 feet up the slopes of Er Omei the porphyry has been weathered, and the amygdaloids are thickly scattered in the fields. Those picked up here cannot be distinguished from those collected on Wa Shan, the Chin Tin (Mt. Omei), and in the T'ien Ch'uen region to the northwest of Yachow.

No sediments lie above the igneous rocks at the top of Mt. Omei, unless a clastic formation on the north side of the top should prove to be of sedimentary origin. It seems rather to be a pyroclastic. Its relations are indicated in the Omei section (Fig. 2).

Near the base of Mt. Omei the porphyry seems to have been intruded beneath the red shales, giving them a baked appearance, as between Ta O Si and Flying Bridges, and near the foot of the Shin K'ai Si spur, at and below the Tung family.

The history of Wa Shan seems to be similar to that of Omei. The chief difference lies in the fact that the top of Wa Shan is covered by a lava that has small amygdaloids instead of the porphyry. The lava here seems to have cooled rapidly and formed a scoriae at first. Later infiltration has filled the cavities with agates coated with malachite, but very small as compared with those at a lower level, which are like those near the top of Omei. The total thickness of the igneous rock at Wa Shan is about 2,000 feet. While it cannot be asserted positively, it is thought that Wa Shan was the outlet of a volcano in ancient times. The central portion of the mountain rises gradually above the rims of the horst, and at its center there is a yellow sandy, loose material that may be a broken down spine.

About five miles north of the Omei spur known as SE Chi Pin is another known as Shin K'ai Si. This is one of the foreign summer resorts for this region of Szechuan. It reaches an elevation of about 5,500 feet. Reference has already been made to the occurrence of porphyry on this spur, intruded beneath the red shales which have been tilted and baked by it. A fault at the east foot of this spur brings vertically bedded limestone against the tilted red shales. Fossils have not been collected in this section. But near the top of the spur, especially near the bungalow known as "Rocky Roost", several have been gathered. Those most common there are Productus and Bryozoa.

The Productids are of several species, and are at least similar to cuts and descriptions of

P. viminalis
P. burlingtonensis
P. arcuatus
P. semireticulatus
P. ovatus

The Bryozoa may be compared with

Fistulipora waageniana
Fistulipora sp.
Fenestella sp.

One *Zaphrentis* sp. was found.

At lower horizons were found the ones noted below :

Schwagerina sp.
Leptodus sp.
Cystiphyllum sp.
Cyathyphyllum sp.
Syringopora sp.

In a clay bank at the rear of the church were found :

Euomphalus sp. Crinoid stems
Cyclonema sp. Foraminifera sp.

This material was no doubt weathered from above and washed in here.

About five hundred feet below the top there is a red quartzite sandstone tilted at about 60 degrees to the S-E. In contact with it at an angle of 10 to 15 degrees is a gray shale which has some fossils, as *Monograptus*, *Orthoceras annulatum*, and a few diminutive brachiopods. Above this gray shale is a red shale much discolored by limonite, and rich in trilobite remains. Data at hand do not seem sufficient for definite determination. One glabella appears to belong to *Homolonus*. A nearly complete outline with hypostoma and one eye may be a species of *Phillipsia*.

The limestone and shales of the upper part of the Shin K'ai Si series are rich in carbonaceous matter. In certain horizons it crumbles like sawdust when wet.

The above assemblage of fossils suggests that the sediments of the Shin K'ai Si region were deposited in the seas of late Carboniferous and Permian time, and perhaps to some extent in the seas of the early Mesozoic. The red shales and sandstones lie 1,000 to 3,000 feet below the top. In the fracturing, folding and elevation of the region Omei was thrust up above its surroundings. Possibly a counter movement occurred on the flanks, and the area between the Min River and the foothills near Omeih sien was thrust down. This gave the streams new vigor, and the renewed power enabled them to erode rapidly and the material was brought down and laid in the basin formed between Omei and Kiating. The tops of the old mountains composed of Permian or Carboniferous Sediments now stand but a few hundred feet above the T'ung and Ya Rivers, while the Omei horst stands 9,000 feet or more above.

Wa Shan

Scale: 1 inch equals 10 miles

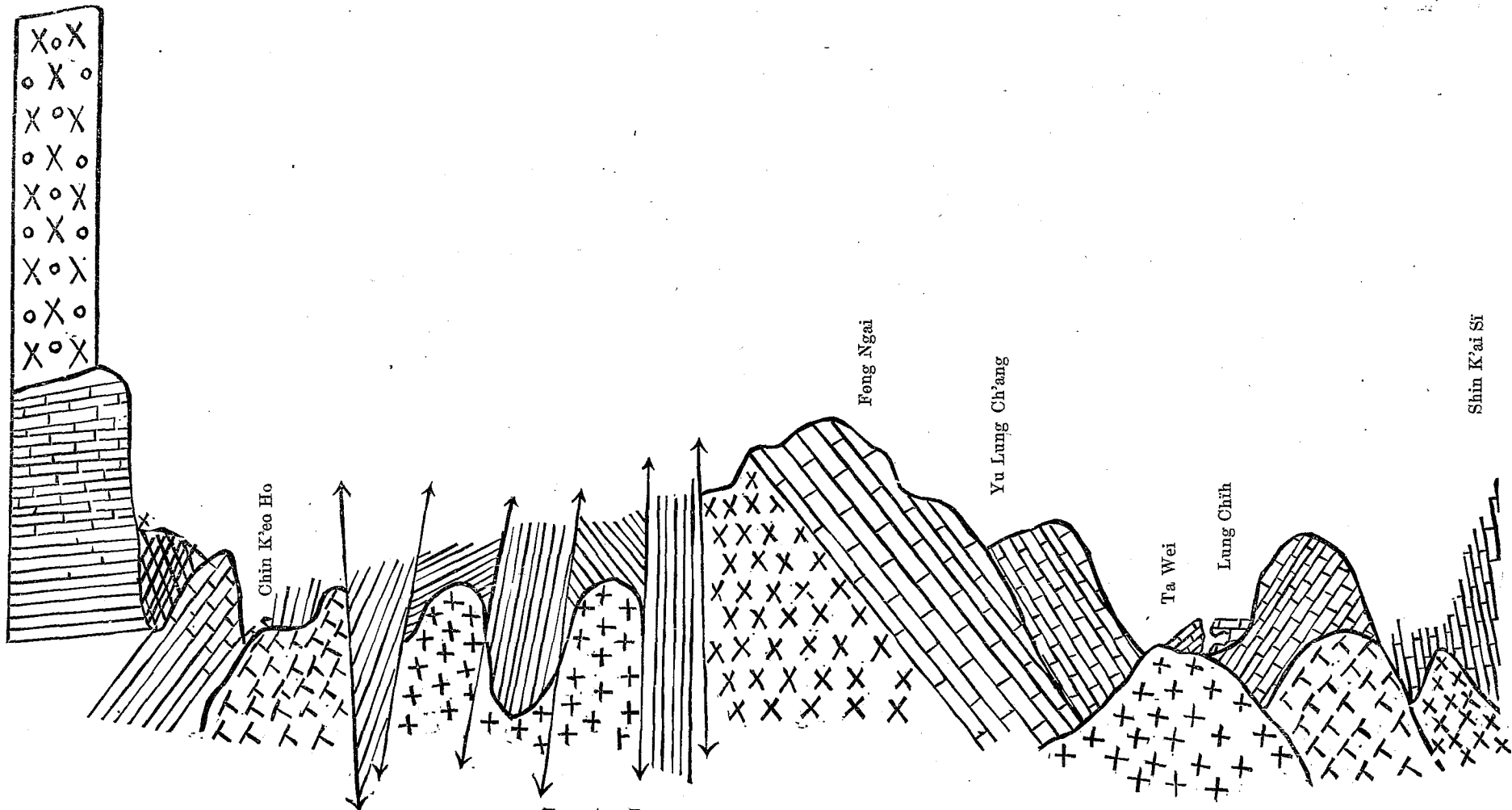
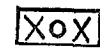

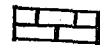



FIG. 4.—PROFILE FROM SHIN K'AI SI TO WA SHAN

-  Igneous Rock
-  Limestone
-  Sandy Shale
-  Limestone

Other points in Szechuan that seem to be related in time and physical conditions are to the North and West of Yachow. In a gorge of the Ya River 15 li above Yachow there is faulting and tilting of the red shales and sandstones. The section (Fig. 7) will make clear the relation.

Conglomerate is present here in four places. If our interpretation is correct, the rock of all four belong to a single stratum. The pebbles in this are mostly quartz, and the groundmass is red debris of the eroded red sandstones.

About 30 miles to the North of the Ya Gorge is a gorge near Shuang Ho Ch'ang. The red shales tilted about 30 degrees to southeast lap onto a conglomerate about 3,000 feet thick. It is composed of boulders not exceeding two feet in size, rounded, and cemented with calcium carbonate. Near the top the material is finer, the pebbles averaging about one or two inches. Both fine and coarse ingredients are almost wholly limestone fragments. The cement of the finer part contains argentite and malachite. At one time these minerals were extracted. The fact that they are not now worked probably means that the amount of mineral is too small to make it worth while. This conglomerate is burned for lime. The minerals were first noticed by the Chinese in the debris from the lime kilns.

A light gray or black and white fine sandstone lies below the conglomerate. Coal deposits are associated with this sandstone formation. This conglomerate may be the shore deposits in marginal seas during the transition period of the Permo-Mesozoic. At least it shows a change of conditions from low-lying swamps to lands that gave fall enough to the streams to carry fairly coarse material.

About 10 miles northwest of Shuang Ho Ch'ang is a market town called Lin Kwan. Limestone abounds there, rich in several forms of coral, including *Favosites* sp. A few miles north of Lin Kwan the sediments give way to igneous intrusions. These culminate near Mu P'in, about 15 miles to the North in a coarse gray granite, very similar in texture to that at Hwang Ni P'u at the southern side of the Big Pass (Ta Shiang Lin).

From the above notes, incomplete as they are, we may assume that the great intrusions of central Szechuan are not earlier than Middle or Late Mesozoic. The wide distribution of conglomerate, while it does not demonstrate glacial conditions, in the absence of striae is suggestive of great changes in the capacity of the streams to move the debris brought into them. It is possible that these changes were altogether due to the crustal movements that brought to a close the conditions that favored limestone deposition.

Location of Snow Mountains

G. G. HELDE

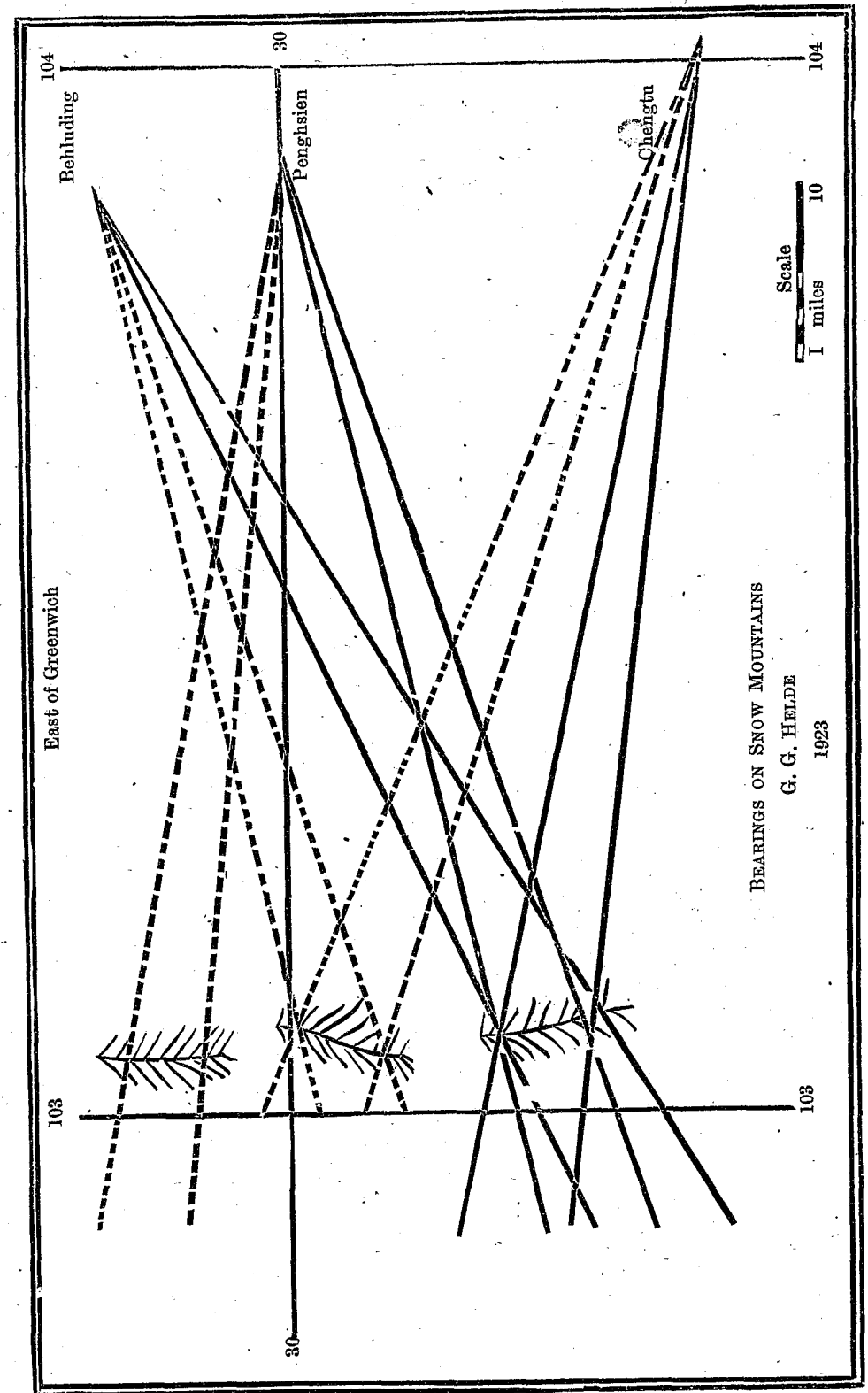
Considerable interest has been shown in the location of the snow peaks which are frequently seen from Behluding, one of the summer resorts in Szechwan, and occasionally from Chengtu. A fine view of them was obtained from Chengtu on the morning of May 28, 1923, and at that time their bearings in relation to the magnetic north were taken. Two masses of peaks could be seen, the southern one lying between 8 and 13 degrees north of west, and the northern one between 18 and 23 degrees north of west.

On the morning of June 5, 1923, two groups of peaks were seen from a point about a mile outside the small north gate of Penghsien, and the bearings taken. Reference to sketches made of the mountains at Chengtu and Behluding show that the northern group seen from Penghsien is not the northern group seen from the other two places. The bearings for Penghsien of the southern group are 12 to 8 degrees south of west, and of the northern group, 7 to 12 degrees north of west.

A week later, the same mountains that were seen from Chengtu were seen from Behluding, and the bearing again taken, giving three different observations of the southern group and two of the northern. The group still farther north, and seen from Penghsien, is hidden from Behluding by the nearby mountains. From Behluding, the bearings of the southern group are 24 to 30 degrees south of west, and of the northern group, 12 to 17 degrees south of west.

The latitude and longitude of the three points, Chengtu, Penghsien and Behluding were obtained from observations made some years ago by French scientists, and were further checked for direction by bearings taken of Behluding from Chengtu and Penghsien. These three points were used as the ends of two base lines and the bearings plotted on the map made by the writer after two trips, one from Kwanhsien north to Weichow, west and northwest over the Hung Ch'iao Pass into the Shao Chin Valley, south to Mongkung and east to Kwanhsien; the other, from Yachow to Tachienlu, north over the Ta Pao Pass to Romi Chirango and Tsung Hua, southwest over the Kung Ko Er Pass to Mongkung, and east to Kwanhsien. In drawing the map, it was checked by figures given in Wilson's "A Naturalist in Western China" which gives the latitudes and longitudes of Chengtu, Ya Chow and Tachienlu. Use was also made of the observations of the French scientists and Fergusson.

The lines showing the bearings of the southern group cross at a point about fifty miles west of Kwanhsien, the mountains being north of the Ba Lang Pass on the road between Mongkung and Kwanhsien. The northern group is in the same range about two



miles farther north, and the group seen from Penghsien still another ten miles to the north. This range of snow mountains has been seen at close range by the writer when crossing the Hung Ch'iao Pass, again from the west from the Shao Chin Valley, and again from the south from the Ba Lang Pass.

Notes on the Primitive Religion of the Chinese in
Szechuen.

D. C. GRAHAM.

Near Suifu on the Yangtse River is a small temple known as the White Stone Temple. (白石廟). Originally there was only one large, white stone, taller and whiter than the others. People began to worship it, and ascribed to it the power of healing. Later a temple was built around it, and the more common idols were added. The stone is still worshipped, and for a few cash one can purchase a tiny bit of the rock, which will cause him to recover from illness if he will grind it to sand, soak it in water, and then drink the water. No phallic worship is evident in connection with the white rock. Probably the process began with the natural sense of awe aroused because of the size and whiteness of the stone.

South of Suifu is the town of Shuin Gien Si (巡檢寺). Near this town is a man who runs an oil factory. He has some big, fine bulls run the stone rollers. He has prospered, and the value of his bulls has increased. About two years ago the owner burnt incense to the biggest bull and worshipped it as a god. In this man's experience we have illustrated the history of many primitive tribes, such as the Todas. The animal on which the welfare of the tribe most depends becomes sacred.

Probably the essence of the popular religion of the Chinese of Szechuen is belief in and fear of demons, which cause pestilences and do all kinds of harm, and the attempt to protect oneself and others from the demons and guarantee happiness and prosperity by means of magic and charms, and the influence of idols and priests.

Last summer some missionaries asked the abbot of one of the Buddhist temples on the summit of Mt. Omei to preach Buddhism to them. He began, "We Buddhists believe that there are hundreds of demons in the world who are constantly doing harm, and that protection must be found against them." Many of the idols are revered by the Chinese because of their power to drive out demons. Some of the ways in which exorcism is accomplished are, throwing round biscuits (撒齋糰), sprinkling holy water (洒水), imitating the crow of a rooster, setting off firecrackers, and pasting up, wearing, or burning charms. In some villages south of Suifu geese are kept because it is thought that their cries frighten away the demons.

The Ch'uan Miao of Southern Szechuen.

D. C. GRAHAM.

Directly south of Suifu, near the Yunnan border, are several thousand aborigines known as Ch'uan Miao (川苗). The women wear short skirts instead of trousers, and do not bind their feet. The men resemble the Chinese more closely than they do the Lolos. Most of the people are farmers, and they live on high hills, the lowlands being cultivated by the Chinese.

The music of the Ch'uan Miao is attractive. There are a number of folksongs that relate the legends of the tribe. The tunes of these songs bear a slight resemblance to the chants often heard in Christian worship. The instrumental music lacks the harshness so evident among the Chinese, and is really pleasant to hear. Especially interesting and attractive is the Luh Sen (六笙), which has six tubes. When it is played the musician performs a dance much like that of a Scotch bagpipe player.

We have found no evidence of the existence of tribal gods, unless their ancestors may be considered as such. Ancestor worship is thought to be original with the tribe, but even this shows marks of Chinese influence.

An old legend states that formerly the tribe buried its dead on their backs with their heads to the east. This was because their ancestors came from the west, and in order that the deceased, on coming to life, could rise with their faces to the west and go directly to the land of their ancestors. However, some of these Miao assert that the tribe migrated to this place from the Province of Canton.

One Miao family has several members whose complexions are light, and a nine-year-old boy who is a regular towhead. His hair and skin are lighter than is the case with most white children, and his eyes are a light blue or grey. I am told that albinos generally have pink eyes, so that this boy is probably not an albino.

It would be well worth while to make a more thorough study of these people, especially those who live further south and have had less contact with the Chinese.

Smithsonian Institute

In the Proceedings of the National Museum of Washington, U.S.A., No. 4, 1922, Rev. David C. Graham, one of our charter members, is given credit for the discovery of three new species of bees:—

1. A species of the *B. mastrucatus* group: two females from Suifu, W. China:
2. *Xylocopa orichalcea*, Lepeletier, from Suifu, West China.
3. *Spechodes Grahami*, new species from Suifu, W. China. Mr. Graham has been honored for his painstaking work by having this species named after him.

Also from the Biological Society of Washington, Mr. J. H. Riley states that among birds, Mr. Graham has also discovered a new variety of *Dryonastes* near Suifu. It is called after him, and known as the *Dryonastes Grahami*. At the Smithsonian Institute this specimen is catalogued, *Dryonastes Grahami*, sp. nov. Type, adult male, U. S. National Museum, No. 257, 204, Shin Kai Si, Mount Omei, Szechwan, W. China, July 6, 1921. Collected by David C. Graham.

We congratulate Mr. Graham on his well-deserved honors.

The White Stone

J. HUSTON EDGAR.

The white stones occur from Tatsienlu to Kanze in the Hor country, and are used as

1. The capping stones for walls and corners of houses
2. Culminating points of religious mounds and shrines
3. They are worked in walls as oxheads and other designs
4. And are objects of worship in Kanze city.

The designs have already been sent to the Society with notes. In and around Kanze white fragments on *mani* mounds are quite common and occasionally lines of them may be seen on the plain. In Kanze a conical stone, apparently white quartz, is an object of worship on the street. It is a "Tibetan Idol" known as the "Lord of the Earth", or "God of the Region" (*Sa Bdag* = Chinese *t'u-di* 土地), but

the Chinese have built a shrine over it and strips of paper with Chinese sentiment adorn the sides and *mani* inscribed stones decorate the roof. It is said to be most uncanny (*wai*). In quite a different place we witnessed a peculiar ceremony in which fragments of white stones played a part. The lamas had predicted a severe earthquake in Kanze and sinners of all classes had been confessing sins and doing penance therefor. A pile of stones in the form of a thin wall, slightly off the perpendicular was built against the *mani* mound. About four feet high it was capped, with a fragment of quartz or inscribed slate or sandstone. At the sides, sometimes, were flat slabs of the former material. The devotee, facing the lamasery and his shrine, went through a process of stimulated prostrations, touching the white stone with the head, and the others with the chest, while the two hands slid along the smooth slabs if there. Just what additional value the quartz or the *mani* inscribed stone gave to the performance I did not learn, but in these regions both are powerful talismans for warding off calamity. The bleached bones of an oxhead are sometimes placed in positions usually occupied by cones of white quartz, and I have seen one with the norms intact topping a *mani* mound. The accompanying figures of yak are copies of house talismans (?) done in white lime wash. There were other designs—conch-shells, swastikas, shrines, etc., but these yak seem to be of special value. They are copies of drawings made by the owner himself. The grotesque and bad drawing may be intentional—caricatures in fact.

Note Accompanying Sketch of the Gang Ka.

J. H. EDGAR.

The enclosed sketch is an attempt to give an idea of the Gang Ka, which I understand General Pereira suspects may be higher than Mount Everest. This peak may be seen from the Chengtu plain and even from Meichow. The thought in my mind is that this peak may be 30,000 feet. The sketch is taken from Ying Kwan Chiai looking East. When on a plateau of 15,000 feet I had a wonderful view of a great frontier arc say of 90 degrees, studded with many peaks over 20,000 feet, but this rises so far above the 15,000 feet plateau, and even the snow line (18,000) that nothing but a scientific measurement will make me relinquish the 30,000 foot hope. To the North along the arc is a group of four other peaks of extraordinary altitude and bewildering grandeur, but far behind the heavenward thrust of the Gang Ka.

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HOUSE PAINTINGS OF YAK, DONE WITH LIME

(see page 58)

Notes on the Kiating Caves and Buddha, with
Suggestions on the Origin of Litholatry.

J. HUSTON EDGAR.

The following notes from the Kiating History may be of interest. The first deals with the caves in the Kiating and other districts; the second gives some information about the great Buddha in the cliff below Kiating city; and the remainder deals with early Semitic litholatry.

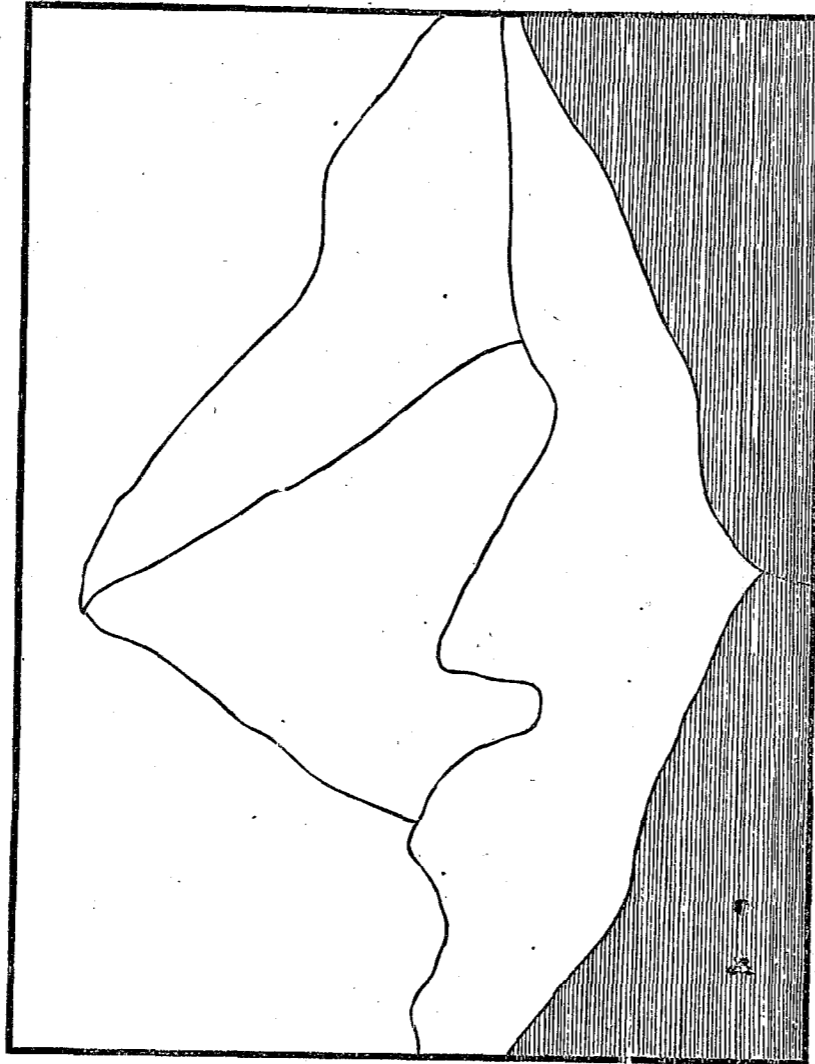
I Translation—

The caves of the Liao people. They made caves by tunnelling into the mountains. They are found in the hills around. Some of the caves are several fathoms deep and others several tens of fathoms. Tradition says they were dug by the Liao people between the Chin (or Hsin) and Song (Liu?) dynasties (265 or 477 A.D.).

人丈洞山獠
所者數谷人
鑿。傳。丈往洞
也。深。往。鑿
。音。有。岩
。宋。至。之。爲
。間。數。之。洞
。獠。十。有。

2 During the reign of K'ai Yüen (713-741 A.D.) a priest made the great Buddha, height 60 ft.

3 Under Asherah, Dr. James Orr, D.D., says, "... the trunk of a tree or a cone of stone which symbolized Asherah was regarded as a Bethel, or 'house of the deity' wherein the God was immanent. . . . The trunk of the tree was often provided with branches. . . ." It is worth noting that very often in connection with the white cones of quartz, portions of pine or spruce are set up to represent small trees. I have noticed this custom as far apart as Lifan and Litang. Again, under "Ashtoreth", Rawlinson assumes this goddess was the female principle in Nature. She represented the Moon and bore the head of a heifer with horns curving in a crescent form and became sometimes the Astarte of two Norms. She was a Phoenician goddess. Asherah and Ashtoreth were probably the same objects of worship in Babylonia originally. This being so, and assuming a Semitic origin of the frontier litholatry, the separation must have taken place when Asherah and Ashtoreth were one deity, perhaps before Abraham left Ur. of the Chaldees. The inherent phallicism and the title "God of Heaven" applied to the white stone cones or pillars, clearly indicate the very ancient attitude of an early people towards the stones and crescentlike norms. Needless to say, Chinese history assures us of the existence of these tribes on the frontier from the most remote times.



THE GANGKA FROM YING KWAN CHIAI

The Story of the Nya-Rong (Chantui)

J. HUSTON EDGAR.

Until 1911 a strip of country, Chantui or Nya Rong, was ruled by a high functionary from Lhasa known as the "Spyi-Kyab" of the Nya Rong, a title which means Governor-General. As the most eastern point of this region was only about one hundred miles from Tatsienlu, and as it was really detached from Tibet proper, the Lhasa claim seemed somewhat of an enigma. And as time can only add to the mystification, the present even meagre information may be of interest. My sources of information are dictionaries and old frontier inhabitants, especially one aged gentleman of sixty-eight years.

1. The Nya Rong are Horpa and have been divided into eighteen tribes. Regarding the etymology of the term "Hor" we are quite in the dark. It is a very ancient designation for tribes of Turkish origin and may be traced in such terms as "Ti Khara", "Tu Chüch" and even our word "Turk". But before we accept this suggestion as proof of racial identity, it is well to remember that Ta Hsia (大夏), the Han Dynasty name for Graeco-Bactria, is also a corruption of "TuKhara", and a famous conquest or inroad into Tibet about 270 A.D. (?) of sojourners in India known in Chinese histories as Enah I'eh K'o Keh may be ascribed to the same "Tochari". But neither the Graeco-Bactrians nor their conquerors the Yüeh Ch'i (月氏) were Turks in the present day sense. Indeed Sze-Ma-Chien would suggest what Schuyler hints at—a Gothic origin. Then owing to their occupation of Graeco-Bactria we must assume a considerable addition of Greek blood before their hordes swarmed into Northern India; and by the time Lhasa was reached a further modification by Aryan blood must be suspected. The question now is—Can the Szechwan "Hor" be in any way the descendants of the old "Tochari" modified by a sojourn in both Bactria and India? We hesitate, but point to the etymology of the family name; to undoubted Greek types; and to a statement in a late geographical journal that an inroad of Graeco-Bactrians entered northwest Szechwan about the beginning of our era.²

2. Until about sixty years ago the Chantui Horpa were independent of China and Tibet. That implies they were professional brigands and a general nuisance to everyone. About this time a chief united the Tribes of Chantui and losing all ideas of proportion imagined himself one of the great monarchs of the earth. His name was Kong Pa Long Chia. During the halcyon days of this swash-buckler a sister of the reigning king of Chagla was given as wife to the powerful Prince of Derge. The King of Chantui, hearing of her accomplishments, and no doubt aware of her beauty, sent an army of his desperadoes to abduct her. This they did, and the outraged lady entered the harem of the outlaw king. But robbing

caravans was one thing, and abducting queens, the daughters and sisters of kings was a different matter. And as a consequence of Chantui's undiplomatic action we had the programme of Troy enacted on a small scale. In this case the girl's brother, the king of Chagla, became the champion and went out gaily to exterminate the abductor of queens. But just here the Trojan parallel breaks down, for the man with the righteous cause was soundly beaten and his unfortunate forces subjected to unspeakable atrocities. What Derge was doing in the meantime we have no information, and if China sent help it was to no purpose, for the wicked man of Chantui remained the victor. But Lhasa was alarmed and, no doubt anxious for the friendship of Derge, sent out an army under one P'un-Rog Pa, who by some means conquered Chantui³ and sent him a fugitive to the unsubdued Golos. The princess was sent back to her husband and P'un Rog Pa put the subdued territory under Lhasa whose satraps specialized in misgovernment for one generation or so.

3. About twenty-five years ago, however, an important section of the population rebelled and fled into the territory of Chagla, China's tributary kingdom. This, of course, was the signal for hostilities in which by the combined action of China and Mi-Nyag⁴ the Lhasa party in Chantui was defeated and the country came under the Viceroy of Szechwan. But a strong protest came from Lhasa, and for unknown reasons China handed back the conquered territory to the former masters.

4. For the next ten years, under the Lhasa Governor-General, Chantui did not improve in wealth or morals. Widespread brigandage was rampant, and the Lhasa functionaries, out for exploitation, could not or would not control the Nya-Rong. And since my appearance in the Marches the region has been a hatching ground for intrigue and rebellion against China. But even in Chao's very definite programme in the Marches, Chantui was not formally considered a legitimate sphere for operations. And right up to the last, when all around her was submerged in the great sea of Manchu conquest, Chantui remained like an island among the ruins. Why? Simply because China wished to humour the Dalai. And if my opinion is doubted it is sufficient to refer to the fact that when the Tibetan "God" sought an asylum in India, Chao, as a detail, when returning triumphantly from the Tibetan wars, tweaked Chantui into line with the other conquered regions. And in August, 1911, the Lhasa Governor-General of the eighteen Horpa Tribes was seen en route for India where the Dalai was safely watching events.

I have at times been guilty of wasting sympathy on the Nya-Rong⁵. That was a mistake, because when men are unable to use independence, a period of tuition is manifestly necessary. Moreover, these folk although preferring independence, if a choice between Peking and Lhasa were the only alternative, the present *status quo* would remain unaltered.

1. Spyi-K'yab—general coverer.
2. The types and the alleged immigration make us diffident about classing the Hor among true Turki tribes. But it must be remembered that the Yüeh Chi, or Chinese Goths (Getae) in their flight from the Hsiung Nu, left a remnant

which may easily have migrated south along a natural line of expansion, and, finally, settled in the hills and vales of the upper Yalung. The main branch, which conquered Graeco-Bactria, was known as "Tachari" Hor or Khor, and, indeed, gave the name to Graeco-Bactria, Ta Ha or Hsia. So it is not unlikely that the Hor are Sze Ma Ch'ien's "Lesser Yüeh Chi" (小月氏).

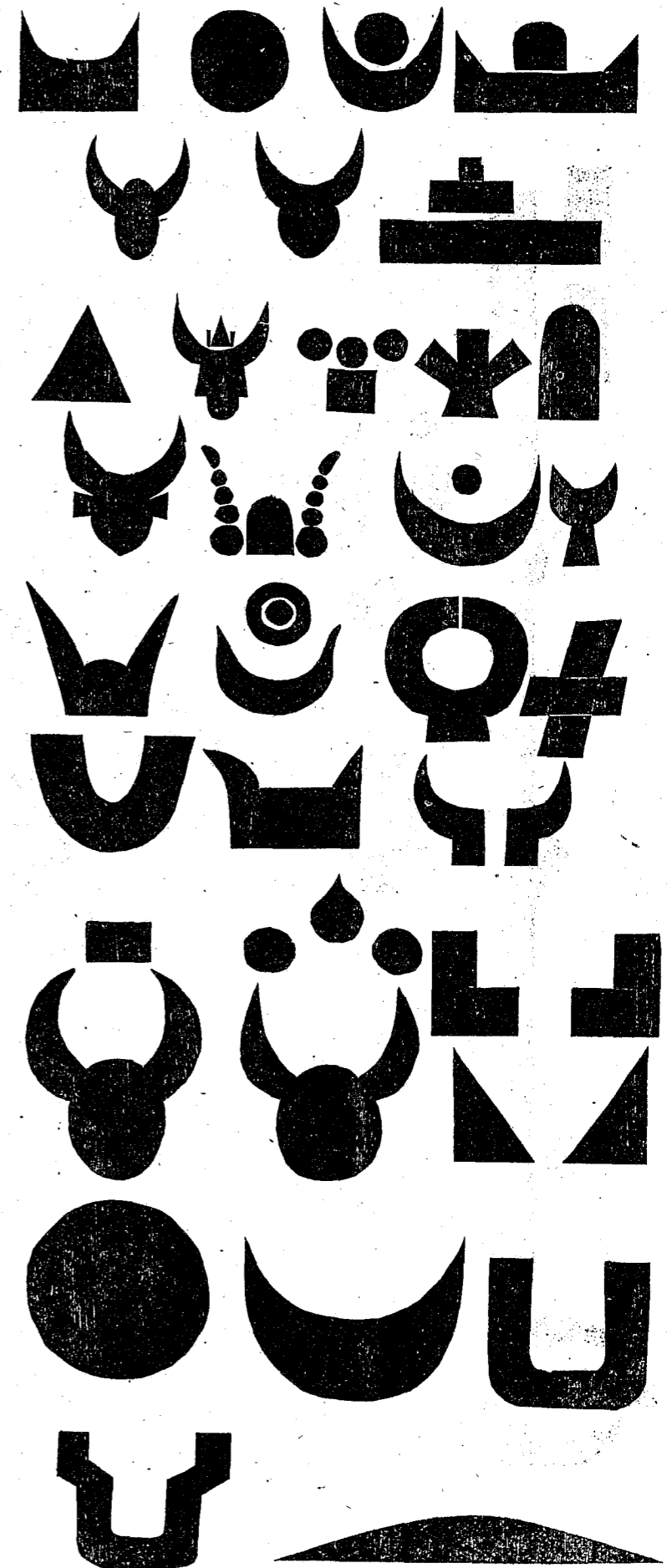
3. It was probably Kong Pa Long Onia who claimed the *j'us primæ noctis* (Seignorial).
4. An ancient kingdom often mentioned with the Hor. It at least included the present Chagla.
5. The term "Yalung", an important river in eastern Tibet, is a corruption of the Tibet "Guya rung".

White Stone Ornamental Designs.

J. HUSTON EDGAR

I am sending you a sample of designs worked into the stone work of Tibetan houses between here and the Yalung, five days journey to the west. They are in every case fragments of white quartz. Their meaning is so far a mystery, but they almost incline one to think of them as the remains of a pre-Tibetan script. The fact that the fragments used in mosaics are of white quartz add to the interest. On the Litang side of the Yalung, the ox-head design is said to commemorate the death of the faithful animal whose soul is thought to reside in the figure. Considerable attention is paid to designs representing the Heavenly Bodies, and the last hieroglyphic of the first line is the sun rising over the earth. No doubt we have here not only ornaments, but talismans also. The last figures of lines 6, 7, 8, and the first of line 9, are window designs. It is interesting to remind readers that the Tibetan name for window is "The white hole".

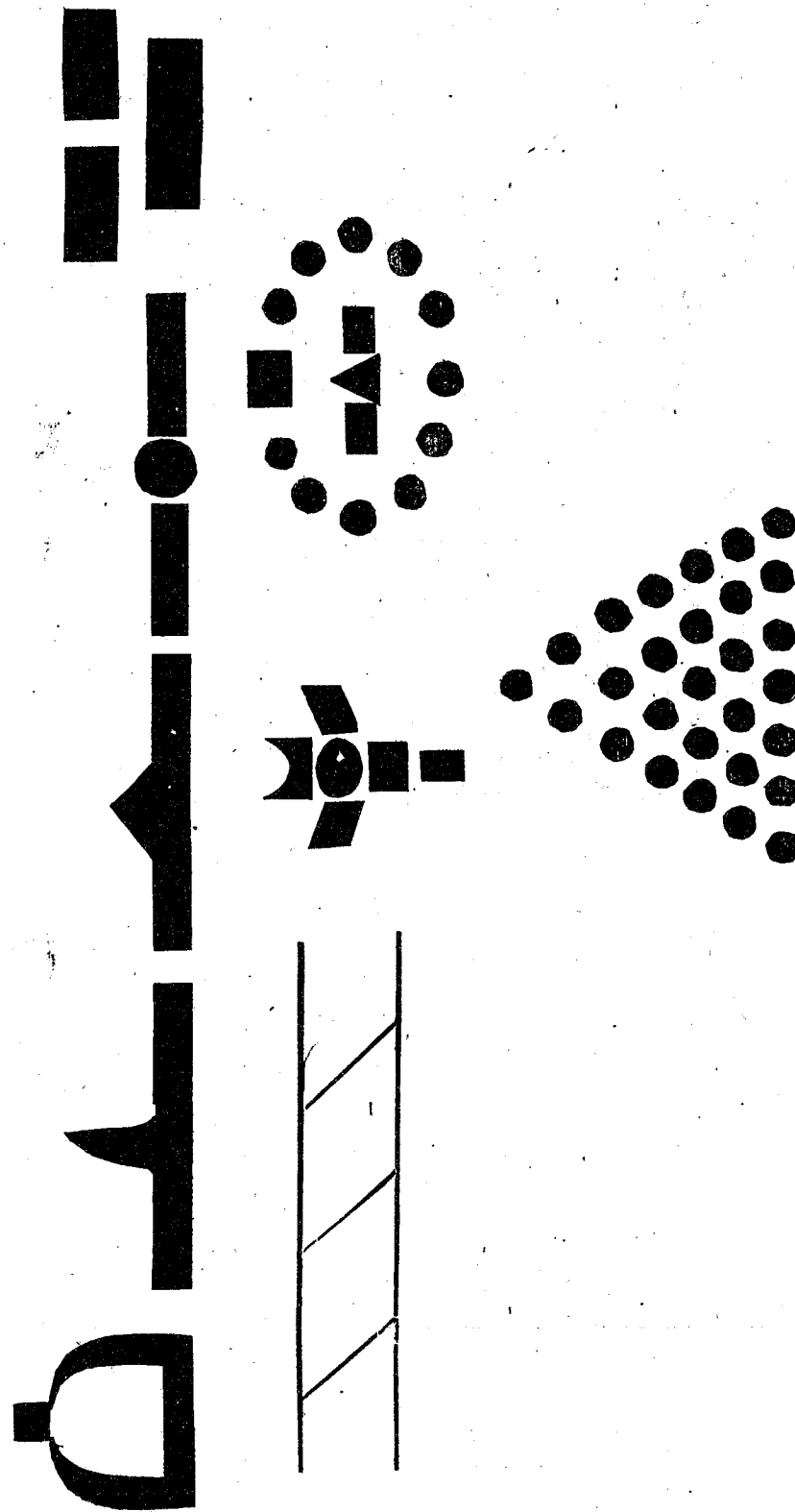
Between here and the Yalung, apart from the above designs, fragments of white quartz are as prominent as in the Min and Kin valleys. They are invariably the means by which praying flags are supported, and the material of which incense stones are made. Then they adorn walls, graves, tops and corners of houses, shrines and the praying pyramids of inscribed stones. And on the hillsides the Tibetan letters of "Om mani pad me hum" worked on white quartz are not uncommon. But what is even more peculiar, the pyramids of manure are often adorned with a large conical, oblong or square piece of white quartz. Very often, also, where quartz is not plentiful, white-



QUARTZ ORNAMENTAL DESIGNS

wash takes its place; and the sacred juniper invariably emits large quantities of white, fragrant smoke during the daily morning sacrifice.

White is undoubtedly a sacred or lucky color and it may be the snow mountains, so often the fancied abode of gods, have sanctified both the color and the material under discussion. But in this part of Tibet the quartz, although sacred, is not a god. It is more of the nature of a fetish like the prayer flags and the fir poles with tufts of leaves at the top. Indeed, the prayer flag is probably an imitation of the moss draped trees of the sombre forests. In making inquiries about the meaning of the white quartz, the answer has invariably been "It is the capping stone". In other words it gives a beautiful finishing touch to all structures and eminences as the snow capped peak does to the mountains. But the "Mountain God" and the "Sky-God" both had dwellings far beyond the abodes of men and could any place be more suitable than those grandly beautiful and inaccessible regions of eternal snow so common on the eastern frontier of the Marches. That this is not all theory may be proved by the Tibetan custom today of piling up mounds of quartz and granite fragments to tempt the "Sky God" and the "Mountain God" to dwell among men. Such Bethels are common on all the great passes, and as they are passed by, the travellers energetic expressions of thanks and appeals for further mercies are uttered (*Gsol lo, gsol lo*). And it may be that in a former day the quartz cone being a suitable and desirable dwelling for the god, the soul of the sky or the mountain was a guarantee of safety and prosperity; and later when the original faith was forgotten the fetish and talisman phrase remained. But this only refers us back to pre-Buddhist animism, when very much in Nature, the sky, mountains, forests and rivers were given souls modelled on that of human beings, which like men had abodes where they dwelt.



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Notes on Wei Chow

A. J. BRACE, F.R.G.S.

While visiting Wei Chow and other "inside" places in July, 1921, in company with Mr. J. H. Edgar, F.R.G.S., the writer was struck with the antiquity of Wei Chow, and the mention of this observation was enough to start the veteran traveller and investigator of the Tibetan Marches on an interesting résumé of some of the ancient history of this most historic spot. We walked together to the middle of the old walled city of now less than a thousand people, and turning down a narrow alley came suddenly upon a venerable temple building with the two large gilded characters confronting us, 仁壽 Ren Sheo, or the Temple of "Benevolent Longevity". Here is situated the Hall of Brahm, with the characters 梵王 Fan Wang, over the doorway. Within is a famous tablet of the Tang Dynasty, A. D. 830. The pillar is octagonal. Quotations from the Sanskrit "Sutras" are clearly discernible. It is claimed to have been brought by a celebrated priest from Kabul. The writing is in Chinese script, but in the style of a famous senior wrangler of the Tang Dynasty. Right opposite is an obelisk of the Song Dynasty, made of carved Buddhas of rather unusual workmanship. In the Hall of Brahm there are three fine idols, excellent specimens of Tibetan workmanship. Also at the back is a brass idol apparently of Syrian or Persian cast of countenance.

On the hill above Wei Chow there are extensive and interesting ruins. The mud walls reinforced with timber are still from fifteen to thirty feet thick and twenty five feet high in spite of the weathering of centuries. It is surrounded by a formidable moat. There are three great earth terraces also surrounding the ruins that were evidently used for defensive purposes. The position commands the two rivers and was strongly fortified from every angle of approach. Manifestly very ancient tradition makes it the capital of a very famous frontier warrior, 姜維 Chang Wei, of the Three Kingdoms. From references in the Wen Chuan history it may represent the site of ancient Wen Chuan Hsien. In Duhalde's History of China (1741 edition), Wei Chow was for two hundred and fifty years the Eastern Capital of Tibetan-kings who had an Imperial palace here. The remains and architecture would indicate that this is the site. With little effort quite ancient bits of pottery can be dug up. While on a brief visit for the purpose of photographing the ruins Mr. Edgar, with his cane, turned up a valuable piece of glazed pottery of ancient symmetrical design. We secured fair photographs. Overhanging clouds prevented our taking really good pictures. This very interesting ruin awaits scientific investigation.

No.	Skin Color	HAIR			Moustache and Beard		EYES		Forehead	Supraorbital Ridges
		Color	Character	Lost	Color	Character	Iris	Conjunctiva		
1	black	straight	no	no	black	wavy, scanty	brown	yellow white	slope, med.	not pron.
2	"	"	"	"	none	none	"	"	straight	"
3	"	"	"	"	black	moust. heavy	lt. brown	yellow white	straight	slt. pron.
4	"	"	"	"	"	beard, scanty	"	"	sloping, med.	fr. pron.
5	"	"	"	"	"	scanty	"	"	straight	not pron.
6	"	"	yes	"	"	"	"	white	med. slant	"
7	"	"	"	"	gray	"	lt. brown	yellow white	slt. slant	"
8	"	wavy	no	some	black	"	brown	"	"	"
9	"	straight	yes	"	"	"	"	"	"	"
10	"	wavy	no	"	"	very scanty	"	"	med. slope	"
11	"	"	yes	"	"	"	"	"	"	"
12	"	"	no	"	"	"	"	"	"	"
13	"	"	"	"	"	"	"	"	"	"
14	"	"	yes	"	brownish	"	gray-brown	"	straight	"
15	"	"	no	"	black	"	brown	"	"	"
16	"	"	"	"	"	"	"	"	slt. receding	"
17	"	"	"	"	"	"	lt. brown	pearly white	straight	"
18	"	"	"	"	"	"	brown	yellow white	"	"
19	"	"	"	"	none	none	"	"	"	"
20	"	"	"	"	"	"	"	"	low, slt. reced.	"
21	"	"	"	"	"	"	"	"	"	"
22	"	"	"	"	"	"	"	"	"	"
23	"	"	yes	"	black	very scanty	dk. brown	white	receding	"
24	"	"	no	"	"	quite heavy	brown	dirty white	"	"
25	"	"	"	"	"	very scanty	"	"	straight	"
26	"	"	"	"	"	"	"	"	slt. receding	"
27	"	"	"	"	"	"	"	"	"	"
28	"	"	"	"	"	"	"	"	"	"
29	"	"	yes	"	"	scanty	"	inflamed	"	"
30	"	"	"	"	gray	rather heavy at mouth cor.	"	"	"	"
31	"	"	no	"	black	scanty	"	white	"	"
32	"	"	"	"	"	quite heavy	"	"	"	"
33	"	"	"	"	none	none	"	"	"	"

No.	Eye-slits	Malars	Nose	Nasion Depression	Lips	Alveolar Prognathism	Chin	Angle of Lower Jaw	Calves
1	straight	fairly pron.	straight	fr. well mrkd.	medium	straight	straight	medium	small
2	"	medium	flat	none	full	medium	"	"	"
3	"	pronounced	straight	slight	medium	slight	narrow, slt. reced.	"	"
4	"	med. pron.	thick tip	"	full	"	slt. receding	"	"
5	"	not pron.	curved	"	medium	"	straight	"	"
6	"	fairly pron.	retrouse	very slight	thin	no teeth	slt. receding	"	"
7	"	Not pron.	straight	none	medium	slight	straight	"	"
8	"	"	Roman	"	thick	marked	protruding	"	"
9	slt. slant	pronounced	straight	slight	medium	slight	receding	"	"
10	slanting	"	"	"	thick	marked	protruding	"	large
11	slanting	pronounced	"	"	medium	slight	protruding	"	small
12	straight	slt. pron.	"	very slight	"	slight	slt. receding	"	"
13	"	pronounced	"	depressed	"	"	very slt. reced.	"	"
14	slanting	slt. pron.	"	very slight	"	"	"	"	"
15	straight	"	"	medium	"	"	very slt. protrud.	"	"
16	"	"	"	"	"	"	"	"	"
17	"	"	"	"	"	"	"	"	"
18	slt. slant, inner	"	"	medium	"	"	"	"	"
19	canthus lower	pronounced	"	"	full	"	"	"	"
20	straight	"	"	"	medium	"	straight	"	"
21	"	slt. pron.	"	slight	"	"	"	"	"
22	"	pronounced	"	depressed	"	"	"	"	"
23	slant	pronounced	"	slight	thick	medium	slt receding	"	"
24	(See (O)	pronounced	"	depressed	medium	slight	"	"	"
25	straight	not pron.	"	slight	medium	"	"	"	"
26	"	not pron.	"	none	thick	"	straight	"	"
27	"	slt. pron.	crooked	slight	thick	marked	protruding	"	"
28	"	not pron.	flat	very marked	medium	medium	straight	"	"
29	(See (Pz)	pronounced	straight	slight	thick	medium	slt. receding	"	"
30	straight	pronounced	"	"	medium	"	straight	"	"
31	"	slt. pron.	"	"	thick	"	straight	"	"
32	"	pronounced	"	"	medium	"	straight	"	"
33	"	pronounced	"	"	thick	"	straight	"	"

Number	Diam. Bizygom Max.	Facial Index	Physiognomic Index	Diam. Frontal Min.	Diam. Bigonial	Nose: Height to Nasion	Nose, Width Max.	Nasal Index	Mouth Breadth	Chest, (Neutral) Circumference	Chest, D. Ant. Post.	Chest Index	Left hand Length	Left hand Width	Hand Index	Left Foot Length	Left Foot Width	Foot Index	Left Leg Circum, Max.
1	14.8	82.4	73.2	12.5	12.7	5.4	4.2	77.7	6.	93.			19.	9.5	50.	24.6	10.8	43.9	
2	14.3	81.8	81.7	12.1	11.6	5.6	3.5	62.5	5.2			16.8	8.	47.6					
3	13.7	77.3	80.1	13.3	12.4	4.8	3.9	81.2	5.2	92.		17.2	8.8	51.1	25.7	11.	42.8		
4	13.5	81.9	76.7	13.7	12.7	4.8	4.	61.5	5.3	92.		20.4	9.8	41.1	25.	12.	48.		
5	14.9	81.8	73.4	11.5	11.7	6.5	4.2	80.8	6.4	84.7		18.7	8.8	49.7	24.5	10.5	42.8		
6	15.	82.1	73.8	14.	13.3	5.2	4.3	66.6	5.4	88.		18.	8.8	48.8	24.5	10.5	44.4		
7	13.9	85.6	73.3	11.5	11.4	5.	4.	86.	6.	87.		16.8	8.5	50.5	22.5	11.	44.5		
8	14.2	92.2	69.2	13.2	12.7	5.2	4.3	82.7	5.2	87.		19.	9.	47.3	24.7	10.5	44.5		
9	15.4	77.2	77.	13.1	12.4	5.1	3.8	70.	6.	94.		18.	8.7	48.3	26.	10.5	40.3		
10	14.2	83.5	74.8	12.4	12.5	5.1	4.2	84.4	5.2	87.5		17.5	9.	48.6	25.3	10.2	45.8		
11	14.2	83.5	66.	12.7	12.	5.1	3.9	78.4	5.3	83.		18.5	8.8	51.8	24.	11.5	44.2		
12	14.8	87.8	73.6	13.2	12.6	5.1	4.2	76.4	5.8	96.5		19.2	9.2	47.9	26.	11.	44.2		
13	13.7	86.	68.1	11.2	11.2	4.8	3.8	79.1	5.5	89.		17.8	8.8	45.6	24.8	10.5	43.7		
14	13.7	86.	68.5	11.4	11.7	5.2	3.8	73.	5.3	85.		18.4	8.2	44.5	24.8	9.7	39.1		
15	13.7	114.	68.5	11.4	11.7	5.2	3.8	73.	5.3	85.		18.4	8.2	44.5	24.8	9.7	39.1		
16	14.	97.8	73.5	12.3	12.5	5.	4.8	96.	5.2	81.		17.	8.8	51.7	25.	11.	44.		
17	14.	83.5	71.8	11.7	11.8	5.	3.3	66.	4.4			19.	8.3	43.7	25.	10.5	42.		
18	12.9	82.1	70.5	11.9	11.2	4.6	3.3	65.2	4.4			16.7	8.5	43.7	25.	10.5	42.		
19	13.8	71.7	75.4	12.7	12.1	4.6	3.2	69.5	4.9			17.5	7.9	50.9	21.2	9.7	47.7		
20	13.9	83.5	77.3	12.5	12.7	4.9	3.8	76.5	4.9			18.	8.5	45.1	23.2	11.	43.1		
21	14.8	82.7	76.3	13.1	13.3	5.2	3.5	77.5	5.5	98.		18.	9.	46.6	26.	11.	42.3		
22	14.9	79.	79.1	13.	13.3	5.2	3.5	80.	5.5	88.		17.4	9.3	48.9	23.3	10.5	45.		
23	14.8	85.2	76.3	13.3	12.7	5.	3.8	67.3	4.9	88.5		19.5	9.	46.1	26.3	11.2	42.9		
24	15.	82.	77.3	13.2	12.9	5.	4.4	80.	5.3	84.		18.	8.9	49.4	24.	10.5	43.7		
25	14.5	82.7	71.2	11.9	12.4	4.9	4.9	100.	5.1	84.		20.	9.4	47.	25.5	12.	43.4		
26	14.5	87.5	73.9	12.7	11.8	4.9	4.	81.4	5.	83.		17.2	8.2	47.	23.	10.	43.4		
27	13.7	92.7	71.7	11.7	12.7	5.	3.2	64.	4.9	84.		18.	9.4	47.	23.	10.	43.4		
28	13.7	85.	75.2	11.7	12.7	5.	4.1	80.	5.3	87.		18.	9.	50.	24.	9.5	39.6		
29	15.	106.	71.4	11.5	13.1	5.1	4.1	80.3	6.	87.		18.	9.	48.9	23.	11.	47.8		
30	14.9	106.	76.9	12.7	12.8	5.1	4.9	76.9	5.2	95.		18.5	9.3	48.9	25.2	11.	47.8		
31	14.7	80.2	76.9	12.8	12.8	5.2	3.9	75.	5.2	88.		17.5	8.2	44.1	26.7	10.7	43.6		
32	14.7	80.2	76.9	12.8	12.8	5.2	3.9	75.	5.2	88.		17.5	8.2	44.1	26.7	10.7	43.6		
33	13.7	74.4	85.6	13.2	12.2	4.6	3.7	80.4	5.	89.		15.7	8.3	50.9	23.	10.	43.4		

This data, which is only a preliminary report, therefore not analyzed, was secured at Tatsienlu with the aid of Dr. Andrews. After data is secured from a larger number the full report will be published at a later date. It was thought advisable to publish this report now, as the writer is proceeding on furlough at an early date and will not be in China for the next two years.

Number	Name	District	Sex	Approx. Age	Stature	Max. Span	Excess of Span over Height	Sitting Height	Sitting Height per cent. of Total Height	Head: D. Ant. Post. Max.	D. Lateral Max.	Cephalic Index	Height Base of Meatus Line to Bregma	Mean Cephal. Height Index	Cephalic M. Module	Cephalic Mod. vs Height	Face: Menton-nasion	Mentoncrinion	Height of Fore-head (Nasion-crinion)	
1	Ma	Mina	M.	44	173	187	14.	92	53.2	19.4	15.7	80.9					12.2	20.2	7.8	
2	Ndrn	Mina	F.	35	149	147		79	53	18.9	15.5	82.					11.7	17.5	5.2	
3	Ma	Mina	F.	21	153.5	154.5	1.	83.2	54.2	18.1	14.8	81.2					10.6	17.1	6.7	
4		Mina	M.	53	172	182	10.	90	55.8	22	16.3	74.					12.7	20.2	8.3	
5		Damba	M.	45	176	179.3	3.3	89	50.5	19.5	17.3	75.8					12.2	20.3	8.5	
6		Chambo	M.	44	173.5	173.4		91.5	52.7	20.5	14.8	84.4					12.3	20.3	8.5	
7			M.	65	154	145.5		88	51.4	17.8	14.8	83.1					11.5	19.1	7.6	
8	Re	Gantze	M.	61	171	171		88	53.2	19.3	15.3	83.1					11.9	20.5	8.3	
9			M.	30	160.5	168	8.	87	54.2	18.5	15.3	82.7					13.1	20.5	8.8	
10			M.	25	163	164	9.	90	55.2	19.8	15.8	79.9					11.9	20.	8.8	
11			M.	34	165	157		83.5	50.6	18	15.1	83.9					11.7	18.7	6.9	
12	Tzudring	TsanTnei	M.	30	169.9	177	7.1	85.2	50.1	20	16	74.5					13.5	21.5	9.	
13	Bukang	Draya	M.	27	163.5	164.5	1.	87.2	53.3	19.1	14.9	83.8					13.	20.1	6.5	
14	Sorti	Chando	M.	45	164.5	165.5		84.2	53.6	18.3	14.5	79.2					11.8	20.1	7.8	
15	Chang	Draya	M.	24	160	165.5	5.5	84.2	55.6	19.3	15.5	80.3					15.7	19.1	7.8	
16	Buka		M.	20	164	169	4.5	81.2	50.9	17.6	14.9	84.6					11.7	19.5	6.7	
17		Mina	M.	20	164.5	156		86.7	56.8	19.1	15.3	80.1					13.7	18.2	7.7	
18		Mina	F.	23	148.1	147		79.2	53.4	17.6	14.9	80.1					11.6	18.3	7.7	
19	Lu	Mina	F.	23	158	160.2	1.8	86.7	51.8	18.8	15.	74.4					10.9	18.3	7.7	
20		Mina	F.	22	167.3	166		86.7	51.8	18.4	14.8	80.9					11.7	18.1	7.7	
21		Mina	F.	22	159.1	161	1.9	82.2	51.6	18	14.8	82.2					11.7	18.1	7.7	
22		Mina	M.	33	170	166		89.5	52.6	20.5	15.5	75.6					11.5	18.2	6.4	
23	Tsu	Mina	M.	52	167	168	1.	89.5	52.6	20.5	15.5	75.6					12.7	18.2	6.4	
24	Chung	Mina	M.	30	172.7	180	7.3	89.2	59.4	18.8	16.	83.1					12.7	19.5	6.9	
25	Bude	Tanlin	M.	41	168	166		84.2	48.7	19.4	15.3	84.2					11.7	18.7	7.4	
26	Losung	Hsin	M.	43	175.5	175		83.2	49.5	19.1	15.3	80.1					12.3	19.4	7.4	
27	Dryshi	Mina	M.	21	161	159	3.	83.8	52.6	19.1	15.3	84.2					12.7	20.2	8.8	
28	Chieh Tu	Mina	M.	49	167.7	168		84.6	51.2	19.3	15.1	81.2					12.7	19.6	7.8	
29	Beisong	Mina	M.	21	165	168		86.6	52.2	22.	15.8	81.8					11.2	18.2	6.9	
30	Dinzin	Mina	M.	48	167.7	173.3	7.6	87.7	52.5	19.3	14.8	71.8					12.7	18.2	7.1	
31	Ho	Mina	M.	35	175	176.5	1.5	91.	52.5	19.3	16.6	85.5					15.9	17.9	8.8	
32	DoDe	Mina	M.	22	153.2	161	7.8	80.8	52.7	18.9	16.6	82.5					11.7	19.1	7.4	
33	Ban Tso	Mina	F.	20	146.7	147	.3	83.2	56.7	18.	15.2	84.4					11.8	19.2	6.9	
																		10.2	16.	6.4

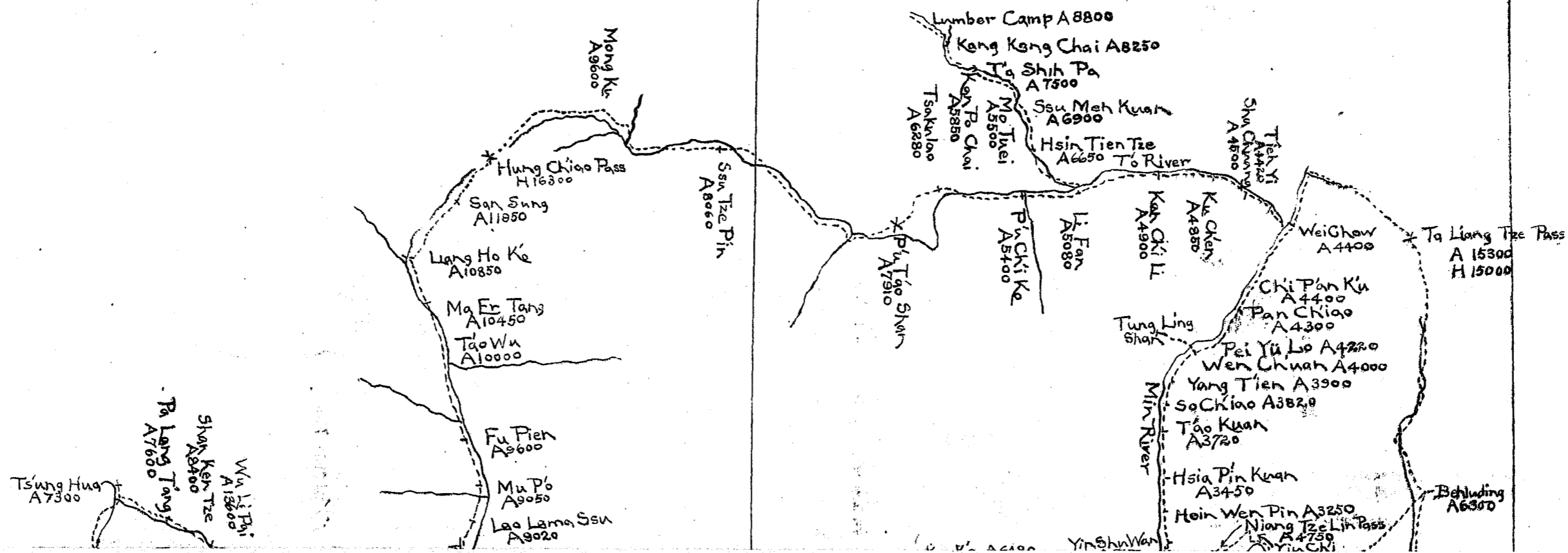
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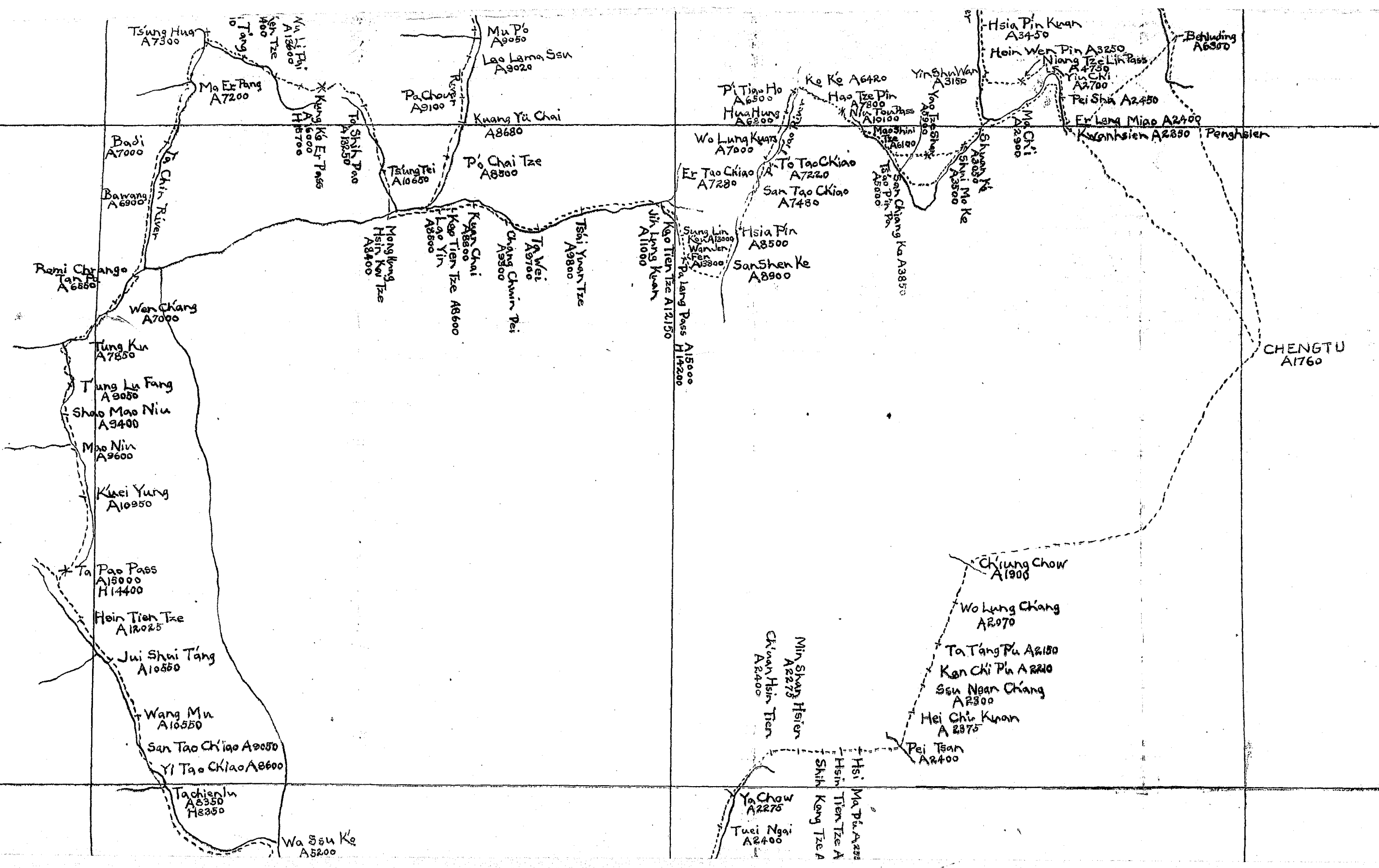


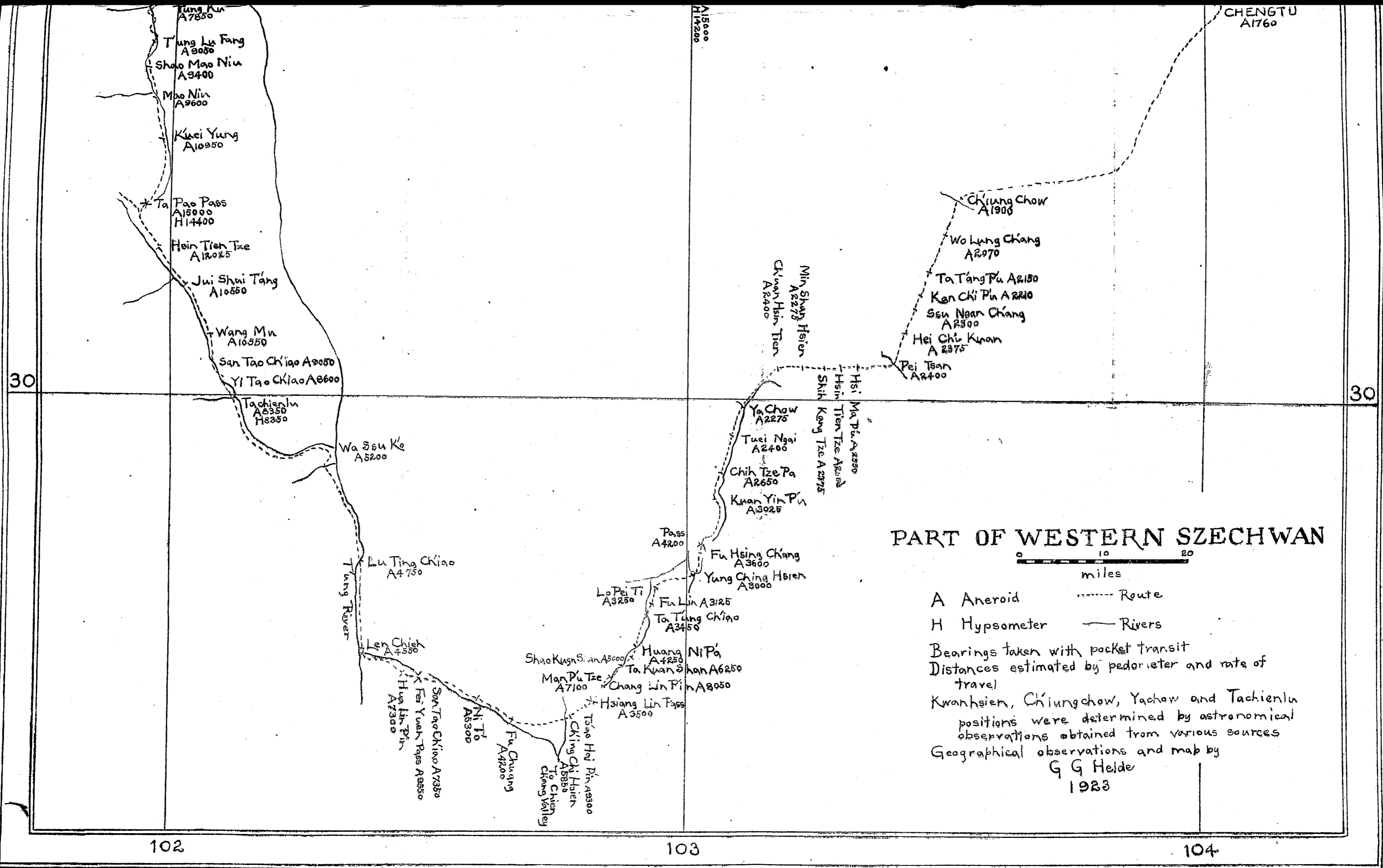
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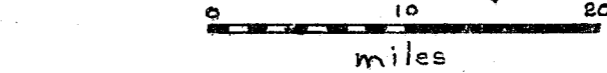
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PART OF WESTERN SZECHWAN



A Aneroid
 H Hypsometer
 ----- Route
 ——— Rivers

Bearings taken with pocket transit
 Distances estimated by pedometer and rate of travel

Kwanhsien, Chiungchow, Yachow and Tachienlu positions were determined by astronomical observations obtained from various sources

Geographical observations and map by
 G G Helde
 1923

JOURNAL

of the

WEST CHINA BORDER

RESEARCH SOCIETY

華西邊疆研究學會

雜誌



Volume XI

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Vol. XI, 1939

Editor
LESLIE GIFFORD KILBORN

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The late Dr. W. R. Morse, at work in Miaoland, making physical measurements on a member of the Hua Miao race near Shih Men K'an.

WILLIAM REGINALD MORSE

On November 11th., 1939, Dr. William Reginald Morse, first president of the West China Border Research Society, passed away in Boston, Mass., U.S.A. By his death our Society has lost one of its most enthusiastic members and one of its keenest promoters. His presence among us was a constant stimulus to research, to the quest "beyond the ranges" for that something which is never completely found.

He himself was an enthusiastic anthropologist, and made a large number of journeys into the border regions of west and south-west China. On every trip he gathered data on the physical anthropology of the inhabitants. This mass of information was put into print as a supplement to Volume VIII of the Journal, and at the time of his death he was working at the Peabody Museum on a final statistical analysis of this data.

In addition to anthropology Dr. Morse was vitally interested in Chinese medicine, and in the pages of this Journal is evidence of his work along this line. His book on "Chinese Medicine," in the Clio Medica series, has been praised as the best short exposition of the subject in English.

As an educationalist he will always be remembered as one of the pioneer members of the faculty of medicine in the West China Union University, and he was for many years its dean. At the time of his death he was Director Emeritus of the College of Medicine and Dentistry. His own department of anatomy he had built into one of the best in the university, and had accumulated a considerable museum on both human and comparative anatomy. In addition he always retained an interest in surgery, and until recently continued in active surgical work.

"The Giants are Gone" wrote Pearl Buck a few years ago in reference to the pioneer missionary. But some of them have departed very recently, and in these western regions the impress of their personality is still strong and vivid upon those to whom they have "passed the torch." Among the giants of West China will be included William Reginald Morse, anthropologist, anatomist, surgeon, medical historian, educationalist and missionary.

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FOREWORD

Volume Eleven of the Journal of the West China Border Research Society goes to press as the third volume to be published under war conditions. With the editor in Chengtu and the printers in Shanghai, and the only means of rapid communication being by air via Hongkong, the difficulties of publication have increased enormously. Delays have been inevitable. However, we are glad to be able to present to the members of the Society what we believe to be an interesting and valuable volume of our Journal.

The favorable comments aroused by our first attempt with a colored plate (the frontispiece of Volume IX) has encouraged us to once more use this means of making more vivid to our readers the beauties of some of West China's old pottery. The increased cost was met by the West China Union University, by means of a grant from their funds for the study of Chinese culture. We are happy to record our gratitude to the university for its generosity.

This issue of the Journal also contains a report of the first piece of research towards which the Society has made a grant-in-aid, namely the chemical study of the potteries from the Chiunglai and Liu Li Ch'ang kiln sites. It is to be hoped that the funds of the Society may permit it to do this frequently, but until the value of the Chinese dollar has become more stabilized it is doubtful whether the resources of the Society will enable it to offer much financial assistance towards the carrying out of research projects. So far practically all work being done by members of the Society is either privately financed or paid for by the West China Union University or some other educational institution. The enormous amount of work still to be done is sketched by Prof. D. S. Dye in his article on "The West China Museum." For those who have the imagination to catch the feel of their environment and the eyes to see under the surface this paper should bring a real stimulus to renewed effort. And it is to renewed effort, greater insight and unwearied persistence that we commend our members if the purposes of this Society are to be achieved.

L. G. K.

THE MUSIC OF THE CH'UAN MIAO

R. GORDEN AGNEW*

FOREWORD

In the preparation of this material, the writer desires to express deep gratitude to the following members of the staff of the West China Union University for valued cooperation and assistance—Professor David C. Graham, Curator of the Museum of Archeology; and Esther B. Stockwell, Margaret H. Phelps and Lucy Lo, of the Department of Fine Arts.

INTRODUCTION

The study of the music of any ethnic group may be productive of significant results both in the scientific and the cultural fields. In the cultural life of the group music commonly holds a place of great, and in some instances of dominating, importance. To the student of western cultures it is necessary only to draw attention to the significance of music in Hebrew or in classical Greek culture, or to the place of music in the cultural life of the American negro, as outstanding examples. As a means, therefore, toward the understanding of any people, music offers a medium of great value.

Amongst peoples who possess a written language the study of music provides a means of comprehension of the group through a mode of expression which is not approximated by any other human function. It is obvious to the student of the so-called 'Fine Arts' that the emotions and concepts communicable through music are in many instances utterly non-convertible into any other form of human expression. In the case of groups which do not possess a written language, the value of music is even more evident. In such instances it is commonly found that a heritage of song is passed on from father to son, and the ideas portrayed by both the music and the words of a song are thus preserved for posterity with varying degrees of accuracy. The social anthropologist and the historian are familiar with countless examples which might be cited to illustrate the invaluable contribution made by such unwritten songs which have been passed on for many generations and ultimately have been recorded.

As an illustration of the value of music as a means to the understanding of a people, a simple and readily accessible study is that of the "popular song", especially of songs such as national war songs popularized during periods of national crisis. A profitable investigation awaits the musical historian

*West China Union University, Chengtu.

and psychologist who will relate the songs most widely accepted during periods of stress and upheaval with the basic mental and emotional states which conditioned the mass mind at such times, and who will compare such findings at chronologically separated periods in the life of a people.

Other ethnological and social values may be derived from musical research. In the field of philology we may find the perpetuation of otherwise obsolete terms. In illustration of this subsequent mention will be made of an expression commonly used in Ch'uan Miao songs but apparently obsolete as far as ordinary speech is concerned.

The obvious esthetic and cultural values of musical research need not here be emphasized. To the musician, professional or amateur, the study of unfamiliar music of civilized or primitive peoples cannot but be enlightening and informative. For example, when recently an eminent western musician was asked his opinion of Chinese music he made the astonishing reply that he had heard nothing up to that time which had not made him want to laugh. Needless to say, his contacts with Chinese music had not been extensive. Regional, national or racial complacency is an reprehensible in the field of music as it is in other spheres of learning.

THE CHU'AN MIAO PEOPLE

(a) **The Miao Groups as a Whole**—For the purposes of this study it is unnecessary to include the historical background of the various ethnic groups comprising the Miao people. In the Chinese Classics there are frequent references to the Miao tribes people, and it is claimed that they lived in the Yellow River area nearly four thousand years ago. An exhaustive study of this subject has been made by Dr. David C. Graham,¹ who suggests that the Miao people lived originally in the Torrid Zone, in the region of India, Burma or Tongkin, or on some island in the Pacific or Indian Ocean, whence they migrated northward as far as the Yellow River Valley, and southward into Kwangtung or Kwangsi.

(b) **The Ch'uan Miao**—Legends suggest that the Ch'uan Miao came from somewhere in South China, probably from around Kwangtung, Kwangsi and Fukien, and that they were brought as captives and released, not more than three hundred years ago, in the highlands where they are now found.

This ethnic group may be a mixture of several smaller Miao groups, absorbed, or in process of absorption, into one cultural entity. This would explain minor variations in language, customs and physical structure, but general similarity. Minor variations were likewise found in the musical study now under discussion.

The Ch'uan Miao are found south of Suifu in Szechwan Province, on the borders of Szechwan, Kweichow and Yunnan.

They live in highland country of from three thousand to six thousand feet altitude. The group numbers approximately one hundred and fifty thousand people. They do not isolate themselves from the Chinese, but are interspersed among them.

Graham draws attention to several divisions of the Ch'uan Miao—the Hsiao Hua Miao in northern Yunnan; the Ya Chiao Miao in northern Kweichow; and other smaller groups known as the White Miao, the Basket Miao, the Ch'ing Chi Miao, the Ho Shang Miao, etc.

Physically the Ch'uan Miao are of a rather shorter stature than the Szechwanese, and are of a less rugged build. There is a less marked epicanthic fold of the eye, and other major and minor differences which are not pertinent to this study. The reader, if interested, is referred to anthropometric studies of this group by W. R. Morse² and to a study by the author³ of the nutrition and related problems of these people.

The Chinese character "Miao" 苗 consists of the character for field with that for "grass" 艹 above it, and has the composite meaning "tiller of the soil." The people are predominantly agricultural. All live on farms, owned or rented; hamlets and villages of the usual types with streets are not found.

Socially, the family is the unit. There is no tribal organization in the ordinary sense of the term. The people are, on the whole, quiet and peace-loving. This was not always the case, for at an earlier period in their history they were probably warlike and fought frequently with the Chinese. At the present time, however, they are unable to resist either the Chinese or the Nosu (more belligerent tribes people whose territory is in some areas contiguous to that of the Ch'uan Miao.)

Their social life is very limited. There are no theatricals, few sports, and not much gambling. Their diversions are "visiting, feasting, attending of marriages and ceremonies, and love-making" (Graham). In the autumn, when crops are ripe, but not yet harvested, girls and women are accustomed to go out in the moonlight to play; the elder women tell stories, and teach the younger women to sing folksongs. Mouth harps are played on such occasions. Men and children play various games, and the men are fond of hunting.

THE LANGUAGE OF THE CH'UAN MIAO

There is no written language. The spoken language will be described only in such detail as is necessary to an understanding of the tribal songs. For an excellent study of the language the reader is referred to the monograph on that subject by D. C. Graham¹, to whom credit is given for the following observations on the language.

The language is monosyllabic and tonal. The verb follows the subject, and the object the verb, but the adjective follows the noun instead of preceding it. Among sounds to be distinguished are:

- the aspirate
- the non-aspirate
- the French *j*
- the dental *t*
- the nasal *n*
- the Welsh *l*
- a uvular *g*

An initial *n* or *m* before other consonants is more common than in most languages. One means of distinguishing words consists in using a stronger or a weaker emphasis in pronouncing the same sound.

Tones. The language has nine tones. (Sometimes five tones only are described, and it is claimed that the Hua Miao have seven.) It should be pointed out here that the Chinese language as spoken in West China makes use of four or five tones, but eight or nine tones may be distinguished in Kwangtung, Kwangsi and Fukien. This is very significant as we shall see.

First tone is high; voice is kept level.

Second tone is lowest, and also level. There is a difference of about one octave between first and second tones.

Third tone begins at *one* and descends almost to *two*.

Fourth begins at *two* and ascends almost to *one*.

Fifth is half way between *one* and *two* and is level.

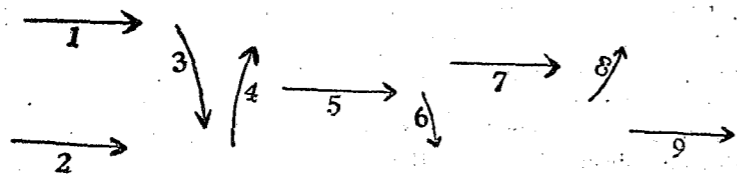
Sixth begins at *five* and descends to *two*.

Seventh is about halfway between *five* and *one*, and is pronounced with a slightly greater stress of voice than the others.

Eighth begins at *five* and ascends to *one*.

Ninth is about halfway between *five* and *two*, and is level. (This tone is very common, yet difficult to distinguish.)

The Ch'uan Miao language has been greatly influenced by the Chinese; many Chinese terms have been introduced, with, perhaps, change in pronunciation.



THE CH'UAN MIAO MUSIC

A complete description of Ch'uan Miao music would include eight divisions:

- (a)—Songs.
- (b)—The Lute or *Liu Shêng*. 六笙
- (c)—The Mouth Harp.
- (d)—The Drum.
- (e)—The Leaf.
- (f)—The Flute.
- (g)—The Jointed Bugle.
- (h)—The Brass Gong.

The last three of these, however, are of minor importance, and do not merit consideration in this study. Of greatest importance are the songs, the *liu shêng* and the drum.

THE DRUM

It is unnecessary here to emphasize the fundamental place of rhythm in music. The vital function of rhythm in melody or harmony has long been recognized by musicians. The sequence of development from primitive rhythmic sounds or movements to more complicated patterns is doubtless as true in the case of the Ch'uan Miao as in that of any other primitive group. Amongst the Ch'uan Miao the drum is not constantly used; its main function is in connection with funeral and memorial ceremonies.

FESTIVAL MUSIC

Festival music is of such importance to our study that it will require brief description. There are four kinds of festival music (a)—at death; (b)—funeral ceremonies; (c)—memorial ceremony, approximately one year later; (d)—memorial ceremony, approximately three years later.

In these ceremonies there is always a team of two musicians; one is the singer and drum-player; the other is the player of the lute or *liu shêng*. In the course of the ritual, when the time comes for singing, the singer simply stands erect at one side of the drum until his song is finished. Then he becomes the drum-beater, and the *liu shêng* player begins to play and dance. For reasons which will appear later, the singer never sings to the *liu shêng* accompaniment. In general, when the *liu shêng* is played rapidly the drum is beaten quickly and vice versa.

The *liu shêng* player, as he plays, commonly walks or skips around the drum. There is a definite custom for each of the four festivals mentioned above:

- (a)—Festival at death—walking only.
- (b)—Funeral ceremony—walking and skipping.
- (c)—Memorial ceremony (one year later)—walking and skipping.
- (d)—Memorial ceremony—walking only.

However, at the close of each section of the ceremony in the four festivals, the player will whirl around several times, either to left or right. As each section is short, it may be played several times without stopping: the player will then rest and later participate again. Likewise the singer may sing once, rest for a time, then sing again. Precision in the intervals of singing and playing is not considered essential. At the very close of a major portion of the ceremony the player will clasp his hands before him, and bow from the waist, once only in the direction of the listeners.

SKIPPING SEQUENCE

There is a more or less definite skipping sequence. The *liu shêng* player passes around the drum as he plays, first in a counter-clockwise, direction. Later he may alternate. As he steps around he will put the feet down more or less *ad lib* on the notes which he emphasizes on his instrument.

The skipping sequence as commonly employed is as follows:

- (1)—Right foot in air, thrown slightly outward....skip
- (2)—Left foot in air, thrown slightly outward....skip
- (3)—Right foot in air, thrown slightly outward....skip

Then the player may wheel about and repeat *ad lib*, or he can take a few steps walking before repeating. Alternatively, he may stay in one relative position, skip outward with the right foot, then outward with the left foot, and repeat. A further alternative is as follows: on the retreat, when the left foot is brought back for the last time, it may be turned toward the left, so that the player may step off in the new (left) direction.

DRUM RHYTHMS

The drum rhythms for the four festivals are given below.

The syllables used to indicate these rhythms are those which were used by the Ch'uan Miao musicians themselves during the analytical studies, and the use of capitals and small letters indicates the relative accents or emphases employed.

- (1) ceremony at death —Dong—jie-jie
—Dong—jie-jie
—Dong—jie-jie continuously
- (2) ceremony at funeral —Dong—Dong—jie—jie
—Dong—Dong—jie—jie
—Dong—Dong—jie—jie
- (3) memorial (1 year) —Dong—Dong—jie—jie—jie—jie
jie—jie (alternating sticks)
- (4) memorial (3 years) —Dong—jie—jie—jie—jie—jie—
jie—jie (alternating sticks)

(Dong indicates a major emphasis—jie a minor one, and the intervening dashes indicate approximately the relative intervals.)

During the entire time that the drum is played the drum-beater circulates around his instrument, which is suspended from a pole with the bottom four to five feet above the ground, in a convenient position for striking. The point when the drum is struck is dependent upon the emphasis given by the *liu shêng* player. Feeling the rhythm, the drum-beater plays his heavy *Dong* coincident with the *liu shêng* emphasis. In the case of two heavy *Dong*—*Dong*, the *liu shêng* player also emphasizes two notes. The emphasis given by the *liu shêng* player is not fixed in the music, but may vary in position with the will of the player. It will be seen that there are thus no rigidly fixed rules and regulations, and the players, whether on *liu shêng*, voice, or drum, may introduce many variations. Even when replaying or resinging a certain passage, they may change it somewhat. This lack of precision is, of course, confusing to the musical analyst, but is a characteristic common to practically all tribal music, and, in fact, may be observed to some extent in the folk music of nearly all peoples.

THE LEAF

The leaf is predominantly used in love-making. It may be played softly, or with it an individual may call loudly to a distant friend. For example, the farmer working in the field may, with the leaf, call to his lady love, even when at a great distance. The leaf may also be used in times of trouble to summon members of the clan, since the sound, when played loudly, is strident and carries for a surprising distance.

According to our sources of information, any type of leaf can be employed. The leaf of the spiraea is frequently used. The leaf is placed on the lower lip, overlapping slightly onto the upper lip. It must not overlap too far on the upper lip, since the air passes between the upper lip and the leaf, causing the edge of the leaf and the lip to vibrate. The lips are nearly closed. Words may be articulated as the leaf is played. Examples of leaf music are given later in this article.

THE MOUTH HARP

The mouth harp is not an instrument of great importance in Ch'uan Miao music. It is not comparable to the major instrument, the *liu shêng*, and does not merit detailed description here. In structure it resembles, in many respects, the Jews'-harp of the West.

THE LIU SHENG 六笙

This is the instrument of greatest importance. It is constructed of wood and bamboo, and consists of a vertical pipe or mouthpiece connecting with a bulbous air chamber into which six pipes of varying lengths are inserted, giving the typical scale of the instrument. These instruments vary

greatly in size, from small ones whose pipes are only a few inches in length to large ones with pipes five to six feet long (see illustrations). In the instruments examined, the mouth-pipe was found to be usually about two-thirds of the length of the longest tone-pipe. This mouth-pipe is frequently spirally bound with thin strips of reeds, for purposes of strength and beauty. Occasionally an expensive instrument has a mouth-pipe bound at intervals of approximately two inches with bands of silver.

The mouth-piece consists solely of the tapered opening of the mouth-pipe, without reed. The tone-pipes pass directly through the bulbous enlargement of the mouth-pipe, and project for a few inches at the back of the instrument. At a point on the upper surface of each tone-pipe in the portion located within the bulb of the *liu shêng*, the bamboo is perforated, and a brass reed is inserted. In some instruments the shortest pipe contains two reeds placed side by side. Inasmuch as the tone-pipes are made of such young bamboo as is available, naturally the length of pipe and the diameter of the opening cannot be fixed, as is possible with machine-made instruments. Hence the relative length of the tone-pipes will not be constant, but will vary with the bore of the tubes employed. Furthermore, the tonal construction is not always strictly accurate, and there may be unintentional deviations in relative pitch from the scale as indicated below.

The scale is pentatonic, with the sixth note constituting a so-called "octave", or having twice the vibrations of the lowest pipe. The tones in the scale are as follows:

- (1) keynote (2) whole tone (3) whole tone
- (4) whole tone (5) tone and a half
- (6) so-called "octave".

Note that the scale is different from the vocal scale which will later be described. The third interval is, in terms of the vocal scale, an augmented one, involving a note never used in the songs. Therefore songs are never sung to the *liu shêng* accompaniment. This is one of several surprising and inexplicable observations made during the course of the analysis of Ch'uan Miao music.

In recording melodies and harmonies, the figures 1 to 6 were employed—1 indicating the shortest pipe, 2 the next in length and so on. Harmonies were indicated in the form of fractions, as for example 4/6 and 3/5. The intervals commonly used are:

- Perfect fourths—4/6, 3/5
- Perfect fifths—2/5, 1/4
- Octaves (so-called)

The following intervals are sometimes used:

- Minor thirds—4/5
- Major seconds—5/6

The following intervals are apparently never used, although they are commonly employed in occidental music.

- Major thirds
- Major sixths

It is worthy of note that the triad, although considered indispensable in Western music, is never played on the *liu shêng*.

In the playing of the *liu shêng* tonguing is frequently employed, somewhat after the manner of tonguing on the harmonica or mouth organ of the West. This embellishment, where it occurs, is indicated in the examples of *liu shêng* music which are appended.

As has already been pointed out, the *liu shêng* is played with characteristic melodies and harmonies at memorial festivals; sacrificial ritual to ancestors; the escorting of the soul of the dead to heaven; it is also played for amusement only. Itinerant Ch'uan Miao *liu shêng* players, often without their companion drum players, may be seen in Chinese towns playing and dancing on the streets to ever interested audiences.

THE SONGS OF THE CH'UAN MIAO

The songs of the Ch'uan Miao are characteristic of that ethnic group and are considered to be of sufficient importance to merit the number of examples provided in the appendix. As indicated in the introduction, folksongs become of added significance in the historical estimation of ethnic groups which do not possess a written language. Insight into the thought-life of primitive peoples may be secured in this way. Also certain words, phrases or idioms, now obsolete in the spoken language, frequently survive for a long time in folksongs. A common example in the songs which are appended is the phrase *mao ia li*, which appears with considerable regularity at the close or near the close of songs but which has no function in modern Ch'uan Miao speech. (In the examples appended only one or two instances of the words, transcribed in international phonetic, are included).

THEMES OF RECORDED SONGS

Ch'uan Miao songs cover a variety of themes, but from this study and from the observations made by D.C. Graham the themes of songs may be classified as follows: (1) Hunting songs; (2) War songs; (3) Fishing songs; (4) Love songs; (5) Songs sung by go-betweens when making engagements; (6) Songs sung when sending a bride away from her home on her

wedding day; (7) Songs sung when welcoming a bride at her wedding, and during a wedding. (8) Songs sung when exorcising demons; (9) Songs sung at deaths and funerals; (10) Songs sung during memorial ceremonies; (Graham).

TECHNIQUE OF RECORDING SONGS

The songs were recorded with the aid of a piano tuned to international pitch. The tones, as far as practicable, were approximated to those of the piano, and this was usually accomplished with little loss of accuracy. The singer was required to repeat each song phrase until the rhythm and tonality seemed to be definitely established. There was the danger, commonly encountered in the recording of primitive songs, that the singer, when asked to repeat a phrase or a measure or group of measures, might vary, to a certain extent, the melody or the rhythm. The singers employed included both old and young men, the youngest being twenty years of age, and the oldest being over sixty years. These men cooperated excellently, and in some instances showed an enthusiastic interest in the accurate transcription of the songs. Although women sing, yet the so-called professional singers are invariably men. Singing is a vocation or an avocation which is highly regarded, and the art is frequently passed down from father to son.

ANTIPHONAL SINGING

Group or communal singing was not commonly found among the Ch'uan Miao, and there was no evidence of antiphonal singing such as has been found by the author among the Ch'iang people of the upper Min valley in Northern Szechwan.

VOICE PRODUCTION

While it is not the purpose of this article to record detail as to the voice production of the Ch'uan Miao singers, it should be mentioned here that all the singers employed in this study sang with comparative freedom from muscular interference, that is, in a natural and easy manner. In timbre and range, the voices would be classed in most instances as baritone. Resonance conditions for fundamental and overtones were not markedly effective. The tones used in the various songs did not approach what might be described as either high or low limits. In recording the songs the usual treble clef was employed, and it should be pointed out that, of course, these male voices actually sang an octave lower than the clef indicates (This is the customary method employed in the West, except where a special clef symbol is used.) The vibrato, recognized in occidental music as essential to beauty and feeling in the voice was not present. A variety of tone color and shading was not at the command of the singers, at least

to the Western ear. Certain embellishments were employed as indicated in the songs appended. The singing of these professional and semi-professional singers stands in marked contrast to that of the professional Chinese singers with whom there has been a predominance, at least until recent years, of the so-called theatrical or forced voice production, sometimes unscientifically referred to as 'falsetto'. Those familiar with this type of singing will recall the extreme muscular interference involved, the strident tones produced, and the rapid deterioration of the voice which not infrequently follows. It has been fortunate that this artificial voice production has not been copied by the singers of the tribal groups who live in close contact with the Chinese. This is true at least of the ethnic groups whose territory mingles with or adjoins the Chinese in the Szechwan, Yunnan and Kweichow sector. It should also be pointed out that the science of voice production is making rapid strides in China, with the result that the fine voices often found among the Chinese have added latitude and increased opportunity for development.

RHYTHM IN SONGS

As in the songs of every people rhythm plays a part of fundamental importance in the songs of the Ch'uan Miao. However, there is a marked lack of precision in the rhythm, and this leads to considerable difficulty in the recording of the songs. Periods of rest or intervals for breathing are observed with great freedom, and in the repetition of the song confusing changes in rhythm may occur. The rhythms most commonly observed were— $2/4$, $4/4$, and $5/4$. It is rather surprising that no $3/4$ rhythms were found in the songs although this rhythm occurs occasionally in drum ceremonies. By far the greater number of songs fell exactly or approximately into a $2/4$ or $4/4$ rhythm.

SCALES EMPLOYED

The type of scale employed is the pentatonic. It will be recognized by those familiar with musical theory that this is not one single scale, but that there are actually five pentatonic scales (the "five pentatonic scales of Helmholtz") in which the same notes occur, but in which the scales are different depending upon the tone which is used as a starting point. (4)—i.e. (1)—G.A.C.D.E. (2) A.C.D.E.G. (3) D.E.G.A.C. (4) C.D.E.G.A. (5) E.G.A.C.D.

Major and minor modes may be expressed according to the choice of scale from this group of five, since songs written in the different scales vary according to the note which serves as keynote. (There is not the same situation in connection with our ordinary diatonic scale, because with it the keynote is always definitely perceived, whereas in many folksongs using pentatonic scales the keynote is perhaps only with difficulty

ascertained.) It is interesting in this connection to study scale development in ancient Chinese music and to note there the role played by the pentatonic type of scale. Similarly, in occidental music, the pentatonic type of scale has been widely used. Illustrations may be found readily in Scotch melodies using the pentatonic type of scale and exemplifying both major and minor modes. Examples of major and minor modes in Ch'uan Miao music will be observed in the songs appended.

MELODIC ANALYSIS

Tonality—Of the songs studied the majority were found to be in the minor mode, the minority in the major, while some were irregular. The reader will note this prevalence of the minor mode in the examples given.

Tonal Progression—*The "Neumes"—Basis of Musical Forms.* Levis, in his monograph on Chinese music (5), has very justifiably revived the musical term "neume" which for many years has not figured prominently in musical literature. The neume referred originally to a type of expression mark which was placed over the words of a plainsong melody for the guidance of the singer. At that time (around the eighth century) the staff notation was not used; the melodies had to be learned by ear, and there was no indication of pitch or time values. As musical writing gradually developed, the neumes were given arbitrary positions on the manuscript to indicate variations in pitch, and later, of course, lines were employed. Subsequently, the neume came to represent a group of the many sounds as could be uttered in one breath. Other meanings were at various times attributed to the neume, but slowly the term came to signify units of a melody, or musical phrases, related to the natural breathing intervals of the singer. It is in this sense that the term may now be profitably used to indicate not just the musical phrases determined by the requirements of respiration, but, rather, the structural "bricks" or basic units by means of which a melody is constructed, and into which a melody may correspondingly be analyzed. Thus we may speak of the neumes as constituting the basis of musical form.

It would seem that the neume assumes a significance which varies according to whether the language is tonal or non-tonal. For a study of the neumes in a non-tonal language the student of musical history is referred to the Byzantine neumes. In a tonal language a common example and one readily available to students of music is found in Chinese songs. Levis has clearly pointed out that the tonal progression or basic unit in Chinese melody is, in all probability, integrally related to the rising, falling and level progressions made necessary by the tonal structure of the language. As is commonly known, the Chinese language possesses from four tones in Northern China to eight and ten tones in Canton.

Naturally, in any given composition, the tonal progressions would not necessarily correspond to the exact tonal variations of the syllables or characters in that particular composition. Rather, it is believed that a primitive tendency to create a melody following the natural tone variations of the chosen words has gradually, over many years, resulted in the common acceptance of this form of basic musical phrase or unit. In consequence, Chinese melodies have a characteristic form which sharply differentiates them from melodies written by peoples whose language does not show a similar basic structure. This can readily be appreciated by comparison of the following example, a typical Chinese love song, with any of the songs of similar theme by, for instance, Schubert. A few measures only of the Chinese song will be given.

LOVE'S LAMENT IN MID-AUTUMN *



As already indicated, the Ch'uan Miao language is tonal in structure, consisting of no less than nine tones. It would seem from the present study that the neume, or tonal progression—the basis of form—is fundamentally derived from the tone patterns originally fixed by the tonal structure of Ch'uan Miao speech. A study of the songs appended would indicate the prevalence of this structural characteristic. This relation between language and melodic form is not as prominent in certain types, such as warlike songs. In some of these songs the melodic form suggests rather the rhythmic and monotonous beat of the drum, as for example in the *Dang Bin Go*, in the appendix. However, in most of the songs which were available for study, the speech-neume was evident.

SUMMARY

- (1) A study of the music of the Ch'uan Miao, vocal and instrumental, is reported.
- (2) The Ch'uan Miao festival ceremonies and ritual, including ceremonial dancing are described.
- (3) A description of the *liu shêng* or six-piped lute is given, and its melodic and harmonic capacities are outlined.
- (4) The study of the folksongs of the Ch'uan Miao people provides further evidence of the fundamental similarity in

*From "Song of Cathay" compiled by T. Z. Koo—Association Press, Shanghai.

origin, made of transmission and theme between the folksongs of peoples in various parts of the world.

(5) Among the obvious differences between the songs of occidental and of oriental peoples, the structural relationship of the melodic unit to the variations in pitch necessitated by a tonal language constitutes a major characteristic. Not only is this true of Chinese songs, but it is believed by the author to be true also of the melodies indigenous with the Ch'uan Miao tribal groups.

(6) It would seem reasonable to suppose that, as the musical forms characteristic of the various peoples are more widely understood, and their values appreciated, a wealth of new modes of musical expression will be available for the composer. While it is not to be expected that racial and national musical characteristics will be discarded in composition, yet it would seem that skilful fusion of musical patterns would contribute to added richness in artistic expression. This, of course, is not restricted to the vocal field, but influences would doubtless be felt also in instrumental and orchestral composition.

(7) A collection of typical Ch'uan Miao songs, leaf and *liu shêng* melodies, and *liu Shêng* harmonies is appended.

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- (1) Graham D. C.—This Journal, Vol. IX, 1937, and Vol. X, 1938.
- (2) Morse W. R.—Supplement to Vol. VIII of this Journal, 1937.
- (3) Agnew R. G.—“Nutrition and Dental Health of the Ch'uan Miao People” (to be published).
- (4) Helmholtz H.L.F. “The Sensations of Tone as a Physiological Basis for the Theory of Music.” (translated by A. J. Ellis) London 1885.
- (5) Levis J. H.—“Foundations of Chinese Musical Art”—Henri Vetch, Peiping, 1936.

1. AN OPENING SONG

bla: li: -da: na:G io:— loi:
-neG- mau ia:— li:

2. A TWILIGHT SONG

teu lou d3e d3eG vo:G han dei la: d3e
-G3eG- la: teu la:— la:— bo:— bu: bu:
gei geu d3eG han dei lau d3e d3eG- la:
teu- neG d3eG- iei bu: gei la:— li:

3. AN AFTERNOON OR TWILIGHT SONG

(Work is finished)

A musical score for a love song, consisting of seven staves of music. The music is written in a treble clef with a key signature of two sharps (F# and C#). The melody is simple and romantic, with a mix of quarter and eighth notes.

4.

LOVE SONG

(Sung by young man to young woman)

A musical score for a love song, consisting of two staves of music. The music is written in a treble clef with a key signature of two sharps (F# and C#). The melody is simple and romantic, with a mix of quarter and eighth notes.

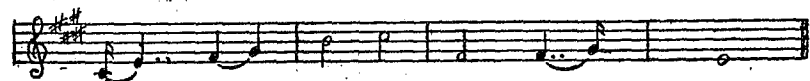
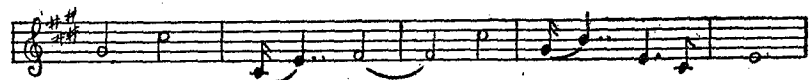
A musical score for a song about nature, consisting of seven staves of music. The music is written in a treble clef with a key signature of two sharps (F# and C#). The melody is light and cheerful, with a mix of quarter and eighth notes.

5.

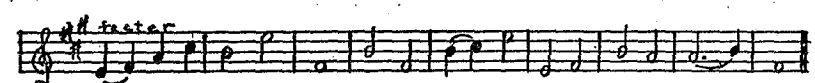
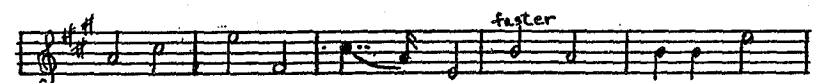
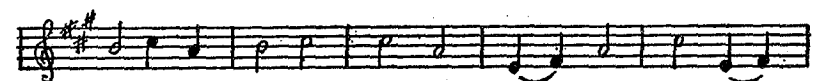
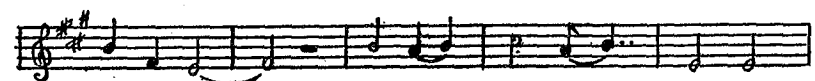
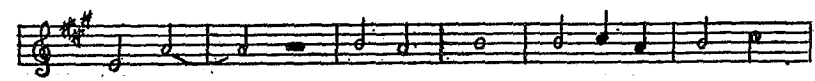
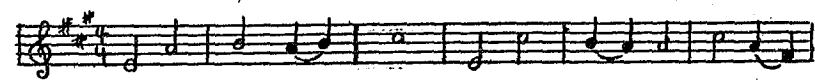
BEAUTIES OF NATURE

(A happy song about Flowers, etc.)

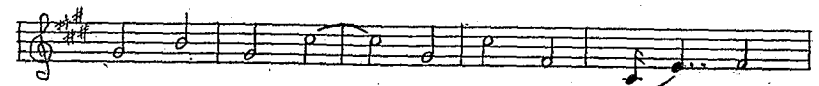
A musical score for a song about nature, consisting of three staves of music. The music is written in a treble clef with a key signature of two sharps (F# and C#). The melody is light and cheerful, with a mix of quarter and eighth notes.



6. A PEASANT WELCOMING SONG
(A song about bartering and trespassing on property)



7. ABOUT A RICH PERSON WHO CAN AFFORD
TO KEEP HORSES AND MULES



8.

A COMMERCIAL SONG

A trader comes from elsewhere to a community and asks how everything is going, how much money the people have, etc.

Musical notation for 'A Commercial Song' consisting of eight staves of music in G major (one sharp) and 4/4 time. The melody is written on a single treble clef staff. The music features a mix of quarter, eighth, and sixteenth notes, with some rests and ties. The key signature is G major, and the time signature is 4/4.

9.

A MAN GOES AS A SOLDIER TO FIGHT

Musical notation for 'A Man Goes As a Soldier to Fight' consisting of seven staves of music in G major (one sharp) and 4/4 time. The melody is written on a single treble clef staff. The music features a mix of quarter, eighth, and sixteenth notes, with some rests and ties. The key signature is G major, and the time signature is 4/4. The word 'glis' is written above the first staff and below the second staff.

10.

WIND BLOWING

Musical notation for 'Wind Blowing' consisting of one staff of music in G major (one sharp) and 4/4 time. The melody is written on a single treble clef staff. The music features a mix of quarter, eighth, and sixteenth notes, with some rests and ties. The key signature is G major, and the time signature is 4/4.

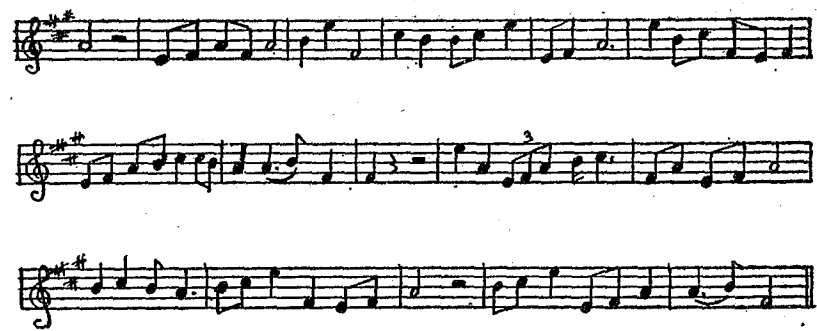
A musical score consisting of nine staves of music. The key signature is B-flat major (two flats) and the time signature is 4/4. The notation includes various note values such as quarter, eighth, and sixteenth notes, along with rests and dynamic markings.

12. SONG OF A MAN WHO BECOMES A SOLDIER
AND GOES TO FIGHT

A musical score for a song in G major (one sharp) and 4/4 time, consisting of six staves. The notation features a mix of quarter, eighth, and sixteenth notes, with some rests and dynamic markings.

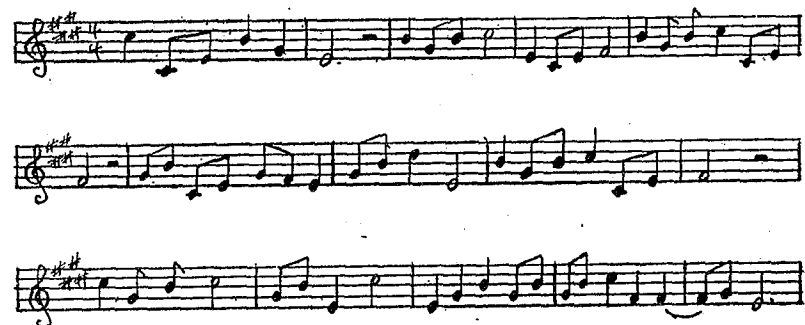
13. A SONG OF REGRET WHEN A YOUNG GIRL
LEAVES THE COMMUNITY

A musical score for a song in G major (one sharp) and 4/4 time, consisting of two staves. The notation includes quarter, eighth, and sixteenth notes, with rests and dynamic markings.



14. WELCOMING A TAILOR AND PRAISING HIM FOR HIS SKILL

1st verse



2nd verse



15. A SONG OF WELCOME (12 verses)

1st verse



2nd verse



3rd verse

Musical notation for the 3rd verse, consisting of five staves of music. The notation is in a single system with a key signature of one flat and a common time signature. The melody is written on a treble clef staff, and the accompaniment is written on four staves below it, likely representing different instruments or voices.

4th verse

Musical notation for the 4th verse, consisting of four staves of music. The notation is in a single system with a key signature of one flat and a common time signature. The melody is written on a treble clef staff, and the accompaniment is written on three staves below it.

5th verse

Musical notation for the 5th verse, consisting of one staff of music. The notation is in a single system with a key signature of one flat and a common time signature. The melody is written on a treble clef staff.

6th verse

Musical notation for the 6th verse, consisting of five staves of music. The notation is in a single system with a key signature of one flat and a common time signature. The melody is written on a treble clef staff, and the accompaniment is written on four staves below it.

7th verse

Musical notation for the 7th verse, consisting of two staves of music. The notation is in a single system with a key signature of one flat and a common time signature. The melody is written on a treble clef staff, and the accompaniment is written on one staff below it.

8th verse

9th verses

10th verse

11th verse

The first system on the left page contains four staves of musical notation. The top three staves are in treble clef, and the bottom staff is in bass clef. The music consists of a series of eighth and sixteenth notes, some beamed together, with occasional rests.

12th verse

The 12th verse on the left page consists of three staves of musical notation. The top staff is in treble clef, and the bottom two staves are in bass clef. The notation continues with eighth and sixteenth notes.

16.

The 16th measure on the left page consists of three staves of musical notation. The top staff is in treble clef, and the bottom two staves are in bass clef. The notation continues with eighth and sixteenth notes.

The first system on the right page contains four staves of musical notation. The top three staves are in treble clef, and the bottom staff is in bass clef. The music consists of a series of eighth and sixteenth notes, some beamed together, with occasional rests.

A FAREWELL SONG SUNG BY A GIRL AS SHE
LEAVES HOME TO TRAVEL

The second system on the right page contains four staves of musical notation. The top three staves are in treble clef, and the bottom staff is in bass clef. The music consists of a series of eighth and sixteenth notes, some beamed together, with occasional rests.

17. In the Morning of Time the Miao People do not have any Songs. They ask Heaven, "Where are Songs?" Heaven replies, "They are here," and gives this song

Musical notation for piece 17, consisting of six staves of music in a single system. The notation is in a single melodic line with a treble clef and a key signature of two sharps (F# and C#). The piece consists of six staves of music, each containing a sequence of notes and rests.

18.

Musical notation for piece 18, consisting of three staves of music in a single system. The notation is in a single melodic line with a treble clef and a key signature of two flats (Bb and Eb). The piece consists of three staves of music, each containing a sequence of notes and rests.

Musical notation for piece 19, consisting of eight staves of music in a single system. The notation is in a single melodic line with a treble clef and a key signature of two flats (Bb and Eb). The piece consists of eight staves of music, each containing a sequence of notes and rests. A fermata is present over the final note of the eighth staff.

19.

Musical notation for piece 20, consisting of two staves of music in a single system. The notation is in a single melodic line with a treble clef and a key signature of two flats (Bb and Eb). The piece consists of two staves of music, each containing a sequence of notes and rests.

A musical score for the first part of the song, consisting of ten staves of music. The notation includes treble clefs, a key signature of one sharp (F#), and a 2/4 time signature. The music features a variety of note values, including quarter, eighth, and sixteenth notes, as well as rests. There are several triplet markings (indicated by a '3' over a group of notes) and some slurs. The score is arranged in a single system across ten staves.

21. A SONG ABOUT THE BIRDS
Welcoming birds in spring

1st verse

A musical score for the first verse, consisting of five staves of music. The notation includes treble clefs, a key signature of one sharp (F#), and a 2/4 time signature. The music features a variety of note values, including quarter, eighth, and sixteenth notes, as well as rests. There are several triplet markings (indicated by a '3' over a group of notes) and some slurs. The score is arranged in a single system across five staves.

In this 2nd verse the fledglings ask the mother birds—now we have to leave the nest, what shall we have to eat—and the mother birds reply, "Go out early and find worms to eat."

2nd verse

A musical score for the second verse, consisting of three staves of music. The notation includes treble clefs, a key signature of one sharp (F#), and a 2/4 time signature. The music features a variety of note values, including quarter, eighth, and sixteenth notes, as well as rests. There are several triplet markings (indicated by a '3' over a group of notes) and some slurs. The score is arranged in a single system across three staves.

22.

A DAYBREAK SONG

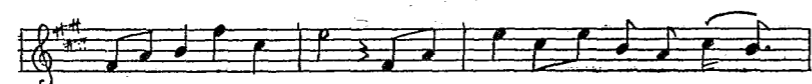
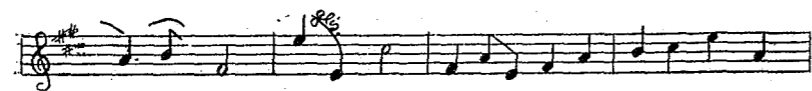
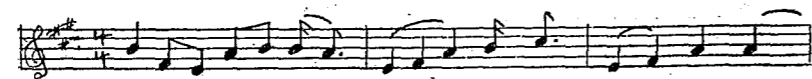
Welcoming the daylight

23.



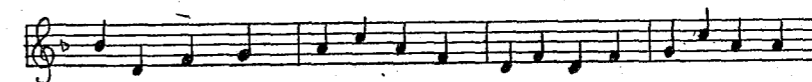
24.

FIGHTING SONG (1)



25.

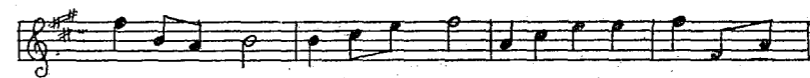
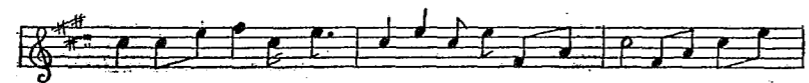
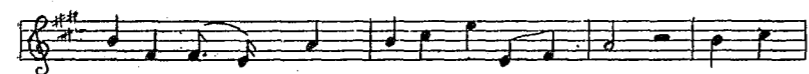
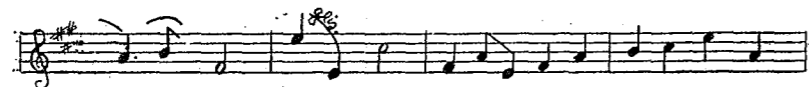
FIGHTING SONG (2)





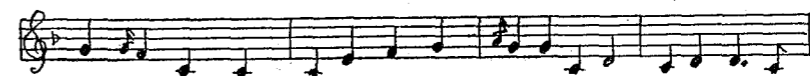
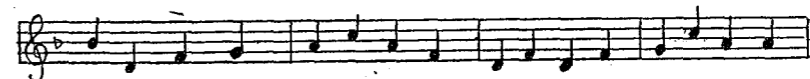
24.

FIGHTING SONG (1)



25.

FIGHTING SONG (2)



26.

WEDDING SONG

Musical notation for 'WEDDING SONG' consisting of four staves. The first staff begins with a treble clef, a key signature of one sharp (F#), and a 4/4 time signature. The melody is written in a simple, folk-like style with eighth and quarter notes.

27.

ABOUT THE MALE AND FEMALE ELEMENTS

Musical notation for 'ABOUT THE MALE AND FEMALE ELEMENTS' consisting of four staves. The first staff begins with a treble clef, a key signature of one sharp (F#), and a 4/4 time signature. The melody is written in a simple, folk-like style with eighth and quarter notes.

First staff of musical notation for 'MELODY ON LEAF', starting with a treble clef, a key signature of one sharp (F#), and a 4/4 time signature.

Second staff of musical notation for 'MELODY ON LEAF', continuing the melody from the first staff.

28.

MELODY ON LEAF

(An octave higher than written)

Third staff of musical notation for 'MELODY ON LEAF', starting with a treble clef, a key signature of one sharp (F#), and a 4/4 time signature. The melody is written in a simple, folk-like style with eighth and quarter notes.

Fourth staff of musical notation for 'MELODY ON LEAF', continuing the melody.

Fifth staff of musical notation for 'MELODY ON LEAF', continuing the melody.

Sixth staff of musical notation for 'MELODY ON LEAF', continuing the melody.

Seventh staff of musical notation for 'MELODY ON LEAF', continuing the melody.

Eighth staff of musical notation for 'MELODY ON LEAF', continuing the melody.

Ninth staff of musical notation for 'MELODY ON LEAF', continuing the melody.

Tenth staff of musical notation for 'MELODY ON LEAF', continuing the melody.

Eleventh staff of musical notation for 'MELODY ON LEAF', continuing the melody.

29.

A DANCE MELODY

Lu Shen
Melody



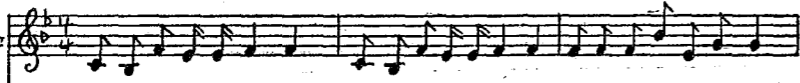
Harmonic
Arrangement



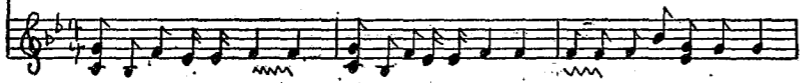
30.

FESTIVAL SONG

Liu Sheng
Melody



Harmonic
Arrangement



31.

FESTIVAL SONG

(at the close of the drum beating)

Lu Shen
Melody



Harmonic
Arrangement



32.

LIU SHENG MELODY

Lu Shen
Melody

Harmonic
Arrangement

33.

OPENING MELODY FOR DANCE

Lu Shen
Melody

Harmonic
Arrangement

34.

HARVEST SONG

Rapid Tempo

Lu Shen Melody

Harmonic Arrangement

(touch lightly)

(touch & lightly)

The musical score for 'Harvest Song' is written in G major and 4/4 time. It consists of two parts: 'Lu Shen Melody' and 'Harmonic Arrangement'. The melody is marked 'Rapid Tempo' and includes two performance instructions: '(touch lightly)' and '(touch & lightly)'. The harmonic arrangement provides accompaniment for the melody.

35.

FINDING COAL IN THE MORNING

Lu Shen Melody

Harmonic Arrangement

The musical score for 'Finding Coal in the Morning' is written in G major and 4/4 time. It consists of two parts: 'Lu Shen Melody' and 'Harmonic Arrangement'. The melody is a simple, rhythmic line, and the harmonic arrangement provides accompaniment.

36.

LU SHEN MELODY—
Calling the Animals

Lu Shen Melody

Harmonic Arrangement

The musical score for 'Lu Shen Melody— Calling the Animals' is written in G major and 4/4 time. It consists of two parts: 'Lu Shen Melody' and 'Harmonic Arrangement'. The melody is a simple, rhythmic line, and the harmonic arrangement provides accompaniment.

Two systems of musical notation for measures 35 and 36. Each system consists of two staves (treble and bass clef). The music features a rhythmic melody with eighth and sixteenth notes.

37. FESTIVAL SONG

Lu Shen Melody

Harmonic Arrangement

Two systems of musical notation for measures 37 and 38. The first system shows the 'Lu Shen Melody' on a single treble staff and a 'Harmonic Arrangement' on a single bass staff. The second system continues the melody and arrangement across two staves.

Two systems of musical notation for measures 35 and 36. Each system consists of two staves (treble and bass clef). The music features a rhythmic melody with eighth and sixteenth notes.

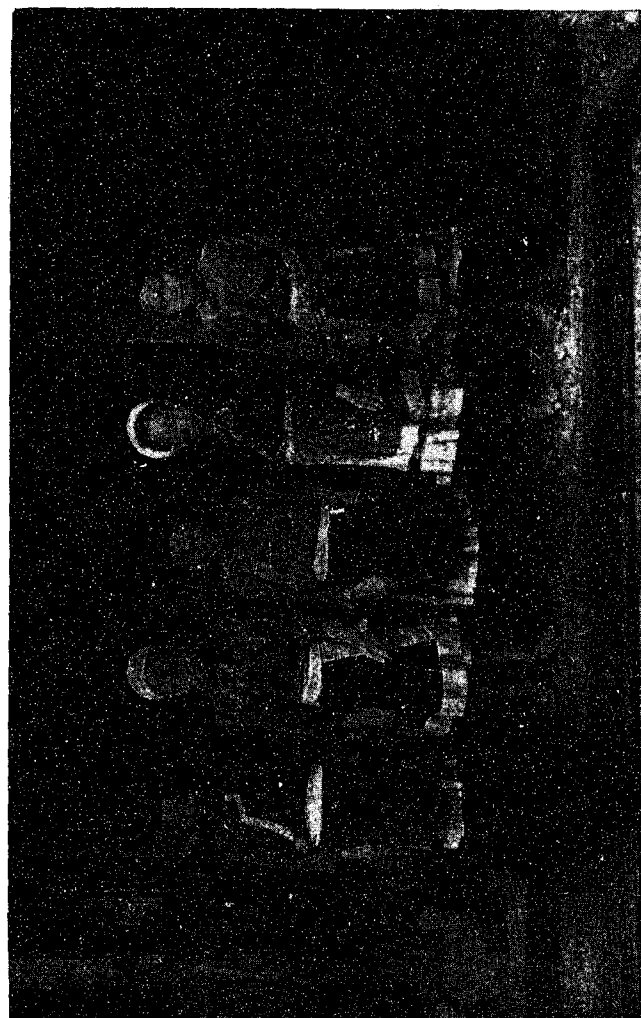
38. MELODY ON MOUTHHARP



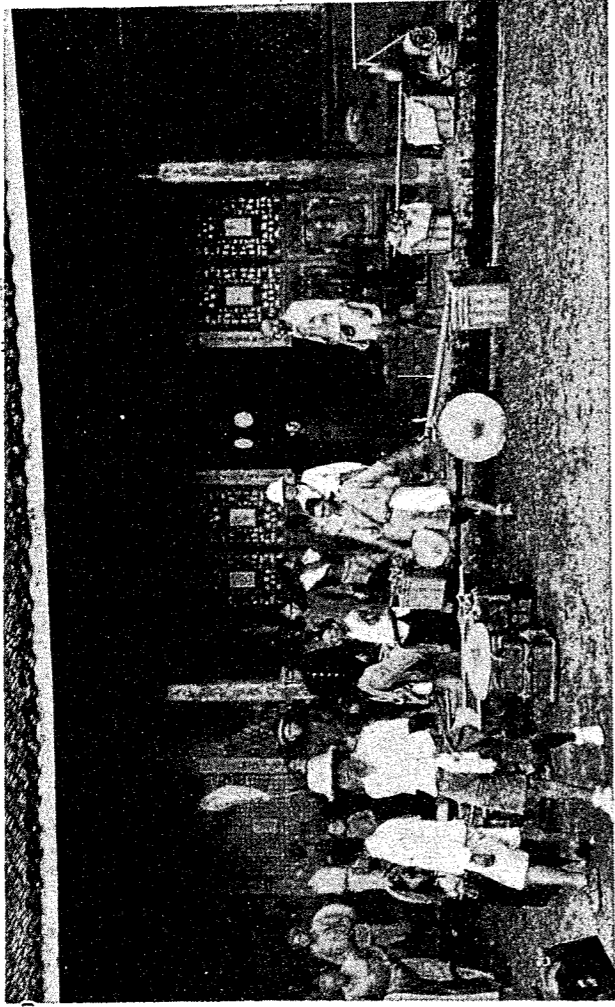
Before the melody begins there is an accompaniment figure like this

Two systems of musical notation for measures 37 and 38. The first system shows an accompaniment figure on two staves (treble and bass clef). The second system continues the melody and accompaniment across two staves.

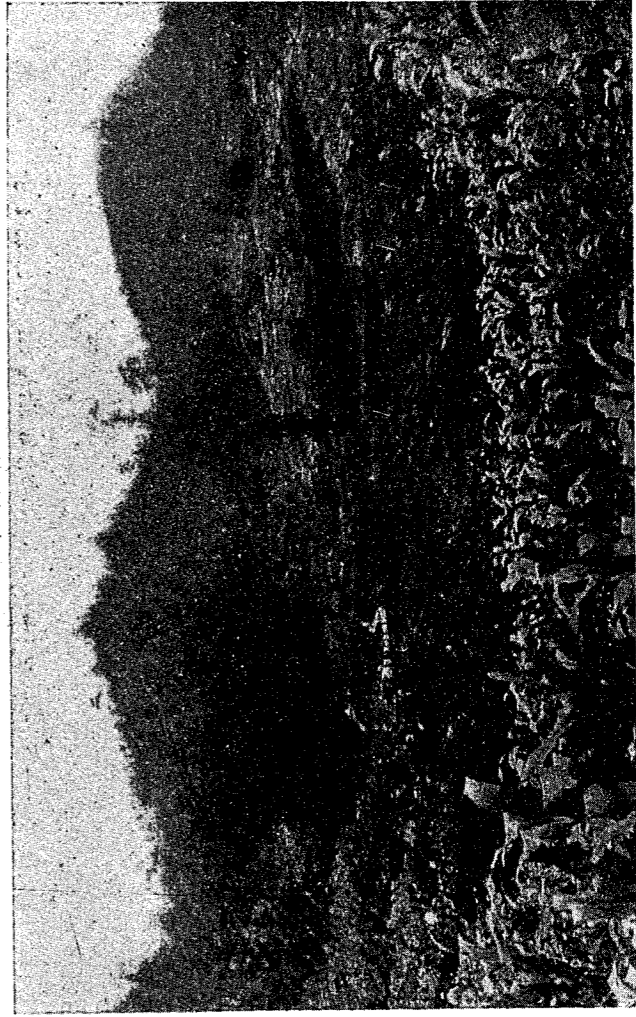
Five systems of musical notation for measures 39 through 44. Each system consists of two staves (treble and bass clef). The music features a rhythmic melody with eighth and sixteenth notes.



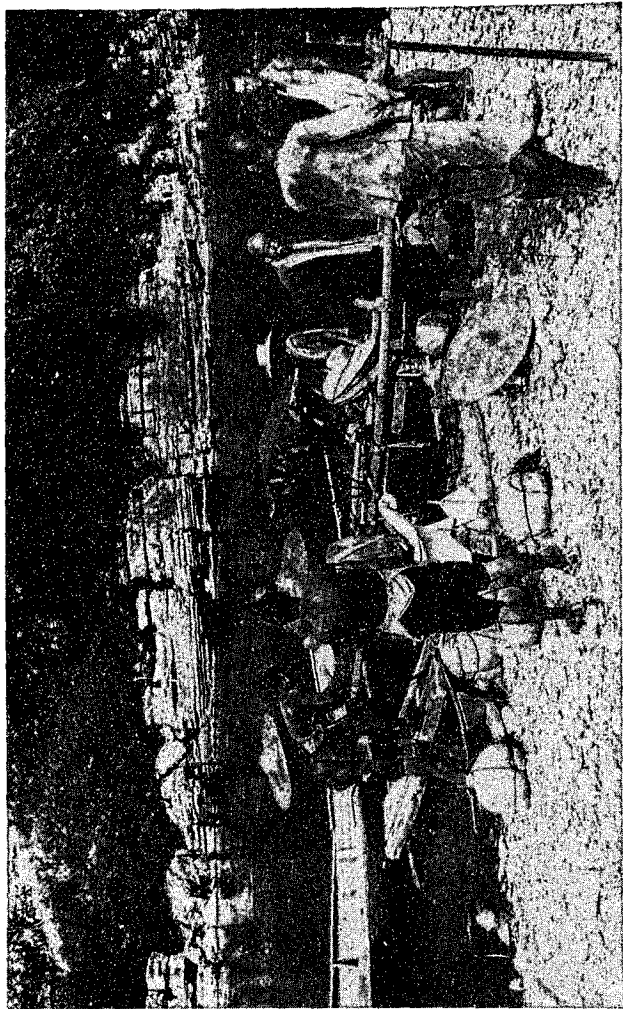
A group of typical Ch'uan Miao Women



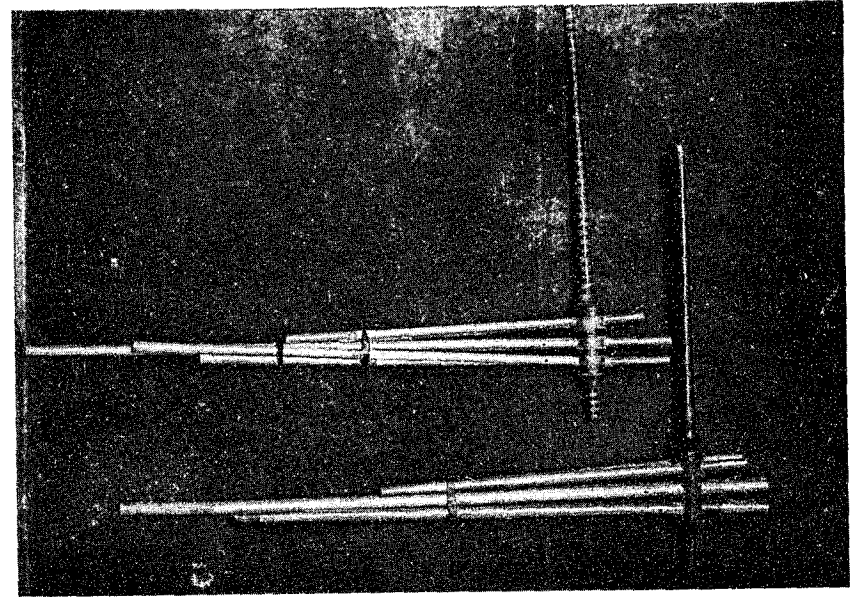
At the home of one of the Leading Men of the Ch'uan Miao.
Note the Chinese architectural designs, and the Chinese characters.



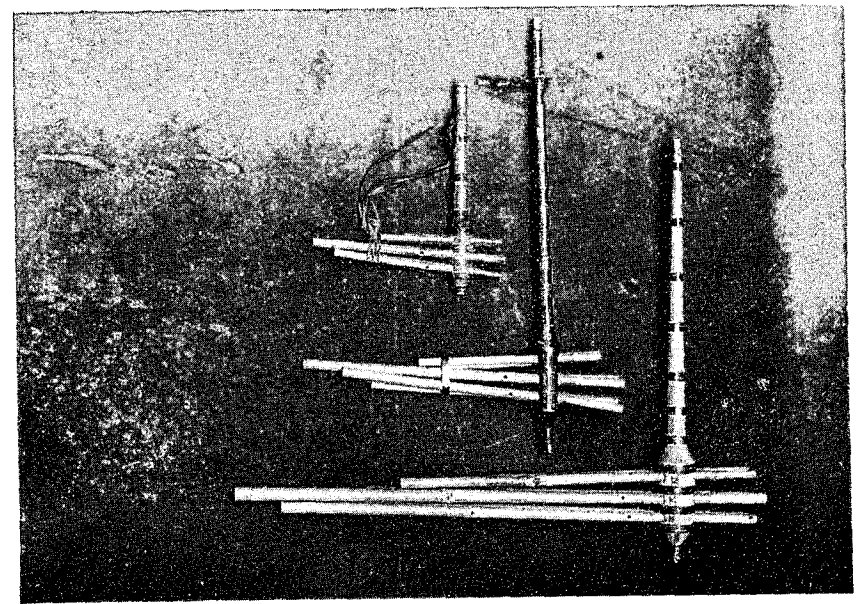
In the Hills of the Ch'uan Miao Country



Chair and load carriers crossing a river en route to the
Ch'uan Miao Country



Types of the "*liu shêng*" or six-toned Lute



Types of the "*liu shêng*" or six-toned Lute

SOME INCARNATIONS AND REINCARNATIONS ON THE ROOF OF THE WORLD

ROBERT CUNNINGHAM

My thoughts were turned to the subject of Incarnations by the death of Panchen Lama which is supposed to have taken place at Jyekundo at the end of November or the first of December, coinciding very closely with the "passing" of the Dalai Lama which took place in Lhasa in December 1933. Naturally I started to discuss the subject with Tuden and Daben as we sat by the fire learning the gentle art of Tibet conversation.

I have made no effort to corroborate or substantiate anything in the following lecture from books or notes we have on hand, apart from my Tibetan dictionary. The effort therefore may be very simple, as a beginning, but it is research as far as I am concerned, and as such should be acceptable to the Border Research Society. It is correct however, as far as two Tibetan teachers are concerned. If I had had time I might have consulted Waddell and Bell and the other authorities we have on hand, but I was afraid to do this, as it might have coloured anything I had to say. Therefore the following paper is largely, if not entirely, original. It will, I hope, form the basis for the future study of Incarnations, Reincarnations, and Transmigrations on the Roof of the World.

As I write, the Panchen's body is being carried towards Tachienlu with great pomp and ceremony and I believe a cortage of some 2000 followers and animals forms part of the procession. Why, if the body now being carried to Tachienlu, was only the temporary abode of the famous Incarnation O-ba-meh—Boundless Light, and that Incarnation may by now be in occupation of some small child in the Land of the Lamas, should there be all this trouble and anxiety and expense? The Panchen's Drugu may already be functioning in some part of Lamaland; should there be any necessity, therefore, to do more than bury the present body, knowing what we do about the principle of Incarnation?

Apparently the idea in bringing the body of the Panchen Lama to Kanze or to Tachienlu is that the "empty case" has still a blessing for all who have the privilege of seeing it. True, it is only an "empty house"—the Incarnation having taken up its abode in different quarters, but there is "release" or "deliverance" probably, from the Wheel of Transmigration, to all who desire it. The fact that reverence is still paid to the "deserted house" may be simply respect paid to its former inhabitant. The village or country-side may never have seen the Panchen in the flesh, but the fact that his embalmed body

is now carried through it, will surely bring blessing and deliverance to the devout. This deliverance is known as the Deliverance of the Five Senses; Sight Deliverance; Taste Deliverance; Touch Deliverance; Hearing Deliverance; and Feeling Deliverance, or Smell Deliverance. And all this means deliverance from the fateful wheel.

Some years ago, 1934, Nanking sent a delegate to Lhasa to be present at the burial rites of Tuden Jamtso. Enormous gifts were carried and magnificent presents offered—to what? John Brown's body may go marching on but not the body of Tuden Jamtso. His spirit, (however, does,) which carries with it memory, consciousness, and intellect, up to the present day has (so far) not found a body. We are asking why, and still keep asking. Has the bottom dropped out of the famous Tibetan Incarnation theory and will another function on the Roof of the world?

In making a study of Incarnation or Reincarnations on the Roof of the World three lines of thought must be followed: The simple minded nomad who spends his days attending to his herds of yak, and his nights in dreaming about fairies, has his own peculiar ideas regarding Incarnations; to him they are gods functioning in the affairs of men. To the draba, or unordained priest, an Incarnation is merely a Reincarnation of some Tibetan saint, whose unfinished task in the Land of the Lamas is still being carried on. The draba is uneducated, ignorant, and superstitious, and these disadvantages to a certain extent, colour and modify his conception of an Incarnation. The lama, highly educated and cultured, gives the Incarnation idea a spiritual value and brings to it a meaning and conception which are sometimes difficult to understand. If we therefore try to follow the nomad, the draba, and the lama, in their different conceptions of an Incarnation we shall understand something of this dark mystery as it is understood and practised in the Forbidden Land.

The principle, as the nomad sees it, is very simple; the idea as the draba regards it is something he accepts without very much knowledge of its inner meaning; the lama has no difficulty in explaining its esoteric significance, and to him it is purely a spritual experience. The nomad bends his knee before the Incarnation; the draba bends his body; the lama merely bends his head. The nomad seeks the Incarnation's blessing; the draba seeks his help; the lama seeks his presence. In the presence of the Incarnation, wonder characterises the sheep-skinned nomad; superstition paralyses the poorly clad draba; and dignity and solemnity inspire the red-robed lama. To the ordinary rank and file, an Incarnation is simply a saint manifest in the flesh, walking about among men, seeking in different ways to help them and do them good. Originally, there may have been only three Incarnations, there are

now thousands all over the Land of the Lamas; and some Incarnations have hundreds of Reincarnations, and their names are Legion. The idea, when it first began, may have been very simple and very beautiful; it is now profoundly mysterious and only understood and appreciated by a very few. Lozang Tuden, my Tibetan teacher, once a lama, but now fallen from grace, or law, tried to explain some of the intricacies surrounding the mystery of an Incarnation. Being his humble pupil, of course I was permitted to ask questions; and I am afraid, in my simplicity and stupidity, I asked some the poor fellow was unable to answer.

At the present time both the Panchen Lama and the Dalai Lama have passed from the scene of human or sacred activities. The Dalai died in December 1933 and the Panchen passed away in December 1937. If their Incarnations or Reincarnations have not yet taken place, where, at the present moment dwells, lives, or moves that part of them which is waiting for Incarnation or Reincarnation? Is the spirit or soul or spiritual entity in heaven or hell or somewhere in between? I asked Tuden, When that "thing," by whatever name we name it, left the body of the Dalai or the Panchen, did it immediately enter some pre-arranged body of some known or unknown child, and if it did not, then where is it at the present time? Tuden confessed his ignorance. Death released the spirit, or soul, or spiritual entity, known in Tibetan as the *namshé* or *tushé*. Where, I asked Tuden, if the new Incarnation has not yet been found, can it be? Is it possible, I asked him, that there will be no further Incarnations of these great religious dignities in the Land of the Lamas? To most of my questions he merely shook his superstitious head.

Other questions perplexed me on which Tuden could give very little light. What, I asked, was the controlling principle behind the idea of the Incarnation? Was there, I continued, a spirit or power, dark and mysterious if you like, at work, directing the State inhabited by Incarnations? What power or spirit or principle directed or controlled the "thing" which left the body and redirected it to its new abode? Was there such a principle, or spirit, or power? Tuden, unfortunately, had never heard of it so could give me practically no information, inside or outside, regarding the movements guiding the activities of Incarnations. Tuden shook his head, not being willing to risk his reputation on any statement or theory which he could not substantiate. Was there an Incarnation hierarchy seated somewhere in the heavens or in the lama's paradise directing the private or public movements of the lama's soul after it left one residence and before it entered another? Tuden, from the lama's standpoint could give very little information. A few days later my old Tibetan teacher arrived in Tachienlü from Jyekundo. Drendong Dabun is the most highly educated man we have ever met, and has acted for

many years as the chief secretary to the Panchen Lama. He called one day and I asked him some of the questions I had put before Tuden. What I wanted particularly to know was: What controlling influence or spirit directed the soul from the body of the old Incarnation to that of the new; and, was there such an influence and control? Drendong immediately threw tremendous light on this apparent difficulty. When the time for an Incarnation, that is, a "drugu," has arrived to leave one body and pass on to another, like the poor fellow (who sat) by the Pool of Bethesda lame for 38 years, it simply takes up its bed and walks to its new home. According to my old teacher Drendong, when the *nam-she* leaves the clay or dust, the mind, the memory, the intellect, and the knowledge are seeking a new abode in some born or yet unborn body. The whole mystery of Incarnation is understood when we realize and remember that the activity taking place is an intelligent one and not something characterised by blind chance. An Incarnation is working out some definite purpose or mission in the world of human beings; and so, to accomplish that object an Intelligence makes its home for the time being in some living form. The living form being of necessity mortal, the work of the Incarnation immortal, it must pass on, and in doing so occupies another residence. What moves on is not an inanimate block of wood or stone but apparently an intelligent spirit, or soul, or mind, or memory, or intellect, or knowledge, intelligently and consciously aware of what it is doing and where it is going. And this, according to Drendong Dabun, is what actually takes place. So the next time I discuss the principle of Incarnation with Lozang Tuden, my present teacher, I will be able to explain the migration and the mystery.

The *nam-she* from what we have seen is not a mere automaton, but an active, living, intelligence, occupying during hundreds and thousands of years one body after another, the body occupied being known as *drugu* or Incarnation. The *nam-she* or *nambar-sheba* is defined as: Perfect knowledge, consciousness. In philosophy it is one of the five "aggregates." Some authorities define it as phenomenal consciousness, and consciousness of external things, or that which distinguishes one thing from another. There are nine kinds of perfect knowledge or consciousness, some of which are as follows: Self-consciousness, the "ego," image-receiving knowledge; tactual knowledge; auditory knowledge; taste, smell and visual knowledge; so when a *nam-she* takes up its new abode in some other individual as a *drugu* it does so with all this consciously acquired knowledge; and in many ways must be a moving encyclopaedia of things human and divine, spiritual and temporal.

The nomad, the *draba*, and the lama, however, have still hazy ideas regarding many of the mysteries common to the

Roof of the World and there are three Tibetan words which call for some explanation, namely, *druba*, *drugu*, and *jaywa*. If we take the last of these three words first *jaywa* means, birth, rebirth or Transmigration. The nomad, unfortunately, gets *druba* and *jaywa* somewhat confused, the former being an emanation and the latter a transmigration, both being, as he thinks, somewhat similar. A little story told to me some days ago by Tuden will illustrate this point. Some years ago a boy was born near Derge and soon after his birth both his parents died. The boy was cared for and grew up to be a yakherd. When ten or twelve years old he drove a herd of yak day by day out on to the surrounding mountains. With a cake of flour tucked away inside his sheepskin he would make a fire, warm up the cake, and enjoy his mid-day meal. Being of a religious turn of mind he would offer half of the flour cake to the deities inhabiting the surrounding mountains. One day, when partaking of his frugal meal, he was accosted by three strange looking individuals. One was the demon Dzen, another was the demon Jalbo, and the third was the demon Terong. Entering into conversation they asked him as follows: "This little bit of flour cake which you offer day by day, do you do so because you can't finish it, or as a freewill offering to the gods?" "It is a freewill offering, gladly offered to the gods for their help and protection," answered the young nomad. This so pleased the three demons that they proceeded at once to make their gifts to the young lad. The demon Dzen gave him the gift of prophecy; the demon Jalbo gave him the gift of a black horse; and the demon Terong gave him the gift of performing miracles. Some five or six years later, with these three gifts the young nomad left his simple home in Derge, wandered all over that part of Tibet, and in time became a widely known worker of miracles. He was known far and wide as the Dana Lama, that is, the lama with the black horse, as he was seen everywhere riding a black horse. In the course of time, like all great lamas, he made his way to Lhasa. There his reputation was already known. Many in the sacred capital had heard of his miraculous gifts. Dana Lama, on his black horse, rode all over the country, and in any district he could bring a famine one day and remove it the next. Pestilence in one part of the Land of the Lamas devastated the country-side and when appeal was made to Dana he suggested a certain course of action which immediately removed the disaster. Cattle in one part of the Forbidden Land were dying by the thousand; Dana suggested the performance of acts of virtue and the reading of sacred books and the plague was removed. Fortunately for the lama it was unknown that Dana not only caused the trouble but was also the means of its immediate removal. As a worker of miracles he brought destruction; as a prophet he brought relief. So with his black horse he rode up and down the Roof of the World making himself not only famous but very wealthy.

Very soon his followers could be counted by the hundreds. Lamas and drabas left their lamaseries and followed the Dana Lama. A prophet is not without honour save in his own country, so Dana Lama left Lhasa and moved towards Drashe Lhumbo, the home of the Panchen Lama. On the way, while passing a famous lake, Dana Lama died. There lay the body of this famous lama; where had his soul or spirit or *namshé* gone? While his followers were lamenting their terrible loss, the Panchen Lama, with a large following, was seen coming in the distance. On dismounting, the Panchen was appealed to. Could His Highness tell them, would there be a reincarnation or a rebirth, and where would it take place? Both the Dalai and the Panchen have the title of the "All Knowing;" nothing being beyond their ken. Pointing to the lake, the Panchen showed the distressed followers of Dana an enormous frog: "There" he said "is the Dana Lama." On the back of the enormous frog could be seen thousands of smaller creatures, apparently eating the life out of the larger animal. The Panchen Lama told Dana's followers that this rebirth would last for one thousand years as the Dana Lama had deceived and destroyed hundreds of harmless people and creatures; and the small creatures would live on him for one thousand years. This apparently was very bad news and was the end of the Dana Lama for some time to come. The point is: how did this end react on the simple-minded nomad? Three of the most wicked demons in the Land of the Lamas took possession of a nomadic lad and used him to work destruction on the Roof of the World. Was he a wicked Incarnation or what?

Gesar, a great warrior, supposed to have lived about the 7th century A. D. was a notorious war-lord who ravished, and plundered, and murdered the inhabitants along the frontier; yet this great destroyer of human life was an Incarnation of the famous Jenrehzee; the Grand Lamas of Tibet also being Incarnations of this patron saint, an emanation of Goondu Zangbo, "The All Good." How "The All Good" could possibly find itself operating in what might be termed "The All Evil" will demand some explanation. Yet Gesar slaughtered people by the thousands. Langdarma, one of the most notorious kings in the long history of the Forbidden Land, made it his business in life to destroy religion, and in doing so destroyed hundreds of lamaseries and burnt thousands of sacred books. For many years he was a terror to the lamas and drabas on the Roof of the World. Yet Langdarma claims to be an Incarnation, and in being so was simply carrying out his mission in life. In the midst of his evil days, when watching a public dance from the roof of his palace he was shot by a well-known lama, who was also an Incarnation of a well-known emanation. The Dalai and the Panchen are both Incarnations of well-known

emanations yet the Panchen some years ago had to flee from Tibet to China as an attempt was made on his life. The Dalai has also been in a similar position and he too fled from the Land of the Lamas to India.

This now brings us to the point that on the Roof of the World there are both evil and good emanations, and therefore evil and good Incarnations: one working for the destruction of mankind, and the other for the uplift of the human race; and at war with each other. This in its simplest form is the idea behind the nomad's conception: one manifestation is seeking to do him harm; the other is trying to do him good. That there was war in heaven is one of the great mysteries in the Book of Revelation; but to the unsophisticated nomad dwelling somewhere in his yak-hair tent on the Roof of the World it is no mystery. As he sees it there is an eternal struggle and perpetual war, not only in heaven, but carried right down on to the Grass lands of Tibet. From this position he sees powers coming to destroy him, while others are coming to his rescue; one influence is dragging him down, another is pulling him up. Hence the idea of an emanation or Incarnation on both sides of the fence. An emanation is simply a manifestation; an emanation in occupation is an Incarnation. *Druba* is the former—*drugu* is the latter.

However it is not all gold that glitters. Gusho Draba is an old friend and is the Yellow Incarnation at Jeeleeku, three days from Tachienlu. Many of our friends from Chengtu have met this Incarnation and conversed with him. We have known him for fifteen years and a more covetous rascal it would be difficult to meet. He is not only head of a lamasery with 300 drabas but head also of the local militia and usually travels with a brace of pistols. Some years ago, when on a visit to this city, a thief crawled into his bedroom and gently relieved him of almost everything but his skin. He called to see us a few days later and we asked him if he could tell who the thief was and where his lost property was hidden. He smiled, and we changed the subject. The Batang Drugu called some months ago on his return from Nanking. One day he wore military uniform and the next the lama's robe. With his retinue he called to see us and we considered it advisable to remove anything of any value while he was in the room. I asked him ten times in half an hour to please be seated he continued to prowl about the room. While he remained in town we kept our dining room nick-nacks in a place of safety. A visit to any surgery or dentistry would have had dangerous mental reactions on this appalling Incarnation. Latterly he saw our suspicions and didn't like us. The Geda Drugu was the most crafty, scheming fellow we have ever met on the frontier. He would call at ten and stay till one. He would come at two and remain till five. He had a mind of intelligence and was tremendously interested in geography. He

brought us all kinds of presents. Since his return to his lamasery near Kanze he has frequently sent us pats of yak butter. He spent fifteen years in Lhasa. The Reds suffered heavily in Kham and lost considerable man power. Having 2000 extra rifles they did not know what to do with, the Geda Drugu kindly promised to look after them; and thereby hangs a tale. Machiavelli would be ashamed of himself in the presence of this Incarnation. He had studied Christianity and was acquainted with the New Testament. One day I asked him the meaning of Incarnation. You have it in the new Testament, he replied: "God was in Christ." Is this not different from a lama Incarnation I asked him; only in degree he answered. He was deeply involved in politics, apparently leaving spiritual affairs to the other members of his lamasery. Geda, his name, means, "unchanging virtue," Geu-tsang frequently comes to see us. He was the Incarnation in the large lamasery at Drangu, along the north Lhasa road. Formerly he was the spiritual head over some 2000 lamas and drabas. He is fairly well educated and sometimes lectures on the Ganjur and the Denjur in the local temples. Geu-tsang is an Incarnation deeply interested in lama philosophy and loves to discuss "Which was the first, the fire or the smoke?" Like Cain, he is now a fugitive and a wanderer, spending his days, first in one lamasery and then in another. On one occasion when travelling in Minya we were approached to write a letter on his behalf appealing to his lamasery to receive him back again. He has undoubtedly committed some unpardonable sin, forcing his lamasery to take up an irreconcilable attitude. Poor fellow, he is now more like a lost sheep than an Incarnation. The point at issue appears to be something like this: As a boy he went up to Lhasa and made an attempt to enter the Dre-u House, also known as the Horba House, in the great Drebung lamasery. He was refused admittance, being unable to give any guarantee or surety, or the name of any lama. Thus disappointed, he went to Horba House at the Sera lamasery, explaining very intelligently why he was refused admittance into Drebung. The Sera authorities were much impressed by the young lad, inviting him to take up residence in the lamasery, and in due course he carried everything before him in his studies; later taking the rank of Geshe. Other lamas and drabas returning to Drangu carried back with them the reputation of Geu-tsang, so when he returned in person he was welcomed as a Drugu, and occupied that position in the large lamasery. Being young, and to a certain extent guileless, he was soon subject to the evil machinations of a clever and powerful lama. This lama, Dolu Hsingo, finally ousted Geu-tsang from his position in Drangu, maintaining that he was only a Geshe and not a Drugu. So dangerous became his life that he decided to flee from the lamasery, while he still had it, and took refuge in Tachienlu. He had, however, a strong following at Drangu who some years later

lay in wait and murdered Dolu Hsingo. Geu-tsang is still unable to return as there are many at the lamasery who still deny his right to be a Drugu, maintaining that life can only come from life, that is, that a Drugu can only come from a Drugu.

While in Lhasa the case of Geu-tsang caused quite a sensation, and excited considerable interest. When this Geshe became an Incarnation, Drebung claimed him as her own, stating that the Horba boys belonged to Drebung. So bitter became the contest that the lamas in Drebung and Sera were with difficulty restrained from blows. Finally the case was taken before the Dalai at the Jewel Park. Unfortunately the Dalai could make no decision as he had no desire to offend either the authorities at Drebung or Sera. At last the lamas from the two lamaseries decided to cast lots as to the bona fides of the Geshe's claim to be an Incarnation. Drebung said he was a Geshe; Sera maintained he was an Incarnation. By twelve casts to eight Sera won her point, so Geu-tsang was established as the Incarnation of Drangu. Finally, however, the Lhasa decision was over-ruled by Dolu Hsingo and his powerful following, so the Geshe lost his position as a Drugu, though here in Tachienlu he is still known as an Incarnation.

The Bawang Drugu from Jarong is another delightful fellow who frequently comes to see us. We met him in Jarong in 1933 and we have kept up a warm friendship ever since. He returned from Nanking only a few weeks ago and was there during a number of the air raids. He told us how, when the warning siren went, the Tibetans living in the Lolan lamasery would seek shelter under the table. He spent a few days in Shanghai visiting the Department Stores and enjoyed the experience of going up and down the lift. To hear him recount his many experience it was difficult to realize that an Incarnation could enjoy and appreciate all these things. It may be the Drugu has a very human side as well as a divine. That an Incarnation should think about his friends in Tachienlu when leaving Nanking is somewhat surprising. The Bawang Drugu brought us back a nice present of scented soap. Both the Incarnations from the Reegu lamasery have called to see us and both are highly cultured and very wealthy. They are connected with the wealthiest home in Tachienlu, the Wasija. They live two days from the city and when they come to town, which they do every year, they pay us several visits. No one can talk with them and question their high culture and learning. But the point I wish to bring out is, they are exceedingly wealthy and own considerable property. What, we would like to ask, happens to all this wealth and property when the Incarnation reincarnates himself? That the Drugu's culture and wisdom and learning and intelligence and spiritual gifts pass with him in toto into the new Incarnation we can thoroughly understand and appreciate; but what

happens to the gold and silver and Bank of China notes and the accumulated wealth of gold and silver ornaments and other jewelry? Do these mundane things go through some mysterious spiritual metamorphosis, becoming, in the process, treasure laid up in heaven, where moth does not corrupt and where thieves do not break through and steal? Or when the soul makes its departure, being forced thereto by occupying a body made of clay, to its new abode, are these things left behind or left in the bank? Gusho Draba lives two days from Tachienlu. He is very fond of money, power, and other things. He can repair guns and revolvers and mend gramophones, and I believe he can handle clocks and watches. He is very clever with his fingers. How did he come by this manipulation? Did the former Drugu whose Drugu he now is pass this on to him, or is it something he has acquired and will pass on to the next Drugu?

Of baby Incarnations we have met I will not write as their name is Legion. There are three or four in Tachienlu at the present time. Two of them are of doubtful origin as the husbands of their mothers died before they could possibly become their fathers. This however in no way detracts from becoming a Drugu. If the child has the necessary marks, that apparently is all that is necessary; Lamaism does the rest. The outgoing Drugu is evidently not very particular about the nature and origin of his new abode—it must however be a boy: though Tibet is sometimes called the Land of Mystery! The stories of Incarnations, if we liked to record them, would fill many pages, and make interesting reading. But life is short!

The Dzochen Drugu died in Derge some years ago. Years passed and there was some difficulty in finding his Incarnation. The Dzochen lamas met and discussed the situation. The Dzochen Drugu, before he left the house of clay, wrote out the place and direction of his new abode. Samye, near Lhasa, was the name of the place in black and white. So a deputation from the Dzochen lamasery, with all the necessary paraphernalia made its way to Samye. The advice and help of the Samye Drugu was sought but he could give no indication that an Incarnation was anywhere in the district. The help of a *Iha-bab*, that is a lama who lays him-self open to be taken possession of by some god for the purpose of communication, was then sought. The *Iha-bab* called for writing material and wrote the name of the house and family and of the child. On arrival at the house the parents said the boy was five years old and could not possibly be the Incarnation of the Dzochen lama who had died only four years ago. This however was not accepted by the deputation who proceeded to produce the bell and dzamba bowl and rosary and dorje and other things used by the former Drugu, now supposed to be resident in the child before them. The test in one sense seems critical but not when

we remember the principle on which it is worked. The "emanation-body" as the word "drugu" means was before them with all its intelligence and consciousness and would surely remember and recognize its own things. On a low table lay two or three lama bells, two or three rosaries, two or three dorjes. Would the Incarnation recognize his own things? The small boy goes to the bells; yes, that one is his. He goes to the dorjes: yes, that one is his; and so on till the test is complete. Apparently there are three results: a complete success; a complete failure; and a bit of luck, in which some things are recognized, and others not. Explanations are given and one may be that they have brought the wrong bell or the wrong dorje.

Signs and marks and characteristics, of which there are 32 and 80, are carefully examined, and if the evidence is sufficient, even though mistakes may have been made in the recognition test, the Drugu is accepted and returns to the lamasery an Incarnation. Deception, does however, play its part on the Roof of the World, and demons and devils and evil spirits become incarnate and deceive the simple-minded nomad and the superstitious draba and the cultured lama. The Nyara Drugu is a demon Incarnation in the Land of the Lamas, so also is the A-bo-bu Incarnation a demon emanation. Both principles are at work; the difficulty being to discover just where you are. Uriah Heep seemed to be at one and the same time an emanation of both good and evil, until Micawber laid him out. Paul said "When I would do good, evil is present with me." Again; "It is no more I that do it, but sin that dwelleth in me." Therefore at one and the same time both an evil and good Drugu may occupy the same Incarnation; opposing and fighting each other and introducing chaos where there should be law and order.

There is, however, a metaphysical and philosophical interpretation of the Incarnations in the Land of the Lamas and we will now deal with these. When a famous Drugu "passes"—this is the term used, not "death"—he is reincarnated in three different forms, known as *gu-sum* or three bodies. There is a body emanation; a voice emanation; and a mind emanation; these three being necessary in the formation of a complete Incarnation. The real Incarnation, however, is the mind, as that carries with it the memory and the intellect. When an old Drugu "passes" into a new Drugu the discovery has to be made as to which part of the old Drugu he is. In the test: there are three important things: The bell, which represents the voice; the idol, which represents the body; and the receptacle, which represents the mind. If the boy ignores the bell and the idol and pounces on the receptacle, he is regarded as the mind emanation of the Incarnation who has "passed" on. The body and voice have now to be discovered and a search is at once begun. Most of the higher lama Incarnation have

these three Drugus but both the Dalai and the Panchen have five emanations; one for each point of the compass and one for the centre. And each emanation has its definite location: Body, voice, mind, wisdom, and work, all being necessary to continue the benevolent mission of the Drugu among men, and all living and moving creatures in heaven, earth, and hell.

This will give us some idea of the multiplicity of Incarnations in the Land of the Lamas. The Dalai and the Panchen both have five emanations and each emanation has five emanations and so on ad infinitum. Padma Sambhava, a popular manifestation connected with the Red Sect, has at least 10,000 Drugus since he first made his appearance on the Roof of the world. Among the original manifestations which have been reincarnated times without number in Lamaland, we have O-ba-meh—Endless light; Tse-ba-meh—Endless Life; Jen-rehzee; Jambeh-yang; and China Dorje. The two former are well known, while the latter is not a very popular Drugu. The Drugu matter or material from which an emanation began, started with Goondo Zangbo—The All Good—who is also known as "Nangwa Tayeh—Endless Light; who was manifest in Jenrehzee, the Dalai being the incarnate form; the Panchen being the incarnate form of Endless Light. No one was there to see it; but what took place was something like this: A ray of light passed down the right hand of Nangwa Tayeh giving birth to the Drugu Jenrehzee. A ray of light issued from his bosom giving birth to Urjan Behma. A ray of light passed down the left hand of Endless Light giving birth to Pama Drolma—the goddess who saves the Tibetans from a trans-migratory existence. This female Incarnation is a very popular Drugu in Lamaland, and with Balden Lhamo, a bloody and licentious goddess, but also a constant and redoubtable champions of Lamaism, is widely known in the Forbidden Land.

As body, speech, and mind constitute the three spheres of men's doings and sufferings, so a separate Drugu apparently is necessary to reach these three spheres. Again, as there is spiritual existence, a celestial existence, a bodily existence, so separate Incarnations have been evolved to deal with each existence. Further, there is, according to Lamaism, a heaven, a hell, and an earth somewhere in between, with the possibility of the middle place being packed tight unless Jenrehzee, Benevolent Eye, works very hard to redeem the souls of men. So stupendous is the task before Jenrehzee that he has been evolved twice on the earth; first as a ray of light from the left eye of Boundless Light and again, born from a lotus-bud. Jam-bal-yang, Lovely Glory Song, I would gather has to do with the voice. And if we believe what James says: "The tongue is a little member and boasteth great things. The tongue is a fire, a world of iniquity. It defileth the whole body. It is set on fire of hell. It is an unruly evil, full of deadly poison"—then Jam-bal-yang, like other Drugus has

his work cut out. Lozang Draba, Illustrious Good Mind, was an Incarnation of Adesha and was the founder of the Geluba, the Yellow Sect. A-de-sha, incarnate in Lozang, revolutionized Lamaism and brought forth its greatest reformation. Dorje Pamo, Sceptre Sow, frightened and vanquished the enemies of Lamaism by manifesting herself in the form of a sow. Her spirit is incarnate in each successive abbess who presides over the lamasery of Sanding. Finally, we have the three precious Incarnations: The Precious Prince; The Precious Mind; The Precious Vision, each of which is capable of a different interpretation. One great difficulty that has presented itself in the study of Incarnations is the number of different names under which certain Drugus are known. For example, Urjen Behma, or Padma Sambhava, is adored by the Tibetans under twenty different names, and each incarnate name is full of significance and meaning.

In closing it should be noted that the above Incarnations are subject to three modes of rebirth or reincarnation: An Incarnation may find his present abode passing from him months and years before his new abode is ready for him; and it is possible he may never find another residence. An Incarnation may leave his present abode, forced to, of course, and find his new abode waiting for him. An Incarnation may leave his old house of clay just as the new house is coming into being. Death in one case, and life in another, taking place simultaneously. The whole Incarnation principle is one of faith which seems to work in the Land of the Lamas, and in its working will go on producing more and more Incarnations.

THE LIU LI CH'ANG 琉璃廠 KILNSITE

DAVID CROCKETT GRAHAM*

About twenty *li* south of Chengtu, on the road that passes the old arsenal, is Liu Li Ch'ang. Here along the road or in the nearby fields are about twenty small shops and farm-houses. While this place can hardly be called a village, it is well known in Chengtu, for it is the site of old porcelain refuse heaps from which for decades and possibly for centuries have come old porcelains that have piqued the curiosity and aroused the admiration of lovers of antiques.

The Liu Li Ch'ang kilnsite is in the form of a very rough circle and has a diameter of about two thousand feet. Near the edges of the circle are ten or more hillocks roughly conical in form, which are heaps of burnt clay sherds, discarded vessels, and other rubbish from the old kiln or kilns. Much of the soil between the hillocks is underlaid with sherds. There may have been several kilns operating here at the same time.

Diligent search has been made in the old gazeteers by Mr. Lin Min Güin, assistant curator of the West China Union University Museum of Archaeology, and not a single reference to this kilnsite has been found.† There is a reference in the Hua Yang Hsien Chih 華陽縣志 which was published in the twenty-second year of the Chinese Republic or A. D. 1933. It says, "North of this mountain (Chu Wang Shan 祝王山) is Liu Li Ch'ang. During the Ming dynasty it was a place where the government manufactured glazed (materials.)" Since none of the old histories or gazeteers mention this site, and all the evidence seems to contradict the statement that the kiln was operated during the Ming dynasty, it is very likely that this is an interpolation representing the opinions of the scholars who wrote the later history.

The writer made an excavation at Liu Li Ch'ang in March, 1933. Nearly every morning when he returned to work he found that the local people had looted the site during the night, so that the work was very difficult. However, some good results were achieved, and this is the only excavation of its kind that has been made at Liu Li Ch'ang.

During the summer of 1936 some military officials sent a large number of soldiers to dig for antiques in this kilnsite. Their methods were entirely unscientific. They dug everywhere and they dug deep, and finally discontinued their looting when they believed that they had finished the kilnsite and that

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†Mr. Lin Ming Güin has rendered considerable assistance in the study of this kilnsite, especially in searching the Chinese histories and making the translations.

there was nothing left worth searching for. The harm done was irreparable.

Since the fall of 1932 the writer has endeavored to build up in the West China Union University Museum of Archaeology an adequate collection of the materials found in the Liu Li Ch'ang kilnsite. Excepting the one made in 1933 excavation has been impossible because of the strictness of Chinese laws. It is very doubtful whether future excavation will be rewarded with satisfactory collections from this kilnsite. However, when the soldiers were digging in 1936 the writer and others decided that failure to purchase some of the materials dug out would probably mean that a good collection from this kilnsite could never be made. Mr. Lin Min Güin and the writer made several trips to the kilnsite and purchased numerous objects that they saw taken out of the ground. The result is a large collection which is the basis of this article. We assure our friends that the writer and others made earnest efforts to secure permission to excavate scientifically and also to persuade government officials to stop the looting, but to no avail.

Many people have been and still are puzzled as to the date of this kilnsite and also as to the classification of the porcelains. This article is an attempt to show what kinds of materials have been found in this kilnsite and also to reach a reasonable conclusion as to its date.

In the excavation of 1933 the writer found *in situ* a fine, dark, lustrous temmoku tea bowl, several other pieces of temmoku, two fine Tz'ü Chou yao sherds, and several pieces of Ting yao. Later he procured several pieces of Ting yao and a few Yin Ch'in and Chün yao sherds. The writer has never found and has not seen anybody else who has found any typical Ming Dynasty sherds, and only a few that might be T'ang Dynasty sherds.

In October, 1934, the writer made an excavation on the campus of the West China Union University. During this excavation a brick tomb was found containing burnt human bones, a gravestone, dated bricks, some pottery and glazed human images. There were two typical, unbroken pieces of Liu Li Ch'ang pottery. On the bricks was the inscription "Manufactured (fired) in twelfth year of Chia Ting (A. D. 1219)." On the gravestone was the inscription "The fifth day of the eleventh moon of the fourteenth year of Chia Ting in the Great Sung dynasty (A. D. 1221). The deed of the deceased. After birth he lived in the city. When he died he was placed in the house, and by divination this lucky place was found. Hua Yang Hsien.....district.....very lucky (place). To the left is the green dragon 青龍. On the right is the white tiger 白虎. In front is the vermilion bird 朱雀. In the rear is the black military 玄武. In the center is the

hou ch'en 勾陳*. All this is like legal orders." This is definite proof that the Liu Li Ch'ang pottery was in general use in A. D. 1221, or in the South Sung Dynasty. The tomb was made of thin brick between which was packed dirt to fill up the crevices. In this dirt were found small sherds much weathered, all of which seem to be from the Ch'iung Chou kilnsite, but much older than the Liu Li Ch'ang pottery inside the tomb.

Further evidence as to the date of the Liu Li Ch'ang kilnsite is furnished by the objects themselves. Most of the bowls and saucers have very small bottoms and bottom rims, which is a characteristic of the Sung Dynasty. Again, most of the pottery is monochrome porcelain, which is also a Sung Dynasty characteristic. As in most of China during this period, there are occasional variations, among which are floral designs first incised on the body and then glazed, or first stamped on the body and then covered with glaze, or first painted in a light color on the body and then glazed.

One sherd secured by the writer at Liu Li Ch'ang has on it the two characters Lung Hsin 隆興, the year name for A. D. 1103. Since the official using the latter year name ruled in a distant part of China and did not control Szechwan it is not likely that the name refers to the latter date. Another thick sherd has on it a year name, but the first part of it is missing. It has the final stroke of one word and all of the other word on the year name. The legible word is *ho* 和. There is no year name in the Ming dynasty that ends with *ho*. There are such year names in the T'ang dynasty, but this was a fine porcelain glaze that is evidently later than the T'ang dynasty. In the Sung dynasty the year names of A. D. 1054, 1110, 1118, and 1189 all end with the word *ho* 和. The year name of A. D. 1201 ends with this character, but the ruler in whose dominions this year name was used did not reign in Szechwan, so it is doubtful whether the year name would have been used in Szechwan at that time. The National Szechwan University has in its collections two Liu Li Ch'ang dated pieces of pottery. The date of one is A. D. 1102, near the end of the North Sung dynasty, and the other is in the Yuan dynasty, A. D. 1276.

I. MATERIALS AND GLAZES

The bodies of most of the vessels are red or orange red stoneware. This varies in darkness to a black color. A few specimens have been found with light orange yellow bodies. Nearly all the vessels were made on the potter's wheel.

Some of the coarsest objects are unglazed and uncolored and were turned red by the heat of the kiln. Some are painted

*These references are to five stars or groups of stars.

a dark brown or orange yellow. Some of the pottery is merely covered with yellow slip, but most of it is glazed, and most of the glaze is apparently true porcelain. The glazed dishes were first covered with a white or a light yellow slip, then with the glaze, resulting in a lighter and more lustrous color. The bases or feet of the bowls are generally narrow and generally but not always have foot rims. While the insides of the bowls, plates, and saucers are entirely covered with glaze, the bases on the outside are generally unglazed. Sometimes the glaze ends in a thick rim and at other times it flows down the sides in irregular streaks.

Among the glazes is a pure white, varying from a very lustrous to a dull color. The few specimens of *Ting yao* have bodies of white stoneware, and may have been manufactured in east China. The bodies of the local white porcelain are red, dark red, and rarely black. It is possible that the Liu Li Ch'ang white glaze is an imitation of the *Ting yao* of east China, and that the Liu Li Ch'ang porcelain makers were unable to secure or make the white stoneware.

The dominant color is brown, varying in shade from orange yellow to yellow orange. While the best temmoku specimens were all broken before excavation, and are comparatively rare in the kiln, it is possible that they were not manufactured here. On the other hand, tea bowls very closely resembling the temmoku in shape and color are so numerous that it is evident that they are imitations of the best temmoku tea bowls. If this is true, there are numerous vases, pitchers, jugs, and bowls that are local temmoku productions, inferior to the best samples from Chungking, Honan, and Fukien. On the other hand, some of the orange yellow and yellow orange specimens apparently are not temmoku.

A third class of glaze varies from yellow, greenish yellow, yellowgreen, to green. Some of these are lustrous and seem to be a local relative of the *Lung Ch'uen yao*. This porcelain is very common, and includes beautiful tea bowls, food bowls, pitchers, jugs jars, etc.

More rare is a gray porcelain, which may be a variation of the yellow and green porcelain. Only a few samples have been found.

Finally, there is a black pottery that may or may not be porcelain. The color is dull, and may be the result of painting with a paste made with soot or Chinese ink. The only specimens found are food bowls.

Prof. D. S. Dye has carefully tested the hardness of the Liu Li Ch'ang pottery with the following results:—

Local white porcelain on a red body . . . 6.5
Ting yao, white stoneware body, C/5516 . . . 7.-

Brown <i>Chien yao</i> tea bowl, C/5260	6.5
Brown bowl, C/14057	6.0
Brown bowl, C/14455	7.- (temmoku?)
Soft brown colored bowl C/16550	7.-
Brown (temmoku?) sherd with yellow streaks C/5240	7.
<i>Tz'ü Chou yao</i> sherd, C/5616	7.
Yellow dish, C/13949	6.5
Yellow slip, C/13982	3.
Gray bowl, C/13840	7.- or 6.5 plus.
Greenish glaze, C/13941	6.5

As a result of this test we find that the porcelains vary from 6 to 7, including the *Ting yao* and the *Chien yao*, which may have come from another kiln or even from east China. This is one indication that the Liu Li Ch'ang glazes are true porcelain.

The following is a more careful classification of colors based on the Standard Color Chart for Elementary Instruction Based on the Bradley Color Standards, Milton Bradley Company, Springfield, Massachusetts, and on the Dictionary of Color by Maerz and Paul.

C/5840, very dark orange yellow, darker than Bradley shade no. 2; Maerz and Paul, Plate 16, L, 12.

C/14139, very dark warm gray (Bradley).

C/14969, Dark red, Bradley shade no. 2, ornamentation a yellow orange, Bradley shade no. 2.

C/13776, a bowl, red body, Glaze an orange yellow darker than Bradley shade no. 2.

C/13776, a bowl, red body. Glaze an orange yellow darker than Bradley shade no. 1.

C/14503, hollow lamp. Lustrous yellow orange, Bradley shade no. 2, Maerz and Paul Pl. 14, A, 12. Has a red body and a yellow slip under the glaze.

C/13778 Light yellowish gray green. Maerz and Paul Pl. 21, C, L.

C/13987, greenish yellow, or a laurel green, Maerz and Paul L, 1.

C/14580, Light orange yellow, Bradley, tint no. 1, Maerz and Paul Plate XI, L, 3.

C/14730, deep green, Bradley shade no. 2.

C/13967, light blue (very rare) Maerz and Paul Pl. 34, J, 4.

C/14134, Blue green (rare) Maerz and Paul, Pl. 34, J, 4.

C/14134, blue green, (rare) Plate 26, J, 8.

C/13759, temmoku tea bowl, pure lustrous black and in places a lustrous (red) yellow orange. Bradley shade no. 2. Body burnt red in the kiln.

C/13755, Pitcher with yellow glaze and green floral decorations. Yellow is Bradley tint no. 2; M. and P. Pl. 10, L, 2. Green is Bradley shade no. 1; M. and P. Pl. 30, A, 12.

C/5313 (found in situ during excavation) very light yellow slip.

II. DESCRIPTION OF THE OBJECTS IN THE KILNSITE

While the photographs and drawings will "speak for themselves," a verbal description may be of some value.

In the kiln the vessels were separated by earthenware circles in order to make possible the circulation of the heat and to prevent the vessels from sticking together. These generally have "teeth" but not always. The number of teeth varies from five upwards. Sometimes the bases are painted red and the teeth are painted yellow.

In the kiln the dishes were placed in saggars so as to protect them from the intense heat. The saggars are round, open at the top, and have round or oval holes through their thick sides.

Dippers. These vary considerably in size and have snouts that are lips or depressions on the sides at right angles to the handles. The handles are hollow, probably for hafting.

Pitchers. Most of the pitchers have long spouts, but a few are short, and rarely there are lips instead of snouts. Some have one large handle opposite the spout and two small handles on the sides. Some have only one large handle opposite the spout. More rarely one is seen with only two small handles on the opposite sides. The largest in the collection is C/14072: the height of which is 272 millimeters, width 162 mm., length of spout 162 mm.

In the museum collection are two double spouts that have been broken off the pitchers. One of these, C/5277, which was found *in situ* during our excavation in 1933, is a representation of two human legs, and the same is probably true of C/14144. The former is an orange yellow, Bradley shade no. 2, Maerz and Paul Pl. 15, H 11, a brown sugar color. The former is ornamented and strengthened by a single band or ribbon with a knot near the end and the latter has two ribbons with three knots, a pair of bows, and a band around the end.

Saucers. There are very thick saucers which vary in diameter from 96 to 142 mm., and in thickness on the rims from 5 to 16 mm. The bases are generally round and flat, and their diameters vary from 30 to 59 mm. A few have base-rims. The sides are all rounded, but vary as to curve. The rims are rounded, or flat on top, or flat on top and straight on the side. The rims are the thickest part of the saucers.

Many of the thinner saucers can be regarded as shallow bowls. Some of these are very small, being only 32 mm. in diameter. One kind of saucer is peculiar in shape. On the insides the sides are straight, but the bottoms are curved. On the outsides the saucers are more rounded, but in general follow the lines of the inside. A second kind of saucer has

been bent inward from the outside by pressure of some small object like a chopstick, the result being cinquefoil, sexfoil, etc. according to the number of indentures. The number of these indentures on saucers varies from twelve to twenty-two on the saucers examined.

We have seen no Liu Li Ch'ang dishes or sherds of dishes so wide and flat that they could be called plates. This statement can also be made about cups.

Bowls. The sizes and shapes of the bowls show considerable variation. Several broken temmoku tea bowls have been found in which the glaze is thick and lustrous. Large numbers of similar tea bowls have been found conical in shape, having small bottoms and with foot rims, typical Sung Dynasty tea bowls. Some closely resemble the lustrous temmoku bowls in color but have inferior glaze, which may be a local cheap imitation of the temmoku tea bowls for general use. Other tea bowls similar in shape have a greenish yellow or yellow-green glaze that is lustrous and beautiful. Nearly all these tea bowls have foot rims, the diameters of those we have measured varying from 26 to 37 mm.

A second type may be classed as food bowls, although they were probably put to other uses. The bases are wider, and they generally have foot rims. The smaller bowls were probably held in the hands while eating and the larger ones placed on the table and filled with food. Some of these bowls have on the inside floral decorations in yellow or green.

Another type of bowl is covered on the inside with coarse sand which is firmly glued to the vessel. These may have been used for grinding medicines or other materials.

Numerous grater bowls or dishes have been found. While the bottoms were soft they were indented by means of pointed instruments which left sharp protruding rows on the bottom. Objects could be grated by turning the hand to the right or to the left (after the vessel was baked).

Jugs and jars. Many interesting jugs and jars have been found in this kilnsite. Some have two handles, one on each side. Others have four or more small handles or "ears" around the body in a line parallel to and near the top, and still others have four handles two of which are on opposite sides in vertical rows. Most of them are covered with yellow or brown glaze. Some of the brown jugs are ornamented with yellow stripes, and many of the yellow jugs have floral ornaments in green.

Basins. There are several large basins in the collection, and fragments of many more. The body is thick, and covered inside and outside with yellow glaze. The insides are decorated with floral ornaments in green and brown, and sometimes with fish. There are large colored peony and lotus flowers. They vary in thickness from 6 to 14 mm., and in

diameter from 245 to 462 mm. No. C/14977 has a diameter of 462 mm. at the top, of 332 mm. across the bottom outside, and a height of 110 mm.

Vases. There are a few vases in the collection. One, the top of which is broken off, is covered with a pure white glaze. No. C/5283 was found *in situ* during the excavation made in 1933. It is apparently a local dark brown temmoku with floral ornaments made by painting with yellow slip on the body before it was covered with glaze and fired.

Inkstands. In the collection are several porcelain inkstands. They commonly have two short feet in front, where is the wide mouth, which raise the level of the front and give the inkstand a slope towards the base. One, which has been broken and repaired, has four legs and has the form of a frog.

Wine jugs. There are two wine jugs shaped like the water bottles carried by soldiers, with two small handles through which a strap or cord can be passed. The bottles are round, and thicker in the middle than at the edges.

Small images. Another variety of objects is small images of horses with riders, water buffaloes with or without riders, a dog with a child on its back, turtles, a monkey, and other unidentified dog or fox-like creatures.

Spindle whorls. A number of spindle whorls have been collected. Number C/5186 was found *in situ* during the excavation, and the others were secured from farmers or soldiers who had dug them out of the ground.

One type of vessel is very coarse and thick, as well as unglazed. While it is hollow inside, it has a very small opening at the mouth. One suggestion is that this is a sort of bomb.

Other objects found are drainage pipes, glazed and ornamented tiles and bricks, and a few things that have not been identified.

III. PHOTOGRAPHS OF OBJECTS FOUND IN THE LIU LI CH'ANG KILNSITE

The following are photographs of objects from the Liu Li Ch'ang kilnsite, of the site itself, and of objects excavated on the campus of the West China Union University. All the objects are in the West China Union University Museum of Archaeology.

IV. DRAWINGS AND PAINTINGS OF THE LIU LI CH'ANG POTTERY

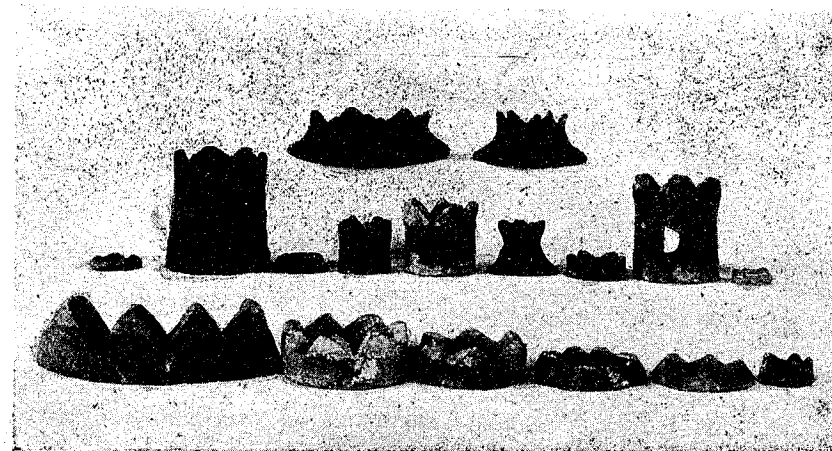
The following are drawings and paintings of Liu Li Ch'ang pottery. Some designs have not been drawn because they can be seen clearly in the photographs. The paintings were drawn

by Mrs. John Kitchen, and by Principal L. C. Walmsley of the Canadian School, Chengtu.* Numbers one to forty-five are designs on the bottoms of food bowls having foot rims. The sizes of the designs in the drawings correspond to those on the dishes, and the circles are meant to be the same sizes as the insides of the foot rims. Numbers 46 and 47 are the year names described elsewhere. Numbers 48 and 49 are designs on the Tz'ü Chou sherds found *in situ* during the excavation. Numbers 50 to 56 are designs on bowls and sherds of bowls and dishes. Numbers 57 to 59 are floral scroll designs common during the T'ang and Sung dynasties, on an unglazed sherd and two pieces of bricks.

V. CONCLUSION

The Liu Li Ch'ang kilnsite is later than that at Ch'ung Chou, with the result that there are fewer affinities with the T'ang dynasty pottery and more with the Sung. None of the Ming dynasty glazes have been found. This kilnsite is evidently a place where porcelain was manufactured near the end of the North Sung, during the South Sung, and at least at the beginning of the Yuan dynasties, approximately during the years 1100 to 1300 A.D. There are important resemblances between the Liu Li Ch'ang and the Ch'ung Chou pottery. While in some ways the Ch'ung Chou pottery is finer and more artistic, the Liu Li Ch'ang shows some of the improvements in foot rims etc. that were made during the Sung dynasty. Both have similar hollow lamps, thick saucers, pitchers with double snouts, grater dishes, the foil ornamentation, saggars, round clay circles with teeth, small images of human beings and various other creatures, monochrome porcelain, floral decorations, and white or light yellow slip under the glazes. It seems very likely that these resemblances are due to proximity of dates in manufacture. Yet the differences are even greater. Peculiar to the Liu Li Ch'ang kilnsite are bowls with small bases and fine base rims, basins the size and shape of dish pans, small bowls with decorations on the bottom, round and rather flat water or wine bottles, ink stands, and white and yellow green and greenish yellow glazes. Peculiar to the Ch'ung Chou site are wide flat-bottomed vessels with or without beveled edges (some have been found also in the Liu Li Ch'ang kilnsite, where the small-bottomed bowls are more characteristic), thick or curved foot rims, bright mustard yellow and soft deep green glazes, dark brown spots on light porcelain, light-blue porcelain with dark blue or blue-green spots, unglazed vessels and objects covered with white or light yellow slip (this also occurs in the Liu Li Ch'ang site, but it is much less common), white or light yellow slip with red or brown

*The writer wishes to express his thanks to Mrs. John Kitchen, Principal L. C. Walmsley, Prof. D. S. Dye, and Mr. Lin Min Gün for their kind assistance in the preparation of this article.



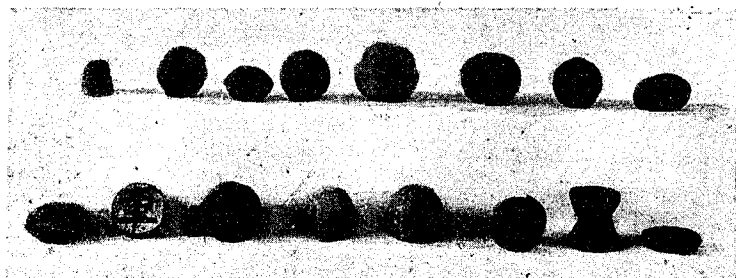
1. Earthenware circle used to separate porcelain dishes while baking in the kiln. Several have been colored red on their bases and yellow on the tips.



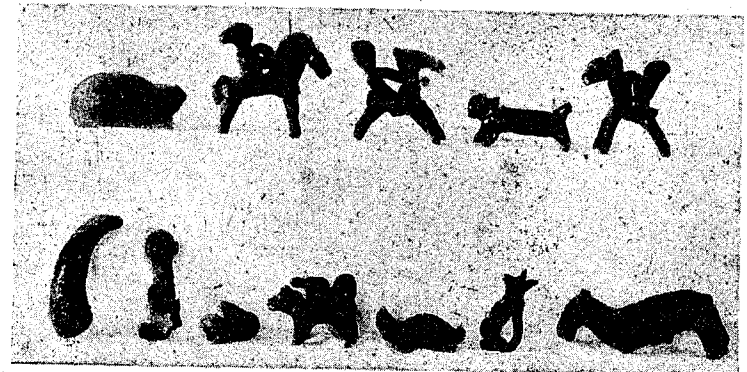
2. Saggars in which porcelain bowls and dishes were baked in the Liu Li Ch'ang and the Ch'ung Lai kilns. In the saggars the dishes were protected from the intense heat.



3. Below, inkstands. The one in the center is shaped like a frog. Of the others each has two feet near the wide end. Above left to right a fine yellow-green porcelain bowl with a white stoneware body showing at the bottom; a peculiar unglazed object, hollow inside; it has crudely incised on it ornaments resembling the floral designs on the bricks and basins; a vase with an inferior brown glaze, possibly a temmoku; a wide flat dish with a handle, and a bowl with a small circular tube inside.

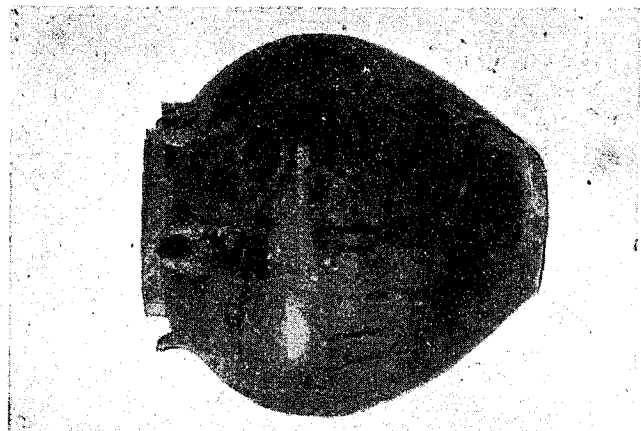


4. Below, a chess man on which is the Chinese character meaning chariot—this was not found *in situ*; four clay horse bells; a tiny saucer. Above, eight earthenware spindle whorls.

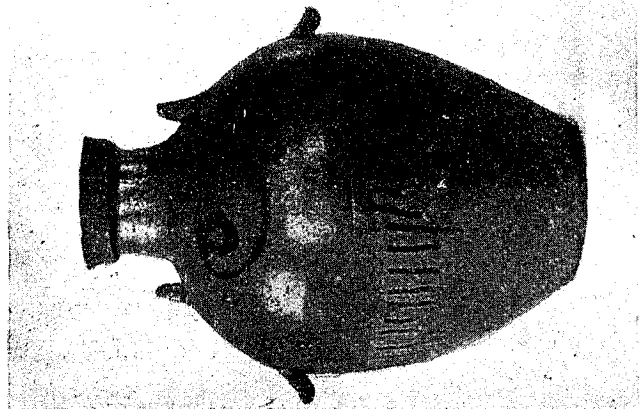


5. Above, an unglazed catlike creature, three riders on horses,* and a lion (?) with a collar-like projection at the neck and a wide tail which is partly broken off. Below, a glazed cow, a water buffalo horn, a monkey with legs broken off, a fishlike head with a unicorn-like horn on the forehead, a child riding a dog, a fox-like animal (possibly a dog), and a water buffalo with horns broken off.

*Note:—In the Journal of the W. C. B. R. Soc'y., Vol. II, page 73 there is a picture of a horse's head secured by Mrs. W. J. Mortimore, found in a well twelve feet under the surface at Penghsien. This is mentioned in the same Journal pages 75-76. We have no doubt that this head is that of a horse like those in the picture above and that it was made in the Liu Li Ch'ang kiln, probably during the South Sung dynasty.



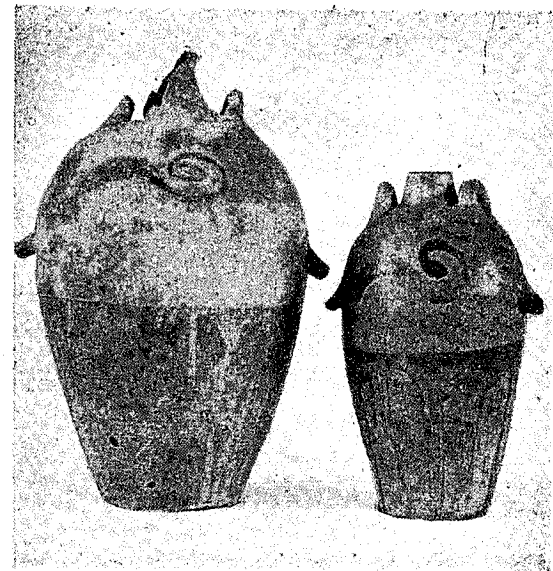
6. A large jug, C/13762, covered above with yellow glaze and with floral ornaments in green. There are six small handles near the top, and streaks of glaze have run down the sides. Height 450 mm., diameter 410 mm.



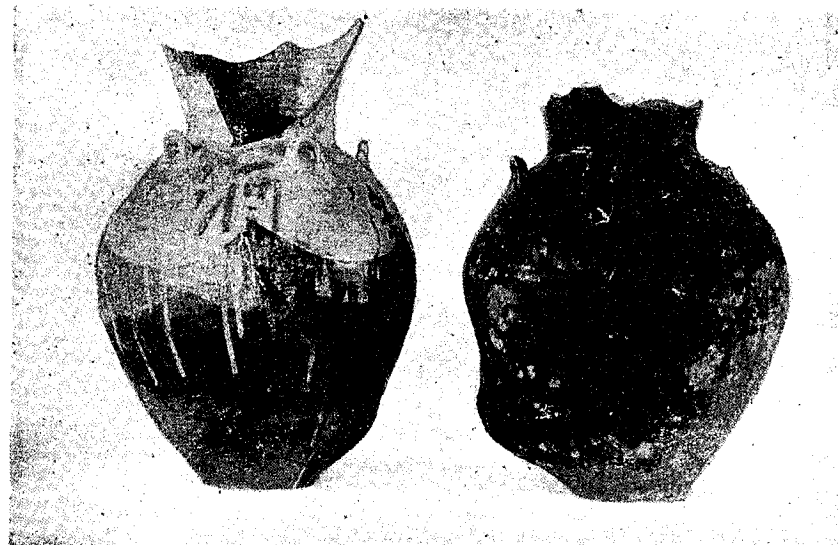
7. Large four handled jugs covered on the upper half with yellow porcelain which has run down in streaks and ornamented with green floral ornaments. No. C/13765. Height 400 mm., diam 285 mm.



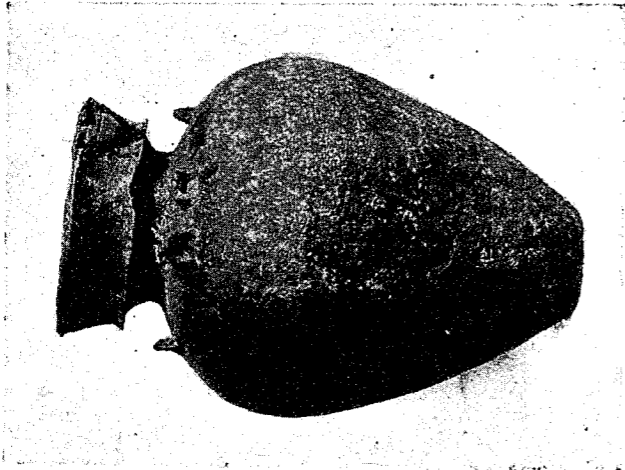
8. A four handled jug, the top portion covered with greenish-yellow glaze. Height 270 mm., diam 285 mm.



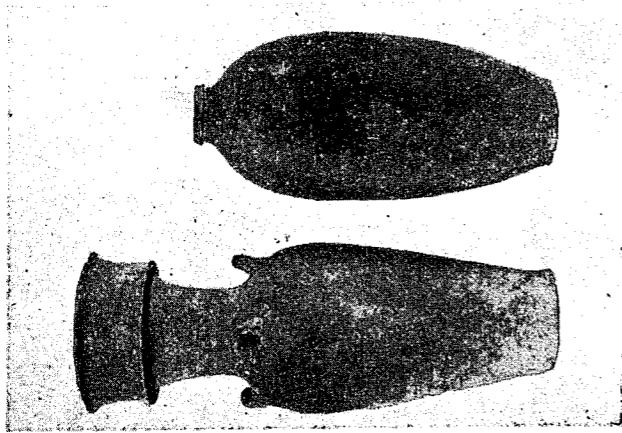
9. Two small-mouthed jugs with yellow glaze that runs down the sides in streaks, and floral ornaments in green. Tip of small jug broken off, top of larger jug bent and broken.



10. Two large broken jugs with Chinese characters showed that they are wine jars.



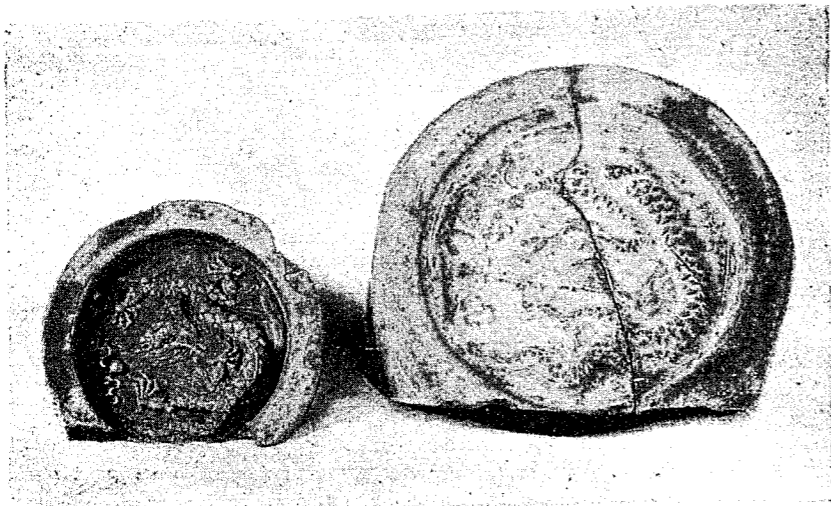
11. A large dark-brown jug with inferior glaze. It has six small handles, and was probably made in Liu Li Ch'ang.



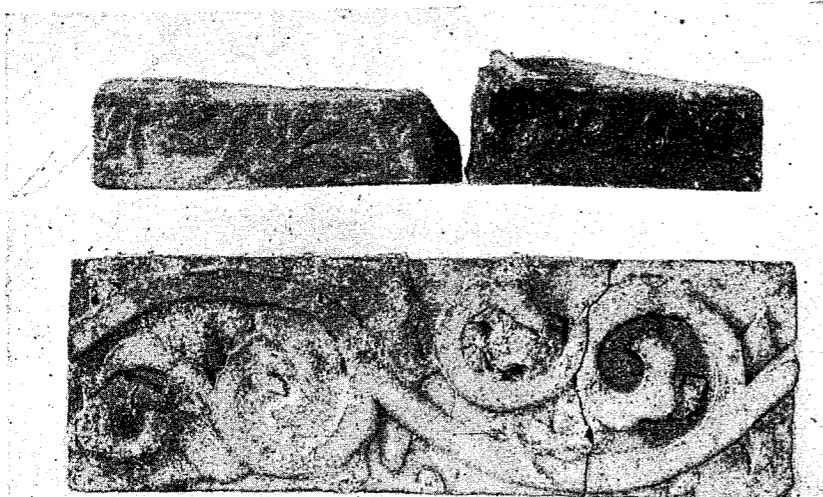
12. A narrow jug with four small handles. Height 418 mm., width 150 mm. Right, a handleless jug or jar the upper half colored a dark brown.



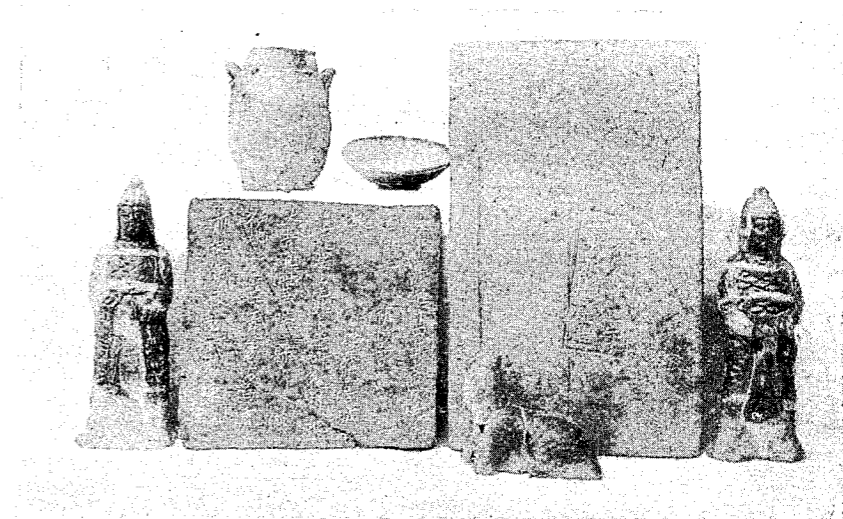
13. A large yellow porcelain jug with four small handles and green floral decorations. The writer saw soldiers dig this out of the kilnsite. Notice the streaks of glaze running down the sides. Height 705 mm., diameter 390 mm.



14. Ends of two tiles with finely-made dragons trying to eat a precious object. The smaller one is unglazed, the larger one has a silver-green glaze.



15. Large red-colored brick with floral-scroll design and a piece of small brick and a sherd with similar floral-scroll designs. Compare the design of the T'ang dynasty vase, Hobson, *Chinesische Kunstwerke*, Verlag Ernst Wasmuth S. G., Berlin, W. Ss., ? CMXXVII, plate VI. Also do., Tafel 30, (a); Tafel 31; Tafel 32 (b), for Sung dynasty patterns on porcelain.



16. Dated brick, dated tombstone, three glazed human images, and two pieces of typical Liu Li Ch'ang pottery found *in situ* during an excavation in a tomb on the campus of the West China Union University, Chengtu. The date of the brick is 1219 and that on the stone is 1221 A. D. This gives a dependable check on the date of the Liu Li Ch'ang kilnsite.



17. Three dark brown jugs with yellow streaks as decorations. The yellow stripes are first painted on the body, then covered with glaze.



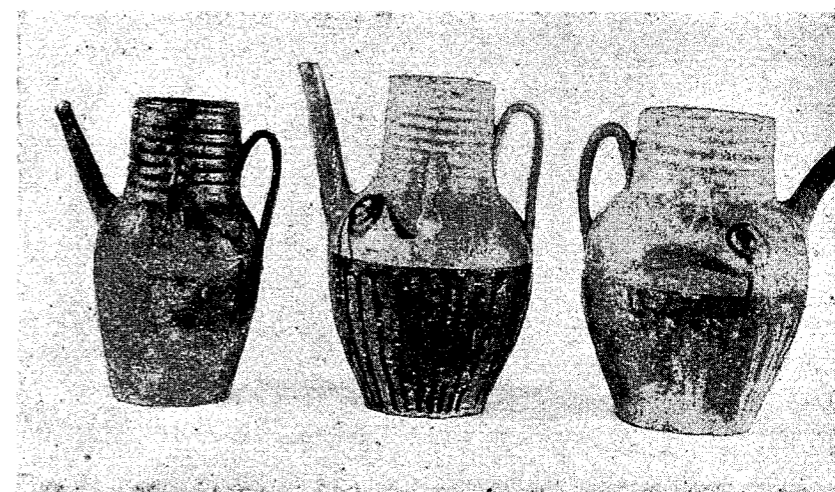
18. Two vases, possibly temmoku. The floral decorations were first painted in yellow on the body, then covered with glaze. The tall vase was found *in situ* by the writer during the excavation in 1933.



19. Typical but tiny jugs, cups, etc. Some were probably used in bird cages.



20. Two pitchers with lips for spouts. The large handle was probably made hollow for hafting.



21. Two yellow and one brown glazed pitchers with long narrow spouts and one large and two small handles.



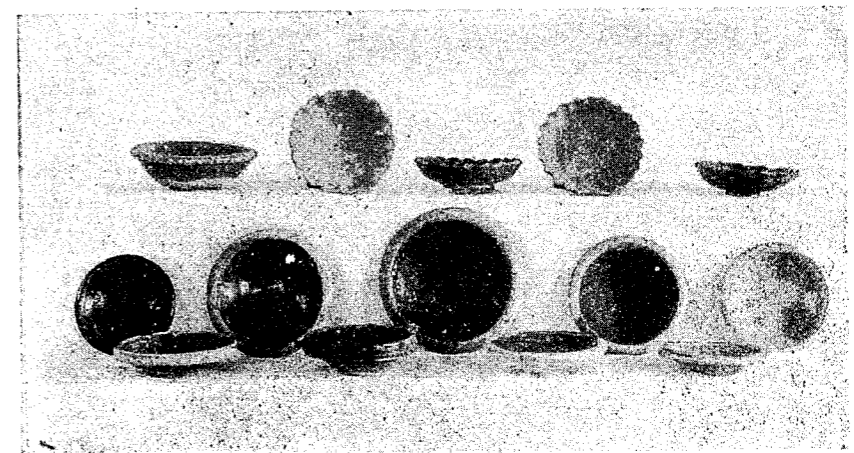
22. Typical brown, yellowish green and yellow glazed pitchers. The yellow pitchers have floral ornaments in green.



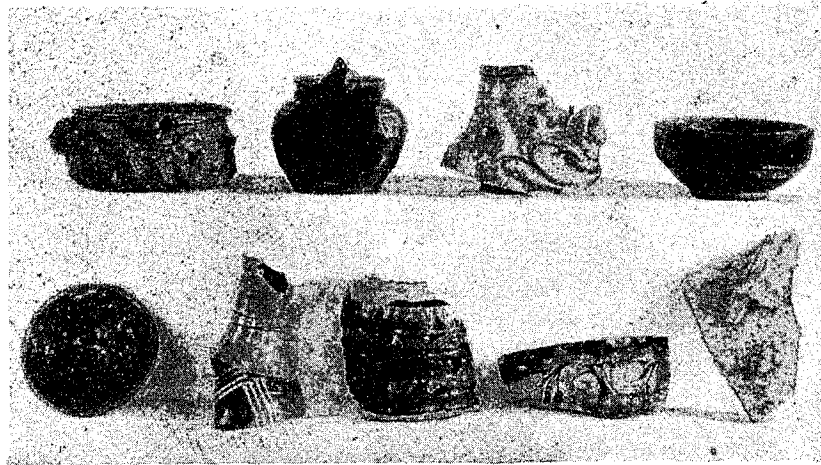
23. Dark glazed pitchers, probably temmoku, with yellow floral ornaments.



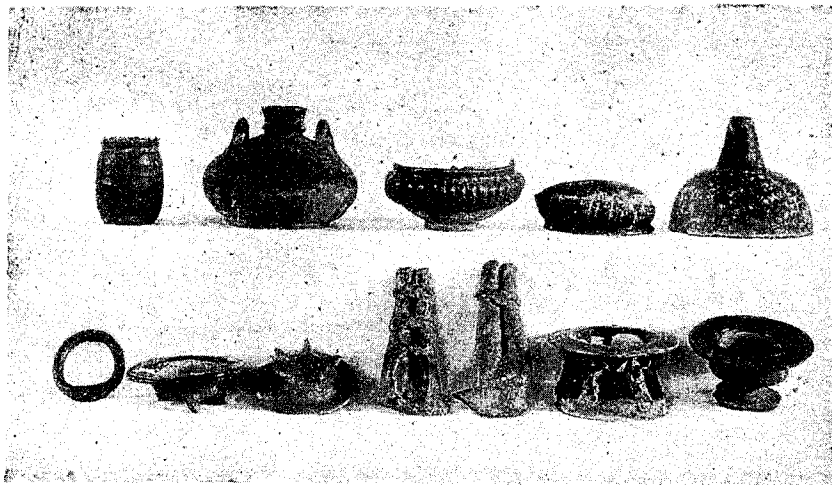
24. A white water or wine bottle with two small handles; three lids; a large jug with handle and dragon ornaments, and a similar smaller jug with a reptile as a handle.



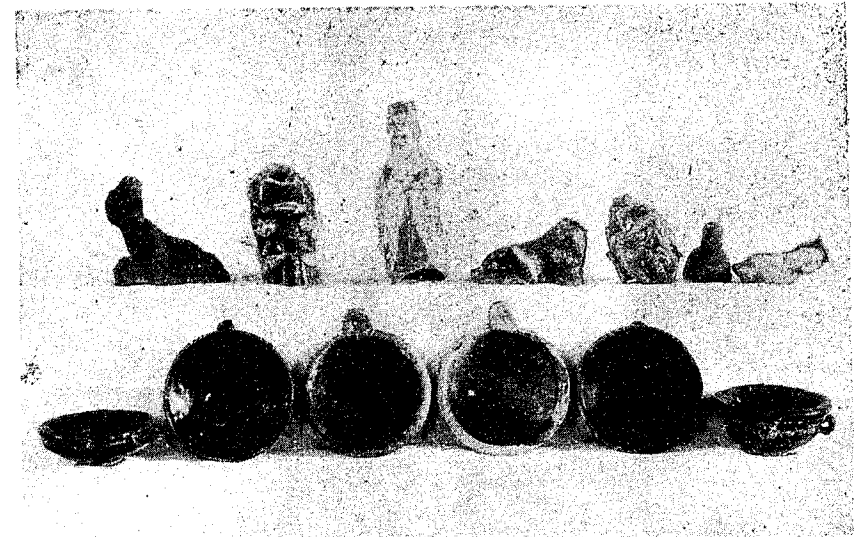
25. Above, small saucers with numerous "foil" decorations. Below, thick glazed saucers of various colors.



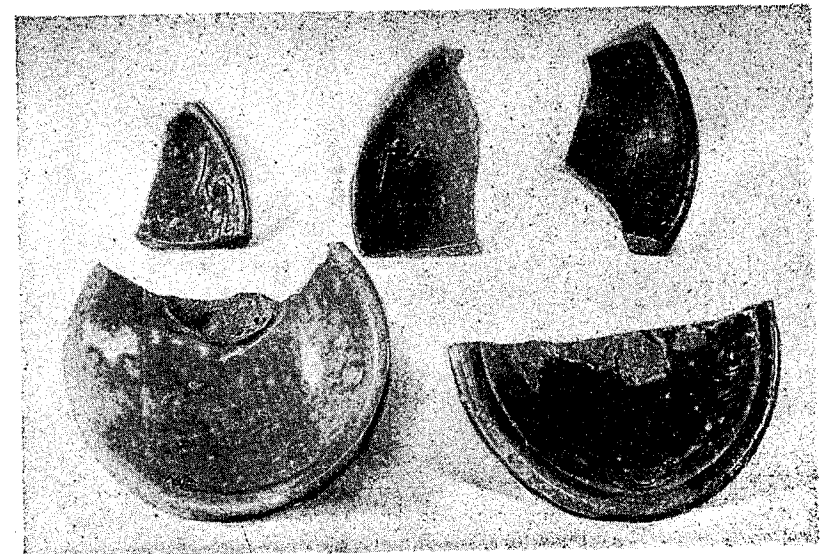
26. Below, left to right, a saucer with "oil spots," the top of a vase or jug, a green and black sherd, a green and yellow sherd, and a yellow sherd on which is what looks like a cross and also a head around which is a crude halo (?). Above, a coarse cup with a small handle, a handless jug with a lid, the top of a jug with handles, and a small brown bowl.



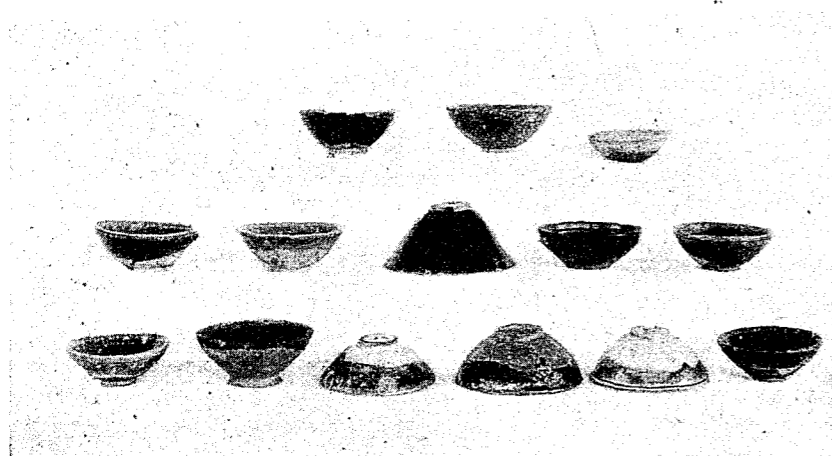
27. Below, a toothless circle, two wide-edged bowls with five legs each, two double pitcher spouts, two wide-edged bowls; above a handless jug unglazed outside and glazed inside, a squatty jug, two pieces of bowls with multifoil decorations, and an earthenware funnel dark brown in color.



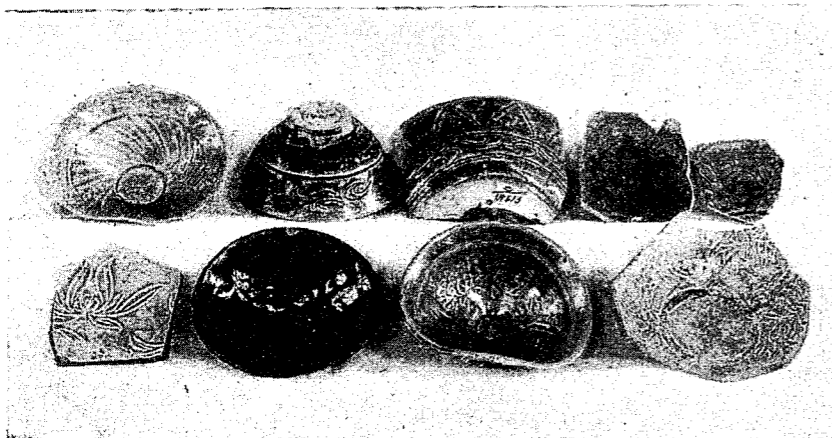
28. Below, lamps. The four outside ones are hollow and have short spouts. The two center ones are not hollow. Above, images of human beings in the kilnsite. They were buried with the dead dating T'ang and the Sung dynasties.



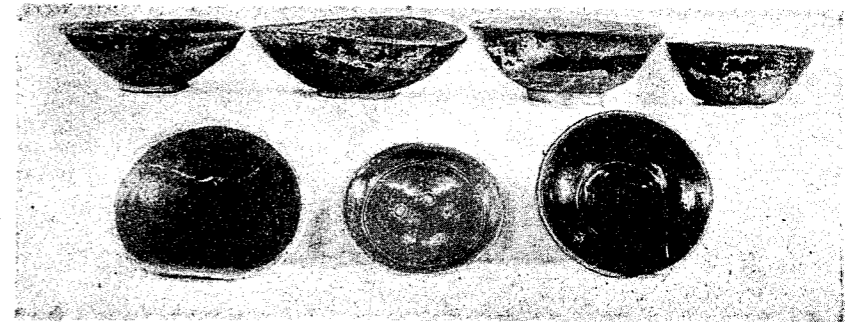
29. Sherds on which are Chinese characters. Three have names, probably of the persons who manufactured them. One has a complete year name for A. D. 1163-4, and the other has the fragment of a year name, probably in the Sung dynasty.



30. Typical Sung dynasty tea bowls. The bases are very small and unglazed, and have foot rims. The glaze on some of these has a fine luster. Some are evidently a local temmoku, and others are yellow green or greenish yellow.



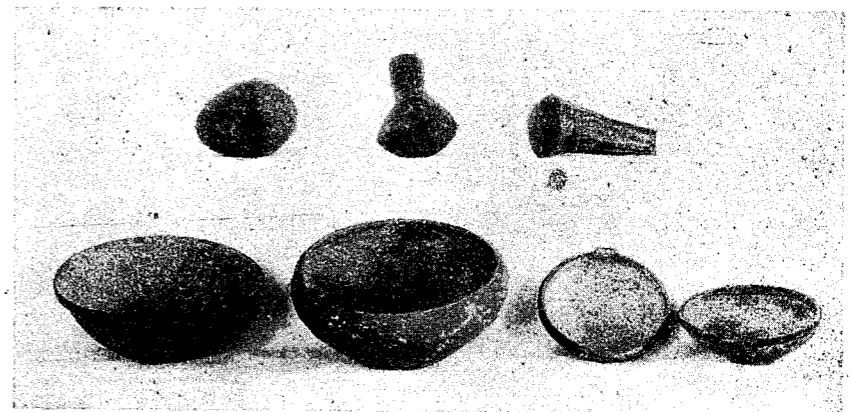
31. Small bowls and teacups with incised or raised designs made on the body before the object was glazed.



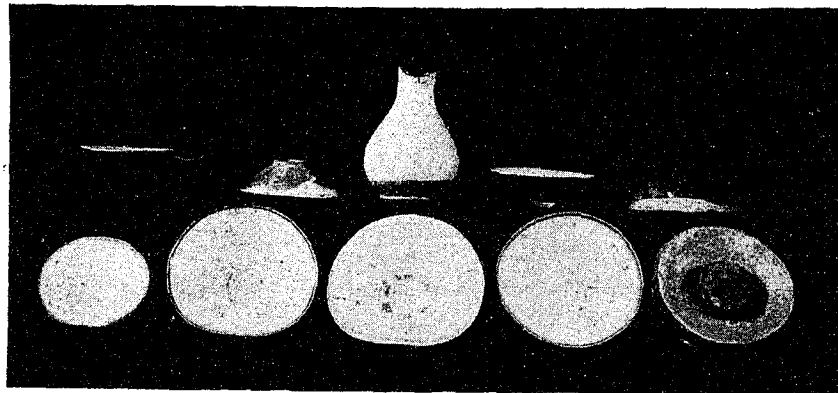
32. Small glazed food bowls, dark brown, yellow-green or greenish yellow in color.



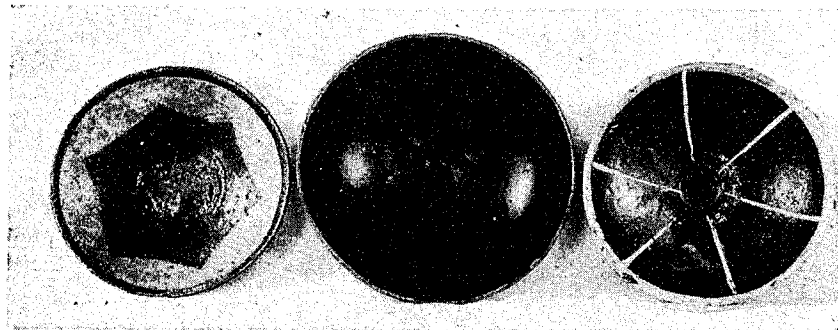
33. Deep bowls, finely glazed, with wide bases and footrims. One is septfoil.



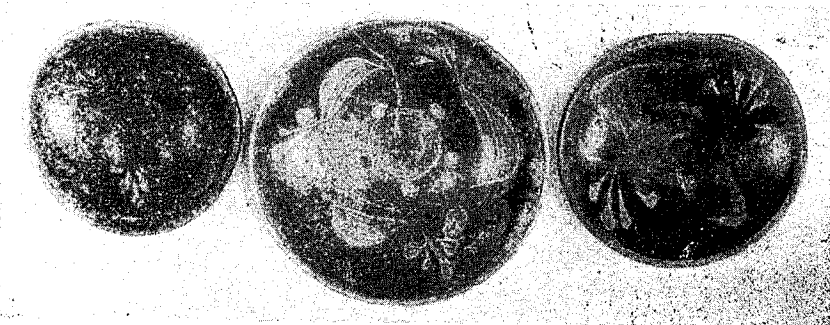
34. Bowls covered inside with sand, and a stone and two earthenware grinders that may have been used in grinding medicine in such bowls.



35. White porcelain bowls and vase. One bowl has a brown ring about the edge and another has a green ring. Note the bowl with a clay circle stuck in its bottom.



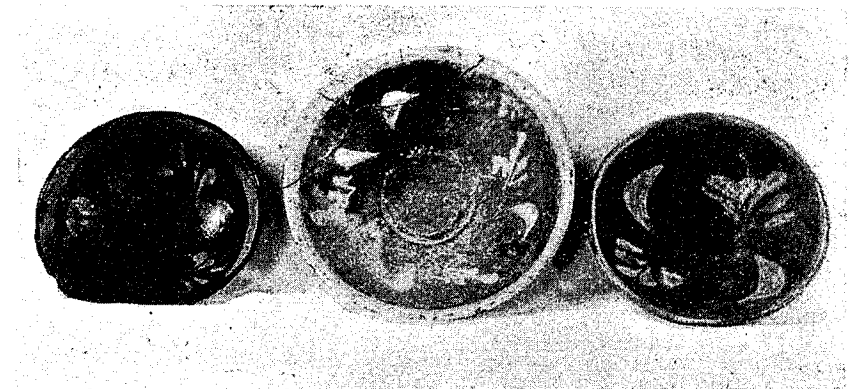
36. Large food bowls. Note the five marks of the earthenware ring in the bottom of the middle bowl, and the six white lines dividing the bowl on the right into six sections.



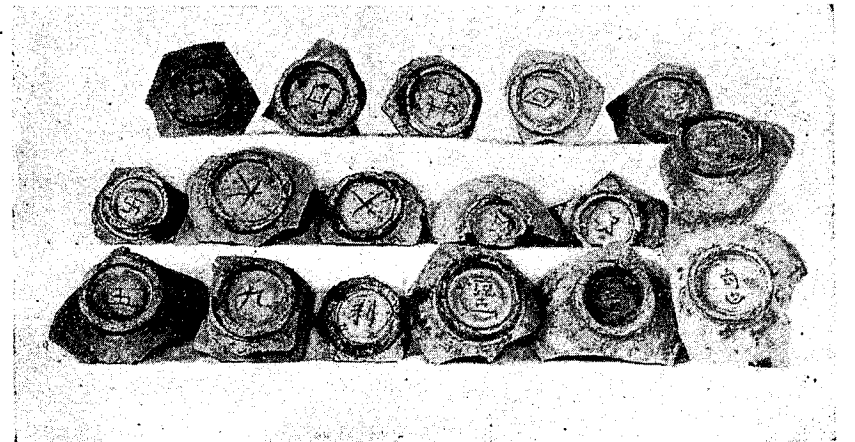
37. Food bowls, possibly temmoku, with floral decorations. These were painted on the bodies with yellow slip, then covered with porcelain glaze and baked.



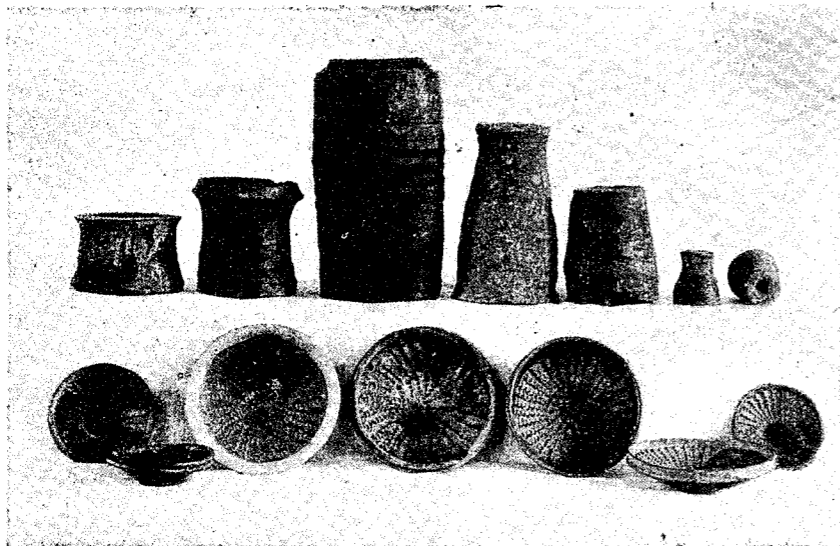
38. Food bowls with floral ornaments.



39. Food bowls with floral ornaments in green. One has a yellow glaze and two a yellow slip only.



40. Bottoms of food bowls with footrims, mostly white glazed, ornamented with various designs. see drawings.



41. Above, coarse, thick unglazed vessels the uses for which are unknown, excepting that the one in the center is a drainage pipe. Below, grater dishes made by incisions in the bottoms of the dishes while the clay was still soft.



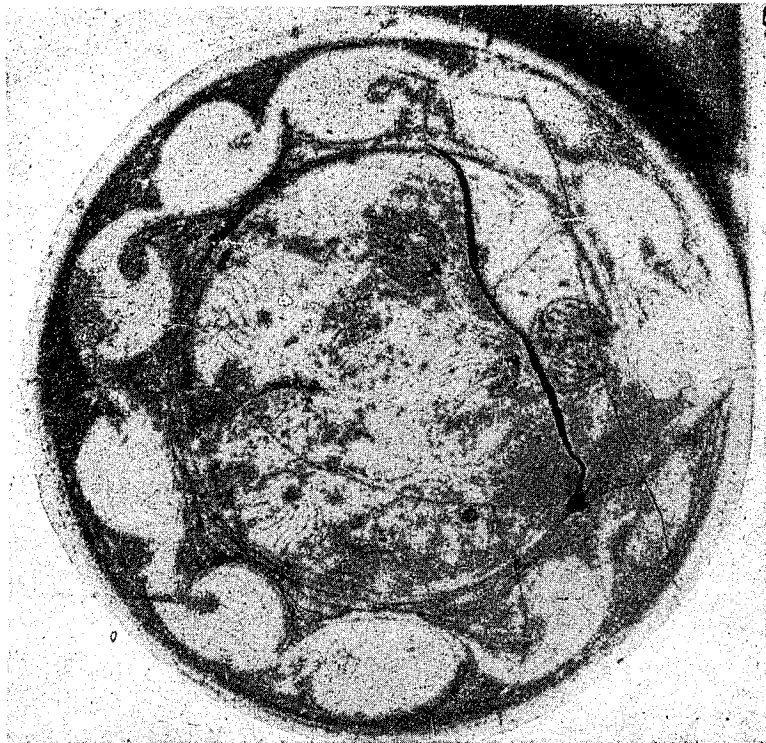
42. Part of a large basin with incised floral ornaments, covered with yellow and green floral designs.



43. Part of a large porcelain basin ornamented with small fish and colored light yellow, green and brown.



44. Peony designs on two sherds of large basins.



45. A large basin with lotus flowers on the bottom and a floral scroll on the side.



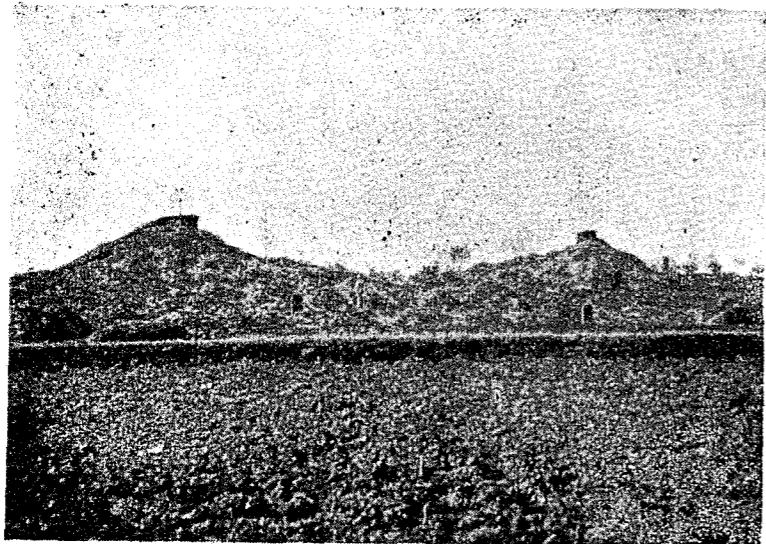
46. A large basin with a pair of fish on the bottom and floral designs on the side.



47. A large yellow basin with floral designs on the bottom and floral scrolls on the side.



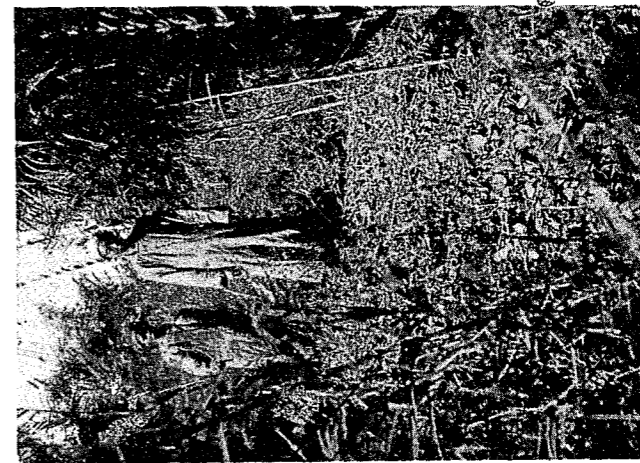
48. Birdseye view of the Liu Li Ch'ang site, taken from the top of a hillock composed of broken sherds, etc. Among the bamboo trees in the distance are two hillocks made of sherds and other kiln refuse. Much of the level ground between is underlaid with layers of sherds.



49. Two hills about fifty feet high consisting of sherds and other kiln refuse.



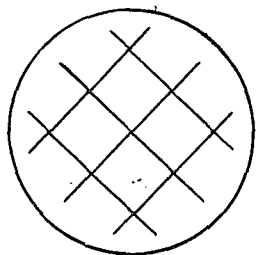
50. A hill consisting of kiln refuse. D. C. Graham is in the foreground examining sherds.



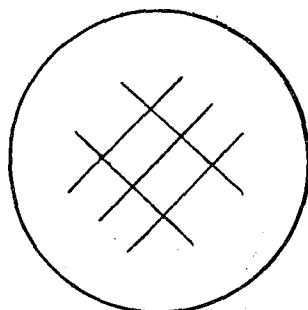
52. Two Chinese standing on a heap of sherds, Liu Li Ch'ang.



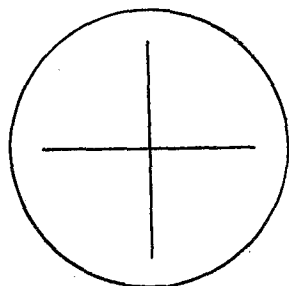
51. David C. Graham examining sherds on the spot where the excavation was made by him in 1933.



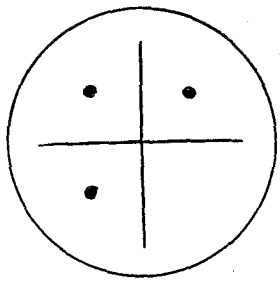
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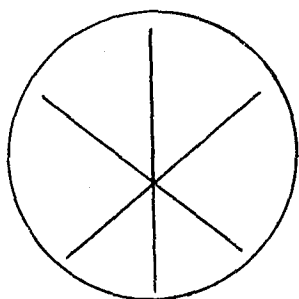
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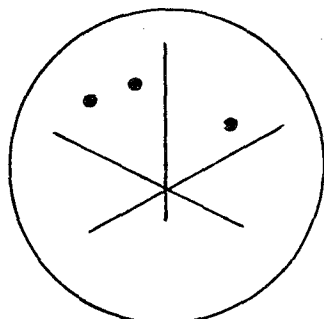
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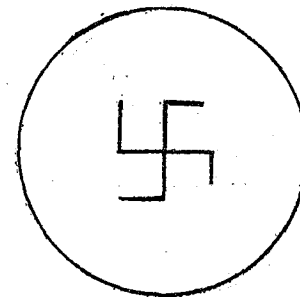


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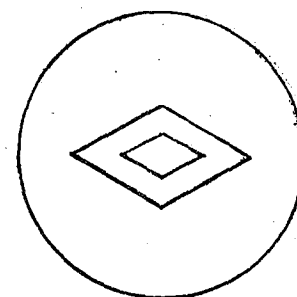


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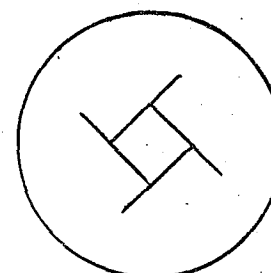
1. C/13805, Sherd of black glazed bowl on a red stoneware body. Diameter 38 mm.
2. C/14569, Cross or Chinese character ten on a white glazed sherd with a red orange body. Diam. 42 mm.
3. C/16572, White glazed sherd on a dark body. Diam. 42 mm.
4. C/14012, White porcelain sherd on an orange-yellow body. Diam. 45 mm.
5. C/14570, White porcelain sherd on a very dark body. Diam. 41. mm.
6. C/14007, Yellow-green porcelain bowl on an orange-red body. Diam 48 mm.



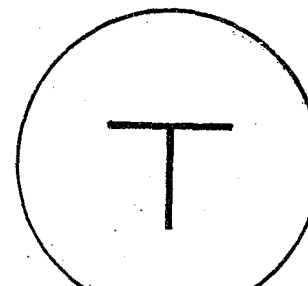
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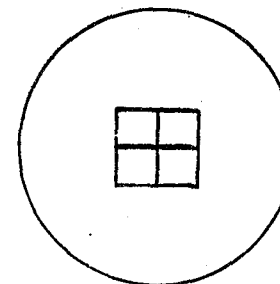
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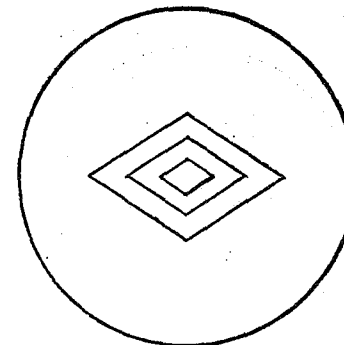
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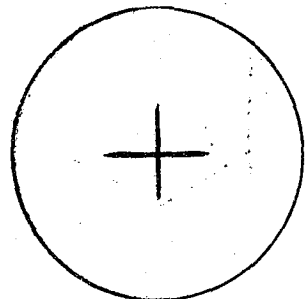


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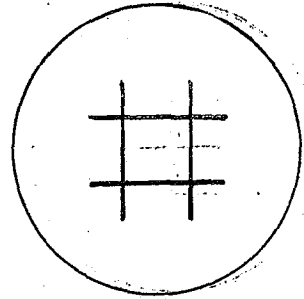


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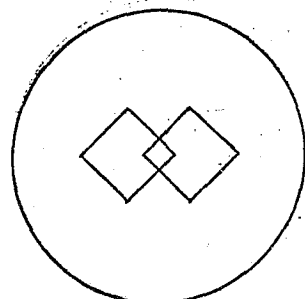
7. C/14010, White glazed bowl with a dark red body. Diam. 39 mm.
8. C/14013, Yellow-green porcelain on an orange-yellow body. Diam. 48 mm.
9. C/14077, White glaze on a dark-red body. Diam. 43 mm.
10. C/13887, White glaze on a dark red body. Diam. 43 mm.
11. C/14565, White glaze on a dark red body. Diam. 45 mm.
12. C/14015, Yellow-green porcelain on a dark body. 52 mm.



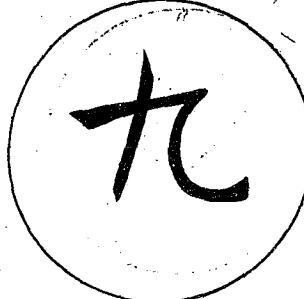
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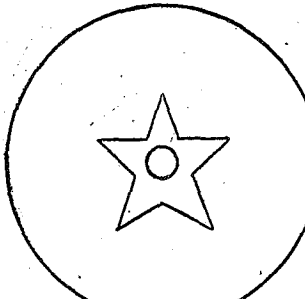
16



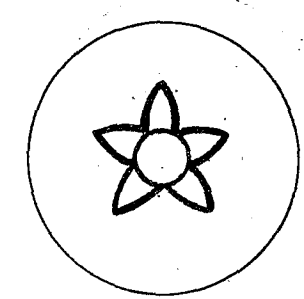
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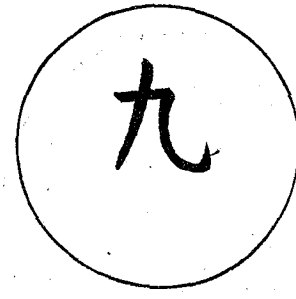


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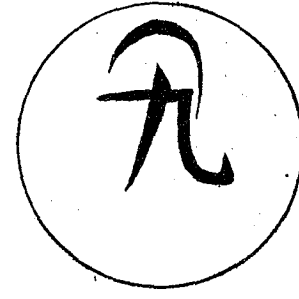


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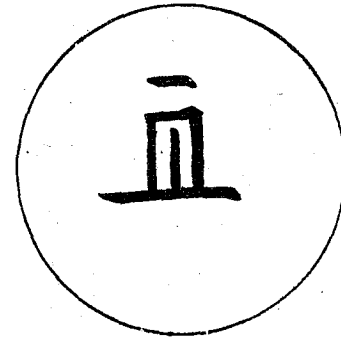
- 13. C/14019, White Glaze on a dark red body Diam. 44 mm.
- 14. C/13996, White glaze with a green rim on the outer edge, on a very dark body. Diam. 41 mm.
- 15. C/13881, White glaze on a red body.
- 16. C/14014, White glaze on a red orange body. Diam. 43 mm.
- 17. C/14018, White glaze on a dark body.
- 18. C/16571, White glaze on a dark red body. Diam. 38 mm.



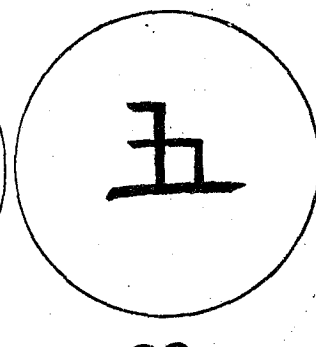
19



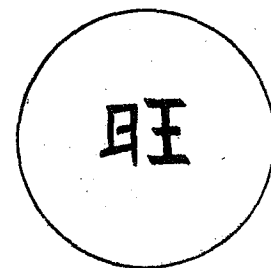
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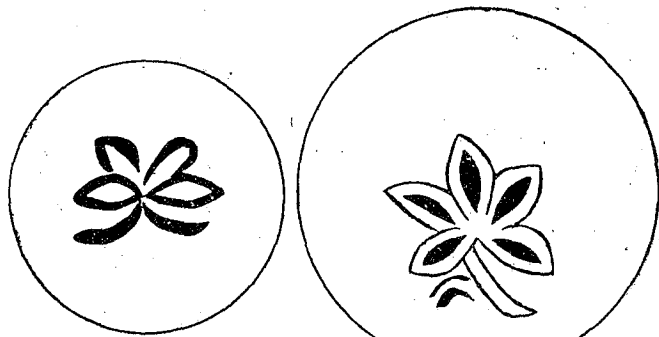


21



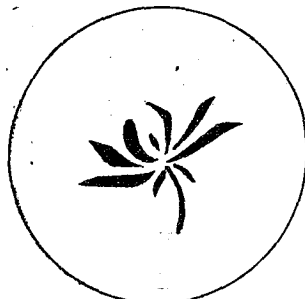
24

- 19. White glaze on a dark body.
- 20. C/14024, White glaze on a red body. Diam. 49 mm.
- 21. C/5638, Yellow-green glaze on a red body. Found *in situ* during the excavation in 1933. Diam. 40 mm.
- 22. C/5033, White glaze on dark body. Found *in situ* during the excavation. Diam 43 mm.
- 23. C/14008, White glaze on a dark red body. Diam. 45 mm.
- 24. C/16572, White glaze on a dark red body. Diam. 45 mm. This is the character li meaning profit.

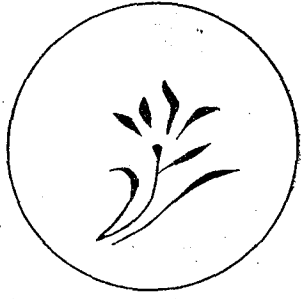


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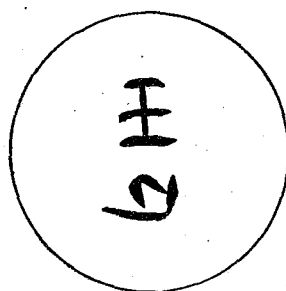
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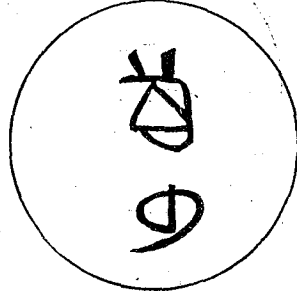
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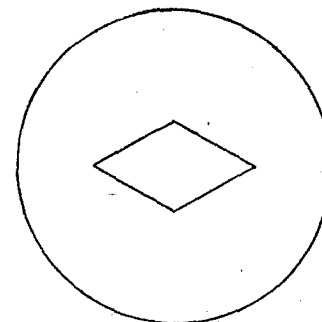


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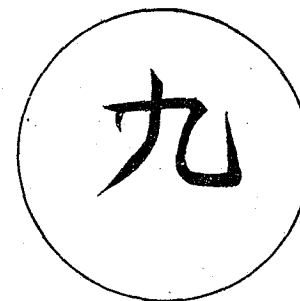


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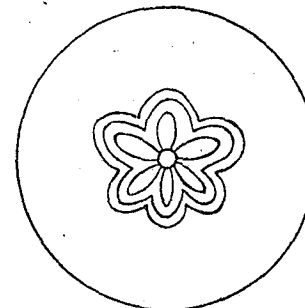
25. C/14137 (or 87), White glaze on a dark body. Diam. 41 mm.
 26. C/14025, Yellow-green glaze on a red body. Diam. 46 mm.
 27. C/14028, White glaze on dark red body.
 28. C/5542, Dark brown or black glaze on a red body. Diam. 55 mm. Found *in situ* during the excavation.
 29. Floral design on a bowl with a red body.
 30. C/14021, White glaze on a dark red body. Diam. 40 mm.



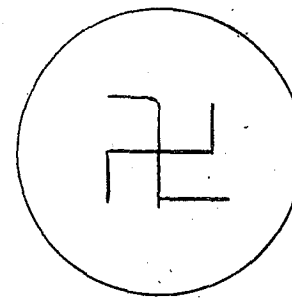
31



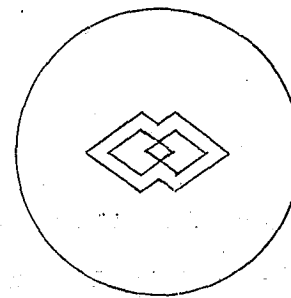
34



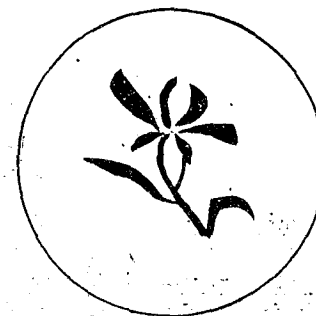
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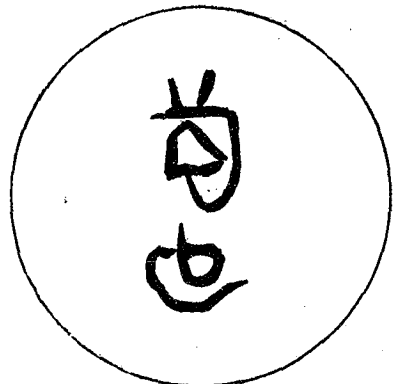


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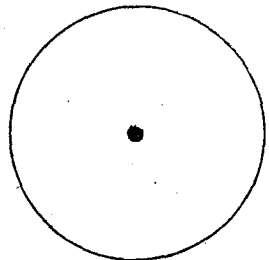
31. C/16551, White glaze on a dark body. Diam. 46 mm.
 32. C/14024, Greenish yellow glaze on an orange yellow body. Diam. 45 mm.
 33. C/14030, White glaze on a red body. Diam. 39 mm.
 34. C/14021, White glaze on a dark body, Diam. 44 mm.
 35. C/14011, White glaze on a dark body.
 36. C/14028, White glaze on a dark body.



37

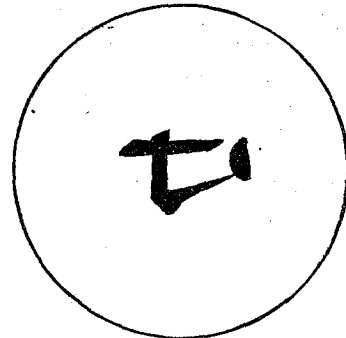


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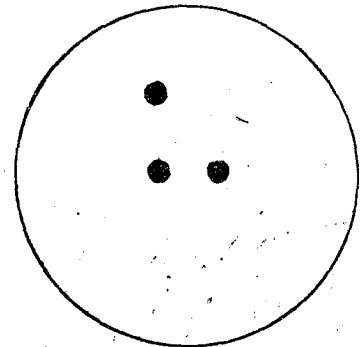


39

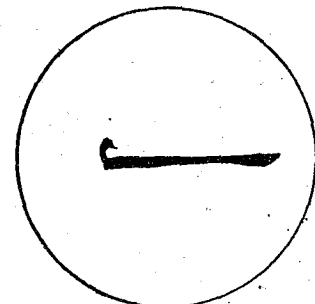
37. C/14022 White glaze on a dark body. Diam. 50 mm. This is the character Kou, a man's name.
38. C/14028, Yellow-green glaze on a red body. Diam 49 mm. This is the character Fan, a man's name.
39. A single dot in the center of the bottom of the bowl.



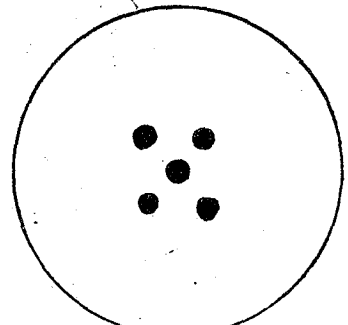
40



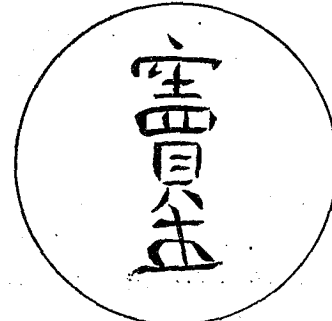
43



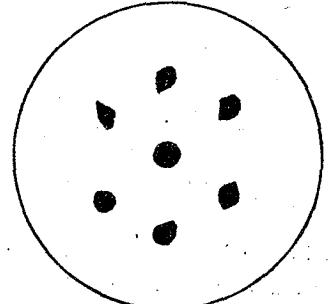
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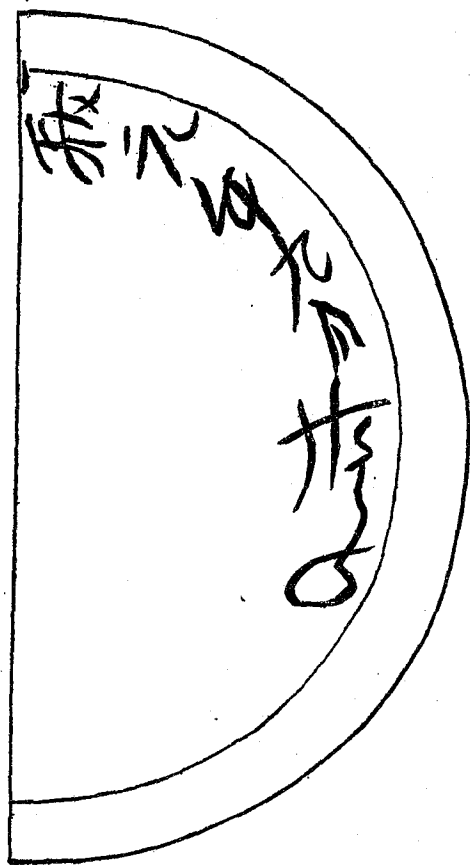


42



45

40. The Chinese character meaning seven.
41. The Chinese character meaning one.
42. The Chinese character meaning aqueduct, a person's name.
- 43, 44, 45, Three, five, and seven dots as ornamentations on the bottom of bowls.



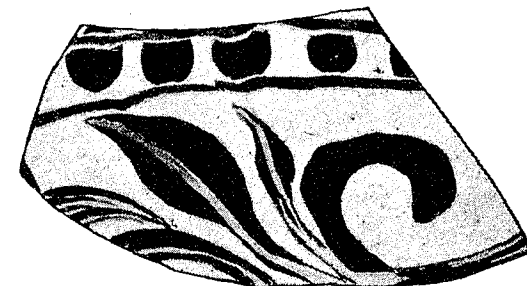
46

46. Sherd with part of a year name ending in ho.



47

47. Sherd with the year name Lung Hsin, the name for the years A. D. 1163-64.

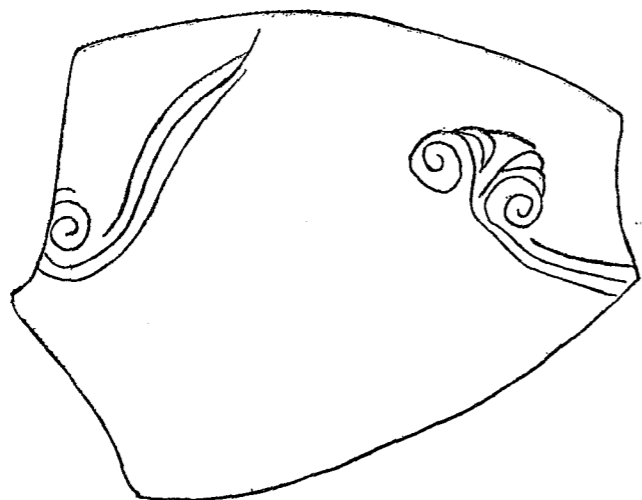


48



49

48, 49. Two Tz'u Chou Yao sherds, C/5617, C/5627, found *in situ* during the excavation in 1933. The floral designs are dark brown, the surrounding surface glazed white, on red bodies. Maximum lengths 67 mm. and 89 mm.



50

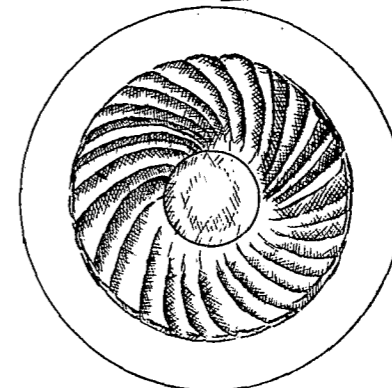


51

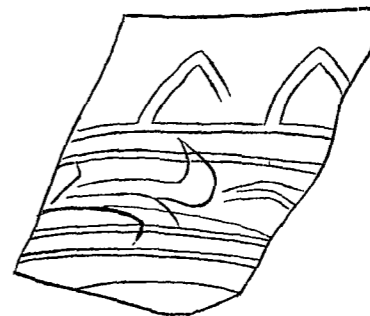
50. C/14616, Sherd of a flat-bottomed bowl with a luscious yellow-green glaze. Length 87 mm.
 51. C/14455, Top of a five-legged wide-rimmed bowl, brown or orange-yellow, diam. 145 mm.



52

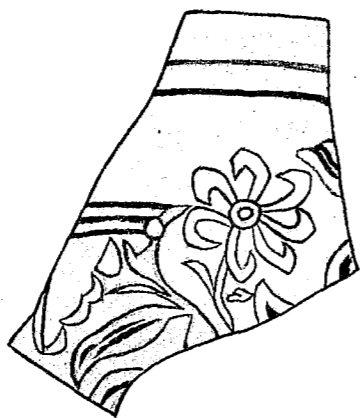


53

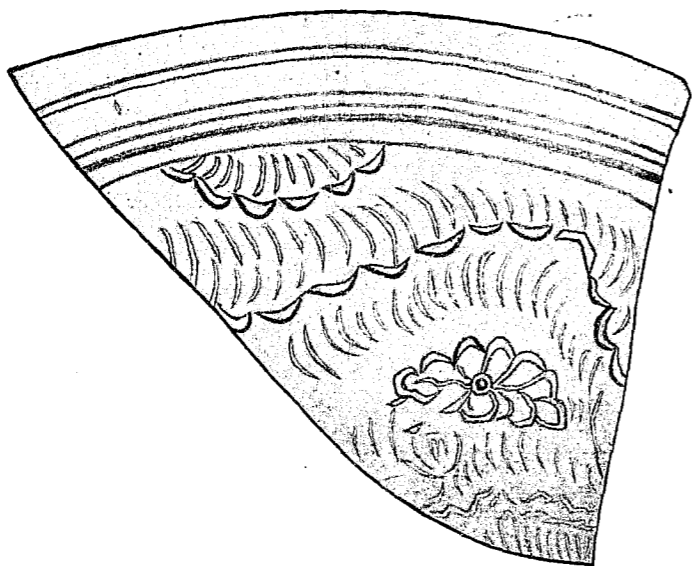


54

52. C/14617, Sherd of a dark greenish-yellow glazed bowl, bottom flat with a small, incised circle to create the impression of a rim. Length 75 mm. Width 60 mm.
 53. Inside ornamentation of a tea bowl, C/14044, with a lustrous light greenish-yellow glaze. The bottom is flat and rimless. Diam. of bottom 31 mm., of the top 116 mm.
 54. C/14613, Pattern on a broken bowl having a lustrous greenish yellow glaze.



55



56

55. Sherd C/16625, floral ornamentation on dark yellow-green glazed sherd, with a dark red body. The design was painted in yellow on the body before glazing. Length 65 mm.
56. Sherd C/16624, with fine floral ornamentations covered with light greenish-yellow glaze. The designs are elevations on the body, probably made by a mould. Length 118 mm.



57

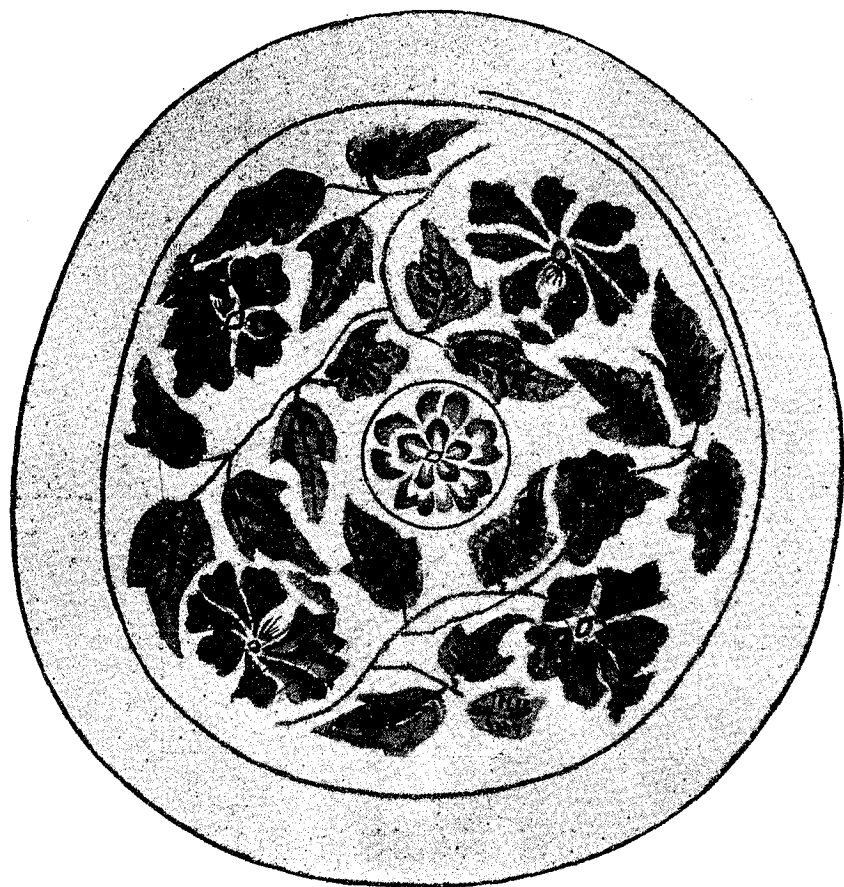


58



59

57. Floral-scroll design on a dark sherd.
58. Floral-scroll design on a brick fragment.
59. Floral-scroll design on a large brick. The writer saw a similar brick that had been built in the side of a clay house wall at Liu Li Ch'ang.



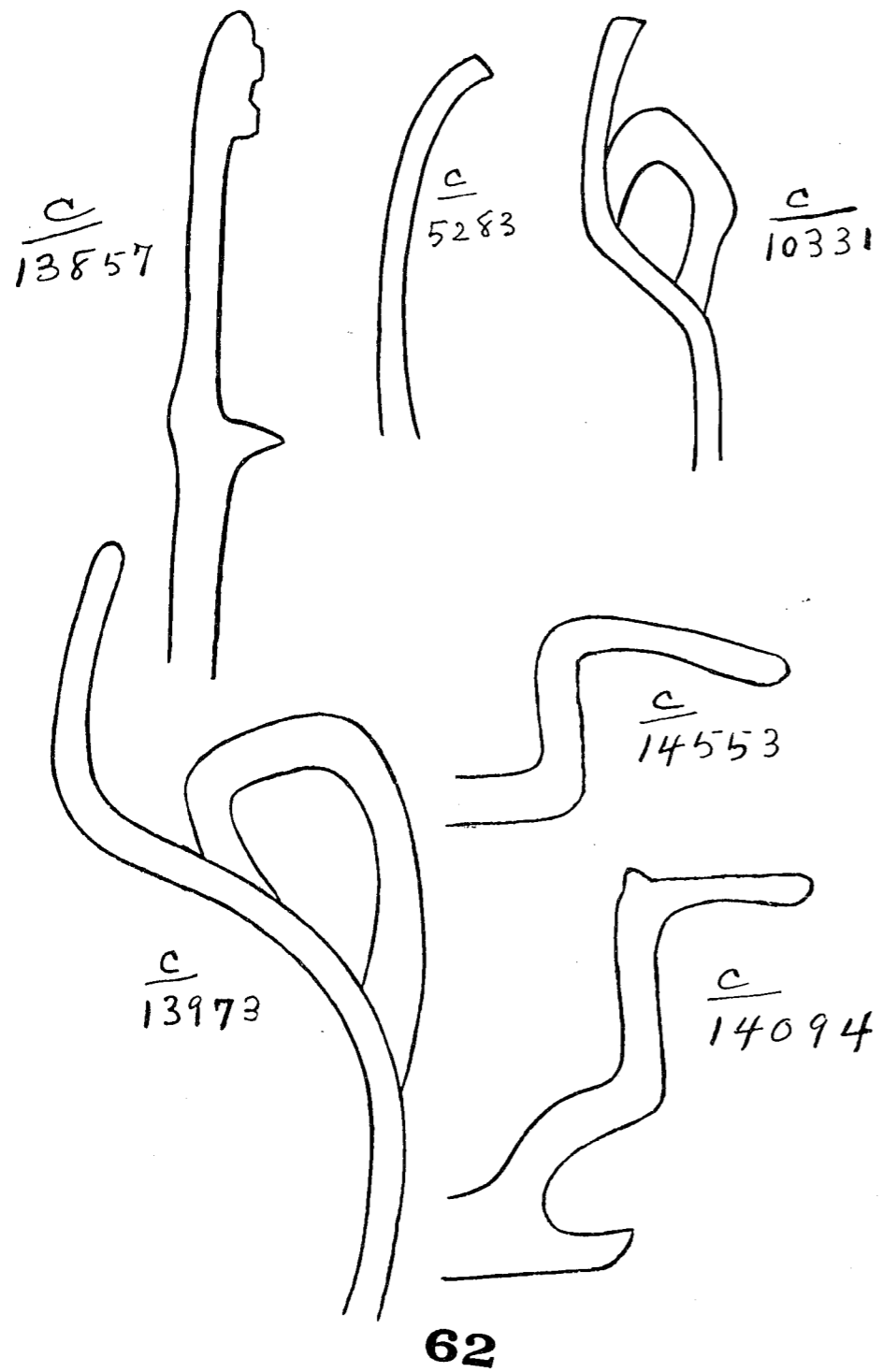
60

60. Floral decoration inside a brown (orange yellow) bowl. This bowl, No. C/16752, is crooked, and has a small base with a base rim. Diameter 115 mm.

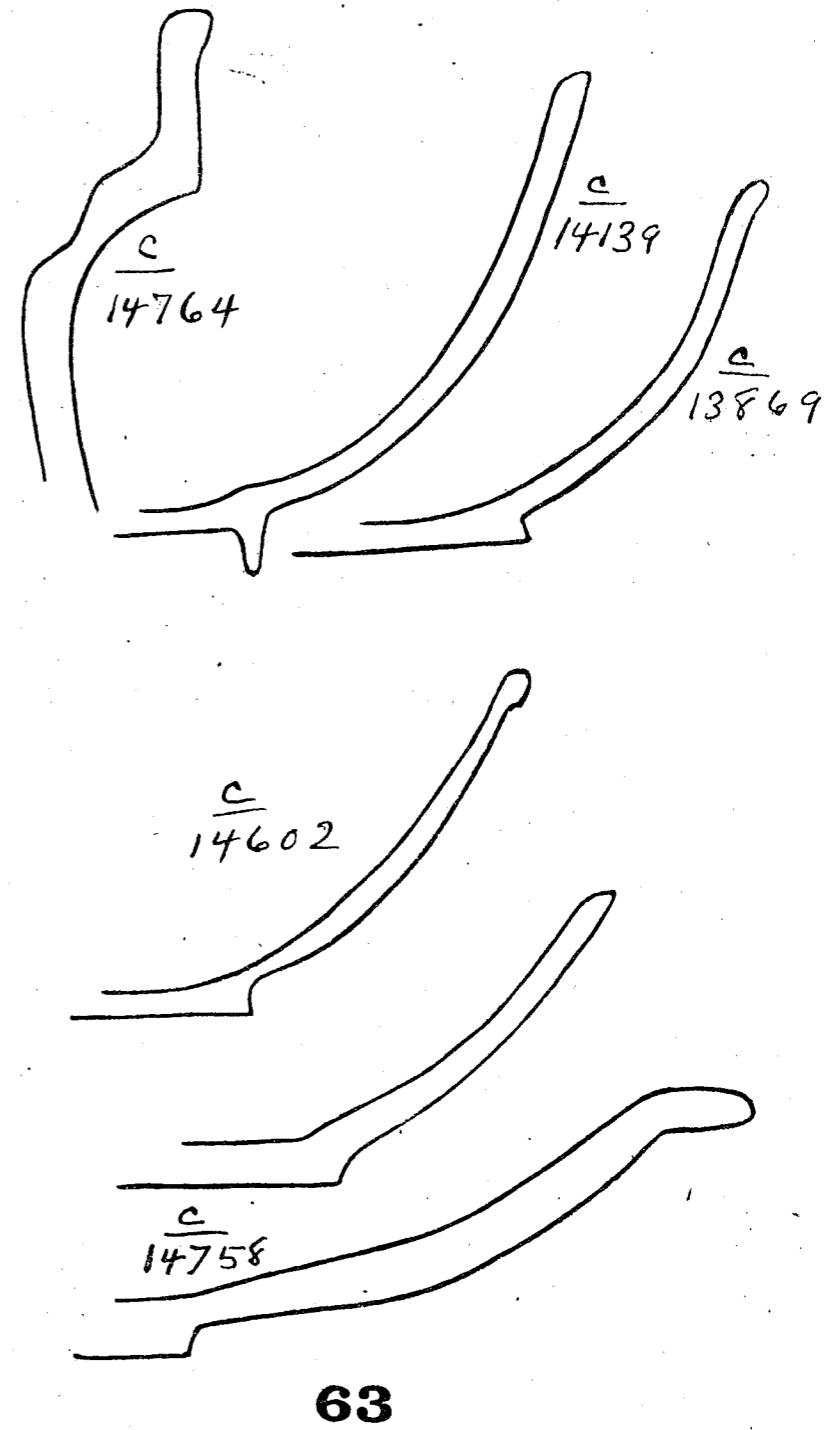


61

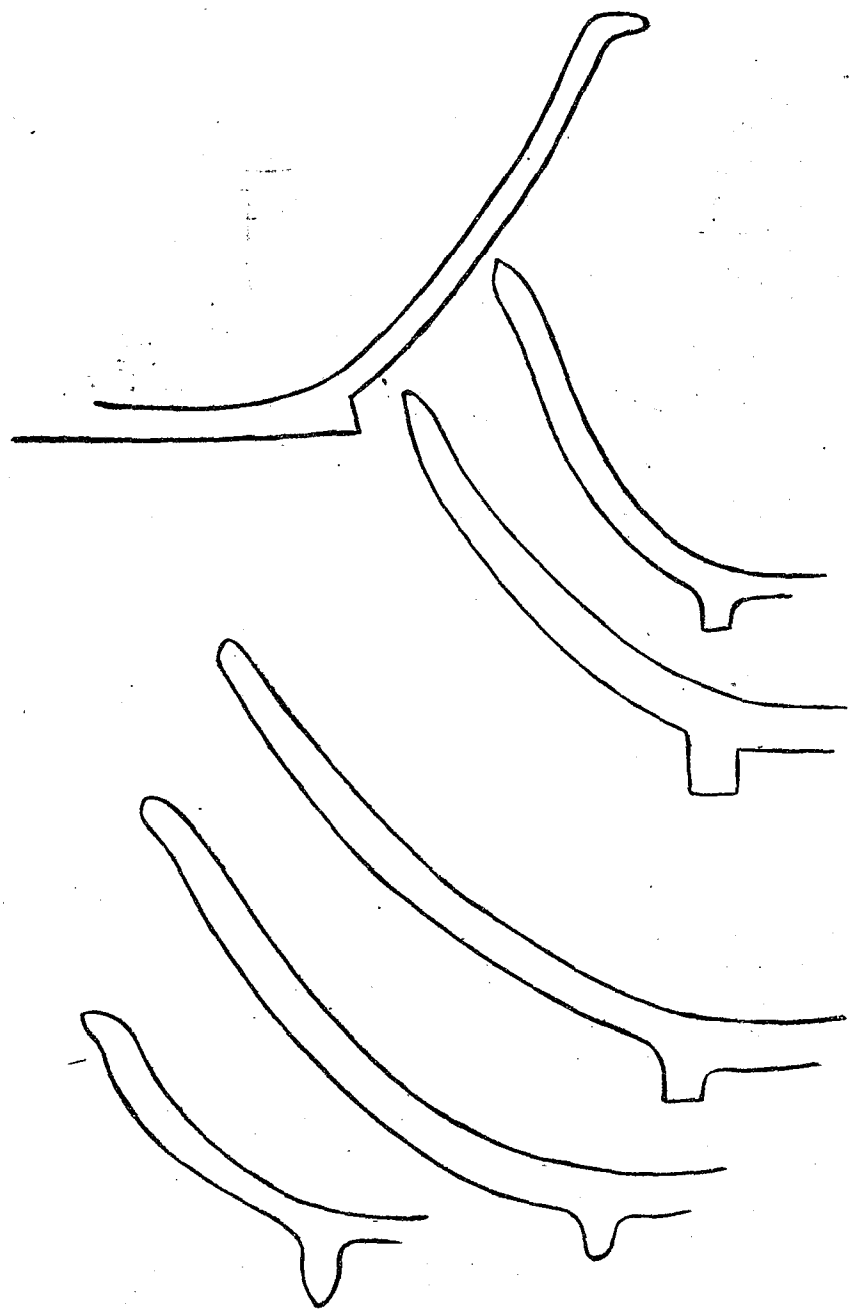
61. C/13821, a Liu Li Ch'ang sherd. The body is brick red. There are grass-green floral ornamentations on a black background. The glaze is over a yellow slip. There is a thick foot rim.



62. Liu Li Ch'ang rim sherds.

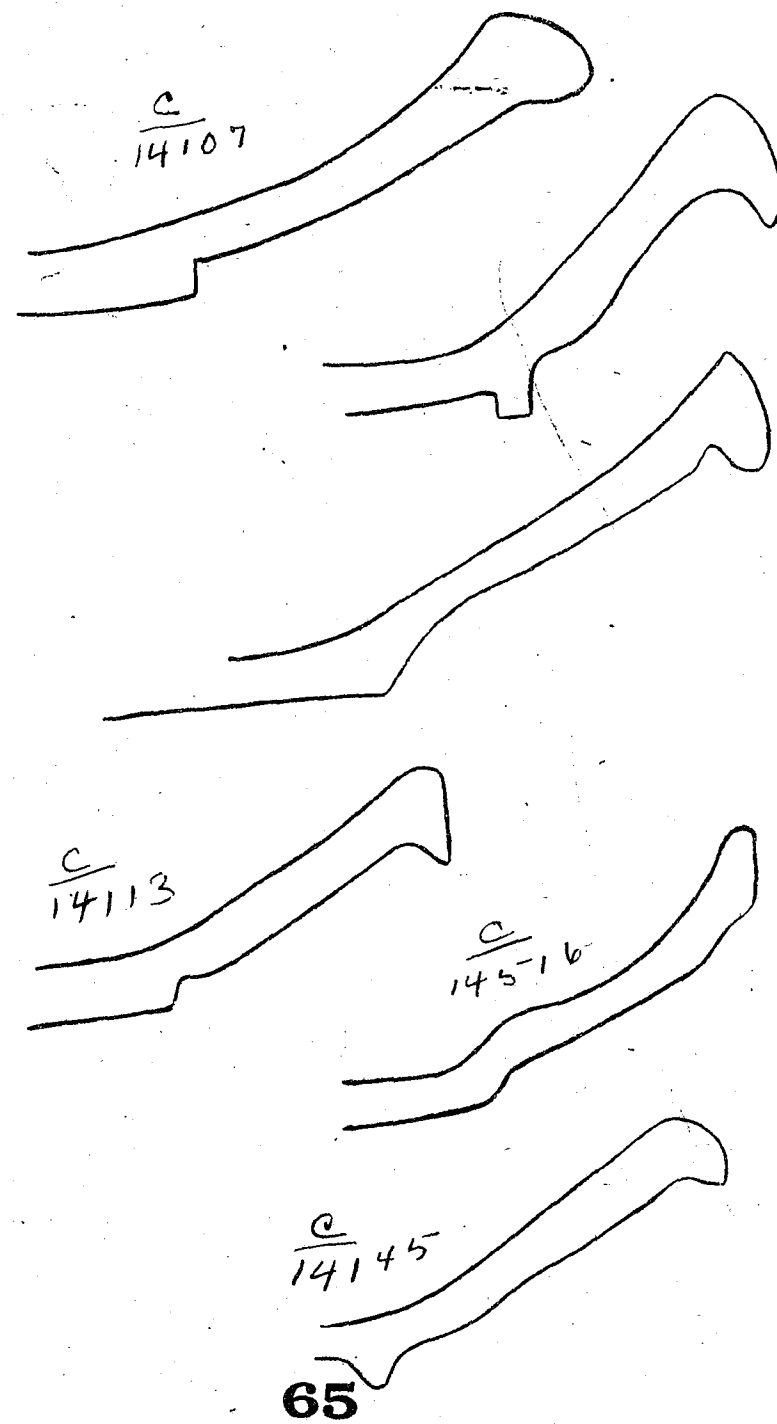


63. Liu Li Ch'ang rim sherds.



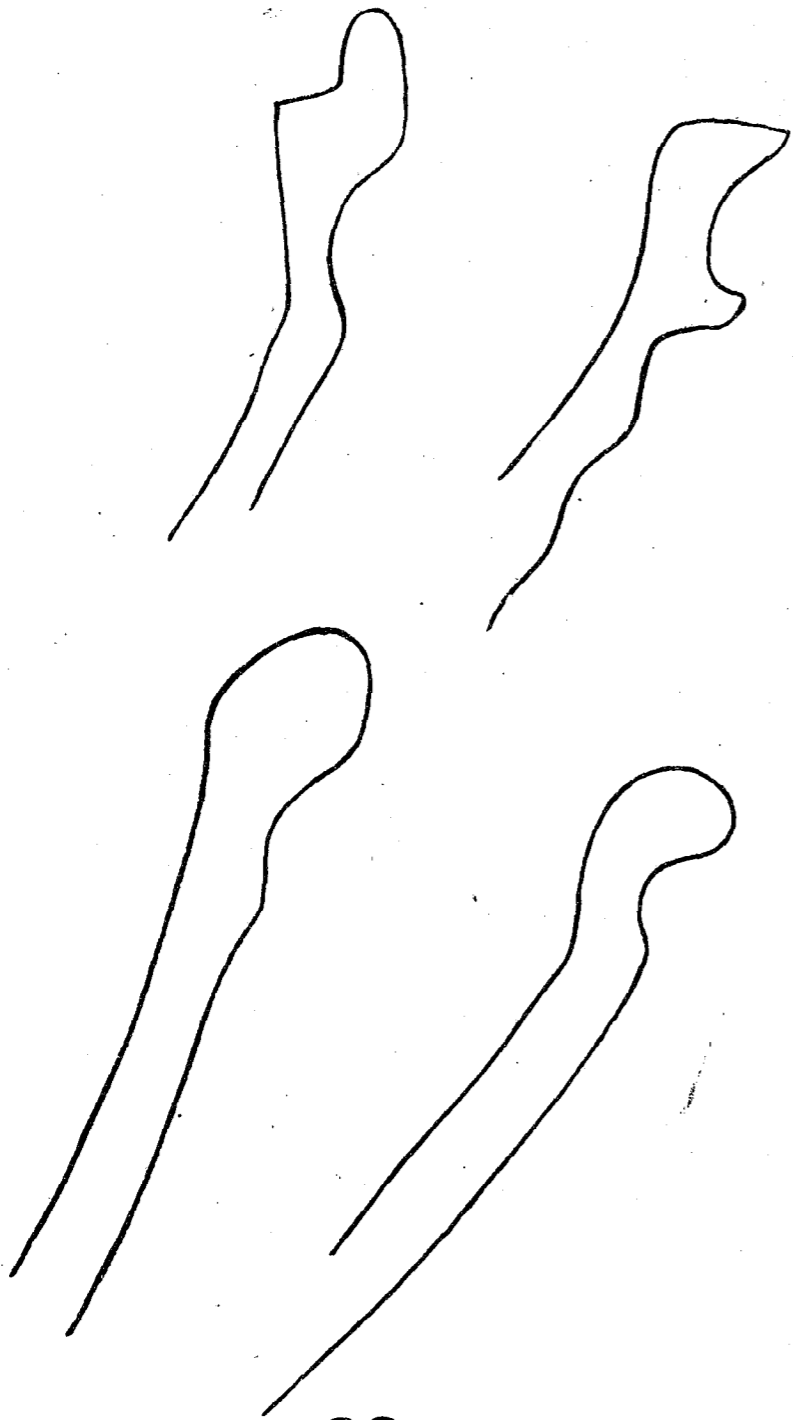
64

64. Liu Li Ch'ang rim sherds of food bowls.



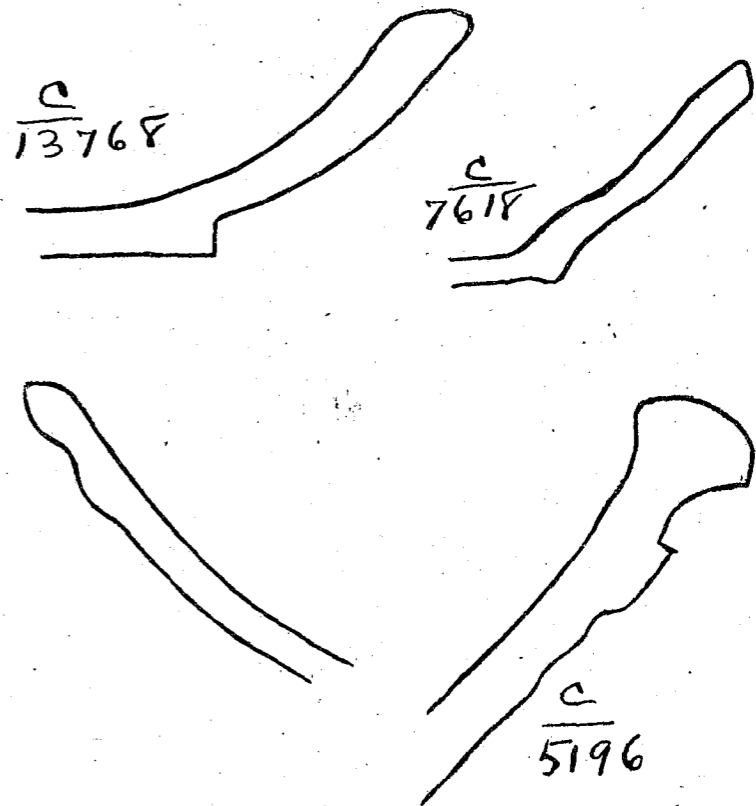
65

65. Liu Li Ch'ang rim sherds of thick saucers.



66

66. Liu Li Ch'ang rim sherds of large basins.



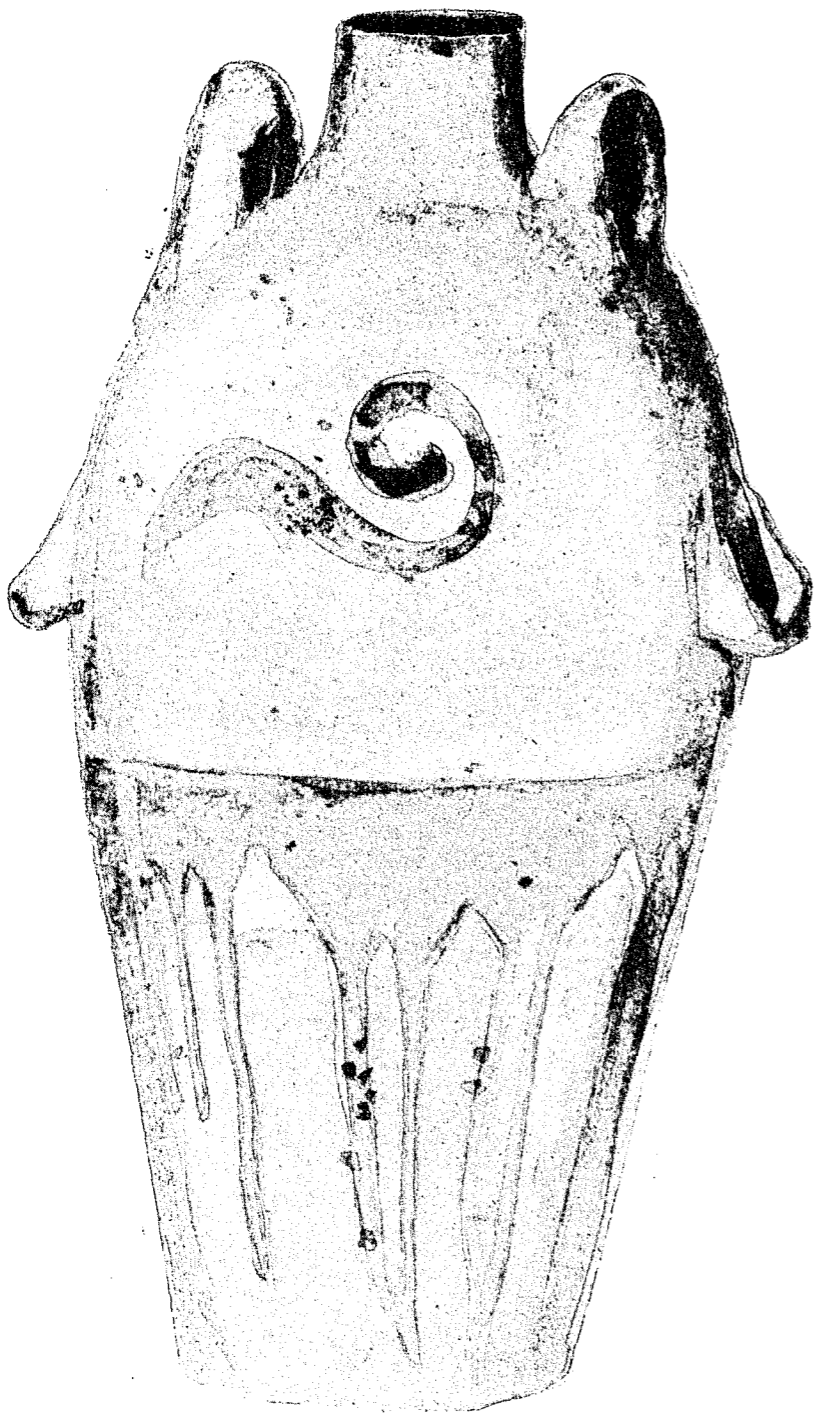
67

67. Liu Li Ch'ang rim sherds.



68

68. A large basin from Liu Li Ch'ang with a floral scroll decoration on the sides, and large lotus flowers on the bottom. Painted by Mr. L. C. Walmsley.



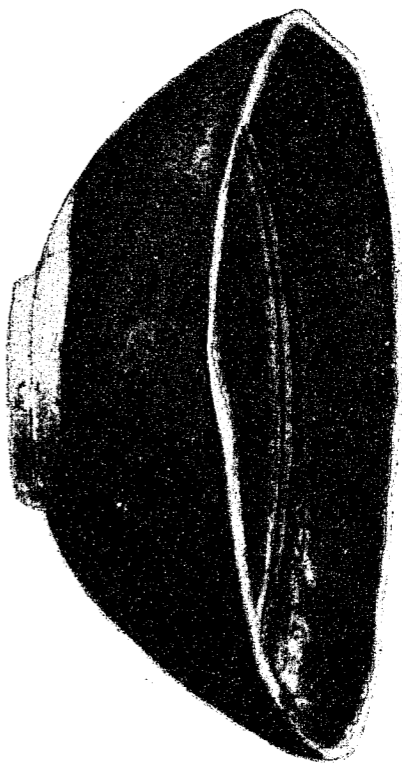
69

69. A yellow glazed jug with a green floral ornamentation from Liu Li Ch'ang. Painted by Mrs. John Kitchen. No. C/13974, height 275 mm.



70

70. A temmoku bowl from Liu Li Ch'ang. The base is narrow and flat. The color is black and the unglazed portion of the base has been burnt a dull red by fire in the kiln. No. C/13760, diam 96 mm. painted by Mr. Lewis C. Walmsley.



71

71. Lustrous glazed bowl with a small flat bottom. Bradley's Standard Color Chart, orange yellow shade no. 2 with a slight tinge of green, Maerz and Paul plate 15 C. 6. Painted by Mr. Lewis C. Walmsley. No. C/13989, diam. 102 mm.

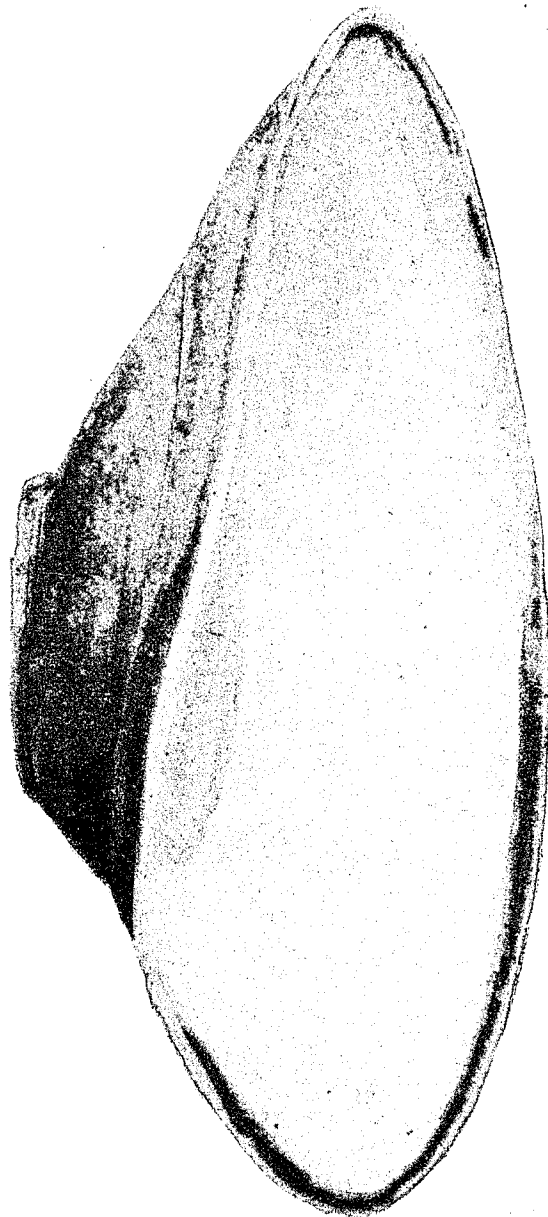
floral ornamentations, five legged bowls, the legs of which are ornamented with lion designs, flat dishes, cups with or without handles, small stem bowls, small round glazed or unglazed stoneware boxes with ornamented lids, flying angels, and porcelain with floral designs painted over the glaze after the vessel had been baked in the kiln. We venture the guess that the manufacture of pottery in the Ch'iung Chou kilnsite began late in the T'ang dynasty and ceased early in the North Sung, approximately 850 to 1000 A. D. For further light we must await the results of archaeological excavation and the chemical analysis of the pottery.

The evidence seems to indicate that the Liu Li Ch'ang kilnsite is a place where porcelains were manufactured near the end of the North Sung, during the South Sung, and during the first half of the Yuan dynasty, but that the making of pottery there ceased before the typical Ming dynasty porcelains were manufactured or used in Szechwan.* We tentatively fix the date from 1100 to 1300 A. D. with suggestion that it may have begun a little earlier and continued a little later.

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華陽縣志廿冊，嘉慶丙子年(二十一年)刊。
- Hua Yang Hsien Chih A. D. 1933.
華陽縣志十六冊，民國廿二年刊。

*The writer has carefully searched the kilnsite for typical Ming dynasty sherds and has failed to find a single one.



72. Lustrous white glazed food bowl, with a yellow-green border and a foot rim, and misshaped. Painted by Mr. Lewis C. Wainsley. No. C/16650, diam. 162 mm.

72

THE POTTERY OF CH'UNG LAI 邛崃

DAVID CROCKETT GRAHAM*

Outside the west Gate of Ch'ung Lai 邛崃 or Ch'ung Chou 邛州, Szechwan Province, China, across the stream called Ta Nan Ho 大南河, is an old pottery kilnsite. It is approximately a thousand feet long, in places four hundred and fifty feet wide, and there are hillocks of debris where the broken pottery and other refuse is probably forty or fifty feet deep.

For decades at least pottery from this site has appeared on the markets of Chengtu and has been purchased and treasured by those who were interested in old porcelains. During the summer of 1936 the entire surface of this kilnsite, to a depth of ten or fifteen feet, was worked over by poor people and soldiers who labored away feverishly in the hope of finding pieces of pottery that could be sold. Even the best sherds were gathered up in baskets and sold by the catty. It is believed that about thirty thousand dollars worth of pottery from this kilnsite was dug up and sold within two or three months.

On September 10, 1936, Mr. O. H. Bedford, Mr. Chêng Teh K'un and the writer went to Ch'ung Chou to study this kilnsite. Later an official request to excavate was sent to the Academia Sinica, but permission was not granted. Since the destruction of the kilnsite went on unabated, and it seemed that it would soon be completely ruined, a collection of Ch'ung Chou pottery was made by the West China Union University Museum of Archaeology so that the materials might be available for future study.

The Ch'ung Chou kilnsite presents a number of puzzling problems. It is large and important, but it is not mentioned in any of the Szechwan histories or gazeteers. In shapes and designs it has affinities to T'ang dynasty pottery, but much of the glaze seems to be true porcelain such as was made during the Sung dynasty. A few pieces of pottery that are believed to have come from the kilnsite have on them dates or year names, and these dates are all near the end of the T'ang dynasty. Tu Fu 杜甫, the famous T'ang dynasty poet, who lived in Chengtu, mentioned a kind of porcelain from Ta I 大邑, which is only fifty li from Ch'ung Chou, but the exact source of that porcelain is unknown.

Tu Fu came to Chengtu in A.D. 756 and occupied his straw hut in A.D. 760, when his poem on the porcelain of Ta I was

*West China Union University, Chengtu.

THE POTTERY OF CH'UNG LAI

47

probably written. A free translation of the poem is given below:—*

Asking Mr. Wei For Porcelain Bowls From Ta I.

"The porcelain made at Ta I is both light and firm. If you strike it, it sounds like sad jade. Its fame has spread to Chengtu. The bowls in your home are whiter than frost or snow. Quickly send some to my straw hut and they will be welcome."

It must be borne in mind that Tu Fu probably used poetic license in describing the Ta I bowls, and also that T'ang dynasty scholars used the word porcelain 瓷 more freely than it is used today.

While the Ch'ung Chou kilnsite is not mentioned in any old Chinese histories, it is, as we have stated, only fifty li from Ta I, and during the T'ang dynasty Ta I was controlled by Ch'ung Chou 邛州. It is possible that the Ch'ung Chou kiln was the source of the Ta I pottery mentioned by Tu Fu. On the other hand, the Ch'ung Lai Hsien Chih 邛崃縣志 Volume 1, contains the following paragraph:—

"Twenty li southwest of the city is K'ung Ming Miao 孔明廟, a small village on the mountain. It is said that Chu Ko Liang passed this place in a chariot, so men of later times built a temple there. Near it are many pottery kilns."*

Another historic reference is the following:—

"Ta I is only thirty li from Ch'ung Ch'ing Chou 邛崃州. When Shao Lin 少陵 (Tu Fu) went to that place ruled by the district 州 Tung Ko 東閣 to see the mei hua 梅花,† he went to Ta I and interviewed the magistrate, seeking the porcelain kiln. He has a sentence of poetry "The porcelain of Ta I is both light and hard."††

It is the belief of some Chinese scholars that the second quotation is a legend that has grown up because of Tu Fu's poem on the Ta I "porcelain." The first reference does not indicate clearly that the place mentioned is a porcelain kilnsite, or even that the pottery made there was glazed. Yet these quotations do raise the hope that if Ch'ung Chou is not the source of Tu Fu's "porcelain" that source may ultimately be

*Mr. Lin Min Güin, assistant curator of the West China Union University Museum of Archaeology, carefully searched the Chinese gazeteers and histories without finding a single reference to this kiln that is not very recent. Mr. Lin has also assisted in making these translations and in other ways.

*Ch'ung Lai Hsien Chih 邛崃縣志 Vol. 1.

†Prunus Mume S et Z.

††Ch'ung Chou Chih 邛州志, issued in the twenty-third year of the reign of Chia Ch'ing 嘉慶 Vol. 37.

found. At present nobody knows the place or the kind or porcelain indicated.

Mr. O. H. Bedford has a short article on the Ch'ung Chou kilnsite in the January number of the *China Journal*, 1936.* In this article Mr. Bedford states that General T'ang, who was stationed at Ch'ung Chou in 1936, was said to have once owned a piece of pottery from the Ch'ung Chou kilnsite on which were the characters Ch'ien Fu 乾符, which is the name of the period A.D. 874-879. Dr. Yang Chih Kao 楊枝高, a physician in the Canadian Mission Hospital for Men, Chengtu, in an article in Chinese published in the *Hua Hsi Hsueh Pao* 華西學報† mentions three dates found on Ch'ung Chou pottery, and a fourth object with an inscription he could not read. The fourth object the writer has reason to believe to be a recent imitation. The dates given by Dr. Yang are A.D. 754, 823, and 874-79 respectively. The writer has not seen any of the pieces of dated pottery mentioned by Dr. Yang, but he has seen a large number of objects on which the dates have been written or incised recently, sometimes very cleverly. Some of these dates may be true, but at present we have not definite proof that they are.

The fact has been mentioned that the Ch'ung Chou pottery shows affinities to T'ang dynasty pottery. The bases of the bowls, jugs, jars, pitchers, and vases are generally wide and flat, with or without bevelled edges. Bases with rim circles are rare, and when found they are generally thick. On some of the vessels, although rarely, there is a circle in the form of a depression near the center of the base. A few of the mustard-yellow bowls have narrow bases and thin base-rims, but the rims curve outward from the bases of the bowls. There are light colored jugs, greenish yellow, greenish gray or some similar light color, ornamented with dark brown splotches, a type which is sometimes classed as T'ang and sometimes as Sung dynasty. The images of human heads that are hollow and can be used as whistles resemble similar images which are generally classed as T'ang dynasty. The flying angels that are on several of the lids of small round boxes are thought to have been a characteristic of the T'ang dynasty.†† The food bowls not only have flat bottoms, but are much thicker than most of the Sung dynasty food bowls. On the other hand, most of the pottery seems to be true porcelain and is monochrome.

The deep blue or purple glazes, as well as the paler blue, blue-green, and blue-gray, sometimes with the small blue or blue-green spots, closely resemble the Sung dynasty *Chien Yao*.

*The *China Journal*, Volume XXVI, No. 1, January, 1937, p. 15.

†The *Hua Hsi Hsueh Pao* 華西學報 June, 1937.

††The *China Journal*, Vol. XXVI, January, 1937, Art Treasures of a Hanchow Pagoda, by Aziza Abraham, pp. 12-13.

There are gray, green, greenish yellow and light yellow glazes that might be relatives of the *Lung Ch'uen Yao*. There are vessels that are dark-brown or dark orange-yellow that resemble some shades of the *Chien Yao*. The *Ting Yao* seems to be entirely missing from this kilnsite. The brown spots on light-glazed vessels closely resemble in color the vessels that are dark brown or orange-yellow. This raises the question, are the dark brown ornamental spots of the late T'ang dynasty and early Sung dynasty possibly the beginnings of the Sung dynasty *temmoku*?

Some vessels have what seem to be the beginnings of vari-colored ornamentation on true porcelain. The vessels were glazed and fired, then floral ornaments were painted on in green and brown. The vessels may or may not have been refired. One vessel, figure 25, shows a similar ornamentation under the glaze, in which case the process may have been completed in one firing.

Crazing is sometimes seen on the Ch'ung Chou 邛州. The white slip, so well known among T'ang and Sung dynasty potters, is very evident in the Ch'ung Chou pottery. So many objects have been found covered with white, light yellow or light gray slip and without glaze that it seems likely that the Ch'ung Chou potters purposely made and sold pottery covered with the slip and without glaze. Closely related to these are the unglazed vessels covered with white, light-gray or light yellow slip on which floral designs have been painted in red or brown. Of course many of these vessels are unglazed because they were defective and not worth glazing.

The methods of ornamentation were as follows. First, designs were incised on the body of the vessels by means of a sharp tool before it was baked. Second, they were painted on the vessel before or after firing. Third, they were impressed on the inside or on the outside by means of a mould. Fourth, lumps of clay were put on the outside and then moulded into shape. It should be remembered that all the objects in the kilnsite are discards, rejected because of some inferiority or defect in manufacture. Yet a fine artistic touch is evident in many of the designs, shapes, and glazes.

In order to be as definite and accurate as possible in describing the colors of the glazes, Bradley's Standard Color Chart and the Dictionary of Color by Maerz and Paul have been used with the following results:—

No. C/12700, blue green (purple?), Bradley shade no. 1 and in places much darker: Maerz and Paul plate 29, 9, K.

No. C/13087, blue green, Maerz and Paul 29, 4, D.

No. C/13484, Bradley, between green shade 1 and blue-green, shade 1. Maerz and Paul plate 30, 8, C.

No. C/12763, a rare and much valued red violet, Bradley tint no. 1, Maerz and Paul plate 42, 8, J.

found. At present nobody knows the place or the kind or porcelain indicated.

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*The *China Journal*, Volume XXVI, No. 1, January, 1937, p. 15.

†The *Hua Hsi Hsueh Pao* 華西學報 June, 1937.

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There are gray, green, greenish yellow and light yellow glazes that might be relatives of the *Luang Ch'uen Yao*. There are vessels that are dark-brown or dark orange-yellow that resemble some shades of the *Chien Yao*. The *Ting Yao* seems to be entirely missing from this kilnsite. The brown spots on light-glazed vessels closely resemble in color the vessels that are dark brown or orange-yellow. This raises the question, are the dark brown ornamental spots of the late T'ang dynasty and early Sung dynasty possibly the beginnings of the Sung dynasty *temmoku*?

Some vessels have what seem to be the beginnings of vari-colored ornamentation on true porcelain. The vessels were glazed and fired, then floral ornaments were painted on in green and brown. The vessels may or may not have been refired. One vessel, figure 25, shows a similar ornamentation under the glaze, in which case the process may have been completed in one firing.

Crazing is sometimes seen on the Ch'iung Chou 邛州. The white slip, so well known among T'ang and Sung dynasty potters, is very evident in the Ch'iung Chou pottery. So many objects have been found covered with white, light yellow or light gray slip and without glaze that it seems likely that the Ch'iung Chou potters purposely made and sold pottery covered with the slip and without glaze. Closely related to these are the unglazed vessels covered with white, light-gray or light yellow slip on which floral designs have been painted in red or brown. Of course many of these vessels are unglazed because they were defective and not worth glazing.

The methods of ornamentation were as follows. First, designs were incised on the body of the vessels by means of a sharp tool before it was baked. Second, they were painted on the vessel before or after firing. Third, they were impressed on the inside or on the outside by means of a mould. Fourth, lumps of clay were put on the outside and then moulded into shape. It should be remembered that all the objects in the kilnsite are discards, rejected because of some inferiority or defect in manufacture. Yet a fine artistic touch is evident in many of the designs, shapes, and glazes.

In order to be as definite and accurate as possible in describing the colors of the glazes, Bradley's Standard Color Chart and the Dictionary of Color by Maerz and Paul have been used with the following results:—

No. C/12700, blue green (purple?), Bradley shade no. 1 and in places much darker. Maerz and Paul plate 29, 9, K.

No. C/13087, blue green, Maerz and Paul 29, 4, D.

No. C/13484, Bradley, between green shade 1 and blue-green, shade 1. Maerz and Paul plate 30, 8, C.

No. C/12763, a rare and much valued red violet, Bradley tint no. 1, Maerz and Paul plate 42, 8, J.

No. C/ , deep green soft glaze, Bradley shade no. 2, Maerz and Paul plate 24, 10, C.

No. C/12675, greenish yellow, very light, almost a neutral gray Bradley tint no. 2, Maerz and Paul plate 20, 1, B. There are spots which are blue-green, Bradley shade no. 1, Maerz and Paul plate 29, 9, K.

No. C/14398, Maerz and Paul plate 21, 1, A.

No. C/14175, light yellow-green with brown spots or splotches. The yellow-green is Maerz and Paul plate 20, 2, D, and the dark brown spots are Maerz and Paul plate 16, 12, A.

No. C/13530, mustard-yellow with crazing that is probably accidental rather than intentional. Bradley, yellow, tint no. 1, Maerz and Paul plate 10, 1, K.

No. C/14198, very dark yellow orange, darker than Maerz and Paul plate 16, 12, A.

No. C/12494, lighter than Bradley tint no. 2, Maerz and Paul plate 10, 3, C.

No. C/14379, gray slip on which are painted red floral ornaments. Gray slip is Bradley, light neutral gray and Maerz and Paul, glaucous gray, plate no. 35, 2, B. The red orange is Bradley, shade no. 2, Maerz and Paul plate 7, 10, J.

Prof. D. S. Dye has made a careful test of the hardness of the Ch'ung Chou pottery, the results of which are given below. A piece of T'ang dynasty tri-colored glazed pottery and a T'ang dynasty glazed image of a man from a Chinese tomb in Szechwan are included for comparison.

Number	Object and Color	Hardness
	T'ang dynasty tri-colored glazed pottery ..	4.5
	T'ang dynasty glazed image of a man	4.0
C/12727, C/12658,	yellow slip, white slip	4.-
C/14374,	gray slip	4.5
C/13530,	bright mustard yellow	5.0
C/13525,	bright mustard yellow	5.5
C/15233,	deep green glazed pitcher (soft)	4.5
C/12751,	yellow bowl with green edge at top	6.-
C/12700,	blue glazed bowl, (<i>chun yao?</i>)	6.5
C/12653,	blue glazed bowl, (<i>chun yao?</i>)	7.-
C/14175,	greenish-yellow with brown spots	6.5
C/12725,	dark brown or yellow-orange pitcher	7.0
C/12735,	large yellow jug	7.0
C/12667,	lustrous brown gray pitcher	7.0
C/13486,	Greenish-yellow pitcher	7.0
C/15286,	yellow glaze with green and brown ornamentations	9.-
C/12665,	yellow glaze with green and brown ornamentations	9.-*

*Note, There was no number eight in the test used by Prof. Dye.

While the shapes, decorations, colors, hardness, and dated inscriptions if genuine throw light on the time of manufacture, an important test is the chemical analysis of the glazes. This is now being made by Prof. Kao Yoh-ling 高毓靈 in the chemical laboratory of the West China Union University. The importance of this test can be seen from the fact according to Hetherington lead was used in the Han and T'ang and later in the Yuan and Ming dynasties glazes, but not during the Sung dynasty, while phosphates were used in the Sung glazes and were lacking in the T'ang and Ming dynasty wares, excepting in the *Ch'ih Chou* and the *Ting Yao* specimens manufactured during the Ming dynasty.* If the chemical tests show that the softer mustard-yellow and the soft deep green glazes contain lead and no phosphates, it will indicate that these two glazes are related to the T'ang dynasty glazes rather than those of the Sung dynasty. On the other hand, if the harder glazes contain no lead but contain phosphates, it will indicate that they are related to the Sung dynasty porcelains.

The following drawings and photographs give an impression of the materials from the Ch'ung Chou kilnsite such as can not be conveyed by mere descriptions. The color paintings were done by Mrs. John Kitchen and by Mr. L. C. Walmsley, principal of the Canadian School in Chengtu. I wish to express my deep and sincere thanks to them, to Prof. D. S. Dye for testing the hardness of the glazes, and to Mr. Lin Min Guin, assistant curator of the West China Union University Museum of Archaeology, who has very diligently and carefully searched the Szechwan gazeteers and histories for references, and has assisted in their translation.

Our study leaves some unanswered questions and some unsolved problems. Was the Ch'ung Chou kilnsite the source of the Ta I Hsien "porcelain" of which Tu Fu wrote? If not, where is the Ta I kilnsite? There are so many affinities to T'ang dynasty pottery on the one hand that it seems necessary to date the beginning of this pottery near the end of the T'ang dynasty. Some of the porcelain seems to be early Sung dynasty monochromes. On the other hand, the small-bottomed bowls with rim circles that are so characteristic of the Sung dynasty seem to be lacking in this kilnsite. It seems safe, therefore, to assume that work in this kilnsite ceased early in the Sung dynasty. Our hope for further light on these problems in the future lies, first, in a scientific chemical analysis. This, as we have stated, is being done by Prof. Kao Yoh Lin. Second, scientific archaeological excavation may bring to light materials, such as pottery with dates found *in situ*, which will make it possible to more correctly date the Ch'ung Chou kilnsite.

*Hetherington, A. L., *Early Ceramic Wares in China*, pp. 61, 66.

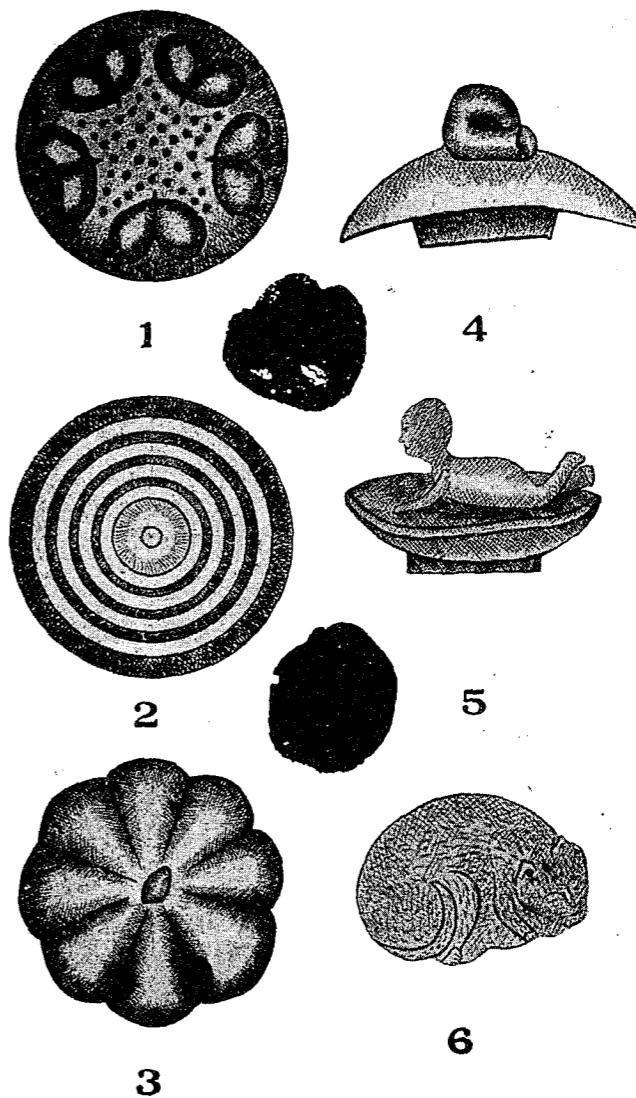
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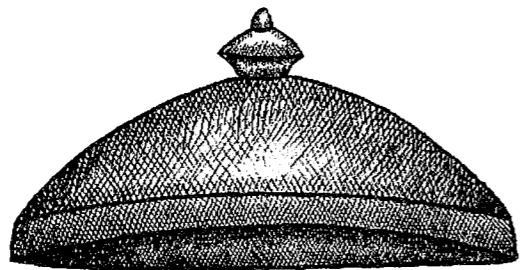
Note:—Since writing this article on the Ch'ung Chou pottery it has been my privilege to visit a number of the great museums of Europe and North America.

In the British Museum there are Chinese porcelain sherds found *in situ* at Samarra on the Tigris river, and others found *in situ* at Brohminabad. These porcelain sherds, which are dated between 800 and 900 A. D., very closely resemble those in the Ch'ung Chou kilnsite.

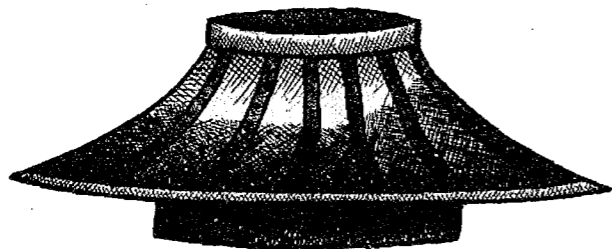
In the Royal Ontario Museum at Toronto, Canada, there are specimens of porcelainous pottery dated during the second and third century A. D., and still others dated between the Han and the T'ang dynasties. There is a whole case of T'ang dynasty white porcelain, A. D. 618—907. In the private collection of Mr. A. Menzies there are two similar white porcelain T'ang dynasty bowls one of which, when thumped, "rings like a bell." Allowing a little for poetic license, the white T'ang dynasty porcelains in the Royal Ontario Museum and the two



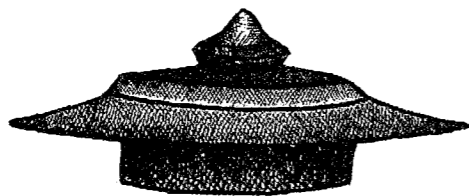
1. A common type of lid with a five pointed star. The glazes vary from blue to green and orange yellow.
2. C/12895, An uncolored lid made of a soft light-yellow stoneware. It has five terraces but is otherwise unornamented.
3. C/14225, Top view of a lid covered with yellow slip with a knob on the top for a handle. Height 44 mm., diameter 42 mm.
4. Lid covered with yellow slip and with a coil for a handle, C/12894. Diam. 51 mm.
5. Side view of C/15263, a lid on which is child lying on its stomach, the lid covered with greenish gray porcelain, and having dark-brown spots. Diam. 51 mm.
6. A porcelain lid in the shape of a coiled-up sleeping cat, No. C/13842. Length 38 mm.



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8



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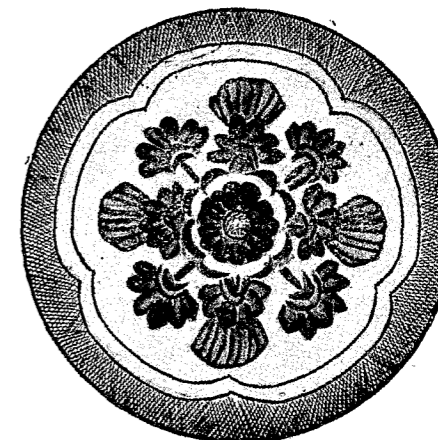


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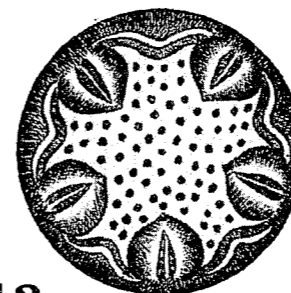
7. A gray porcelain lid with a knob for a handle. C/14217, Diam. 66 mm.
8. A yellow porcelain lid ornamented with brown streaks, No. C/13594.
9. A poorly glazed dark brown porcelain lid No. C/10742. Diam. 72 mm.
10. A lustrous brown glazed lid with a light blue handle. No. C/12905. Diameter 44 mm.



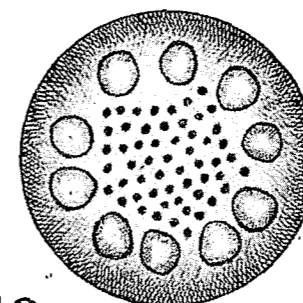
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11. Lid with floral decoration. C/14213 and C/12881 are exactly alike excepting that the former has a lustrous blue-green glaze and the latter is poorly glazed. Diam. 59 mm.
12. Gray-green porcelain lid of a porcelain box, C/16574. Diam. 49 mm.
13. Gray glazed lid of a porcelain box. Diam. 51 mm.
14. Floral design on a "mustard yellow" glazed lid. Diameter 63 mm.
15. Blue-gray porcelain lid on which are a phoenix and a dragon. The head of the dragon is not distinct. Note the long bushy tail of the phoenix.



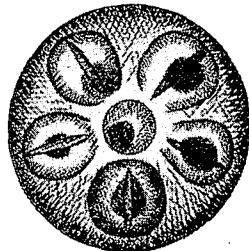
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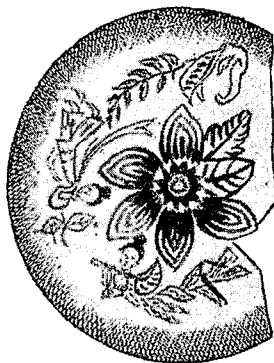
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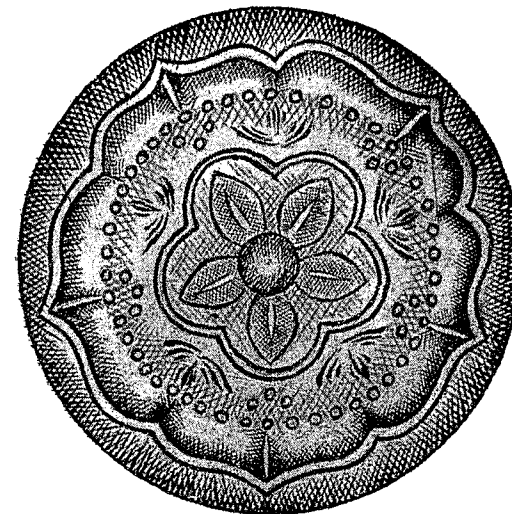
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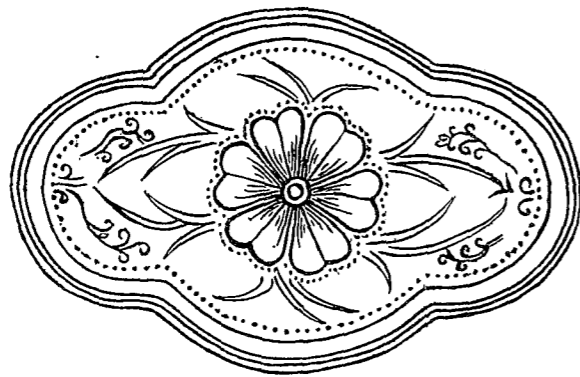
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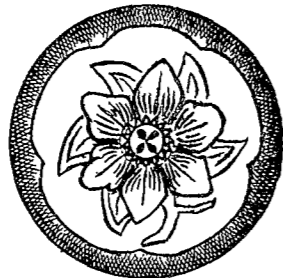
23

- 16. Yellow green and blue green porcelain box on which are two flying birds. No. C/14214.
- 17. Figure of a flying angel, probably on the lid of a glazed box which is deep green outside and bright (mustard) yellow inside. Length 46 mm.
- 18. Two flying angels on the rimmed bottom of a vessel. The body is a light yellow orange. It is covered with a light yellow slip and has a green drop of glaze on it. Diam 60 mm.
- 19. Lid with floral decoration covered with a very light yellow slip. Diam. 48 mm. No. C/13286.
- 20. Gray and green glazed lid. The dark spots on the flower are green and rest gray. Diam. 44 mm. No. C/13281.
- 21. Broken lid with flower and flying angels. It is covered with light blue glaze over gray stoneware. No. C/14757, color, Maerz and Paul plate 25, 2. F.

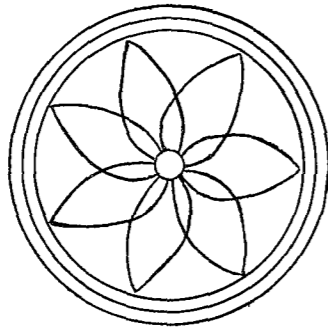
- 22. Gray and blue-gray glazed lid. No. C/12882, Diameter 68 mm.
- 23. Fragment of a lid with glaze outside and light yellow glaze inside. Floral ornament and two flying angels, the head of one imperfect. Length 59 mm., No. C/12766.



24

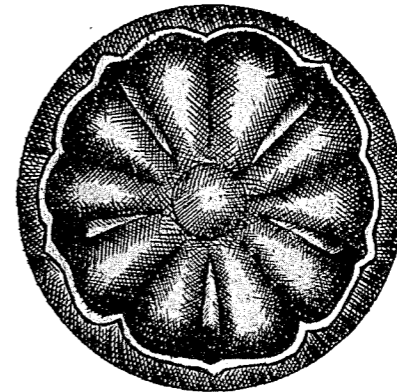


25



26

24. Lid of a bowl with floral decorations and covered with yellow slip. The decoration was stamped on by means of a mould. No. C/12753, length 85 mm., width 60 mm.
25. Lid with floral decoration and covered with light yellow slip. Diam. 46 mm.
26. Lid with floral decoration and covered with yellow slip. No. C/12893, diameter 52 mm.

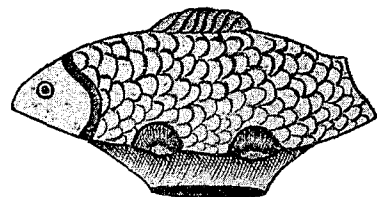


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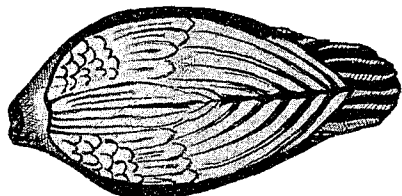


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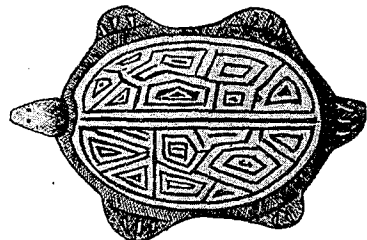
27. Lid covered with a light yellow slip. No. C/12754, diam. 66 mm.
28. Lid with a dragon ornament covered with a white slip. Diam. 65 mm.



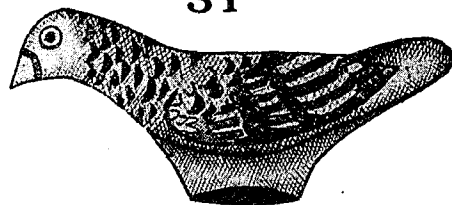
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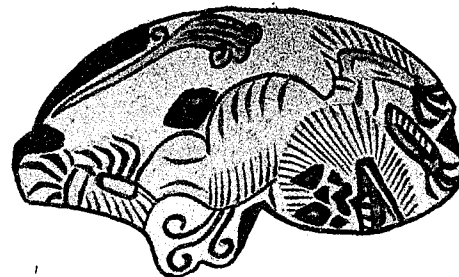


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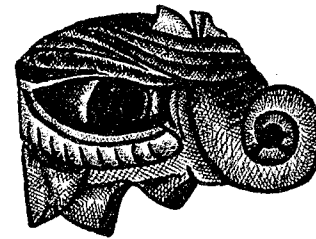


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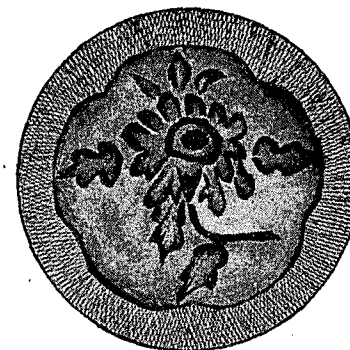
- 29. A green glazed lid in the form of a fish with the tail broken off. Length 54 mm. No. C/14427, diam. 54 mm.
- 30. A green glazed lid in the form of a bird, the head broken off. No. 12838, length 55 mm.
- 31. Lid in the form of a turtle, covered with yellow slip. Head and tail are broken off. Length 56 mm. No. C/14432.
- 32. Unbroken green glazed lid in the form of bird. No. C/14429.



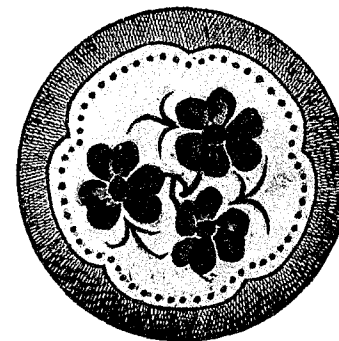
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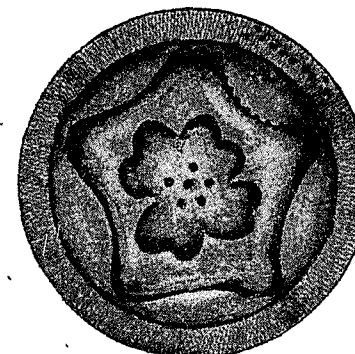
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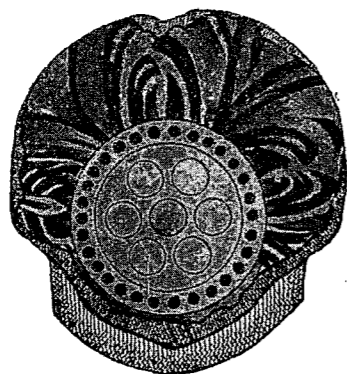


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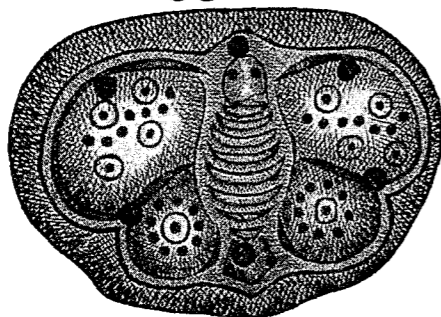
- 33. Image of a lion with a bushy tail on a sherd covered with yellow slip. No. C/15248, length 68 mm.
- 34. An elephant's face and snout on a sherd covered with yellow slip. The inside is marked with sharp rows showing that the vessel was a grater. No. C/12794, length 61 mm.
- 35. Image of a lion on a sherd covered with yellow slip. No. C/15249. Length 68 mm.
- 36. Floral design on an unglazed yellow earthenware lid. Diam. 50 mm.
- 37. Floral design on a gray porcelain lid. Diameter 48 mm.



38

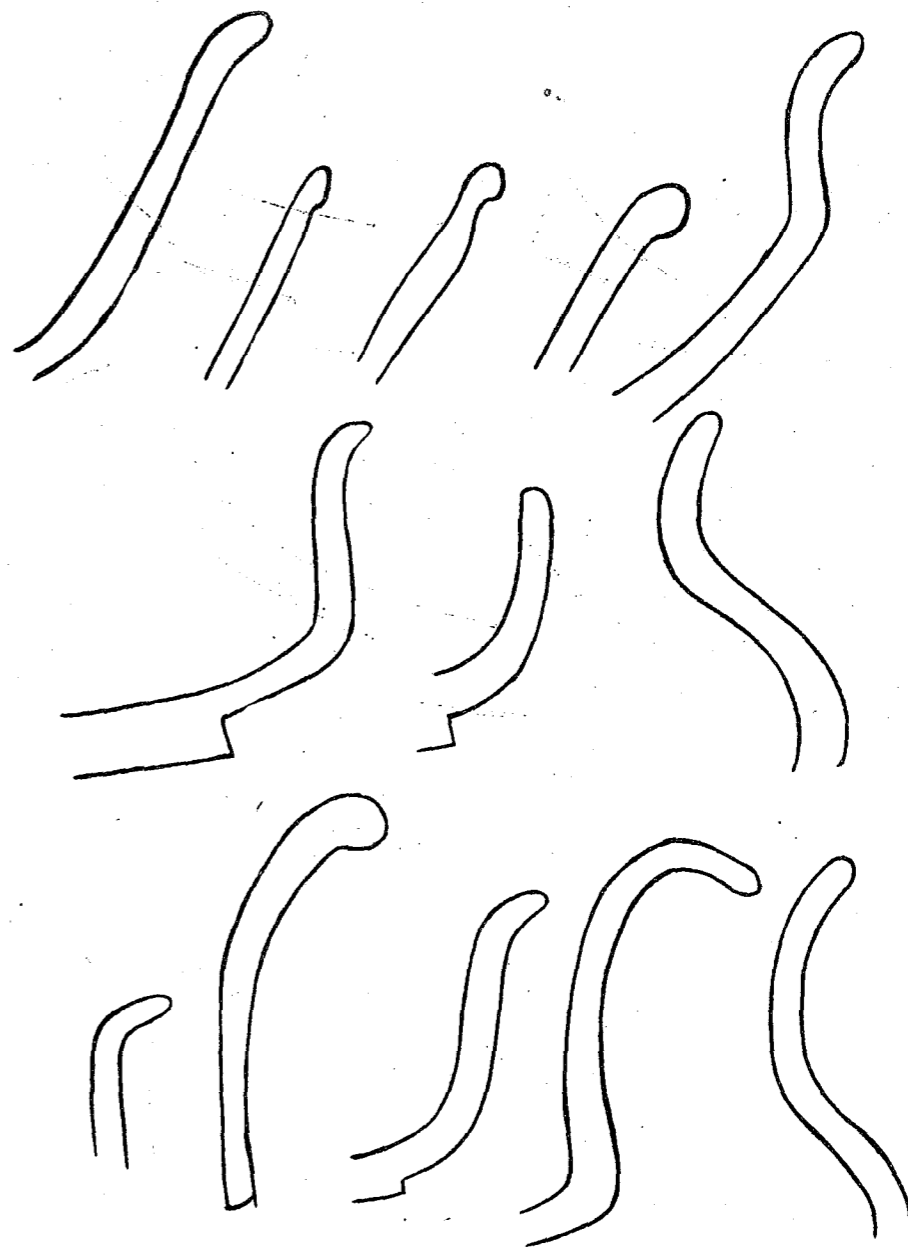


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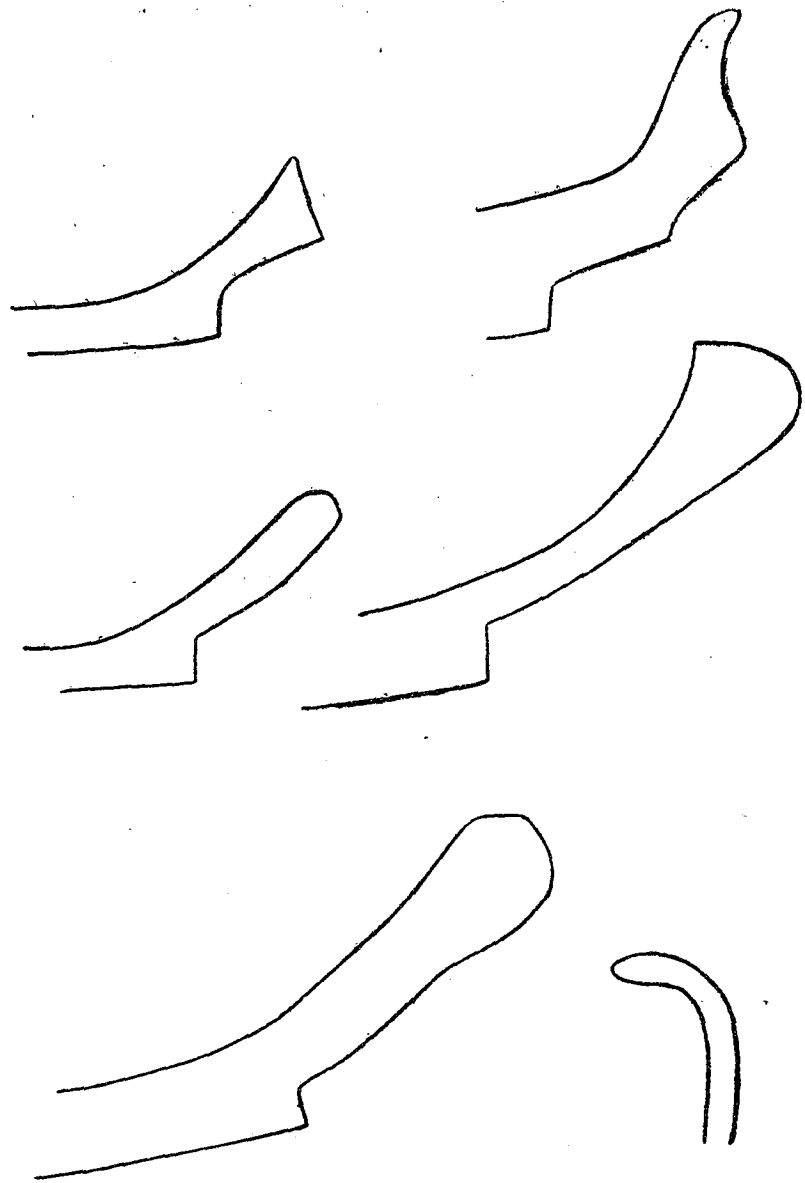
40

38. Inside of a bowl with elaborate decoration covered with a dark lustrous green glaze. The outside of the bowl is mustard yellow. There is a thin base rim that curves outward. No. C/12769.
39. A sherd ornamented by a tiger's head having a protruding tongue and tusks. It is covered with yellow slip inside and out side. This was an ornamentation on a large bowl. No. C/12795.
40. A poorly glazed image of a butterfly with six small holes through which strings could be passed to tie it to some other object. No. C/14292. Length 74 mm., width 53 mm.



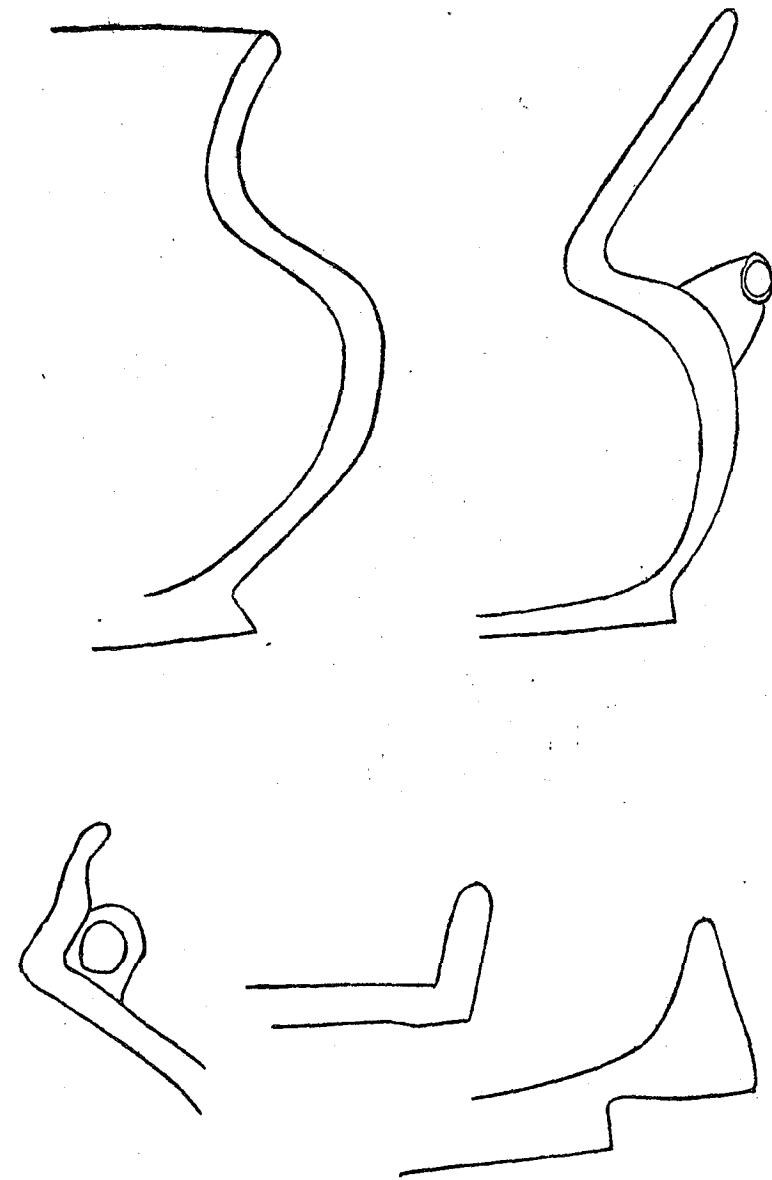
41

41. Rim sherds from the Ch'iung Lai kiln site.



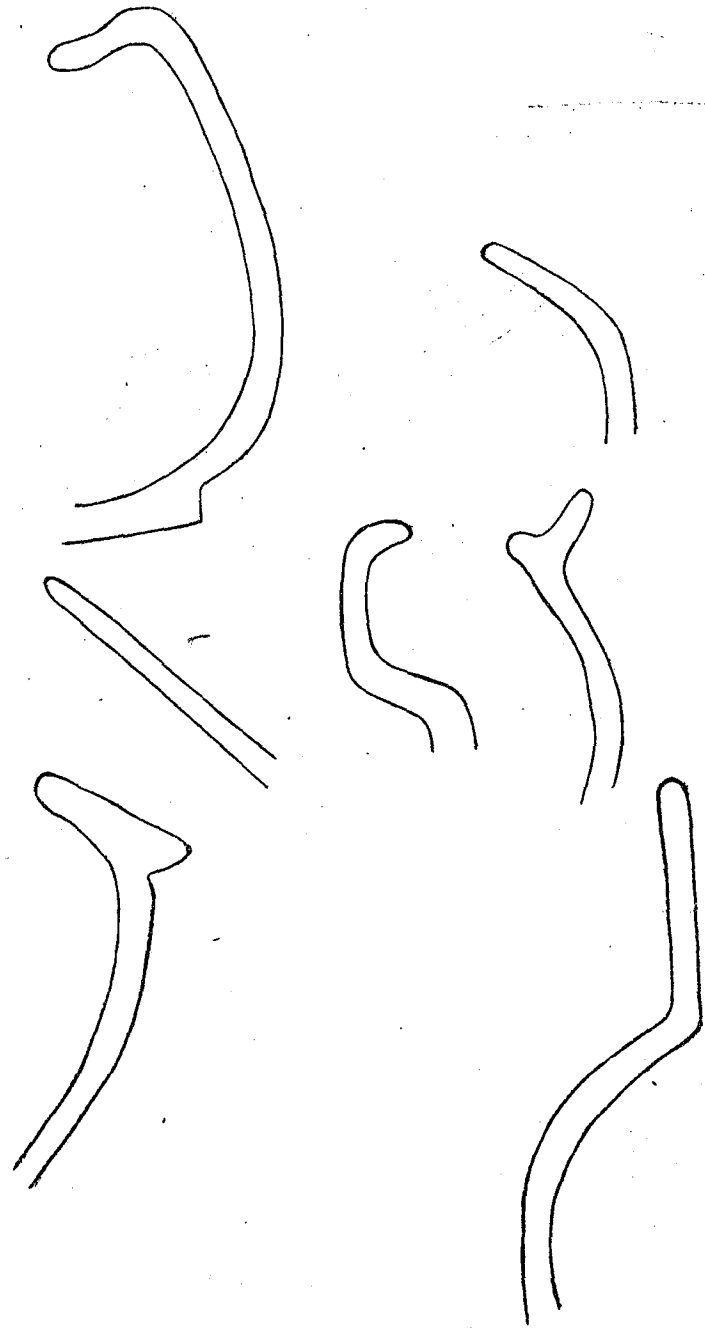
42

42. Ch'ung Lai rim sherds. All but one are thick saucers.



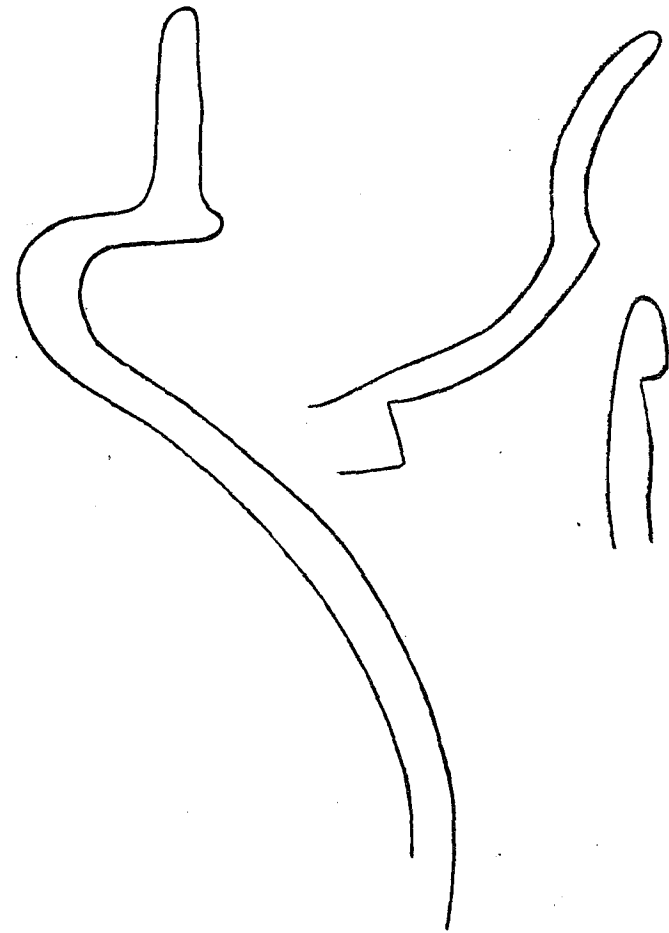
43

43. Ch'ung Lai rim sherds.



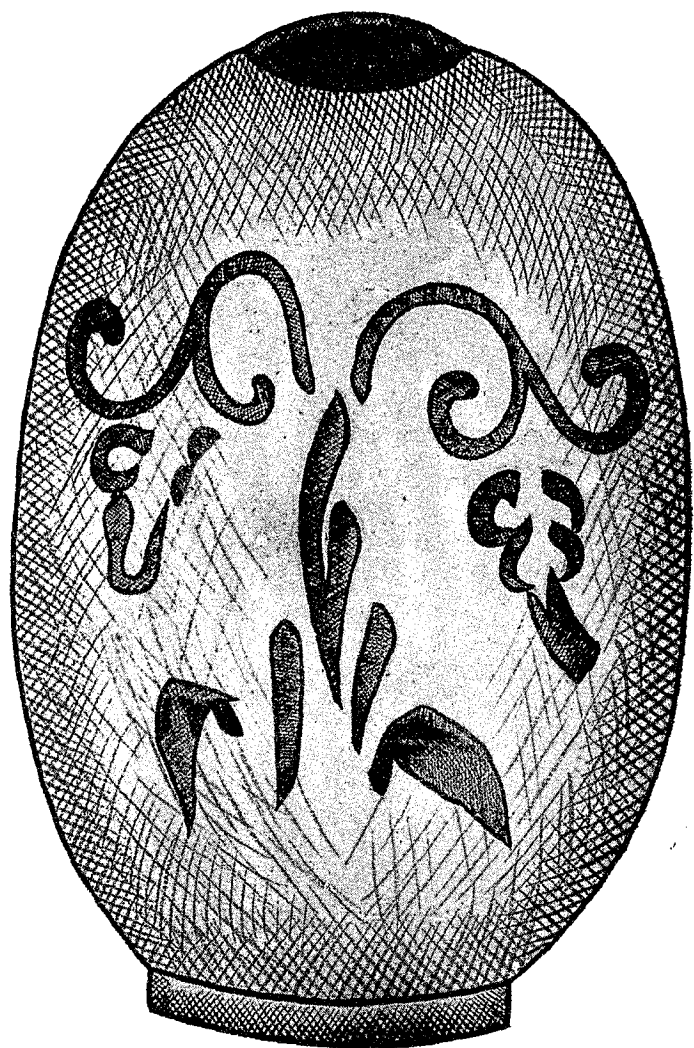
44

44. Ch'ung Lai rim sherds.



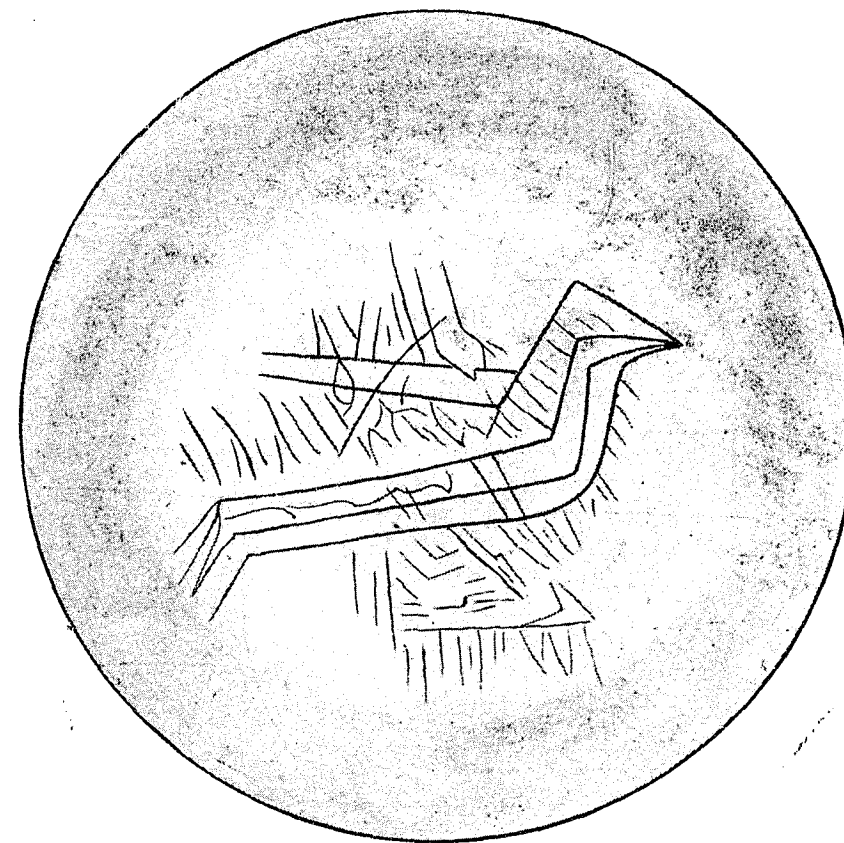
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45. Ch'ung Lai rim sherds.



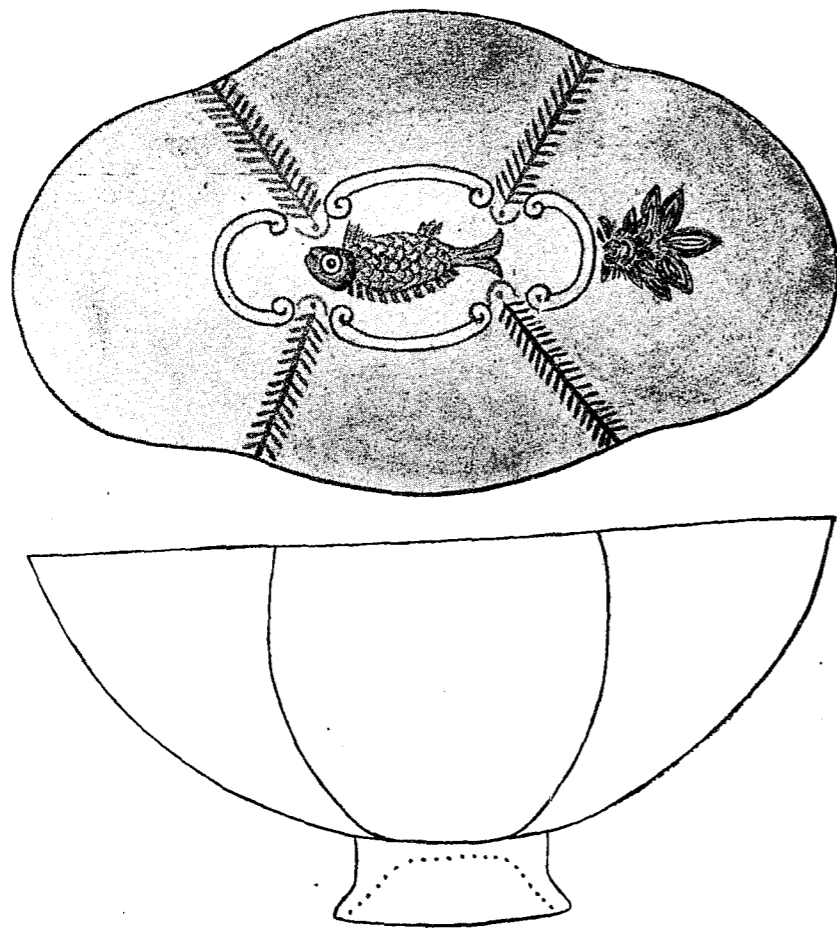
46

46. Floral design in yellow green glaze on a Ch'ung Lai jug.



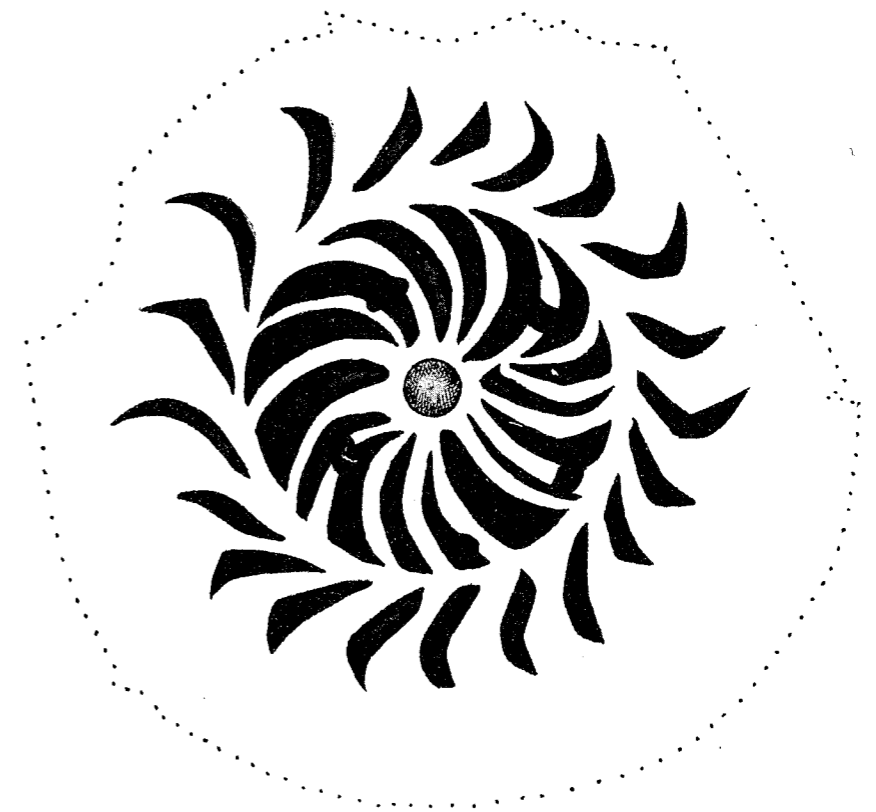
47

47. Incised bird decoration on the inside of a bowl having a light yellow slip coloring over an orange yellow body. Flat bottomed. The incision was apparently made in the yellow slip before it was dry. Diam. 106 mm.



48

48. Inside and side view of a bowl covered with a light yellow slip. The inside designs were made by a mould. Note that the vessel is quatrefoil. The dotted line indicates the inside bottom line of the foot rim, which is thin and curves outward. No. C/13124. Length 131 mm., width 76 mm.



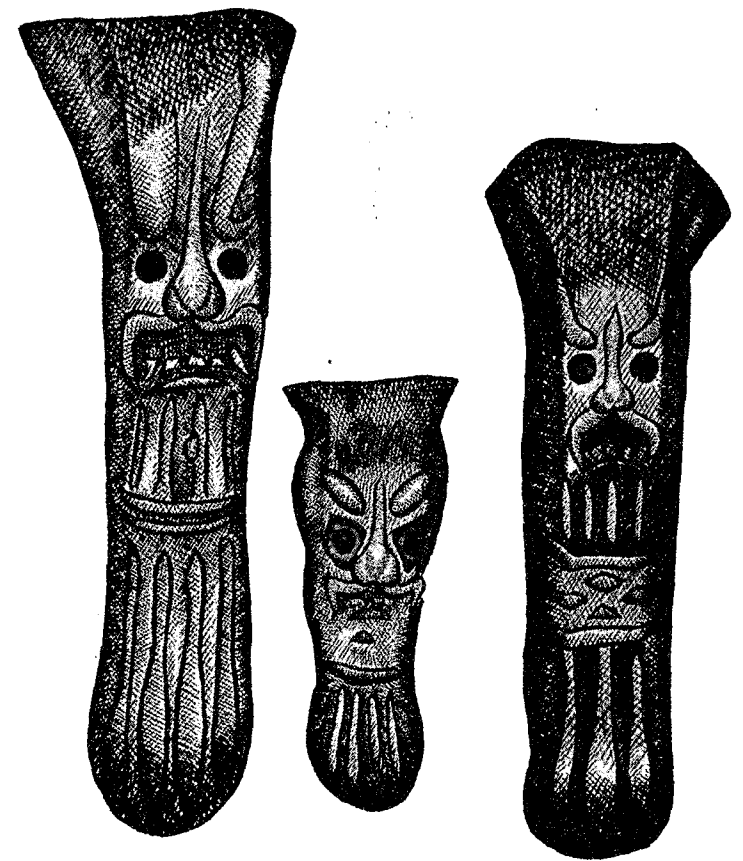
49

49. Inside ornamentation on a blue-gray porcelain bowl. It has a flat bottom with a bevelled edge. The outer rim is broken off and the marks of the teeth of the clay circle used while baking in the kiln can plainly be seen. The dotted line indicates the present shape of the object. No. C/12971.



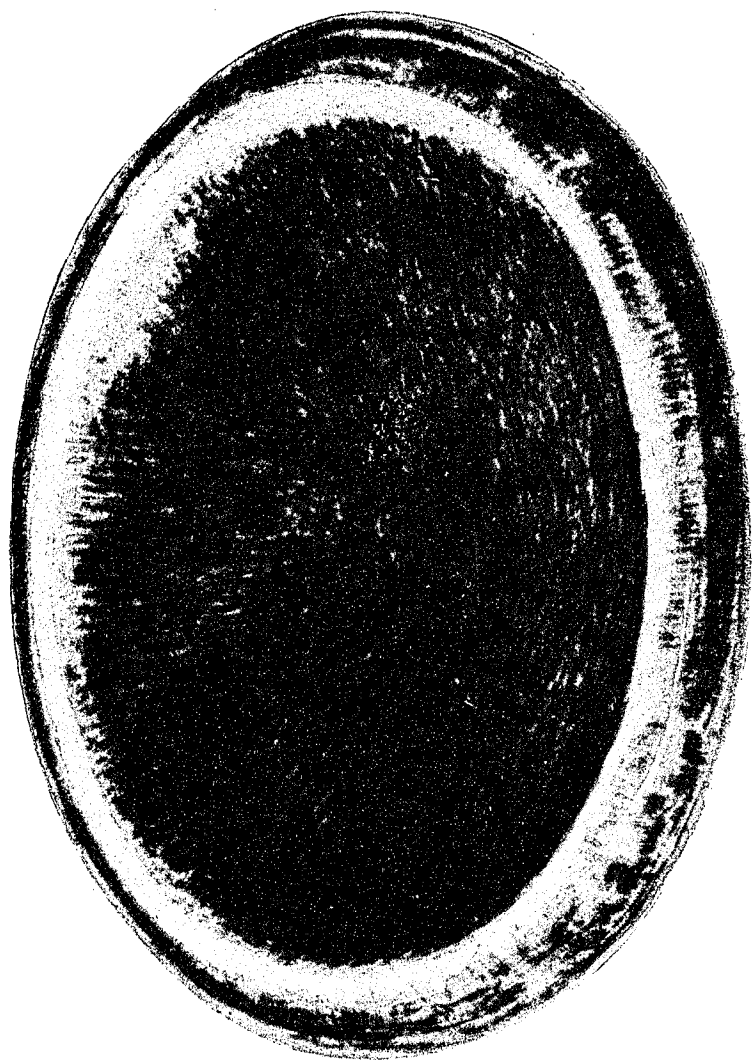
50

50. A light green porcelain pitcher with a double snout, and with the handles and snout broken off. The unglazed portion near the base has been burnt red while in the kiln. Height 202 mm. No. C/12736.



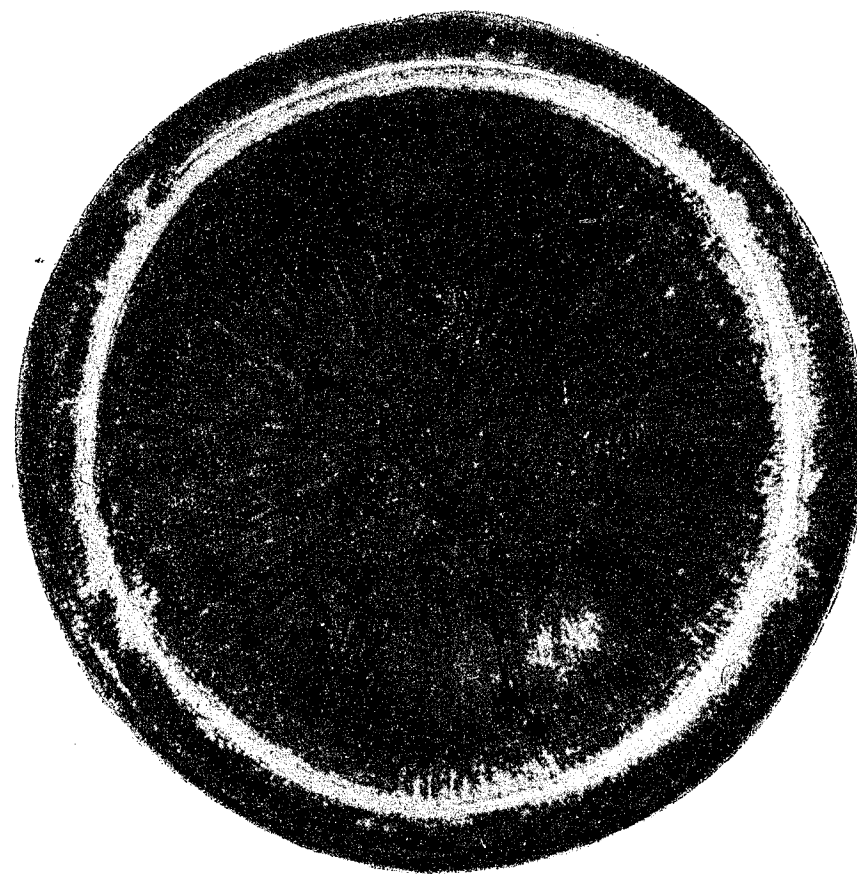
51

51. Lion or ogre designs on the legs of Ch'iung Chou pottery. Left, C/14228, covered with brown glaze, length 103 mm. Center, No. C/15280, light yellow glaze, length 55 mm. Right, No. C/15280, soft green glaze, length 90 mm.



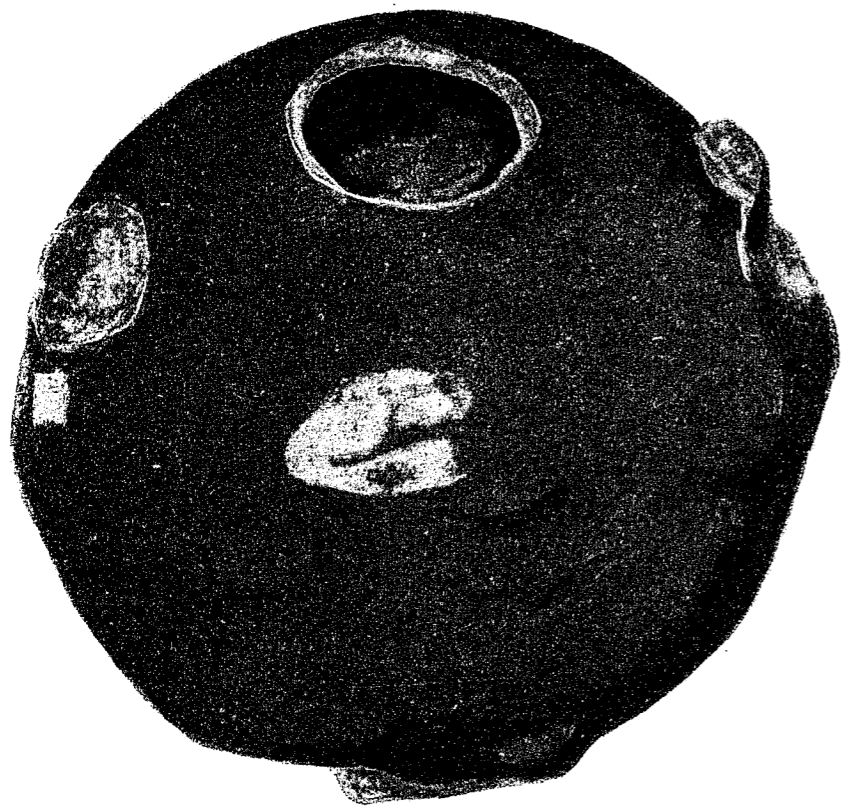
52

52. Side view of a thick blue glazed saucer from the Chi'ung Lai kilnsite, No. C/12653. Painted by Mrs. John Kitchen.



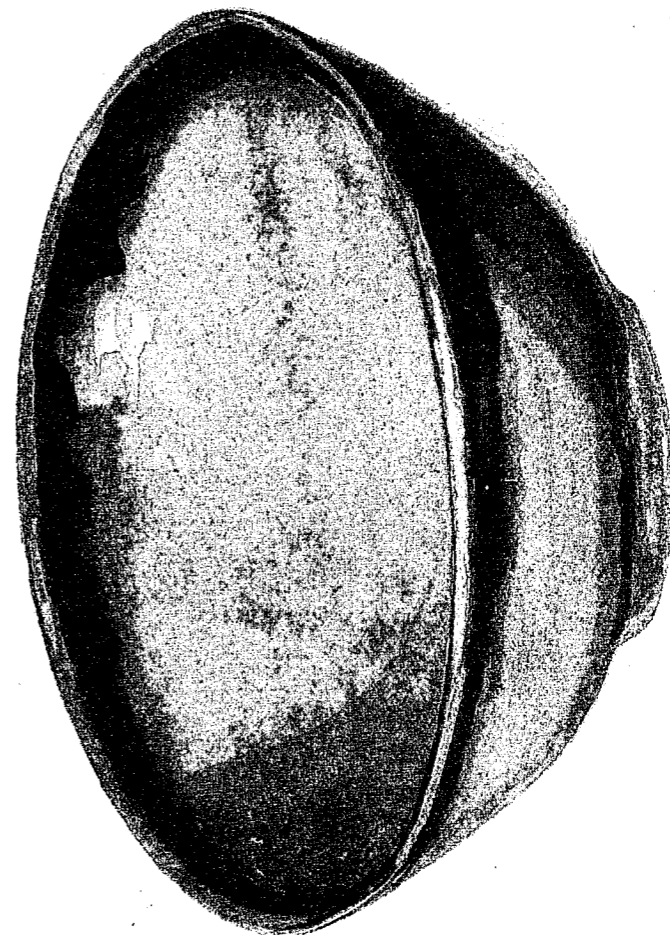
53

53. Top view of C/12653, painted by Mrs. John Kitchen.



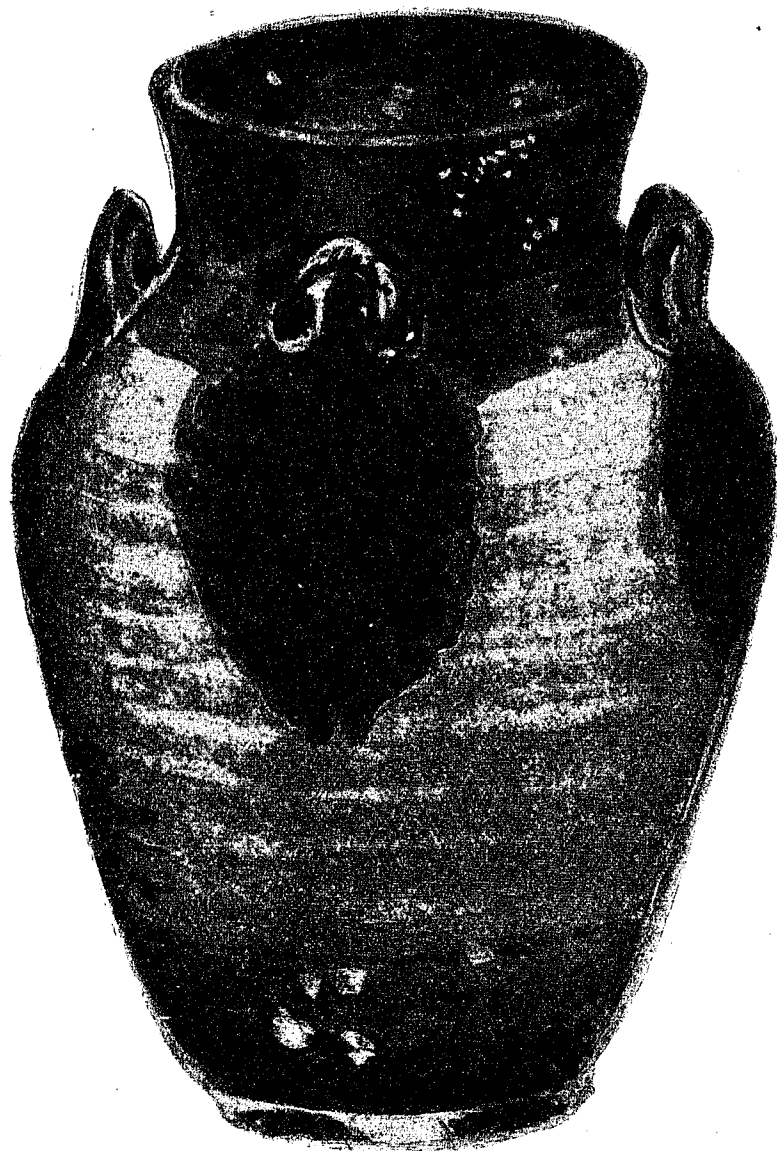
54

54. A broken and very lustrous blue-green jug from Ch'iung Lai kilnsite, No. 12648. Painted by Mrs. John Kitchen.



55

55. A flat bottomed light yellow bowl with a dark brown edge, painted by Mrs. John Kitchen. No. C/14155, Diam. 115 mm.



56

56. A light porcelain jug ornamented with dark brown spots, painted by Mrs. John Kitchen. No. C/14175, height 160 mm.



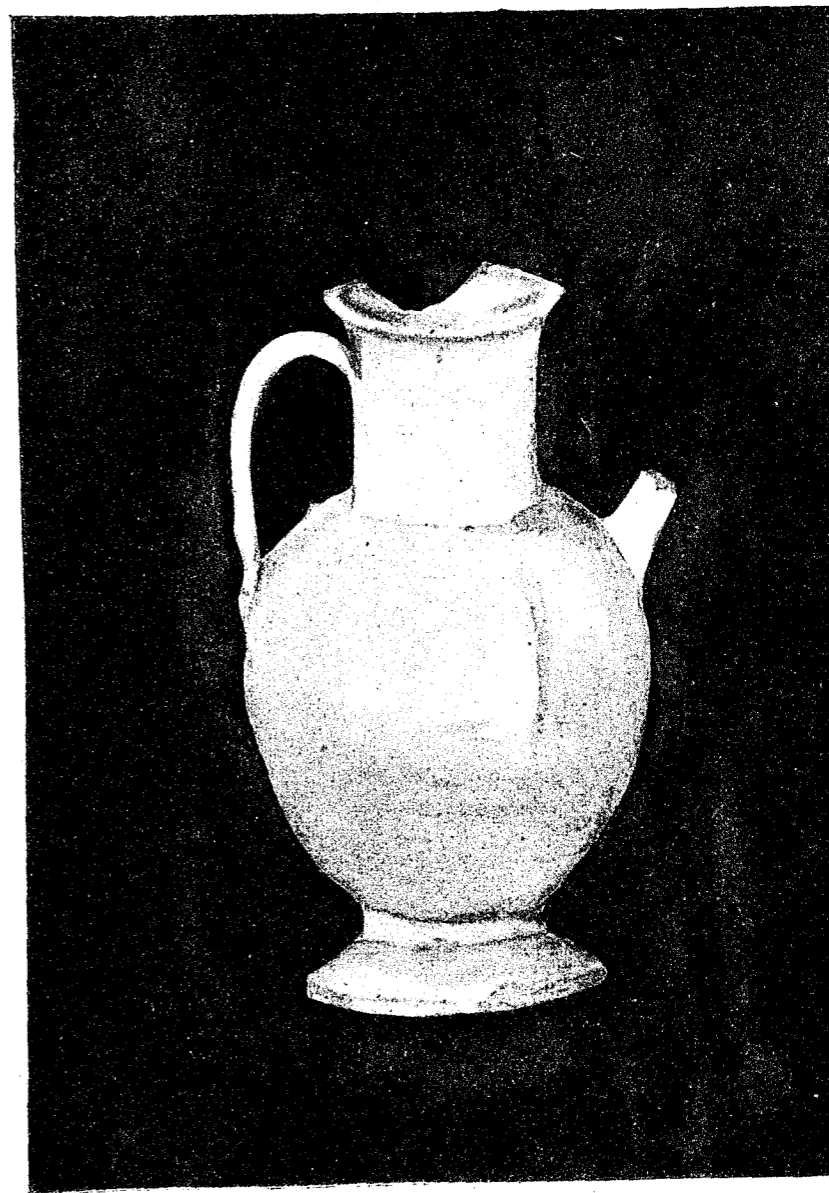
57

57. A one-handed glazed jug from the Ch'ung Lai kilnsite. The glaze, which is slightly crazed, varies from a very light to a dark blue-gray. No. C/7698, height 132 mm. Painted by Mr. Lewis C. Walmsley.



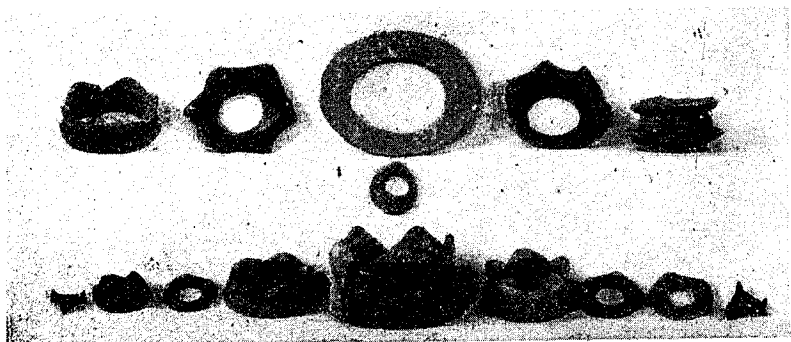
58

58. Sherd of a glazed bowl. The body is yellow-orange. The edge is green, and the bottom red. There is a white slip under the green and yellow glaze, but not under the red portion at the base, where the glaze covers the yellow-orange body. There is a wide, shallow base rim. No. C/16649. Length 95 mm. Painted by Mr. Lewis C. Walmsley.



59

59. A small quatrefoil pitcher with an orange-yellow body covered with a white slip. Painted by Mr. Lewis C. Walmsley. No. C/12658. Height 105 mm.



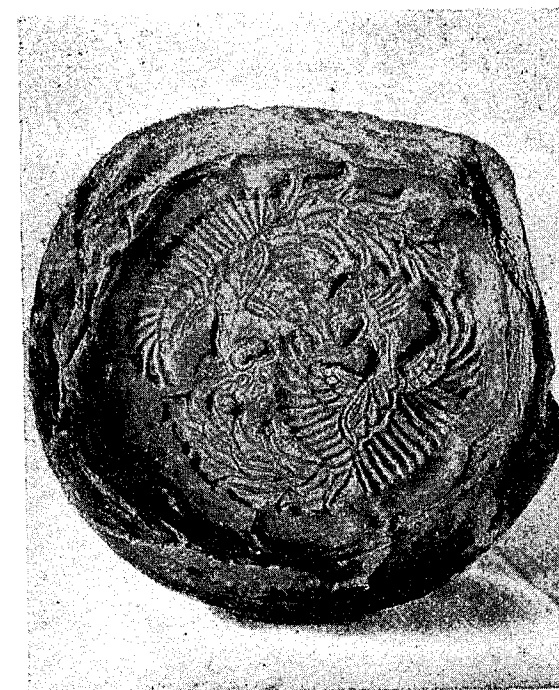
1. Clay circles and triangles used to separate the dishes while they were baking in the kiln. They have points or teeth the marks of which can be seen on the bottoms of many dishes. Some of the circles are roughly glazed on their points. In the center is a crude circle. Note the two dishes stuck to a circle that is between them.



2. Two flat and one pointed circle of unusual types, and five very crude vessels the use of which is not known.



3. Small moulds used to make dishes. Two are bird-moulds, four are for ornamented bowls, four are moulds for round lids, two are moulds for legs of vessels, one is a peach mould, one an animal's head, and one a tiger-like animal.



4. Mould showing phoenixes. The fine ornamental work is evident.



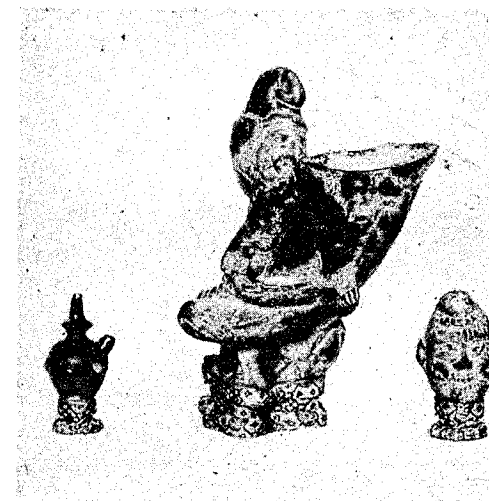
5. Mould with a double phoenix design.



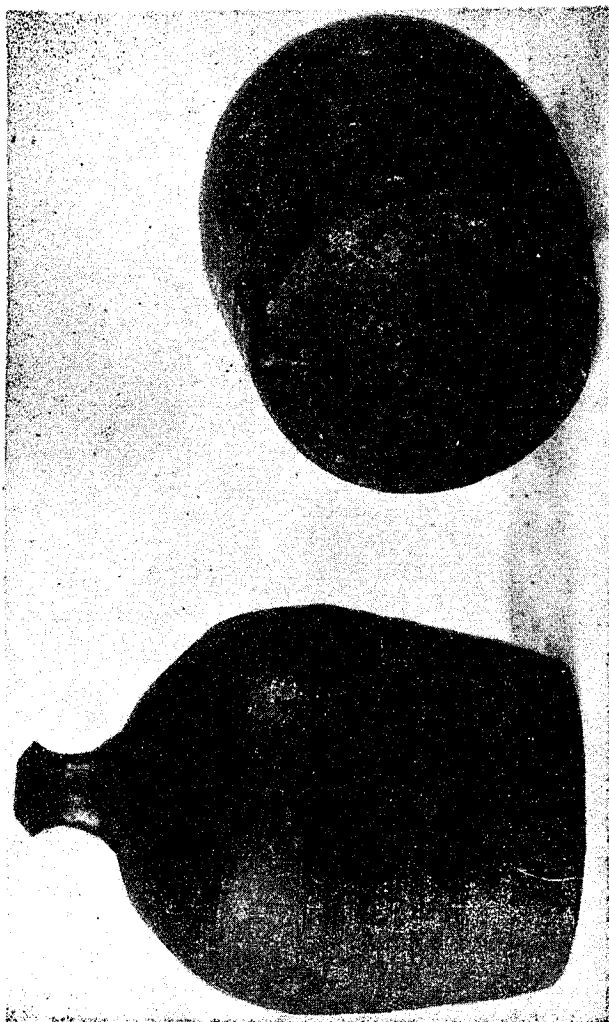
6. Mould of a large deity and several small deities.



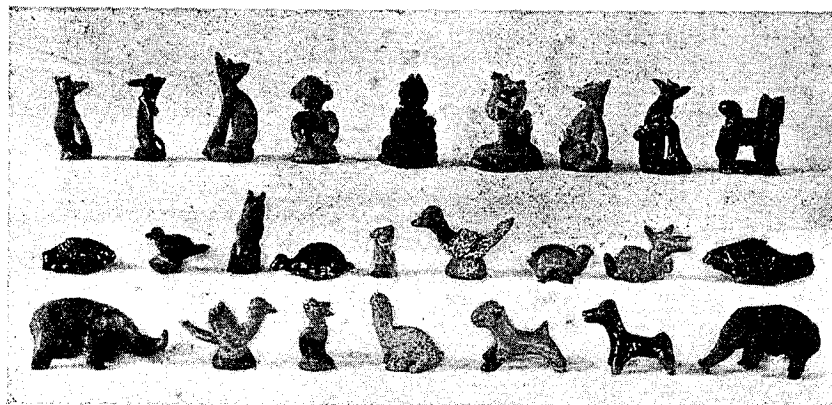
7. Three deities, one headless, from the Ch'ung Lai kilnsite.



8. A strange-looking person holding a horn of plenty. On the left is a small green pitcher, and on the right a head that is hollow and can be used as a whistle. All three are on stands.



9. Two handleless jugs used as strainers. The one on its side has a coat of light yellow-green glaze. The other has been painted dark brown.



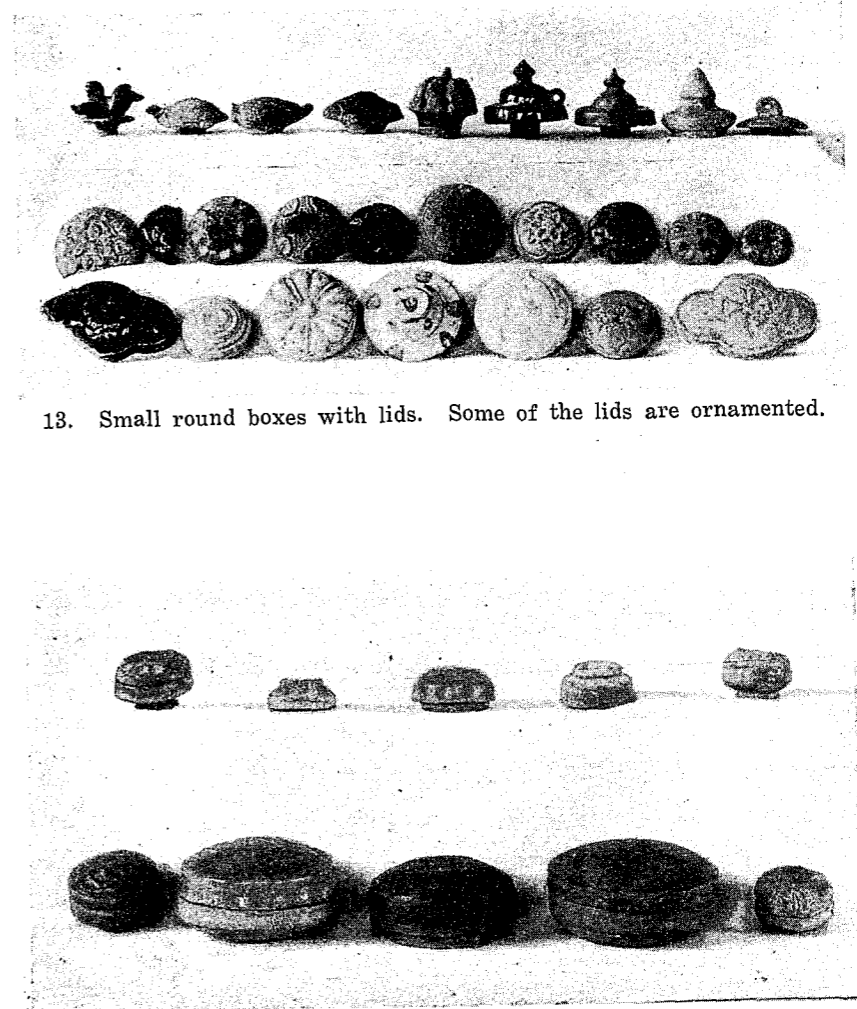
10. Lions, elephants, fish, dogs, turtles, birds, a monkey, and other creatures.



11. Glazed images of people riding horses, dogs, two people praying, a man with his feet in the air, a woman with a baby on her back, a lion, a cow, a turtle, and three human heads hollow inside and usable as whistles.



12. Image of a standing person or deity, with belt, gown, and long sleeves. Note the artificial creases in the garments.

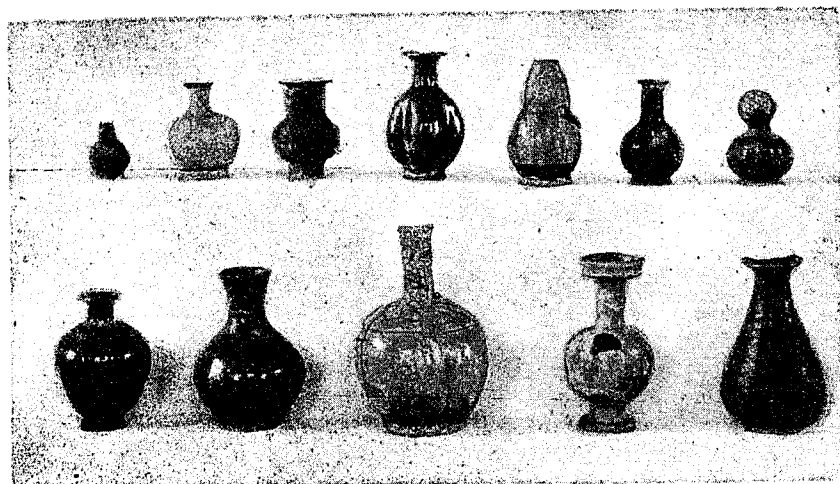


13. Small round boxes with lids. Some of the lids are ornamented.

14. Lids of small round boxes. All the lids are ornamented and either covered with white slip or glazed.



15. Pitchers from the Ch'iung Lai kilnsite, showing the various sizes and shapes. Note the double spout on the dark green pitcher, broken off near the vessel.



16. Small vases from the Ch'iun Lai kilnsite.



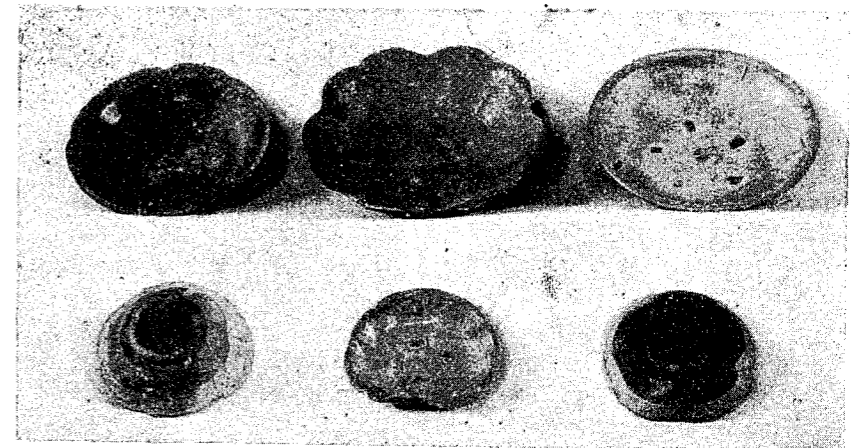
17. Three vessels stuck together, a vase, a blue-green jug, and a handleless jug glazed only inside.



18. Bottom, left, handleless jug glazed only inside; center, cinquefoil bowl; bottom right, spittoonshaped vessel; top, bowls with foil decorations. The bowl in the center got warped while in the kiln.



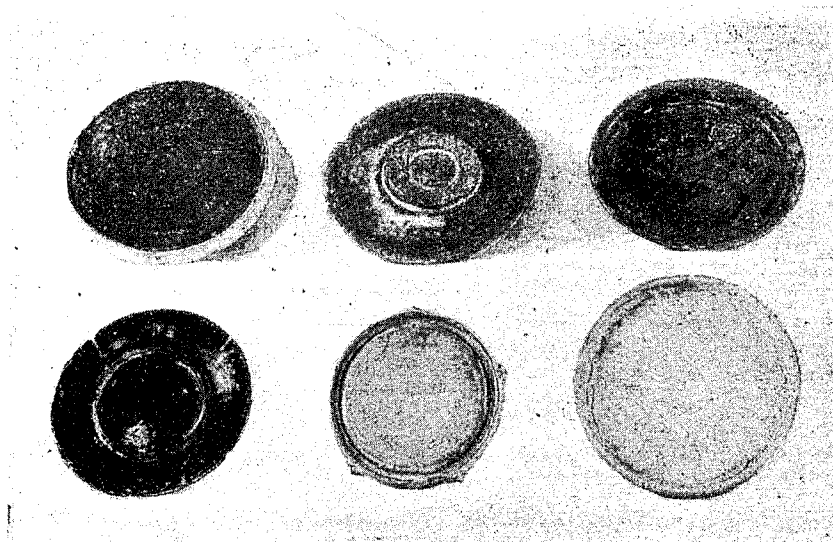
19. Typical food bowls. Notice the wide flat bottoms and the thickness of the sides. The bowl on the right has a circular depression near the center.



20. Plates of flat saucers. All have rim indentations or "foil" decorations.



21. Cups and bowls. Top, left, two bowls with handles; top center, cups with or without handles; top right, bowl with basket-like decoration. Bottom, left, a cup or bowl stuck to a clay circle; bottom, center, three stem bowls; bottom, right, a small cup or handleless bowl.



22. Flat dishes. Top, center, a flat dish turned upside down.



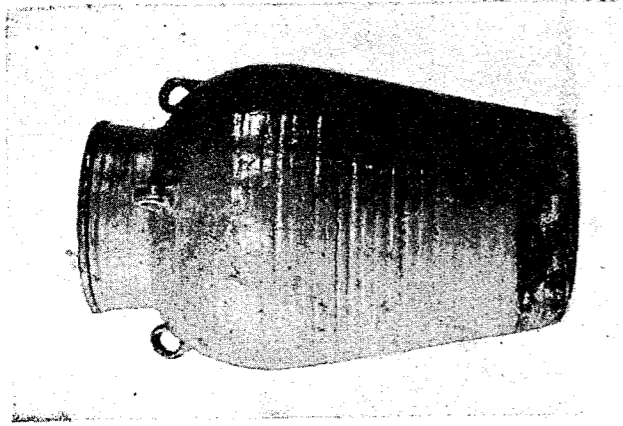
23. Plate, bowls, pitcher, and sherds with mani-colored ornamentation. The ornaments were apparently painted on in green and brown after the vessels had been glazed and fired, and possibly without refiring. The ornaments have been painted over the glaze.



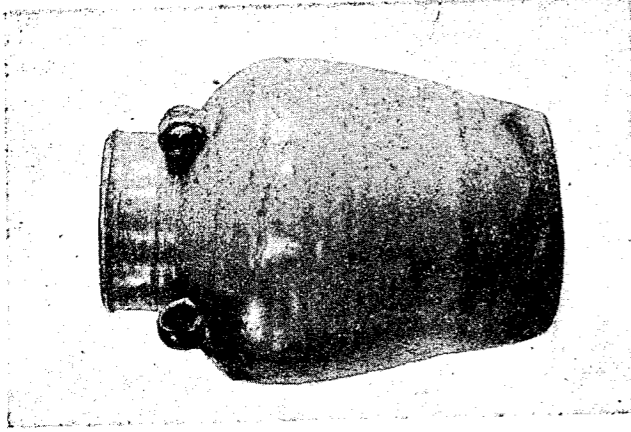
24. Vessels with floral ornaments painted over the glaze with or without refiring.



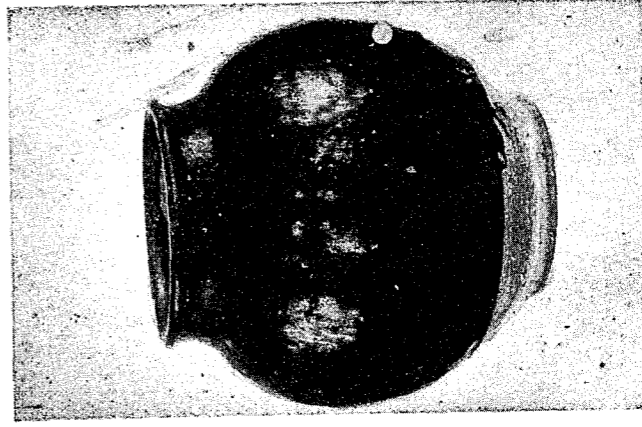
25. Four handled jug with brown floral decoration under the glaze, the whole process of manufacture probably completed at one firing.



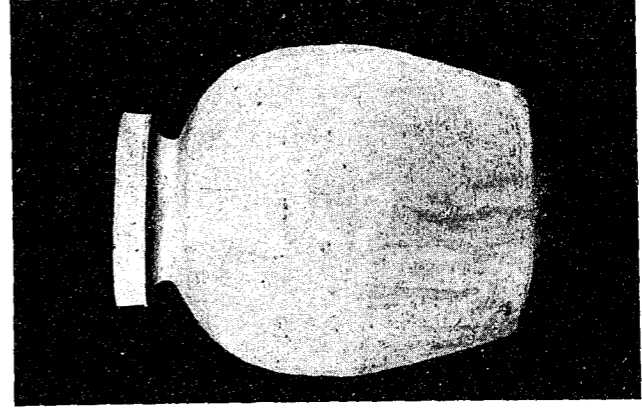
26. A large light greenish-yellow jug, the largest in our collection. It has four handles.



27. Large jug showing crazing or cracking which was probably unintentional.



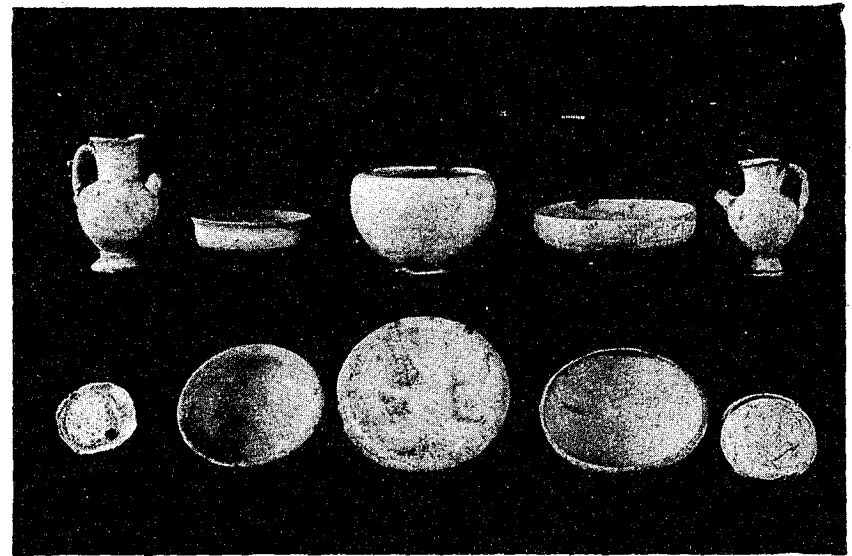
28. A dark brown, nearly black jug with "oil spots," thought to have come from the kilnsite (but this is not certain).



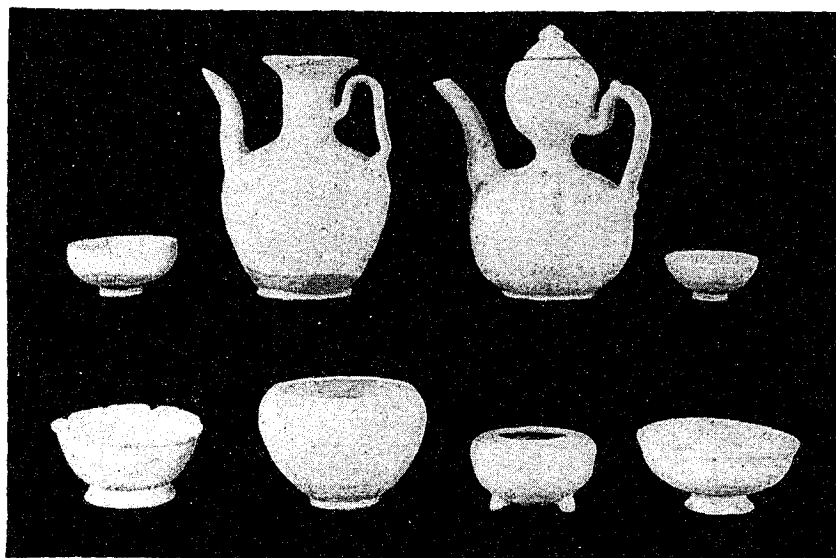
29. Large handleless jug covered with light yellow slip.



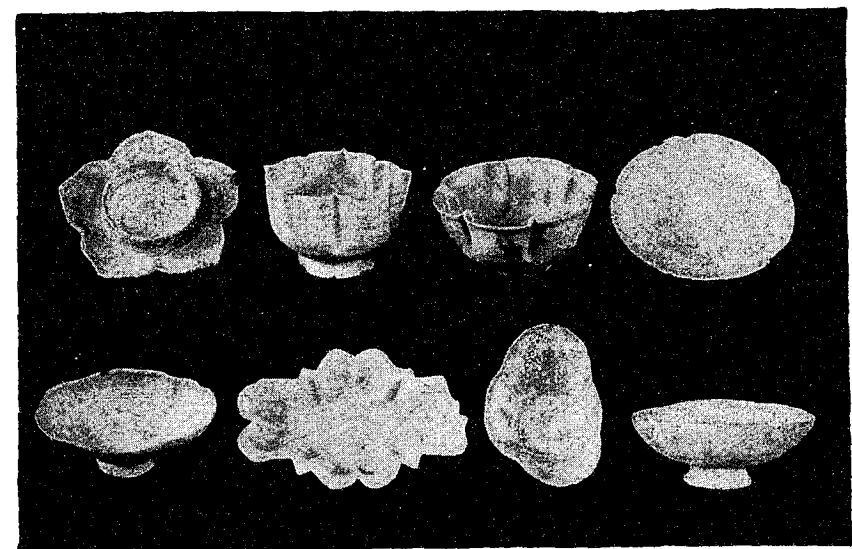
30. Unglazed white bowls covered with a light yellow slip.



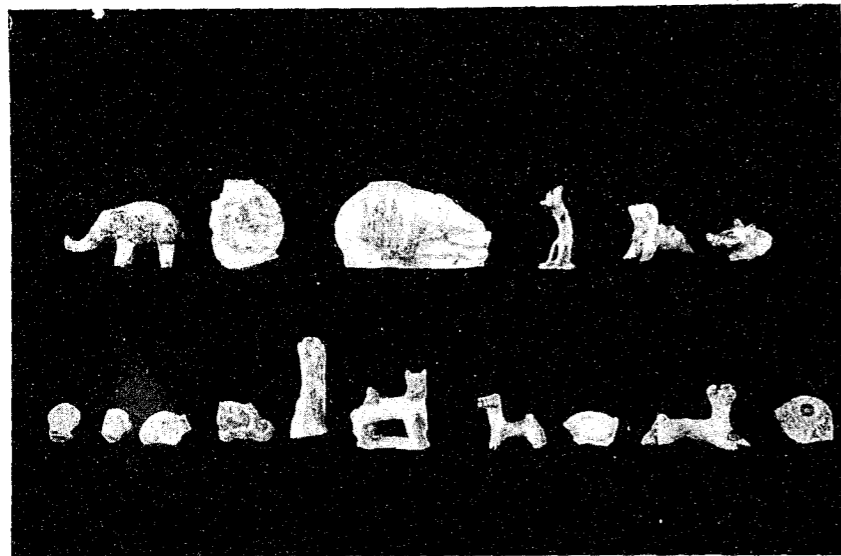
32. Tiny pitchers, bowls, saucers etc. covered with light yellow slip.



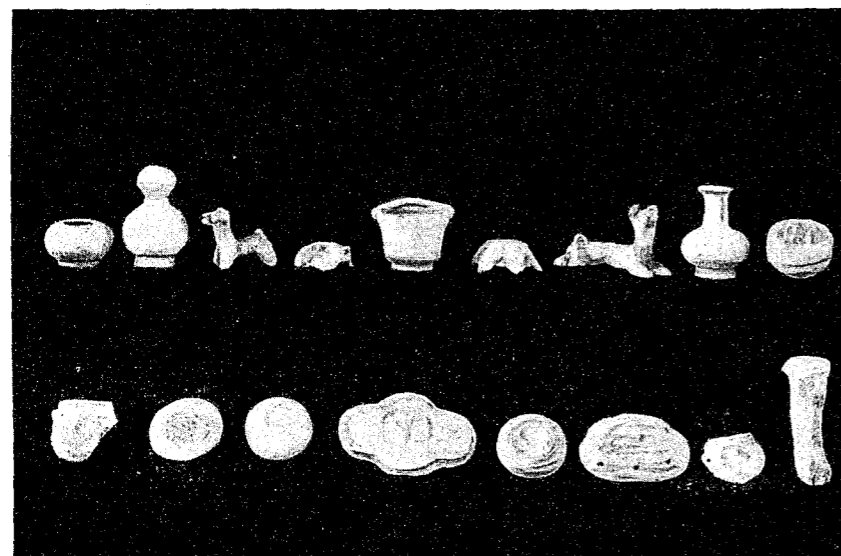
31. Pitchers and bowls covered with a light yellow slip.



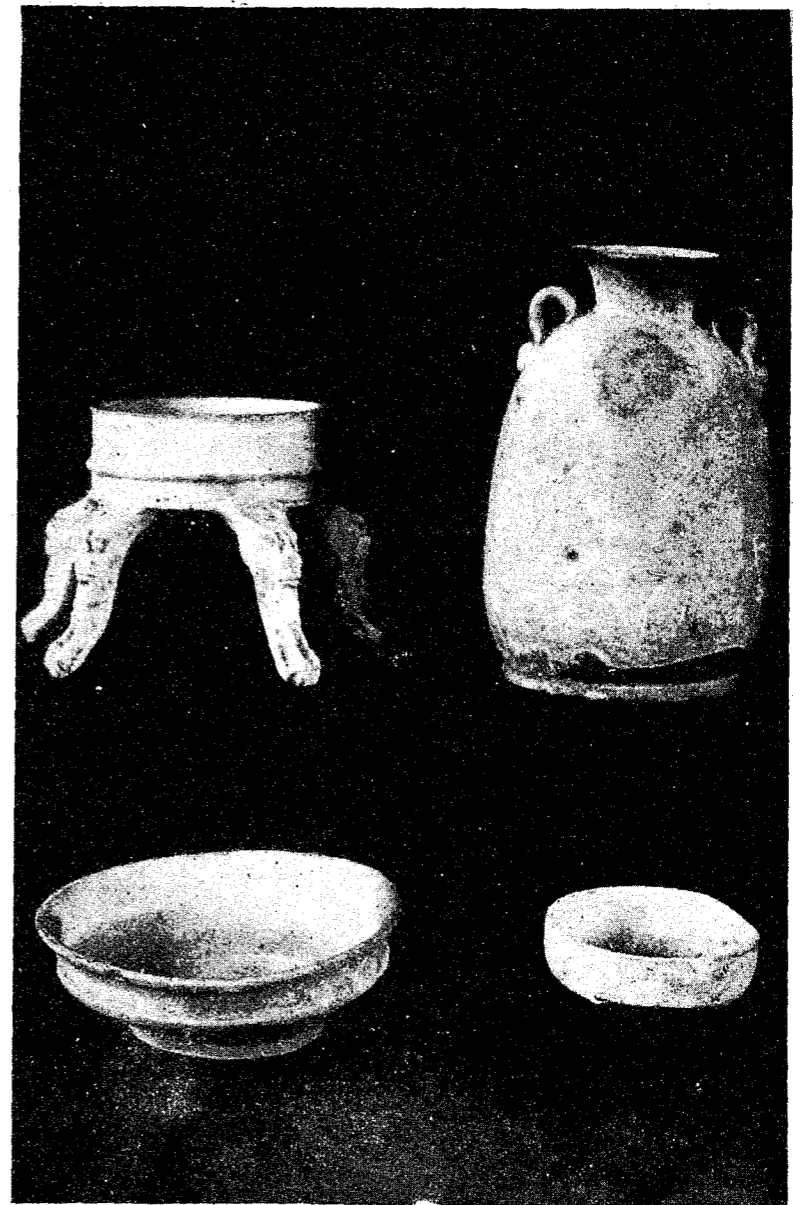
33. Cinquefoil bowls, saucer, and other dishes covered with yellow slip.



34. A human head, dogs, lion, cat, turtle, etc. covered with a light yellow slip.



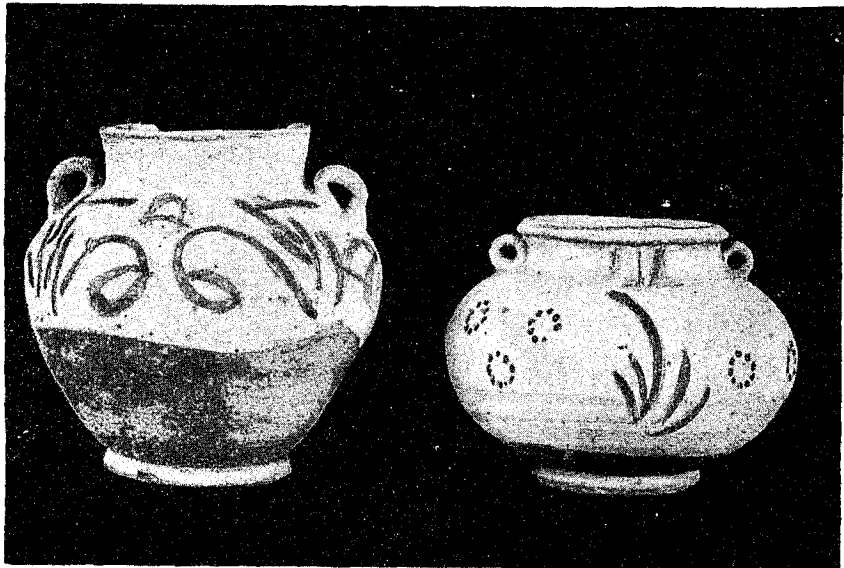
35. Small vases, cat, dogs, leg of vessel, and bowl with handle, all covered with light yellow slip.



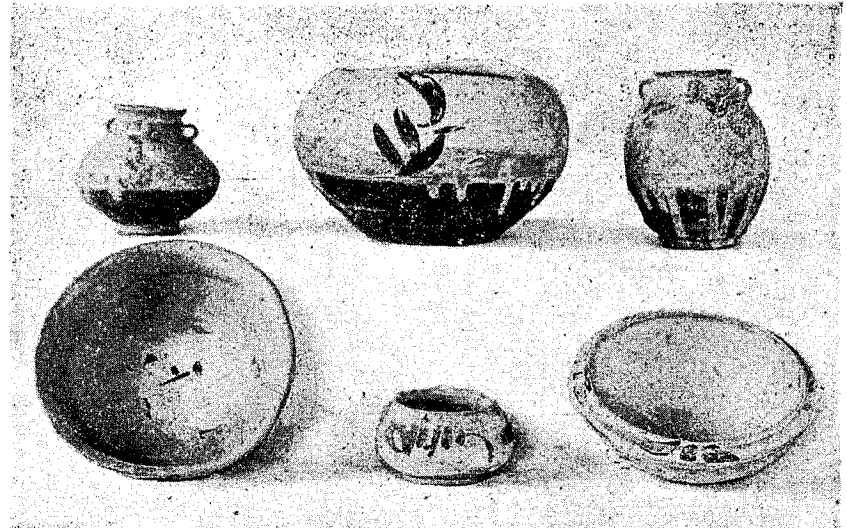
36. Jug, five legged bowl and two small bowls covered with light yellow slip.



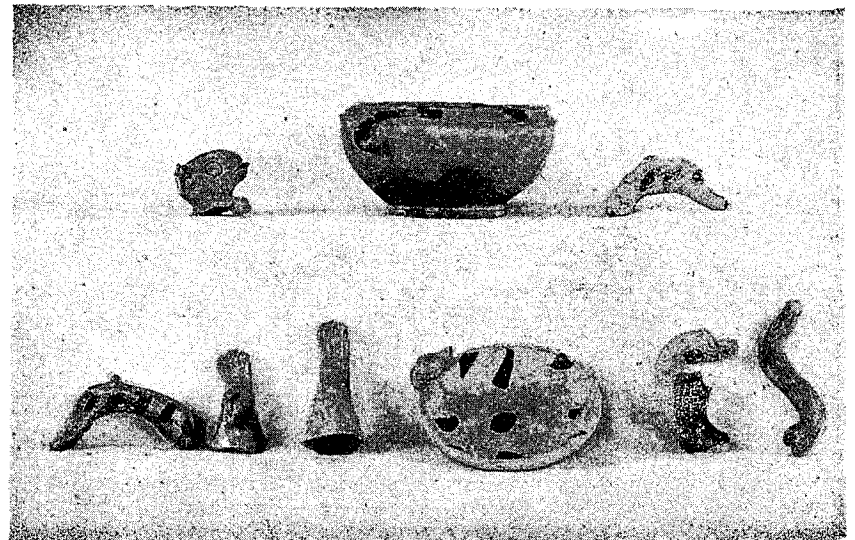
37. Cup, saucers, bowls and jugs covered with yellow slip over which designs have been painted.



38. Jugs covered with yellow slip over which floral designs have been painted in brown.



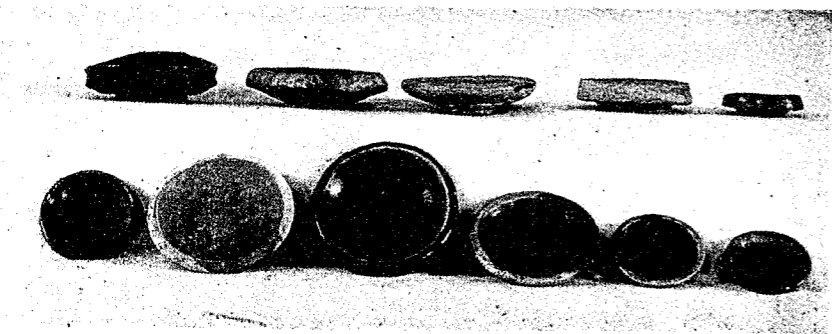
39. Bowls and jugs covered with yellow slip on which floral designs have been painted.



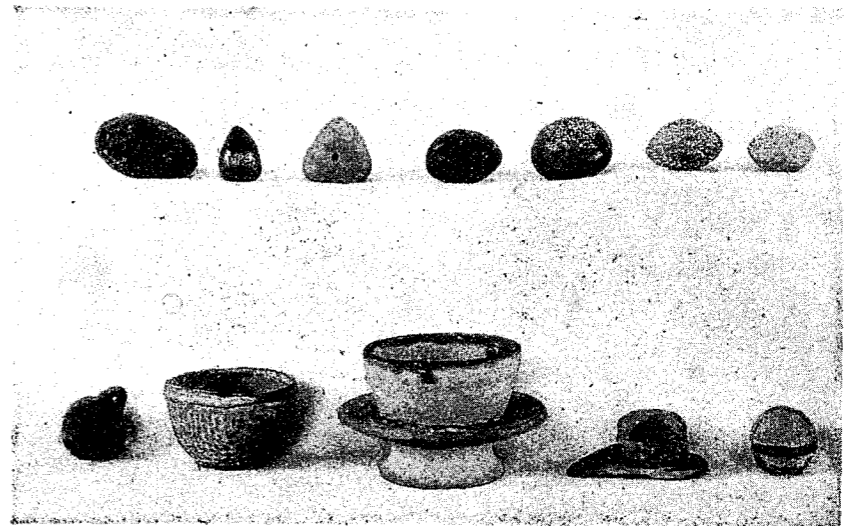
40. Top, left, head of a squirrel (?) with a bell hanging from the collar; two yellow glazed heads of geese, tail of a snake, handleless bowl with a snout; dish with a goose's head for a handle, etc.



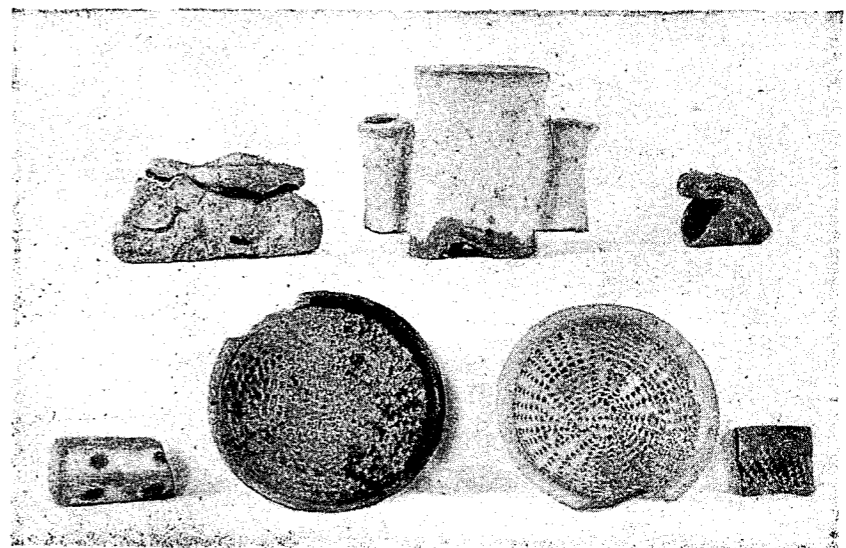
41. Greenish-gray pitcher ornamented with dark brown spots.



42. Thick dishes or saucers.



43. Top, spindle whorls, Bottom, left and right, horse bells, three bowls in the center.



44. Top, water buffalo (?), neck of a large bottle, and fish's head. Bottom, porcelain pestel, and grater dishes



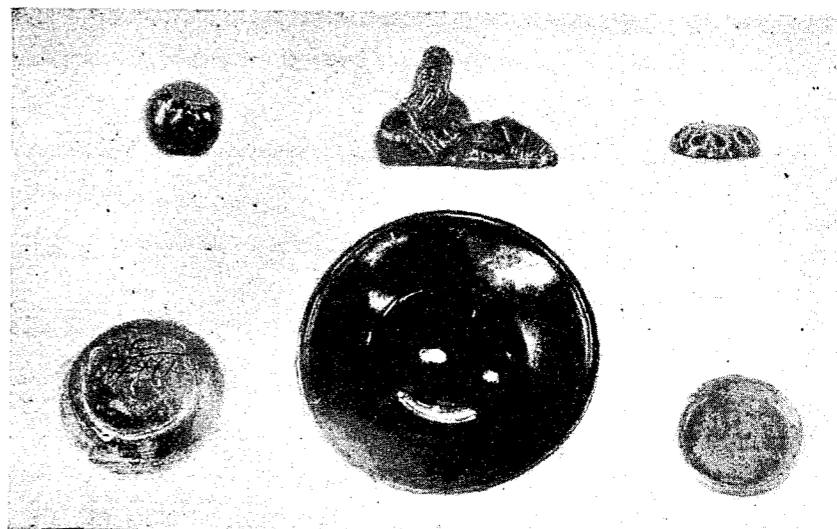
45. Small jugs of various shapes.



46. Odd shaped bowls.



47. Porcelain lamps with spouts (some broken off) and hollow inside.



48. To, left, round object with a lustrous dark brown glaze; center, image of Li T'ai Pai 李太白 with his wine bowl. Mr. Jeffery saw this taken from the debris with dirt. It may be genuine, but it is in such excellent condition that some are inclined to believe that the person who dug it out first buried it, then brought it forth in the presence of Mr. Jeffery. Top, right, lid for procelain box. Bottom, left, reddish base of a bowl; center, a saucer covered with a bright, dark glaze; right, bottom of a bowl.

belonging to Mr. Menzies can be described as "white as snow and frost."

In view of these facts and those which have been presented elsewhere, it seems very likely that porcelains were being manufactured in the Ch'iung Chou kilnsite between 800 and 900 A. D., if not earlier, and that the poem of Tu Fu describes porcelain actually being made in this region at that time. Was Tu Fu's white porcelain made at Ch'iung Chou, or at some other spot near Ta I Hsien yet to be discovered.

IDENTIFICATION OF SZECHWAN PORCELAINS BY CHEMICAL ANALYSIS*

YU-LIN KAO

From the Department of Chemistry, West China Union University.

INTRODUCTION

Chinese Porcelain has a very long and notable history. According to reliable sources we can trace it back to the Chou Dynasty (255 B.C.). At that time although bronze was widely used, porcelain was also found in the form of crude earthenware which might be recognized perhaps as the beginning of Chinese porcelain work. When we come to the Han Dynasty considerable improvement was evidenced and it is believed that the application of glaze was first adopted from abroad during this period. As is well known during the Han Dynasty a certain Chang Ch'ien 張騫 visited western countries. It might have been through him that the technique of applying glaze was introduced to China. In the T'ang and Sung Dynasties porcelain rapidly developed, and was improved and beautified, Different varieties with beautiful designs and decorations, and with very attractive colors were produced. During the Yuan and Ming Dynasties trade with European nations started and porcelain became an important export from China, and a steady demand for Chinese porcelain developed in Europe. The Europeans also began imitating it.

Porcelain, like other branches of art, plays an important rôle in Chinese culture and is definitely related to politics, literature, customs, civilization, religion and foreign influence. It is a fact that the development of porcelain to the extent mentioned above depended to a great extent upon the proper management of politics and finances that made those dynasties prosperous, rich and peaceful, as well as upon imperial interest and encouragement. The influence of literature is seen in the frequent use by the decorator of ideas taken from famous poems that the educated people appreciated and enjoyed. On the other hand some poems and prose were written in appreciation of porcelain. The effects of customs are seen in the changes that took place from very early times when living human beings were buried with their masters, and were later replaced by porcelain figures. Thanks to this custom we are able to obtain by excavation much of the porcelain used for study. The decorations on the porcelain of the Han Dynasty showing men on horseback with dogs following behind sug-

*A lecture delivered before the West China Boarder Research Society, May 20, 1939. This research was aided by a grant from the Society.

gests that hunting must have been very popular at that time. It is obvious that the improvement of porcelain from the early crude types into the fine and beautiful products of later days gives us some idea of the development of civilization in China. In the later T'ang, after Buddhism had been introduced into China, human figures appearing in the designs on porcelain show enlarged ear-lobes such as would be produced by the wearing of heavy ear-rings. The making of porcelain Buddhas was also very common. These indicate the widespread dissemination of Buddhism at that time. As mentioned above the art of applying glaze to porcelain probably was introduced from western countries. In support of this idea there is also other evidence from Greece and other nations. For all these reasons the study of Chinese porcelain gives us a fuller understanding of China's history and cultural development.

PORCELAIN KILNS IN CHINA

Porcelain making in China in past centuries, as also many other kinds of work, largely consisted of family secrets. Although our ancestors developed very fine porcelains through the difficult process of trial and error their experience and knowledge were confined to their immediate families and were applicable to certain limited localities only. The great disadvantage in this system was that when the raw materials for the making of porcelain in a particular place were exhausted local experience was unable to contribute further to the work. Furthermore, if the family was able to guard its secret closely without having it leak to its apprentices and students the secret died when the family members were all dead, even if plenty of raw material remained untouched.

Because of variations in technique between families and localities, and because of differences in quality due to local physical and chemical properties of the raw materials used and also because characteristic styles, designs, etc., were evolved, various kilns became differentiated. The best known are as follows: Ju Yao 汝窑 in Honan; Kuan 官, or Imperial Yao, two in Hangchow and one in Kaifeng; Ting Yao 定窑 in Chili; Lung Chuan Yao 龍泉窑 in Chekiang; Chien Yao 建窑 in Fukien; and Ta I Yao 大夷窑 in Szechwan. The Chili, Honan and Chekiang kilns seemed to have plenty of raw material for porcelain, such as clay. The products of the Ting Yao are reputed to be the best. It is said that the Ting porcelain had such a fine body that it transmitted light and the glaze had lusters and colors resembling ivory.

METHODS FOR IDENTIFICATION OF PORCELAIN

From the above statements it is clear that the study of Chinese porcelain is not a simple task. Many a person has spent a lifetime in collecting information from the historical and religious literature and from miscellaneous books and

other sources in order to obtain a correct system for the classification of Chinese porcelain, differentiating the date of manufacture and the name of the kiln in which it was made.

There are many methods for such identification but most of them are archeological, so I shall mention only a few as illustrations.

1. Shape.

It is believed that Greek and Persian influences affected the shapes of porcelain in the T'ang Dynasty.

2. Ornamentation.

Porcelain made in the Chou Dynasty followed the shapes of earlier bronze vessels. It was decorated with animals and men in primitive fashion. Han Dynasty porcelain was decorated with tigers or men on horseback with dogs following.

3. Color of the Glaze.

Porcelain made in late Han was generally glazed with green but that made in the T'ang was always glazed with yellow or greenish yellow.

4. Design.

After Buddhism had been introduced into China in the T'ang period lotus, dancing girls and representations of Buddha were used as designs.

5. Marks and Inscriptions.

Generally on the bottom of the porcelain are marks or inscriptions which furnish the name of the maker or of the kiln and frequently also the date.

6. Special characteristics.

The products from Chien Yao have spots. Other kilns have the inner surface of bowls fully glazed while still others have the outer surfaces fully glazed.

7. Chemical Composition.

Since glaze is a silicate of complicated nature it can be subjected to chemical analysis. If genuine samples of different dynasties are secured for analysis of the glaze trustworthy and reliable data regarding their chemical compositions can be obtained, and the outstanding constituents, if there are any such, of each dynasty be determined.

For unidentified specimens of porcelain museum curators usually apply the first six methods mentioned above but very seldom study the chemical composition. However, complete scientific investigation requires chemical analysis in order to confirm the identification resulting from the other methods.

In the history of Szechwan archeology an important discovery was made in 1936 when two large ancient kilnsites, were found, one about two hundred *li* south-west of Chengtu

at Chiung Chou and the other only twenty *li* away, at Liu Li Ch'ang.

Many samples of porcelain from these two sites were collected by the West China Union University Museum. Dr. David C. Graham immediately began the study of these porcelains from the archeological side* and asked me to be responsible for the chemical analysis of glazes, hoping that this work might throw additional light on the age of these kilns. The problem was comparatively simple since the kilnsites were known. The main problem was the determination of the dynasties during which these two kilns were working.

EXPERIMENTAL

The results of the chemical analysis are shown, in the following tables.

Table I

From the Liu Li Ch'ang 琉璃廠 Kilnsite

No. 101. C/5515. Ting Yao white porcelain found *in situ*.

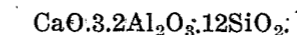
1. Physical Examination.

The white glaze is very hard. The outside appearance resembles the surface of marble.

2. Chemical Analysis.

	percentage
SiO ₂	64.90
Al ₂ O ₃	30.00
CaO	5.01
Total	99.91

3. Molecular Formula.



4. Alumina/Silica

0.30

No. 102. C/5712. White porcelain found *in situ*.

1. Physical Examination.

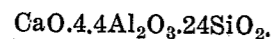
The white glaze is very soft.

2. Chemical Analysis.

	percentage
SiO ₂	67.60
Al ₂ O ₃	30.76
CaO	2.52
MgO	trace
Total	100.86

*See the two papers by D.C. Graham elsewhere in this number of the Journal.

5. Molecular Formula.



4. Alumina/Silica 0.18

No. 103. C/16391. Brown or buff color.

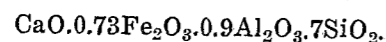
1. Physical Examination.

The pottery is reddish brown in color and covered with a thin layer of glaze.

2. Chemical Analysis.

	percentage
SiO ₂	64.65
Fe ₂ O ₃	12.28
Al ₂ O ₃	14.28
CaO	8.78
Total	99.97

3. Molecular Formula.



4. Alumina/Silica 0.13

No. 104. C/5260. Black or red Chien Yao, found *in situ*.

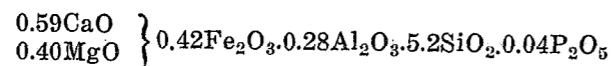
1. Physical Examination.

The very hard, dark, black glaze has a fine shiny luster.

2. Chemical Analysis.

	percentage
SiO ₂	70.10
Fe ₂ O ₃	10.40
Al ₂ O ₃	6.33
P ₂ O ₅	1.38
CaO	7.78
MgO	3.61
Total	99.60

3. Molecular Formula.



4. Alumina/Silica 0.05

No. 105. Cruder local make of Chien Yao, found *in situ*.

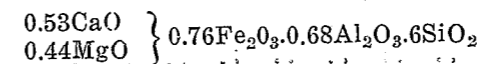
1. Physical Examination.

The glaze is dark reddish brown in color.

2. Chemical Analysis.

	percentage
SiO ₂	65.30
Fe ₂ O ₃	14.20
Al ₂ O ₃	12.00
CaO	5.39
MgO	3.00
Total	99.89

3. Molecular Formula.



4. Alumina/Silica 0.12

No. 106. Yellowish green in color.

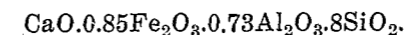
1. Physical Examination.

Between the yellowish green glaze and reddish pottery there is a very thin layer of white slip.

2. Chemical Analysis.

	percentage
SiO ₂	62.50
Fe ₂ O ₃	15.96
Al ₂ O ₃	12.97
CaO	9.50
Total	100.93

3. Molecular Formula.



4. Alumina/Silica 0.09

No. 107. C/13905. Dark Brown.

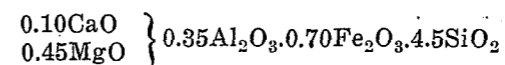
1. Physical Examination.

This glaze has a bright shining surface and there is a layer of slip between the glaze and the dark brown pottery.

2. Chemical Analysis.

	percentage
SiO ₂	66.10
Fe ₂ O ₃	18.90
Al ₂ O ₃	8.80
CaO	1.47
MgO	4.40
Total	99.67

3. Molecular Formula.



4. Alumina/Silica 0.09

Table II
From the Ch'iung Chou Kiln

No. 108. C/13530. The type specimen in the museum.

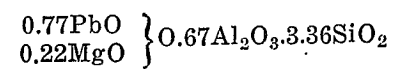
1. Physical Examination.

The glaze is mustard yellow in color. Between the glaze and the body there is a layer of slip.

2. Chemical Analysis.

	percentage
SiO ₂	44.51
Al ₂ O ₃	15.22
PbO	37.68
MgO	2.01
Total	99.42

3. Molecular Formula.



4. Alumina/Silica 0.20

No. 109. Chun Yao Type, Specimen in the museum.

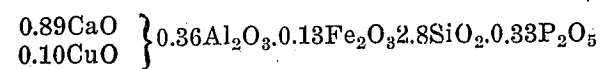
1. Physical Examination.

The glaze is blue or purple in color.

2. Chemical Analysis.

	percentage
SiO ₂	60.87
Fe ₂ O ₃	5.15
Al ₂ O ₃	10.52
CaO	18.35
CuO	3.11
P ₂ O ₅	1.80
Total	99.80

3. Molecular Formula.



4. Alumina/Silica 0.13

No. 110. C/13079.

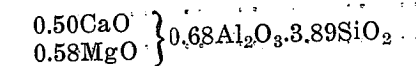
1. Physical Examination.

The glaze is gray in color.

2. Chemical Analysis.

	percentage
SiO ₂	65.40
Al ₂ O ₃	20.10
CaO	7.84
MgO	5.46
Total	98.80

3. Molecular Formula.



4. Alumina/Silica 0.17

No. 111. C/13081 and C/13013.

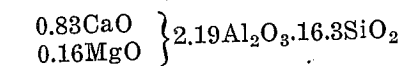
1. Physical Examination.

The glaze is very soft and is a very pale yellow color. Its outer appearance resembles a layer of clay.

2. Chemical Analysis.

	percentage
SiO ₂	75.92
Al ₂ O ₃	19.25
CaO	3.90
MgO	0.59
Total	99.67

3. Molecular Formula.



4. Alumina/Silica 0.13

No. 112. C/13489.

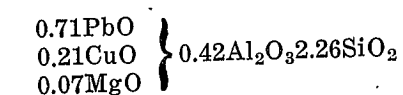
1. Physical Examination.

The glaze is deep green in color. Between the glaze and the pottery there is a layer of slip.

2. Chemical Analysis.

	percentage
SiO ₂	37.76
Al ₂ O ₃	12.50
PbO	44.64
CuO	4.45
MgO	0.90
Total	100.25

3. Molecular Formula.



4. Alumina/Silica 0.18
No. 113. C/13489.

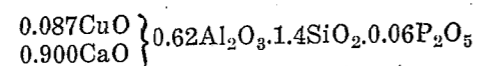
1. Physical Examination.

The glaze is green in color.. . . .

2. Chemical Analysis.

	percentage
SiO ₂	38.70
Al ₂ O ₃	29.78
Fe ₂ O ₃	trace
CuO	3.13
P ₂ O ₅	3.80
CaO	23.10
Total	98.51

3. Molecular Formula.



4. Alumina/Silica 0.44
No. 114. C/14175.

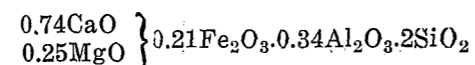
1. Physical Examination.

The glaze is brown in color.

2. Chemical Analysis.

	percentage
SiO ₂	53.05
Fe ₂ O ₃	10.35
Al ₂ O ₃	15.55
CaO	18.25
MgO	4.55
Total	101.75

3. Molecular Formula.



4. Alumina/Silica 0.17
From Chungking Huang Ko Ya.
No. 115. C/16334. Reddish black temmoku tea bowl.

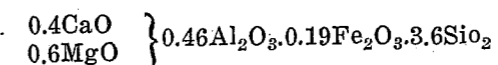
1. Physical Examination.

The glaze is black.

2. Chemical Analysis.

	percentage
SiO ₂	64.90
Fe ₂ O ₃	6.29
Al ₂ O ₃	14.68
CaO	6.72
MgO	7.30
Total	99.89

3. Molecular Formula.



4. Alumina/Silica 0.13
Analysis of Slip.

	percentage
SiO ₂	70.20
Al ₂ O ₃	28.57
CaO	1.20
Total	99.97

Table III

Analysis of the early ceramic wares of China

	Hard Sung Glaze percentage	Soft Sung Glaze percentage
SiO ₂	70.3	68.2
Al ₂ O ₃	10.6	9.5
CaO	5.9	7.1
(K ₂) Na ₂ O	5.0	5.9
Fe ₂ O ₃	2.3	2.5
P ₂ O ₅	7.2	8.0
CuO	trace	trace
Total	101.3	101.2

The above data are taken from Hetherington's "The Early Ceramic Wares of China" and are reproduced here for comparison.

DISCUSSION

From the analytical data we find that two samples of the Ch'ung Chou porcelain contain high percentages of lead oxide and another two contain phosphorus oxide whereas the remainder contain neither. Of those from Liu Li Ch'ang only one contains phosphorus oxide and none contain lead. This is an important fact for when we compare the results of our analyses with those published in England we know at once the periods when these porcelains were made.

From Hetherington's reports lead oxide was found in the glazes from the Han to the T'ang Dynasties, but in the Sung period two entirely new types of glaze were reported to have been used, in neither of which were they able to detect the presence of lead. Of these two one contains phosphorus and the other no phosphorus but belongs to the feldspar type. After the Sung Dynasty lead glaze was again employed.

For the manufacture of the body of the porcelain, clay is used entirely. This is a product of feldspar after long weathering. After it has been made the body is generally porous and absorbs moisture. Since these two defects somewhat limit the uses to which the utensil can be put a remedy was sought and found in the application of glaze to the surface. Glaze not only covers the defects but also provides luster and an opportunity for decoration which in turn beautifies the whole article.

After applying to the surface the glaze paste, which is a mixture of fine ground feldspar, flint, limestone, sand, clay, and metallic or non-metallic oxides it is fired again after drying. It is essential that the firing fuse the glaze into a fluid or semifluid state so that it will fill up the interstices of the body and cover the surface smoothly. Generally the fusing temperature of the glaze should be lower than that of the body in order to prevent deformation.

Lead glaze has two well-known properties: the fusing temperature is low and it is poisonous. The reason that lead glaze was widely used from the Han to the T'ang periods probably was due to the former property, since at that time porcelain work was not far advanced and the soft lead glaze was easily worked. Also our analytical results show no traces of oxides in the glaze, and this, according to present knowledge, is necessary in order to reduce the fusibility as in glass. Possibly the reason Sung porcelain workers had to stop using lead glazes and apply a new type was the poisonous nature of the lead glaze. Since most substances are more or less soluble in water minute amounts of lead would be dissolved out of the glaze into the water contained in porcelain utensils and be quite poisonous; any pealed off pieces of glaze mixed with food might contain sufficient lead to cause fatal results. Hence the porcelain workers were certain to try other raw materials to induce the glaze to fuse easily. Calcium phosphate, which replaced the lead oxide might have possessed a fusibility not far from that of lead glaze, but without any poisonous action. Although I have not been able to confirm this idea from the literature I have reason to believe that phosphorus glaze was used in the early Sung because feldspar glaze generally has a higher fusing temperature, only two or three hundred degrees below that of clay. The men of that time lacked any scientific knowledge of kiln design, gaseous fuels,

heat regeneration, air preheating or induced draft for quick combustion. To reach the very high temperature necessary in using feldspar would be impossible. But since so many improvements occurred in the Sung Dynasty it may be possible that the workers in South Sung succeeded in maintaining such temperatures by using some of the above mentioned principles in a primitive way.

Some of the Ch'ung Chou products have a soft white layer between the body and glaze. In the ceramic industry this is known as slip, and it is used to cover the dark colored body before applying the lighter colored glaze. This was applied to porcelains quite generally in the T'ang and Sung Dynasties. From our chemical analysis it was shown to be pure clay.

CONCLUSIONS

As evident from the above discussion we conclude that the Ch'ung Chou kiln was working for a period from the end of the T'ang Dynasty to the middle Sung period (950-1100 A.D.). This conclusion is based on the fact that some of the glazes contain lead and some phosphorus oxide and the remainder are of feldsparthetic nature. The Liu Li Ch'ang kiln was probably working in the Southern Sung period (1100-1200) as no lead was found and most of the glazes were of the feldsparthetic type. The chemical analysis has led us to the same conclusion regarding the dates at which these two kilns were in operation as reached by Dr. D. C. Graham on other grounds.

A SUNG DYNASTY DOCUMENT OF MOUNT OMEI

DRYDEN LINSLEY PHELPS*

Almost eight centuries ago, seven hundred and sixty-two years to be exact, one of China's poet-statesmen climbed the old sacred mountain of Omei. Already in his day its slopes were dotted with magnificent monasteries; the rocks and streams and peaks had each received the loving tribute of some quaint name born of poetic fantasy or religious experience in toiling up the pilgrim paths.

Fan Ch'eng-ta 范成大 was a native of Wu-hsien 吳縣 (now Soochow 蘇州) in Kiangsu Province. In the twenty-fourth year of the period Shao-hsing 紹興 (A.D. 1154), during the long reign of the Sung Dynasty Emperor Kao Tsung 高宗 he attained the third and highest degree of Chin-shih 進士. Amid lovely scenery to the southwest of Soochow on the shores of Stone Lake he erected his villa. Many years later a succeeding emperor, Hsiao Tsung, heard of the villa sequestered among the hills and wrote the two characters for its name-panel SHIH HU 石湖. So Fan let himself be known as Shih Hu Chü-shih 石湖居士, the recluse of Stone Lake; his poems go by the title of Shih Hu Chi 石湖集, the Stone Lake Collection.

Just twenty years after official recognition, in the year A.D. 1174 during the reign of Hsiao Tsung, Fan Ch'eng-ta became Governor of Szechwan. All was peace and plenty, "and he had nothing to do but happy," quaintly remarks a Chinese historian. So he invited the poet Lu Yu 陸游, a convivial colleague of the muse, whose image even to-day stands beside that of the poet Tu Fu 杜甫 in Chengtu's Ts'ao T'ang Ssü 草堂寺 Monastery of the Thatched Hall, to be his Chancellor. Wine and poetry they mingled with care-free leisure.

Three years passed, and the Emperor called him to be magistrate of Chin-ling 金陵, the present Nanking. But he must not depart from the Land of the Four Rivers without taking with him vivid memories of its vales and streams. So in the summer of A.D. 1177 he journeyed from Chengtu to Kuan-hsien 灌縣 to Ch'ing Chêng Shan 青城山, the Mountain of the Azure City, and thence circled to Kiating 嘉定. There he "rested" some thirty days with his family (the Emperor quite understanding the delay), and included a ramble to Omei's Golden Summit in his itinerary. Along the path like scattered autumn leaves full of colour he dropped his poems, whimsical pictures in rime of the people and the country-side (how little changed with the passing of the centuries), and of his own charming humours.

*West China Union University, Chengtu.



Eight of the sixteen Lo-han (life-size) in the Central Hall of the Pi Lu Tien 毗盧殿. These, and the Lo-han images in the Hua Yen Ting monastery are the most graphically executed on Mount Omei.

From Phelps Collection of Omei Photographs



The finest bronze Ming Dynasty incense urn on Mount Omei, now in the front court of the P'i Lu Tien, 毗盧殿.

From Phelps Collection of Omei Photographs

He adds a descriptive note or two with his poems. In the district of Omeih sien 峨眉縣 he writes, the women work away with linen threads on cloth ornamented with charms: Fu Wên pu 符文布. Perhaps this is because the Fu Wên River runs close by with its rippled surface resembling magic characters. The farmers present burning artemesia, trusting that its fragrance may stifle the stench of the villages and thus give the honourable guest (himself!) a favourable impression. The feathered streamers of the poem's first line are the Governor's insignia.

OMEIHSIEN

In the lonely country districts they have not learned the difference between the official feathered streamers and the yak-tail banners;
Chickens and dogs with welcoming cries enliven the lanes and country roads;
Old village dames gather and stare, busy with threadwork as they come;
Rustic elders, kneeling with clasped hands, welcome me with the incense of burning artemesia.

He makes a crossing of the Ya 雅 River at Yen 燕, outside the West Gate of Lo Shan 樂山, Kiating, and brushes a poem about the clouds called "Tou Lo" 兜羅 and their silver world.

Crossing the River at the Yen Ford, Looking up toward Great Omei with her White Mists like Storied Bastions Standing up amid the Cloud Masses.

Encircling the level wastes, a thousand mountains are dimmed by the mists of summer
Great Omei in her misty vapours and coloured cloud-banners.

Suddenly rises, a peak of white jade, to the height of three thousand *chang*;

This is surely the *Tou Lo* world of silver cloud-lace.

But here! This Pied Piper of old Cathay has led me off by his rimes, and I have forgotten about his gay account in prose of his journey to the peak. How it reflects the glory of the Sung! One can see his lacquered official palanquin, pulled and carried along by some sixty mountain men, and the treasures bestowed on the monasteries by benevolent sovereigns. One pardons his exultant turning of the Dragon Gate Gorge's forty feet height into "thousands of feet of polished jade." One shares his exasperation at water that refused to boil on the summit, and delights in his explanation and remedy. He seems to be more interested in the little and the vast things of nature than in works of man: he passes over the mammoth brass elephant of the Wan Nien Ssü 萬年寺 Monastery of Myriad Ages. Was it cast in the Sung Dynasty after his day? But let him tell his own tale.

RECORD OF A JOURNEY TO MOUNT OMEI

峨眉山行紀

FAN CH'ÊN-TA of the Sung Dynasty
宋范成大

In Omei there are three mountains forming a single line. Their names are Ta O 大峨 Great Omei, Chung O 中峨 Middle Omei, and Hsiao O 小峨 Little Omei. It is said that formerly people used to travel to Chung O and Hsiao O, but now there is no road to them. Among these three mountains Ta O is the highest, veritably touching the heavens. It is the spot where the Great Saint P'u-hsien Ta-shih 普賢大士 made his revelation, as recorded in a Buddhist sutra.

Through the West Gate of the City (Kiating) I crossed by Yen Tu 燕渡 where the rapids are very fierce. It is also called Yachow Chiang 雅州江, having its original source in Suichow, Ch'ung-pu 蘄州, 邱部, meeting the Ta Tu Ho 大渡河 and flowing through the tribes' country and myriads of mountains to Kiating. Ferrying over the river I passed the night at the Su Ch'i 蘇稽 market-town, and thence went to the Fu Wên 符文 market-town. These two towns were full of people. Cloth is the main product of Fu Wên; all the country women came out along the road to see me, each with her hands busily twisting the hempen threads and no hand was idle. On their doors they hung *ai-hao* 艾蒿 *artemesia*. It produces a smudge when burned. I judged they used it to drive away the bad smells in order to make their town more hospitable for the passing official.

The next night I passed at Omeih sien. On the day of *kuei-tzu* 癸巳 I went through the South Gate and then climbed the mountain. Going by the Tz'ü Fu Yüan 慈福院 Hall of Mercy and Happiness¹ and the P'u An Yüan 普安院 Hall of Universal Peace,² we came to the Pai Shui Chuang 白水莊 Village of the Crystal Waters and Su Ts'en Tien 蜀村店 (a hamlet). After walking twelve *li*, we reached Lung Shên T'ang 龍神堂 Shrine of the Dragon God and the Fu Fu Ssü 伏虎寺 Crouching Tiger Monastery. Thence we came to murmuring streams and deep dark woods.

In the Hua Yen Ssü 華嚴寺 Hua Yen Monastery we rested awhile. Passing over the Ch'ing Chu Ch'iao 青竹橋 Emerald Bamboo Bridge, the road-head of Omei Hsin Kuan 峨眉新觀 New Omei Temple, Mei Shu Ya 梅樹埡 Plum Tree Gap, Liang Lung T'ang 兩龍堂 Two Dragons' Shrine,

1. This is the present Shên Chieh Ssü 聖積寺.
2. Now disappeared.

then we came to the Chung Fêng Yüan 中峯院 Middle Peak Hall. In this hall was P'u-hsien Tower 普賢閣 with tens of peaks encircling it. The rear of the hall lies against the Pai Ai Fêng 白巖峯 White Cliff Peak. The highest precipitous peak to the right was the Fu Ying Fêng 呼應峯 Calling and Answering Peak. Under it was once the Mêng Chêng Tsêng Chê An 茂真尊者庵³ Shrine of the Saint Mêng Chêng. Formerly when Sun Ssü-miao 孫思邈 made his hermitage in Omei, Mêng Chêng and Sun used to call and respond. Going out of the hall, I passed the two peaks, Chang Mu 樟木 Camphor Tree and Niu Hsin 牛心 Ox Heart, reached the road-head of Niu Hsin Yüan 牛心院⁴ Hall of the Ox Heart, and thence arrived at the Shuang Ch'i Ch'iao 雙溪橋 Twin Torrents' Bridges.⁵ There disordered hills stand like screens huddled together. Among them stand two face to face. Under each a torrent gushes forth, then they flow together to the bridges. The stone chasms were hundreds of feet deep, of dim dark-green hue. The flying current turned into foam and gushed out from under the bridges. Then it plunged into the midst of a high chasm some tens of paces away.

Then the two streams joined together and rushed into a deep pool. (At this point some lines are lacking from the original manuscript.)

At the Wan Nien Ssü 萬年寺 Monastery of the Myriad Ages, also known as the Pai Shui Ssü 白水寺 Monastery of the Crystal Waters, there were more than one hundred imperially written scrolls given by the Sung Dynasty emperors T'ai Tsu 太祖 (A.D. 960-976), Chêng Tsung 真宗 (A.D. 998-1022) and Jên Tsung 仁宗 (A.D. 1023-1063); also a seven-jewelled head-dress, gold and pearl head ornaments, priests' robes, gold silver urns and begging-bowls, articles for hair-dressing, three-footed urns, spoons, chop-sticks, pottery fruit-dishes, bronze bells, drums, gongs, small bells, wax-tea-pagodas, and such things as felicitous plants.

There were also gifts from the Emperor Jên Tsung of monks' gowns made of vermilion silk and purple embroideries, jewelled bracelets on which were royally penned the wishes: Eternal Prosperity of Buddhism, the Everlasting Turning of the Law of Karma, National Peace and Tranquility of the People, Seasonal Winds and Opportune Rains, Weapons and Spears Forever at Rest, The People in Peace and Happiness, Posterity Flourishing and Manifold,—every living creature together reaching the Further Shore.

3. No remains can be seen.

4. Now called the Niu Hsin Ssu 牛心寺 Ox Heart Monastery.

5. Now called the Shuang Fei Ch'iao 雙飛橋 Twin Flying Bridges.

Also in the reign *Chia-yu* 嘉祐, seventh year (A.D. 1062), of the Emperor Jên Tsung, there was the bestowal by imperial decree of Tsang 藏經 sutras. The paper of the sutras was all *pi-chui* 碧硯 pressed-purple paper, and the characters were penned with liquid silver. The frontispieces of the volumes were all pictures drawn with liquid gold. Every picture represented the contents of its volume. There were silken embroideries, bells and their implements, and characters such as TIEN HSIA T'AI P'ING 天下太平 PEACE WITHIN THE EMPIRE, HUANG TI WAN SUI 皇帝萬歲 LONG LIVE THE EMPEROR, woven among luxuriant flowers and thick leaves, —but this sort of embroidered words can be seen no more today.

Next I went to the San Ch'ien T'ieh Fu Tien 三千鐵佛殿 Hall of the Three Thousand Iron Buddhas. It is said that P'u-hsien, together with his three thousand followers, dwelt on this mountain. For this reason the Buddhas were cast in fashion simple and rude. On that day I besought the Great Saint for three fine cloudless days in order that I might climb the mountain. On the day *i-wei* 乙未 it was indeed beautiful weather, so I ascended the range. Thence I climbed to the Kuang Hsiang Ssü 光相寺 Monastery of the Luminous Manifestation and the Ch'i Pao Ai 七寶崖 Cliff of the Seven Treasurers on the very summit. They are sixty *li* high and probably not less than one hundred *li* from the level of Omei-hsien. No longer were there any stone steps, so we had to cut trees to make long ladders, driving pegs into the cliff-wall so as to ascend. I think that no mountain ascent in the Empire can equal this in peril. By use of strong bearers carrying my mountain chair I forced my way up. Thirty mountain folk with great ropes drew it on ahead. My followers made use of the mountain *t'i-chiao* 梯轎 ladder-chairs (probably the modern *pei-tzu* 背子, frame tied on the back for bearing one person).

Going out from the side entrance of the Pai Shui Ssü, we ascended the Tien Hsin P'o 點心坡 Touching-heart Slope, so-called because the steepness of the slope makes the knees touch the chest. Then we passed over the Mao T'ing Tsui 茅亭嘴 Thatched Pavilion Beak, the Shih Tzū Lei 石子雷 Thundering Stone, deep ravines large and small, the Lo T'o Ling 駱駝嶺 Camel Ridge, and the Tsu Tien 籬店 Bamboo Lodge. This lodge, a wooden apartment facing the road, was so named because if climbers came the monastery monks sent men on ahead to prepare hot water there for meals.

And now we passed on by the Fêng Mên Lo-han Tien 峯門羅漢店 Lo-han Lodge at the Peak Portal, large and small defiles where people must help to carry, the Ts'o Huan Hsi 錯歡喜 Mistaken Joy, the Mu P'i Tien 木皮殿 Wooden Bark Hall, the Fu Sun T'i 胡孫梯 Monkey Ladder, and the Lei Tung P'ing 雷洞坪 Terrace of the Thundering Cavern.

This terrace is so named because one can put his foot down and rest. This Lei Tung is on the left side of the road by a precipice ten thousand fathoms deep. If one stand on the stone-paved road where it is cut out (i.e., by the edge of the precipice), he gazes down into murky blackness like a cavern. Tradition says there was a deep pool, the abode of a holy dragon. There are seventy-two caves. In drought years the people pray at the third cave. At first they throw down incense and paper money but there is no response; then they hurl down a dead pig; then women's clothes and shoes in order to arouse it. Frequently thunder and wind suddenly burst forth. The so-named Revolving Cotton Clouds at the Kuang Ming Ai 光明岩 Luminous Cliff on the ridge summit mostly emerge from this cavern.

Passing by the Hsin Tien 新店 New Lodge and the Pa-shih-Ssü P'an 八十四盤 Eighty-four Switchbacks (or, Plates, because they hold the water after rain), we came to the Sha-lo P'ing 杪楞坪 Terrace of the Horse Chestnut Trees. The leaves of the *sha-lo* tree are like the *hai-tung* 海桐 sea *aleurites cordata* (thorns on bark, large round leaves; at the end of spring the colour is deep red; its seeds like the maple; in the city of Chin Chiang 晉江 in the province of Fukien, in the T'ang Dynasty, the city was surrounded by these trees, so it was called T'ung Ch'êng 桐城 the T'ung City), and also resemble the *yang-mei* 楊梅 arbutus. The blossoms are red and white, flowering between spring and summer. It can be found only on this mountain. When first I reached halfway up the mountain I saw them; but here the mountain is simply full of them. Generally speaking, the plants, trees, herbs and insects of the Great Omei are not such as one finds elsewhere. I came during the last month of summer (i.e., sixth moon of the Chinese calendar). A few days before my arrival a great snow fell. On the leaves here and there were remainders of it. Some extraordinary plants and trees were like the Pa Hsien 八仙, but of a deep purple. Some resembled the Ch'ien Niu 牽牛, *Ipomoea*, but several times larger. Some were like the Liao 藜, *Polygonum* (smartweed) but of a pale green. I heard that in the spring-time there were still more strange flowers, but at that season the mountain is very cold so people seldom (come to) recognize them. Rare herbs and leaves also were countless. Trees cannot grow well because of the mountain altitude and the many winds. All the branches hang downwards. Old lichens like dishevelled hair, cling in a tangle to the trees and hang down tens of feet even to the ground. Again, there are T'a Sung 塔松, Pagoda Pines, in shape like *sha* 杉 fir trees, only the leaves are round and small; also, it cannot attain height. Layer upon layer the branches are compressed together, like the storeys of a pagoda. This variety of tree grows in

abundance on the top of the mountain. There are also few birds on the mountain because they cannot fly over its great height.

From the Sha-lo P'ing we passed over the Ssü Fu T'ing 思佛亭 Thinking-of-the Buddha Pavilion, Juan Ts'ao Ping 輓草坪 Terrace of the Tender Grass, and the Hsi Chio Ch'i 洗脚溪 Foot-washing Brook, and then reached the Kuang Hsiang Ssü on the very summit. This is also a *pam-wu* 板屋 timber structure, unoccupied. In the middle there is only a small Hall of P'u-hsien. At daybreak we had begun to climb and arrived at the top about evening. At first we wore summer garments; gradually, the higher the colder. Once arrived at the Pa-shih-ssü P'an it was bitterly cold. As soon as we reached the top to our double cotton garments we added fur vests and fur robes, emptying all the contents of our clothes' trunks. Wrapped in thick cloth, with fur boots, still we could not bear the chilling cold. So we burned charcoal braziers and stiffly sat down.

On the top is spring water, but we were unable to boil rice with it, for the rice disintegrated like sand or kernels. I always knew that food cannot be cooked by eternal ice and frost, so I brought a jar of water from the bottom of the mountain; thus I got satisfaction.

After a while, in spite of the cold, we ascended to the T'ien Hsien Ch'iao 天仙橋 Heavenly Fairies' Bridge and came to the Kuang Ming Ai. In the small hall which was covered only by wooden bark we offered incense. Once Wang Chan-su 王瞻叔, the Ts'an-chêng 參政 (Sung Dynasty government official), changed it to tiles which were broken within a year by the attacks of snow and frost. Later he again changed it back to wooden bark, which on the contrary can last two or three years.

People said that the Buddha's Glory appeared at noon. Now it was after six in the evening. Hesitatingly the clouds emerged from below the cliff. Beside the chasm was the central Lei Tung Shan 雷洞山 Mountain of the Thundering Cavern. The clouds went along majestically like out-riders. When they reached the cliff they paused a little. In their midst appeared a great sphere of luminosity and concentric coronas of varied colours ranged opposite each other. In the middle was a pale black reflection, like the Great Patron (P'u-hsien) bestriding his elephant. After as much time as it takes to drink a cup of tea the Light disappeared, but beside it again appeared a light like the former one, and after a while it went away. In the clouds again shone forth two paths of golden illumination, shining with level rays upon the central cliff. People call this the Hsiao Hsien 小現 Little Appearance. At twilight, all the clouds and mists scatter;

the mountains on the four sides become tranquil and at night the Lamps come out, filling all the space at the cliff's base, countless multitudes within the glance of an eye. We could not stand long outside because of the night cold. On the day *ping-shên* again we ascended to the precipice for a view. To the rear of the cliff rise the ten thousand ranges of Min Shan 岷山. A little to the north lay Wa Wu Shan 瓦屋山 Tile House Mountain in the Yachow 雅州 district. A little to the south was the Ta Wa Wu 大瓦屋 Great Tile House near Nan Chao 南詔. It vividly resembles a section of a tiled house. At the Hsiao Wa Wu 小瓦屋 Little Tile House there is also a Buddha Glory which people call the *Pi-chih* Fu Hsien 碑支佛現 (a Sanskrit term for Enlightenment achievement by one's own efforts). At the back of these mountains lay the snow mountains of the Hsi Yüeh 西域 Western Regions—high and sharp as if carved and chiselled, some tens and hundreds of peaks. When first the sun illumined them the snow's colour glistened like gleaming silver shining in the rays of dawn. This sun has never melted from ancient times till now. These mountains extend unbroken into the tribes' country of India. From Omei to these snow mountains how many thousands of *li* I do not know, but to glance at them they are as if on stools and tables. So splendidly superb a view crowns my life.

Again we came to the precipice to pay homage. Suddenly mists and fogs arose from the four directions, turning all to white. The monks said it was a silver-coloured world. After a little while came a down-pour of rain. Then suddenly the vapoury mists scattered. The monks called it the Cliff-washing Rain. At once the Buddha's Glory would appear. A revolving net-work of cotton, clouds again spread below the cliff, gradually mounted upwards, and then stopped some tens of feet below the edge. The clouds were as level as a jewelled pavement. Raindrops still remained flying. Lowering our heads we gazed downwards at the central part of the precipice. There reclined on the level floor of clouds a great round sphere of luminosity. The outer corona was in three layers, each layer having white yellow red and purples hues. Exactly in the midst of the Light was a crystal brightness of transparent purity. Every observer beheld his own figure appearing in the transparent spot, not a hair hidden, just as if facing a mirror. If one raised his hand or moved his foot every reflection followed the figure. Yet one could not see persons other than himself. The monks call it the Shê Shên Kuang 攝身光 Body-absorbing Light (equivalent to the expression *shê-yin* 攝影, to take a picture; or, a man's image absorbed in the mirror's reflection). When the Light had departed, wind rose from the hills before us and the clouds scurried away. In the midst of wind and clouds again appeared horizontally over all the mountains the huge round phenomenon of light exhausting every strange

colour gathered into splendour. Peaks, ridges, underbrush, and trees all in fresh and verdant loveliness could not be gazed upon directly. When the clouds and mists had scattered the Light still remained in solitary brilliance. People called it the Ch'ing Hsien 清現 Clear-sky Appearance. Generally speaking, when the Buddha's Glory is about to come out, there must first be clouds spread out, the so-named world of revolving cotton cloud net-work. The phenomenon of the Lights appearance depends on the clouds. But those appearances which do not depend on the clouds are called Ch'ing Hsien, rarely seen. After the time it takes to eat a meal the Light gradually crossed the mountains towards the west. Looking towards the left to the Lei Tung Tz'ü Shan 雷洞祠山 Mountain of the Hall of the Thundering Cavern, we again beheld another light like the former one but somewhat smaller. After a while it also flew away beyond the mountains to the level plain. Circling along, it came directly face to face with the precipice. Hues and forms were all transformed into a golden bridge, somewhat similar to the suspended rainbow of Wu Chiang 吳江. Only the two ends were supported by purple-hued clouds. From noon on, the clouds cleared away; this the people term Shou Ai 收岩 (*i.e.*, the end of the Cliff Show). Only the Golden Bridge lasts on after seven o'clock in the evening, then vanishes.

On the day *ting-yu* 丁酉 we descended the mountain. When first we made the ascent, although clambering and foothold were difficult, we had ropes to pull us on ahead so that although it was steep it was not dangerous. But in going down, although we again tied ropes to the back of the palanquin, the carriers found footing with difficulty. It was both steep and perilous. As we descended we gradually felt the atmosphere of summer. Each time we took off cotton garments. At noon we arrived at the Pai Shui Ssü where we again put on our thinnest clothes. We heard that the night before there had been a tremendous thunderstorm at the monastery, but on the ridge's summit there was sunset and lovely clear sky. We did not know this. After our meal we rambled on to the Hai Shui 黑水 Black Waters, passed over the Fu Ch'i Ch'iao 虎溪橋 Tiger Torrent Bridge,—racing current and hurrying rapids, something like the Shuang Ch'i 雙溪 Twin Streams, but not quite the same. Formerly, the monk who founded (the Hai Shui Monastery) came from the Pai Shui to this spot seeking superb scenery. He came to a flooded torrent which could not be forded. A tiger came and lay crouching by his side. So he rode it across in spite of the wild currents. Hence the name of the stream. The names of the two streams Hai and Pai arise from the colours of the stones in them. Before the Hai Shui stands the Tui Yüeh Fêng 對月峯 Facing the Moon Peak. These monastery pillars and roofs are quiet and tranquil. That night I slept on the eastern portico. In

the autumn seventh moon on the first day *wu-shu* we left the Hai Shui and again came to the Pai Shui Monastery. Before us passed the Shuang Ch'i Bridge, we entered the Niu Hsin Ssü 牛心寺 Ox Heart Monastery. Then the road ceased. The waters in the Pai Yün Hsia 白雲峽 White Cloud Chasm were just overflowing. The green current and the white stones illumined the inner heart of man, as in the midst of terraced glaciers and treasured snows. My palanquin went down through the shallow places in the chasm in order to enter the monastery; flying waves and foamy cascades wet our sleeves and garments. This place was too secluded: our very hair all stood erect. The monastery faced the Ch'ing Lien Fêng 青蓮峯 Emerald Lotus Peak with the two fine pavilions Pai Yün 白雲 White Cloud and Ch'ing Lien 青蓮 Emerald Lotus.

The Niu Hsin was really the hermitage of Sun Ssü-miao 孫思邈. It is said that several times people saw him appear in the monasteries on the mountain. Novels also record incidents of this mountain: asking the monks to chant scriptures and alms-giving. On the peak of this ridge there was the Immortal Sun's crucible for concocting the Elixir of Immortality; also the T'ao Mi Ch'üan 淘米泉 Rice-washing Spring was located in the deepest cleft of the Pai Yün Chasm, away from the monastery about seven *li* where the stream is so deep that it cannot be forded. I went alone to visit the Elixir crucible. Beside it were many peculiar stones. At the rear of the Tz'ü T'ang was a rock especially wonderful, on which one could squat comfortably (as in meditation); it was named Wan Tan Shih 玩丹石 the Enjoying Elixir Stone. In the monastery there was a Lo-han panel picture drawn in the T'ang Dynasty, of superb workmanship. The eyes and eyebrows were as vivid as if speaking to a person. In Chengtu the ancient portraits of monks were numerous, but in my judgment all came below this one. Among the Szechwan artists who have painted Tartar monks only the brush of Lu Ling-ch'ieh 盧楞伽 ranks foremost. Now on seeing this panel I know the source of Ling-ch'ieh's art. The other fifteen panels are gone.

This monastery was founded by Chi-nieh San-Tsang 繼業三藏, whose surname was Wang, a native of Yaochow 耀州 under the jurisdiction of T'ien Shou-wan 天壽院 of Tung Ching 東京. In the second year of *Ch'ien-tê* (A.D. 964 in the Sung Dynasty) by imperial order three hundred monks were sent to India to procure *shê-li* 舍利 (crystalized essence preserved as relics from the pyre of Sakyamuni), and books made of the *pei-to* 貝多 bodhi leaves. The monk Chi-nieh was also one of the three hundred. They did not return until the ninth year of the reign *K'ai-pao* 開寶 (A.D. 976). He went to the palace to present the Sanskrit sutras, *shê-li*, and other things which they had brought. The emperor ordered him to select

a famous mountain in which to practice meditation. So he ascended Omei and looked northward to Niu Hsin where many peaks ranged round. There he made his shrine which gradually became a monastery. He lived to be eighty-four years of age.

Coming out from the Niu Hsin we again passed before the Tung Fêng 東峯 Eastern Peak and entered the Hsin Omei Kuan. From before the temple the newly opened mountain trail descends a steep declivity. In the rain we walked over to the Lung Mên 龍門 Dragon Portal. After having stumbled along for several *li* suddenly we came to a place where the mountain torrent gushed forth from a stone opening between two hills. This was the Lung Mên Hsia 龍門峽 Dragon Gate Gorge. By using a mere leaf of a boat we rowed into the stone opening. On both sides the cliff-walls towered thousands of feet, the colour of purple jade, polished smooth as if carved in that shape. After entering into the gorge more than a hundred feet we saw two waterfalls, each gushing forth from a precipice top and flying downwards side by side. At their foot was a huge rock to receive them. The water striking against the rock became flying raindrops and splashing foam. As our chasm boat sailed by it all our garments were soaked. Further on some tens of feet there was a circular niche in the centre of the cliff above the water some twenty feet. One might reach it by a wooden ladder. This was the Lung Tung 龍洞 Dragon Cavern. In the gorge the water was deep purple and fathomless, stones cold and stream clear,—no longer the world of men! Having rowed along some tens of feet, the stone walls became more precipitous and the current more turbulent. Then we rowed back. The boatmen said that if we went further on it would be stranger still. Because of the pouring rain added to the flying water-falls soaking our bodies, our very flesh trembled, our bones quaked and spirits took alarm. In awe we felt that no one could long remain here. Formerly I heard that the Shuang Ch'i 雙溪 Twin Streams of Omei were not unequal to the San Hsia 三峽 Triple Gorges of Lu Shan 廬山. The other day when I passed there it was indeed a wonderful view. But when we reached the Lung Mên then by comparison the Shuang Ch'i ranked second. (The Chinese expression is *hsia fêng* 下風 under the wind. It is quoted from the *Tso Chüan* 左傳: "Heaven above and earth below have in truth heard your speech; your humble servants presume to stand under the wind;" that is, "We have been humble witnesses to your words,"—an expression of inferiority.) For we must rank the Lung Mên as the finest in the empire among its gorges and streams. But the way to it is extremely perilous with wild rocks obstructing the road. When approaching the gorge one must forsake his palanquin and take to straw sandals. With head bowed and faltering footsteps among out-cropping rocks and overhanging perils one comes to

the gorge's maw. Although the summit of the Great Omei possesses the very finest view in the empire, nevertheless the Szechwanese rarely journey there. And although among these (Omei) mountains the Lung Mên also far surpasses all, yet travellers to Omei are seldom able to visit it. Only those who are fond of wonders and really enjoy this sort of thing, who disregard bitter fatigue and are unfrightened by various ills, are able to reach that spot.

Once more we sought the main road and emerged from the mountains. In early evening we arrived at the *hsien* city. On the day *i-hai* 己亥 we started from Omeih sien and at twilight reached Kia-chou (Kiating).

THE FOUR GREAT KINGS OF HEAVEN—PART II

SCHUYER CAMMANN

(In last year's number of the *Border Research Journal** I wrote a short introductory article on the Four Great Kings of Heaven as they were represented on a pair of Tibetan temple banners in the Museum at Chengtu, stressing their significance as Indian gods, Guardians of the Four Quarters, who had been adopted into Mahayana Buddhism and brought into China. Since writing the former article I have been doing some further research in the Tibetan borderlands of India, and have discovered more about the Kings which I now add to a few facts previously omitted for the sake of unity.)

In Tibetan tankas representing Sakyamuni, the historical Buddha with his two favorite disciples in attendance, and the eighteen Lohan grouped in a circle around him, the Four Kings are invariably shown in a row at the bottom of the painting, often with each holding a begging bowl like a proper disciple. The fact that they are chosen before any of numerous other martial deities as attendant guardians to the Buddha indicates the close relationship they bear to him in Buddhist tradition. In fact they are several times mentioned in the legendary Life of Buddha, and at least two of the incidents in which they played a part have long been familiar subjects in Buddhist and Tibetan art.

At the time of the Great Renunciation, when Prince Siddhartha left his father's palace, the Kings are supposed to have held up the feet of the horse Kanthaka so that his footsteps would not rouse the guards. This scene is often pictured in the relatively modern, gaily-colored frescoes depicting the Life of Buddha on lamasery walls in the Darjeeling District and in Sikkim, but the idea is of great antiquity. In various museums in India there are collections of sculptures in grey schist from the Graeco-Buddhist school of Gandhara which flourished in the first centuries of the Christian era.¹ These examples are worthy of study if only because they were the foundation of most later Buddhist Art. In the Lahore Museum, scenes of the Great Renunciation show only the head and shoulders of a giant supporting the forequarters of the horse, and in them the lower figure looks strikingly like the prostrate slave of Sassanian Triumph scenes. In the Gandhara collection at Bombay (Prince of Wales Museum), a front view of the

*1937, Vol. IX, p. 180.

1. The Kingdom of Gandhara in what is now the Northwest Frontier Province of India was founded by the Yueh Chih (月氏) who became enthusiastic Buddhists after being driven out of Northwest China by the Huns.

mounted prince who was to become the Buddha shows two small figures in royal turbans supporting the front hoofs, and presumably if the carving were more than a relief there would be two more shown behind. This then is probably the first representations of the now familiar legend. There is another ancient example, of some centuries later, among the paintings recovered by Sir Aurel Stein from the 'Cave of the Thousand Buddhas' 千佛洞 at Tun Huang 敦煌 in Kansu.² In a series of narrow vertical panels each with four small pictures from the Life of Sakyamuni painted by a T'ang Dynasty artist, one shows Prince Siddhartha in ancient Chinese court dress on a miniature 'T'ang' horse, with four tiny figures supporting the hoofs.

The second incident took place soon after the Enlightenment, While the Buddha was still sitting in meditation under the Bo tree guarded by the Four Kings, some merchants who had lost their way came to ask the spirit of the tree for help. The spirit responded by calling their attention to the Buddha whom they hadn't noticed, seated on the Diamond Throne (*vajrasana*) beneath the shade of the branches, and mentioned that the enlightened one had eaten nothing for many days. The merchants quickly produced honey and some barley flour like the modern Tibetan *tsamba*. The Four Kings received the offerings in their bowls and handed them to Sakyamuni who, not wishing to offend three by taking the bowl of any one in preference to the others, placed all four in the palm of his left hand and by a miracle caused them to become one.³ A good example of this scene occurs on one of the tankas showing the Life of Buddha in the West China University Museum; but this tale is also one of great antiquity, probably invented partly to show the old gods of India doing homage to the new Teacher. Among the Gandharan reliefs in Lahore are several representations of this scene. The central figure of the Buddha is seated in the lotus-pose, offering the Blessing of Protection⁴ with his right hand, while the left in meditation holds his begging bowl. Above are two clusters of leaves to indicate the shielding branches of the Bo tree. Two Kings stand on each side wearing elaborate headdresses or jewelled turbans with loose toga-like robes, hanging in graceful folds below the waist. They are either cleanshaven, or with small moustaches and close-cropped beards, still a far cry from the hairy visages of later representations; and it is interesting to note that the foreign sculptor has shown them offering their bowls with both hands in the traditional Chinese gesture of politeness.

2. Now on exhibition with part of the great Stein collections in the Central Asiatic Museum at New Delhi.

3. Tradition goes on to say that when Maitreya, the next Buddha comes down to earth the bowl will once more divide itself into four.

4. *abhaya mudra*.

To return to the Tun Huang paintings, it is interesting to note how often the Kings occur,—as the powerfully built, heavily armored warriors trampling red-headed dwarf demons underfoot,—figures which only slightly modified are familiar to us in the first hall of modern Chinese Buddhist temples. In the large pictures of Kuan Yin from Tun Huang, they appropriately guard the corners of the paintings, not yet having been relegated to the bottom row, and a number of vertical silk panels showed individual kings alone.

In the latter, Kuvera, King of the North, does not hold his characteristic jewel-spitting mongoose, his attribute as god of wealth, instead he merely holds a small *caitya*, like a miniature Tibetan chorten, balanced in his right hand, and the usual furled banner in his left. In this T'ang Dynasty form Kuvera resembles the Japanese images of Bishamon, god of war, one of the Seven Gods of Luck,—a reminder that Buddhism first entered Japan at this period.⁵

In my last article I mentioned the confusion in Chinese Buddhist iconography caused by artists and image-makers, having more license than those of Tibet since they were less bound by the hieratic tradition; how one king, for example, is often arbitrarily given the attributes or complexion of another,⁶ making identification difficult. This confusion apparently began early in the history of Chinese Buddhism, because on one Tun Huang painting inscribed "the Western Virupaksha, King of Heaven" 西方毗樓勒又天王⁷ the King

5. Two paintings of the tenth century procured at Tun Huang by M. Paul Pelliot, and now in the Musee Guimet, Paris, show that then Kuvera was actually called Pishamen, his name being given in full as 北方大聖毗沙門天王. Apparently Pishamen is an attempt to transliterate Vaisravan, the popular Hindu name for Kuvera, possibly at that time the syllable had a sound more nearly approximating *vai*. The others also have loosely transliterated names (Virupaksha is 毗樓勒又天王; Virudhaka is 毗樓勒又天王; and Dhritarashtra is 提頭賴又天王). Even in the use of these unwieldy names the appalling lack of organization in Tun Huang Buddhism is apparent, as those of the kings of the South and West are occasionally transposed. For a long time these clumsy transliterations have not been used, and each King is known by a direct translation from the Sanskrit.

6. The facial color of each king corresponds to the color of the precious substance on the wall of Mount Meru which faces his direction—the north wall is of gold; the east, of silver; the south, of lapis lazuli; and the west, of ruby. The few Tibetans intelligent enough to think about such things assume that the kings derived their colors from the walls, but the reverse would seem to be the case, since the Indian gods from whom these guardians were derived had already been given these colors for other reasons.

7. The inscriptions are written in a long vertical cartouche of lighter color in the upper lefthand corner of the picture, a characteristic element in most of the Tun Huang pictures which came down from the Wei 魏朝 sculptured reliefs, and still survives as a convention in Japanese religious scrolls, and prints.

is shown with dark blue complexion, and is in the act of drawing his sword, precisely as Virudhaka, King of the South, has always been shown in Orthodox Buddhist (Tibetan) iconography.

Another puzzling figure is a heavily-caparisoned warrior-king with white complexion, holding a bow and arrow. The museum label, in English, calls him Virupaksha, King of the West. As he bears no slightest resemblance to any existing conception of Virupaksha, or any of the other kings for that matter, This must represent either an archaic type which has not been preserved or else it is an example of extreme artistic license on the part of the painter. I am inclined to favor the former view, as in the mythology of Ancient India Varuna, the Sea-god, was also Lord of the West. He has survived as a white-complexioned god holding a pearl and a snake (exactly like the modern Virupaksha), but in earlier Indian tradition he is mentioned as holding a bow and arrow. This then is probably a throwback, all the more interesting as it was painted at a time when the conventional form of Virupaksha was already well-developed.

On the Indian borders of Tibet the Four Kings are painted on the front wall of every principal temple hall, two on each side of the entrance, seated against a scarlet background, each holding his usual symbols, and having an attendant 'subject' at his knee. The Kings of the North and West are at the right as one enters, while the Kings of South and East are at the left. They are always strictly conventionalized and in one respect only do they differ from those of the West China borderland. Virudhaka king of the South is always shown with a particularly demoniac expression on his blue countenance: his beard is parted and blown back as though by a stiff gale as he unsheathes the fateful Blue Cloud scimitar, the sword of the Winds. He is quite different from the solemn-faced knight, gingerly testing the blade of his straight-edged flame-tipped sword whom one sees portrayed in temples of the Sikong border, or the often fierce image usually found in purely Chinese temples, brandishing his sword overhead. Actually the pure Tibetan representation harks back to the ancient Indian tradition that Yama Lord of Death also acted as Guardian of the South.

Because of the gaily-colored trappings and exotic armor of the Kings, British writers describing lamaseries in Sikkim or Ladakh speak of them as the 'Chinese Guardian Gods' being at a loss to account for the unusual appearance.⁸ It is an unfortunate but all too frequent characteristic of travel writers and even so-called authorities in India that they should de-

8. This error was even made by Dr. Neve, the recognized authority on Kashmir and Ladakh, in his *Guide to Kashmir*.

scribe any strange or unfamiliar element that doesn't quite seem to fit into the Indian scene as 'Chinese.'⁹

In my last article I mentioned that only one of the Kings could properly be called a god.¹⁰ Kuvera, in addition to being Lord of the Yakshas and King of mythical Uttarakuru, is actively worshipped as a god of Wealth, and as such is a very popular deity among the Tibetans. (None of the other Kings are ever actually worshipped.) In praying to him his devotees make use of a rosary of yellow amber beads which is believed to correspond to the golden complexion of the god. An early Gandhara image in Lahore represents him as a warrior king¹¹ but he was almost equally early portrayed as a god of Riches. In his particular form as Kuvera Jambhala,¹² god of Wealth, in addition to the mongoose which always lies in the crook of his left arm, he holds in his outstretched right hand the lemon (*jambhala* in Sanskrit) from which his name was derived. Sometimes Tibetan image-makers, misunderstanding the iconographical significance of the lemon, place a jewel in his right hand, and after all the latter seems a much more logical attribute for a god of wealth. He is a stout bloated figure, like Pu T'ai 布袋 miscalled the 'Laughing Buddha' who is often found presiding in the outer hall of Chinese Buddhist monasteries. He is usually shown seated on his green-maned snow lion, or seated languidly in royal ease upon a pile of *kholbok* cushions in Mongol style, with the pendent right foot resting on one or more overturned vases pouring out their jewels. He wears a bodhisattva crown, a few bracelets and scarves, and little else. Were it not for the mongoose one could never suspect his relationship with the warlike King of the North. There is still another vastly different and scarcely recognizable form which sometimes appears on temple banners; here a blue, de-

9. A case in point is the guidebooks' description of the ugly tower called the *Panch Mahal* in Akbar's Palace at Fatehpur Sikri. It is described as a Chinese tower because its appearance is so unusual, while it actually consists of common Moghul elements combined in a somewhat unique way.

10. A common error is the mistranslation of T'ien Wang 天王 as 'Sky god' because not only do the the Four Kings live in the lowest heaven on Mount Meru, and *not* in the sky, but only Kuvera is actually considered a god in Mahayana Buddhism. Note that in the Tun Huang paintings only Kuvera is called

11. Represented in $\frac{3}{4}$ relief, he is shown with long Hunnish moustaches weak chin, and vapid protruding eyes, wearing an elaborately jeweled helmet, necklaces, and garlands, and a heavy robe falling below his waist. The right hand and whatever it held is gone, but the left holds a broad-bladed spear, a forerunner of the later banner. Child attendants present jewels and a headless armored figure offers flowers. Can one but forget the face, the figure is impressive if only for its size.

12. In the Jambhala form, Kuvera is considered as one of the Yi-dams, or personal protectors, in lamaism, and as such his picture or image is sometimes found in charmboxes, and in personal or household shrines.

moniac Kuvera Jambhala, with a third eye in his forehead and cruel tusks in his leering jaws seems about to choke his mongoose in an excess of rage. (Alice Getty in *the Gods of Northern Buddhism* mentions that the jewel-vomitting mongoose of lama lore was originally a symbol of victory over the Nagas (serpent gods) who are supposed to be guardians of the world's treasures; but its origin was more probably merely as a skin bag full of treasure, as the earliest sculptures of Kuvera in the Indian Museum at Calcutta show him holding a jewel bag made from the skin of a mongoose, with the little beast's mouth serving as the opening of the sack, and I have seen examples in lama temple banners which seemed to carry out this original tradition.)

In the eighth and ninth centuries of our era, when Buddhism was being introduced into Tibet, it was strongly influenced by the debased Tantric practices then in vogue in India. Each god was assigned a consort and their physical union was believed to represent the interrelation of the spiritual and material forces in Nature. (The same concept is infinitely less crudely expressed in China by the familiar T'ai Chi 太極.) Kuvera alone of the Four Kings was granted a consort,—Vasudhara, goddess of Wealth, who is pictured as a golden goddess seated in royal ease on a lotus thalamus, offering a golden vase in her outstretched right hand, while the left usually grasps a stalk of grain. One particularly debased banner of the Tantric School in the West China University Museum shows Virudhaka King of the South in full armor embracing a sakti, but since this is a unique example it probably represents one of those rare instances of an artist taking liberties with his subject.

Only one more thing remains to be said about Kuvera. He is frequently shown with eight or ten attendants called *Vaicravans*, fat little demi-gods like smaller figures of himself either crowned and wearing scarves like miniature Jambhalas, or on horseback in full armor bearing banner and mongoose or perhaps a plate of jewels. Either Kuvera himself or these attendants serve as models for the many local gods of mountains and temples throughout Tibet and one usually sees one of them in the lower corners of larger banners representing the chief protector of some lamasery or district.

In Chinese Buddhism Wei To 韋陀天尊 is considered the Captain of the Kings. Once the mighty 'Indra of the gods,' Patron of the Aryan conquerors of India, his prestige decreased with the rise of Brahmanism until he was considered merely as the ruler of one of the lesser heavens on holy Mount Meru. In Buddhist legend it is said that the Buddha wrested from him the sacred thunderbolt (*vajra*) symbol of his divine power, and gave it to the bodhisattva Vajrapani (*Dorje-chang*, in Tibetan), and thereafter Indra became merely a lesser

guardian of the Faith. In nearly every Chinese Buddhist temple however small, he is shown in a little shrine called the Wei T'o Tien 韋陀殿 which is at the rear of the first hall, facing the Hall of the Buddhas 大雄寶殿. Dr. Reichelt, in *Truth and Tradition in Chinese Buddhism*,¹³ quotes the belief that Wei T'o's wrath against unbelievers is so great that there is danger of his being driven to violence on seeing sinners enter the gates of the temple, so for that reason he is made to face great Buddhas in order that his temper may be soothed by the calm serenity in their expressions.

As I write, I mentally picture a small gilded image in a rustic monastery on Ku Shan 谷山, outside of Changsha. The little armored figure is tilted slightly backward on his heels, accentuating the expression of lofty disdain on the chubby face beneath the tall plumed helmet. His left hand rests lightly on his hip while the right hand extended forward rests delicately on the head of his long mace. In a Yunnanfu temple there is an almost life-sized figure in green bronze which shows him in an alternative pose; he stands with his head reverently bowed toward the Buddhas, and his hands folded in prayer, while the silk-covered mace is laid across his arms.¹⁴

The mace in itself is of considerable interest. It is similar in shape to those borne by Heng and Ha 亨哈二將 the fierce ogrelike marshals who guard the gates of Chinese more elaborate Buddhist temples, and much though it has changed in form and size through the centuries, it can be traced through transition types in the Tun Huang paintings back to the *vajra*, which in ancient Indian sculpture is always shown in the right hand of Indra of the gods.

Though the *vajra*, called *dorje* by the Tibetans plays a prominent part in the Lamaist religion, oddly enough, the few times when Indra himself appears in Tibetan paintings, usually with Brahma as an attendant on Sakyamuni, he is shown holding the conch shell as his symbol. The conception of Indra as a guardian of the Faith, and the captain of the Four Kings never seems to have been evolved in Indian or Tibetan Buddhism, and just as Kuan Yin, goddess of Mercy was derived from an Indian bodhisattva, the conception of Indta as Wei T'o seems to have been independently developed in the Chinese Buddhist tradition.

Bombay, September 1st, 1938.

13. page 245.

15. Alice Getty in *the Gods of Northern Buddhism*, describes such an image in her discussion of Kuvera, apparently confusing Wei T'o with the King of the North. This is a natural mistake for one who has spent a lifetime studying Buddhism from Indian and Tibetan sources without considering all the developments of Buddhism in China.

THE WEST CHINA MUSEUM: Or "West China Man and His Culture"

(A popular paper, presented with exhibits in an open meeting before the W.C.B.R.S., at Chengtu, February 24th, 1940.)

DANIEL SHEETS DYE

If an individual, or a group, or a university, is to accomplish anything significant, there must be a project of major dimensions, and plans so comprehensively and carefully worked out as to be feasible, and then there must be continuous and consistent application until goals are attained. In the case of research, so often the solution of one problem but raises two others. Unless the research worker has unlimited time, he must delimit his field, or he must enlist others, with whom he subdivides the field, and then they together must work along related and correlated lines. Most of us, save the young novitiates, are limited by our own peculiar set of space-time-energy coordinates!

I am attempting two things today: *viz.* (a) to put on record, before going on furlough, certain local items of more than local importance which I believe ought to be insured against loss; (b) to present a broad outline of suggestions for a cooperative study on "Man and His Culture in West China." I am putting together a number of my own findings of these last thirty-one years since I came to West China, and then I am suggesting problems and questions that need solution. I am proposing questions that I cannot answer in more than one life time. I am not proposing entirely new problems, but I am proposing old problems in a new way. I am trying to propose them in such a way that we can come to grips with them.

(By way of parenthesis, I here state that there is in my subconscious mind the fact that there are questions of racial origins, anthropometric data, language studies, social customs, etc., etc. to which others have called attention and to which some are even now calling attention. You may find these in the Journal of the Society, in the *West China Missionary News* since its inception in February, 1899, in fugitive articles scattered here and there, and in the journals of the national scientific societies of China. Some day these papers will take their just and proper place in super-correlation work, even as I hope this paper may so do. I am not arrogating to myself super-knowledge beyond these others. I have been fortunate in peculiar sets of observations that dovetail together.)

This afternoon as I give this general talk on the history and the pre-history of man in these parts, I am presenting some few data, ideas, theories, partial solutions, questions, and suggestions that I have been walking around for more than two decades. I know that I am daring in my presumption as I edge up to the unknown, as I approach the borderline of knowledge. I can hear Darwin say, "Yes, here may be something around which to accumulate data mountain-high by twenty years' work!" Just, so! This is what I am proposing, but I am proposing that the twenty years of work be done in ten, in five, by the multiplication of workers in cooperation. We need to divide the field, to intensify the work, to fill the gaps, to connect the series, to accelerate the work, to sharpen the focus, to draw authenticated conclusions, to fill in the picture.

I have been tentatively putting together a picture puzzle of multiple pieces, where many of the significant pieces have eluded discovery,—up to date. This picture concerns these Western Provinces and their borderlands—the Marches of Western China—as a museum of man and his culture, of history and pre-history. People who can work effectively in certain specific fields are hardly on the horizon as yet, but in other fields there are those who can bend their energies to tasks with an assurance of success. Within the schools on this campus, within the city, and within this and neighboring provinces there are those who are in a position to solve crucial problems even though they be "unit problems" which would help in building up the comprehensive and true picture. To go deeply into such a study will require many techniques, creative imaginations, and the disciplines of many arts and sciences. Here in West China we have been picking up nuggets scattered lavishly hither and yon as we have stumbled upon them or fumbled over them, but the time has arrived when we should supplement this fortuitous placer mining by lode-and-shaft mining.

As papers read before this society are supposed to present personal conclusions based upon personal research and data, I shall present a minimum of other peoples' work and a maximum of my own. Some of this work was reported before the Saturday Night Club, some before the Fortnightly Club ere the West China Border Research Society was organized, and some was presented before this Society or recorded in its Journal, some has been reported elsewhere, some is now prepared for publication, and some is only sketchily reported here this after-noon without all of the supporting data. The more comprehensive and correlated conclusions, I am presenting here for the first time. These correlations and conclusions, let me say again, do not ignore the work of other people, but I must take responsibility for these new conclusions.

At this point, I must needs pay tribute to original men who have passed on, some of whom have written reports, and some of whom have passed on gleanings by word of mouth. I have heard some of these items stated before this Society in Chengtu, (where the speaker was apparently ignorant of sources), or in parlors in Chungking or in Yachow, or on the road in transit. Some of the original men I have never met. Joshua Vale, Sir Alexander Hosie, Wm. Upcraft, W. N. Ferguson, C. A. Salquist, Robert Wellwood, Adam Grainger, James Hutson, Ernest Wilson, J. H. Edgar, W. R. Morse are part of the West China tradition. T. Torrance, L. Newton Hayes, Parker M. Bayne have left a residue in our midst, while today they carry on in other lands. I have also had the privilege of the give-and-take with James Thorp, George B. Barbour and Teilhard De Chardin, and J. G. Andersson who was accompanied by two Academia Sinica scientists. All these men I have escorted to, one or more, but not to the same and not to all the sites, whence I have built up the argument of this paper. As we discussed this and that "on location," our conversations never traversed the same terrain, but their answers have stimulated as well as confirmed my thinking along the lines of this paper. Then too, I have put the present members of the society to tribute in more or less measure, yet I cannot hold these men responsible for my use of their data or of my own. In many of these interpretations and in the extrapolations, most of these individuals would not recognize their contributions or stimulations, were they here today, and some of them would certainly protest my conclusions in part or in whole, even if they would not go so far as to dissociate themselves from what I am saying.

Now as I address myself to the subject of "The West China Museum" I am not thinking of a junkshop or of "curio street" but I am thinking of a collection of raw materials, basic data—collected so far as feasible *in situ*, where the pieces are more or less related and arranged to tell a story. If it does not tell a story at the moment, the collector expects that the oddments will fall into a connected series if he or others are perspicacious enough to relate and to interpret and to further collect "jigs" to fill up the lacunae in the jigsaw puzzle.

"The West China Museum of Man" that I am talking about is still largely housed under the canopy of the sky, concealed in graves, naturally buried under the soil, catastrophically entombed by earthquakes, enclosed in caves, carved in living stone, erected in stone and wood, blanketed by alluvium or loessial materials, or mixed with the debris of tile and brick of buildings destroyed by the ravages of war, fire and time. This museum is as big as West China man of all time, and it has bays or annexes of geology, biology, climatology, and agriculture. The West China Union University Museums are

but small details of the museum about which I am talking this afternoon.

Let me briefly review the background talk which I gave two years ago in anticipation of this talk. I spoke on "Some Geological Horizons and Life-Settings of West China." I spoke of the earthquakes cited in our gazetteers more than a hundred times. I spoke of more than a dozen earthquake lakes that I have discovered in Szechwan, of which some were more and some were less than a half million years old by loessial dating. I spoke of thirteen retreats of terminal moraines of glaciers in Szechwan and Tibet. I spoke of loessial deposits of over fifty feet in thickness on the mountain tops of Weichow and of fifteen feet at the North Airport or Chengtu. I spoke of the concretions formed of the loessial materials when the rainfall was less than fourteen inches, much as saltpeter is collected today in our mud walls around old temples. I spoke of the decay and the etchings of these concretions by the more than three feet of annual rainfall today. I suggested the shifting of myriads of tons of loessial materials hitherwards from the heart of Asia a half million years ago when the glaciers lay over North Europe. I spoke of the later shifting of this and other materials via the river route to the building up of the Lower Yangtse Delta, as well as to the building up and superposition of a small tithe upon the Red Basin here upon the Chengtu area. I spoke of this alluviation as being still in process.

Today I want to step back just a little further. I quote from Bailey Willis in the Scientific Monthly, September 1939: "During the ages of the succeeding Mesozoic Era, for more than a million years, there stretched across Asia and Europe, a sort of Mediterranean. In Asia it occupied that region that is now Tibet, and extended to the east and west." Now Szechwan, or its major part, was of this dividing sea that separated North Central Siberia, Gobi, Tibet, Southern India, and Southeast China of ancient days. These were the days before flowers and the higher animals when cyads and dinosaurs were kings in their own rights. Our Red Basin of Szechwan was laid down in this inland sea upwards of seventy millions of years ago. Changes in levels, changes in wind barriers, changes in climate, changes in glaciers, changes in rainfall and in evaporation, changes in dust storms, changes in salt deposition and in salt leaching, changes in rivers and river action—all of these have changed the environment since Mesozoic times, as from seventy million years ago, say. Here the stage settings have been repeatedly changed in such a way as to be intimately and causally related to the development of the sundry plants and animals of these parts of Western China. It is better to call all of this the background of, rather than the stage for the man-scene with which we are concerned today. (And hereinabouts there is room for a co-

operative team of geologist, climatologist, soil expert, botanist, and zoologist, or a corps of each, who can think causally and relatedly, genetically and with no time limit, and with unfettered imagination—save as constrained by scientific techniques, and by scientific truth and truths.) The details of the Cenozoic scene and life are needed if we are to understand and appreciate this region which probably represents not a detour but a main highway, if not one of the trunk lines of life.

It is generally believed that man has been man for more than a million years. He has used rather well-fashioned tools for more than a half million years. Thus when we find places dated as of twenty million years ago, we may be very sure that the materials were laid down before man appeared upon the scene. But when we find sites in the Chengtu regions dated as of a half million years ago, we can be fairly confident that ancient man passed this way in those times. Last December, I took my geology class ten odd $\frac{1}{2}$ out of the North Gate of Chengtu to a site 礮子山 where I found "inherited topography" in the form of great river-cobbles or boulders in a small gully in the side of a hill. (I had located such in 1911.) Imagine my surprise when we found a crew of road-workers "mining" river cobbles as much as two feet in diameter, from the side of a hill where they were overlaid by fertile red soil as much as five feet thick. This old Cenozoic riverbed rested upon the older Red Cretaceous, alias Red Basin, materials of late Mesozoic times, and was in turn covered over by other Red Cretaceous materials by gravity and erosion from the slope above in recent Cenozoic times! Now such Cenozoic rivers have worked out their own beds in the Red Cretaceous as they have entrenched themselves between butte and mesa topography in such characteristic ways as is seen between here and Chungking, for instance. Now let us return to that river-cobble mine. The "fossil river bed" was deposited by a swift-flowing river—almost as strong and swift as that at Kwanhsien today. Then the river had side-stepped, some forty million years ago, say, to the west as it stepped down to lower levels as of today. (The whole problem is much more complex than this as there have been reversals in levels, and reversals in stream-directions, but this is not the place to elaborate upon this subject.) The earlier Red Cretaceous next came down from the slope above and covered the fossil river bed and the loessial materials were blown onto the top of this covering some half million years ago. Later more Red Cretaceous from the slope above was brought down by gravity and erosion, and covered all. This latter is what the Shuh and the Chinese farmers have been farming for several millenia, and most of them have been ignorant of the river boulders beneath their hillside fields. Lime was leached out of the loess and then was deposited as

concretions wherever there was especial evaporation as there was at the boulder surface when the rainfall was fourteen inches or less. In late times there has been over three feet of rain per annum at Chengtu, and there has been a dissolving of the lime from the surface of the concretions so that these are rough and pitted (save back of the rainscreen in the mountains.) Such materials were deposited around some of the old river cobbles. *Parri passu* there has been the creep of the Red Cretaceous from above, so that the loess has been mixed and covered by the surface soil from upslope.

I reported in Chengtu more than twenty years ago *re* the "Chengtu Alluvial Fan, Compounded in Space" of possibly 10,000 square miles in space-spread, but here is the "Chengtu Alluvial Fan, Compounded in Time" of something less than 70,000,000 years in time-spread. I have been tracing this out these several years, and its significance is partially included in my last report before this Society. As the class and I clambered up and down the open cut where the workmen were taking out road-metal, we paused where never man had stood until last December. Then we stepped up to where ancient man had been, but where modern man had never been until that month, and then we clambered up a few feet more and took our stance where ancient man had never stood, but where only modern Chinese have been plying iron tools in cultivating crops these two thousand years. (Fifteen months before I had found an iron scythe of Han times in a somewhat similar situation.) Then we slid down across ten odd feet of near vertical space and at the same time slipped backward across near forty million of years, and thence we found our way over the very modern Chengtu Plain, back to the university campus, in the December twilight. I believe the students were thrilled, even as I was thrilled, to telescope man's total range within that vertical spread of ten feet.

Unless man has disturbed the soil beneath his level, or built up monuments above his contemporary level, we should not expect to find modern man in the loess, nor ancient man in the original Red Beds naturally buried. Of course man does disturb the soil, yet it is not probable that we can find ancient man in the Red Beds of Szechwan. In 1936, I wrote a paper with James Thorp (in the Bulletin of the Geological Society of China) on loessial materials of Szechwan, in which I prophesied the discovery of ancient artifacts in the loess. Two years later in a road cut through the loess concretions I picked up by the roadside two stones covered with loessial concreted material, which I am confident were worked by ancient man. These fistaxes, as you look them over, bring us a message from ancient men of Szechwan, as of a half million years ago, and the message was sealed in by the loess. These tell a story almost as elegant and almost as eloquent as though it were written on brick in indented cipher. These

speak to me of man-the-hunter beyond Lung Ch'uen Ih 龍泉驛 of five hundred thousand years ago! Many more such stones will be found in such terrain.

Some twenty years ago, J. H. Edgar and Geo. D. Hubbard picked up a well-polished hard-stone tool from out an old slip in the Min Valley beyond Kwanhsien. I suspect that it was from out of an old earthquake slip. I have found a few mondescript remains under these earthquake slides. The *hsien* city of Tiehki 壘溪 was utterly submerged by a mountain falling upon it August 25th, 1934, and the excess materials from the slope dammed back the Min River for ten miles. The whole city and its population was sealed in for time far hence to expose. This lake is rapidly filling up (from the upper end of course) and later it will cut out a channel through the filled up lake, leaving two side river bottoms as river terraces. There are many more than the dozen earthquake lakes that I have found in Szechwan. Someone some day will find ancient man in these slides and river terraces, and will extend our knowledge of him.

Seventeen months ago I was at Sinkaisze, 新開寺 Mount Omei, and I purposely went above the upper tennis courts to look for artifacts, where I had previously found them. I failed this time in my search, but at the tennis court a man asked me to go to his cottage and help with roof advice. On the house level I found that masons had been digging and they had picked up a stone to use as a trowel to spread plaster. It was covered with lime and I asked for the stone. I brought it back to the campus, and here is this undoubted neolith with the lime removed by acid.

Here is a cobble surface that was broken millions of years ago. Under certain circumstances I might suspect that this had been worked by man. It came out of that ancient riverbed, before man had visited that site. Pressure and impact by natural forces may simulate man's handiwork. One must be very careful of interpretation. One should be scientifically courageous, but there is no obligation to be foolhardy! One needs to bring all possible evidence to bear upon mooted questions.

Again I bring a word of caution as I display two artifacts that are less than twenty years old. This one I found on the plate in the attic of the Biology Building of the West China Union University as I was looking for a place to give an extra room to Cheeloo University. It was used by a mason in polishing brick. This second one was used about a year ago as a hammer to drive a chisel in cleaning up brick from the south steps of Van Deman Memorial building. Here are science, iron, and stone tools mixed up most confusedly!

Again, a few years ago on the road to Tachienlu, I found a long "walking beam," pivoted not so far from the middle, with a wooden mallet fixed at one end and a wooden trough at the other, and located under piped water (in bamboo pipes) from the hillside above. The mallet played in a hollow log butt, partly filled with maize. The stream weighted the trough, the trough went down, the mallet went up, the water spilled out, the trough went up, the mallet came down, and the process was repeated until the maize was reduced to meal. Here was a belated method that explained to me some of the great stone implements in the Peabody Museum at Cambridge. Here was a mill that would work equally well for maize or for acorns in the pre-Columbian Americas. We shall call it a trip-hammer water-mill.

J. H. Edgar has been finding artifacts of stone since before 1907, in Ichang, in the Yangtse Gorges, at Luchow, at Kwanhsien, beyond Tachienlu, and up the Min valley, as well as in the loess formations in the Tibetan uplands (whither D. C. Graham led J. G. Andersson a few years ago.) J. H. Edgar was the pioneer in collecting *in situ* ancient artifacts in China. I am not an expert in artifacts, although I have been collecting them from the time I was ten years old in southern Ohio. Yet from casual observations in the Raffles Museum at Singapore, in Bombay, and in Calcutta, I venture to suggest that there have been contacts, repeated contacts, and interchanges of culture around the Tibetan massif in really ancient times. But this comparison should be made by a competent authority.

In these provinces here in the West of China, there are many caves and shelters of sorts. There are lime caves with lime floors of stalagmitic formation, with loessial fills, with Red Cretaceous fills. In the right places early man will yet be found. Peking Man's foster brother is a probability. It will probably take a mint of money and more time than most men can command to uncover him; but some one will find him during these next two decades, by accident or by scientific acumen and technique.

Ten years ago, I was at the foot of a mountain on the edge of the Chengtu Plain, where the Red Basin crimped up and ended like a piecrust on the mountain side. A certain amount of this red material had been washed down and deposited at the piedmont, and then much later a small stream had cut across this alluvium, exposing the early deposits. Ten feet below the surface I picked out a half of a broken spindle whorl that had been discarded by someone many thousands of years ago. Had some watcher of sheep been spinning wool even as my gatewoman was doing four months ago. It had doubtless been discarded upon the surface of the round and then covered over at least ten feet. Later the stream had cut through the alluvium. I found the clay fragment where it had

been undisturbed from that day of the accident until I dislodged it!

Over ten years ago an old but progressive farmer wanted to irrigate by pumping water to a higher level, and he needed more water. He lived not far from Hanchow, Szechwan. He started to dig a pocket below the bottom of his Min irrigation ditch which was eighteen feet deep. He went down three feet deeper and uncovered a dozen hard sandstone discs which are two to three feet in diameter, with central holes four to ten inches across, and with thickness varying from one-and-a-half to three inches. (I later found the stratum whence the sandstone had been quarried.) Now these had been near enough to the surface so that the air and water had changed often enough to etch the surface of the discs. The holes had been drilled by crude V-bits of some sort. These discs or annular rings of stone were aligned above a corpse, but I was not able to get a clear picture of the orientation from the members of the family whom I interrogated. The burial was probably upward of three thousand five hundred years ago. These circles of personalized heaven (?) have come down unto today. These predated the coming of the Chinese into this Shuh country by much over a thousand years.

There were great jadeite knives or chisel-bevel associated with this burial. (The origin of the material is assuredly not Szechwan.) These had been sawn by a stretched wire or string of some sort. The string was under high tension so that it did not bow out by more than a half millimeter in the distance of a foot! The worker may have used an abrasive, or the jadeite flour by the addition of water, but the fact remains that the wire was under tension. He must have used a guide, for this knife does not vary by the thickness of a sheet of typewriter paper in one foot along the edge. Here was a surprising technique of at least 3500 years ago! But the drill hole was very crude as it was in the larger discs. Now the "balance" of this spadeknife or blade is superbly arranged so that it will not "jump the handle." I am convinced that it was hafted by a halberd-like handle, say six-feet long. Now this collar or disc fits snugly over the haft end of the knife, down to the shoulder. Note that the cross-section of this collar is like a T with the top of the T towards the center. (I believe that this is the first time that attention has been called to this use of the peculiar annular ring, although these are widely known from other parts of China.) I have seen pictures of some similarly hafted blades of Mayan manufacture. I suspect that around this collar was arranged colored hair, possibly red, (?) very much as modern spear-actors on the Chinese stage, arrange a tassel. The projecting rib on the collar would not only give strength but also make the tassel stand out. Note that the edge is chisel-beveled, and that the bit is crescent-shaped. Some people may call this a ceremonial

instrument, but it would make a very formidable "social weapon." It may have been a beheading tool in sacrifice of human or of animal, but I cannot account for such a tool of such hardness and of such chisel-edging as being of pure insignia use. (I call attention to human sacrifice as mentioned by H. G. Creel in "The Birth of China," p. 212.)

I want us to note the "imps" on the haft end of the knives. Here is this "tree of life" coin of the Han Dynasty from Szechwan with the same imps. (See this Journal, IV, Plate facing p. 102; and this Journal VI, Plate facing p. 106) These are somewhat suggestive of Mayan art, but there seems to run through Southeastern Asia, such dancing figures in drama and in art. Tibet, Siam and the archipelagos include such grotesques today. It is significant that this same art (or other) motif has carried down to present times in this part of Asia.

This Hanchow, Sze. chance find awaited two years for someone to recognize its significance. Then when the Hanchow official asked V. H. Donnithorne what these things were, he brought them to Chengtu. Then the official invited me to go with them to the site. He and the farmer-scholar presented these to the University. There had been other pieces but these had been scattered afar. Many of the small colored bits were distributed as charms. If such finds can be saved for scientific study it will be well. D. C. Graham added much to these finds, by collecting ancient pottery of crude workmanship in that vicinity.

Here is this large chisel and a much smaller one. I want to call attention to the heavy adz-chisel, but I desire to call especial attention to the small fine-edged stone chisel for fine carving—Shall we venture? Work with such tools as these doubtless prepared the way for the development of a long line of patterns and carvings in wood. We also believe that such work prepared the way for the bronze work with its toolings during the Han in this region.

Some twenty years ago, J. H. Edgar brought out from Weichow, this piece of dichromate pottery in black and red. It was picked up from a crumbled city wall, erected in 680 A.D. I called attention to this in this Journal Vol. II, p. 75 as being related to Andersson's Anyang finds. Prof. J. G. Anderson when he was here two years ago, said that the locating of this shard in the Museum was worth his trip here. "It could come from only one place in Northeastern Kansu at about 1500 B.C." Thus we see that this predicates that the Upper Min Valley has served for long as the Kansu Corridor. Here is very strong evidence that there was the come-and-go of communication along the Upper Min between upper Kansu and Shuh regions. This Kansu Corridor must have been wide open at that time to be carrying pottery such as this. We

must interpret Szechwan culture, at least in part, in terms of communications along this ancient route.

There are pattern brick of Han in this province. These are found in many regions, especially in the hills bordering the Chengtu Plain, at Kiating, at Suifu, at Chungking, and even up the Min River Valley. They are found all along the old Imperial Highway as far as Hanchong, Shensi, where I have found them. These are found in the "Wild Men's Caves" 蠻洞 of Szechwan. T. Torrance reported these Han Dynasty cavegraves over thirty years ago. I want to call attention to the patterns which were copied from windows of that day. These same patterns are found in Chinese lattice windows today. Moreover these same patterns found their way to America, to New York, to Boston, to Philadelphia almost two centuries ago, via the clipper ships. The patterns are found upon colonial wallpaper of America, as well as in some small-pane glass windows. Many of those pattern brick have horses and chariot patterns upon them. It is very obvious that Han was wheelminded as well as geometry-minded. These pattern brick are the predecessors of the present-day paper-cash and paper-house and paper-air-plane service for the dead.

Next, I desire to call attention again to the Altars of Heaven which I have found in Szechwan. The largest is found in earth outside the city of Hanchong, Shensi. (Formerly this region was a part of Szechwan.) There is another at the South End of the Science Block. There is another at Chionghchow 邛州至雅州 (邛嶺), another at Yachow (So Dr. R. L. Crook verbally reports) and there is another at Wasikeo 瓦斯溝 (before one reaches Tachienlu) in stone arranged on an island. Now we must not think of Szechwan as over-religious, but we must visualize the ancient inhabitants of this province as possessed by the same psychological elements as are we of today. These but indicate that there have been repeated instances in Szechwan history when there were those who were more than willing to serve as go-between for the people and Heaven. The would-be governors of Szechwan since the Revolution of 1911 have had their prototypes. A new dynasty needed a new Altar of Heaven. As I read the story told by the West China Museum in history and prehistory, the inhabitants of these regions have been very little more peaceful than other peoples on earth, either now or in the past. The man who insists that the Chinese are the most peace-loving people on earth has hardly read current history or older history or pre-history with understanding.

Ten years ago, coming from Kiating, I found annular rings of clay. They looked like stove lids with holes in them, for heating small pans. I asked two people about them and I was patronizingly smiled at, but I was not sagacious enough to predict the opening up of the Liu Li Ch'ang 琉璃廠 or

the Ch'iong Lai 邛崃 kiln sites of T'ang and Song. Later I found the Han scythe and peculiar pottery near the same place, as I found more kiln accessories. Such discoveries are but in their infancy in Szechwan, and from inquiry, I am confident that Yunnan will tell a similar story.

This green-glazed T'ang sphinx-like figure I found under the Gin-ling College dormitory foundations, three feet below the ground. The Chengtu Plain is gradually building itself up by as much as ten inches a century in some places, more in some, less in others. I found a cash coin like this Pan Liang 半兩 cash at the bottom of the Moon Pool by the Clock Tower. That land has been filled in by at least ten feet since the time of Christ. K'ai Yuen 開元 cash (1200 years old) were found between the ten and sixteen foot levels under the South Street surface some fifteen years ago when the street sewer was being installed. The city fathers replaced a much better sewer which was below the river level in the summer time. Chengtu City is overlaid with broken tile, brick, pottery, boars' tusks, cash, charcoal, and what nots. The wells that were dug in the city a year ago gave a cross-section of the city's history, in terms of objects which do not really decay. If the city were not being filled up by the discards of the past, it would soon become a lake since the rice fields are filling up continuously from sediment deposition. We hardly observe these two processes of fill, they are so gradual. Even so, the crossways of the city are high, and the city corners are low. Within a quarter of a century there were lakes or ponds in the four quarters of the city, due to the failure in building up from the dirt and broken tiles where the houses were too few. It is well to intercalate that Chengtu is a crazyquilt of houses of various dates, but all less than three hundred years old. Chengtu has averaged at least two real fires these last thirty years. In 1916 one fire took a toll of one-fifth of the houses in Chengtu. Remains of T'ang and Sung and Ming in porcelains and in stone work suggest the high culture of those times.

Twelve years ago I found a Han type of bracket, somewhat like those on the Administration Building. (I call these Han because the earliest of this type that I have found are on the facades of the Han graves near Kiating.) But this pottery bracket in green glaze came from immediately back of my house. Today I have over 500 pounds of these in green and yellowish glaze representing roof ornaments, tile for roof, and cornices. These have silver patina from contact with the soil for such a long time. We find them outside the North Gate of the City, near Ssu Sheng T'zu, 四聖祠 the North Parade Ground, and in the two mounds east of the old Nan T'ai Temple 南台寺. The one further east was the older and finer structure. There have been at least four

buildings in these two places. There was a pagoda near there. There was a temple covered with two shades of green in the eastern mound in the Sung Dynasty that was superb. The blacks and greens in different shades gave a dignity to the tile roofs of Sung Chengtu, that we today can scarce visualize. Here was green for the roof that was at home with the green celadon porcelain within.

In the middle of last August I found a Ming Temple with frescos of a type of temple that was covered with tile in greens of these samples which I now show you. Here was something that was a counterpart of Sung and T'ang temples that are pictured in ancient drawings in colours. I have seen more beautiful frescos of Ming in Szechwan but I have seen no such buildings as pictured. Two fine Ming temples have been burned since I came to Szechwan. I planned to visit such on my trip to Songpan two years ago, but when I neared the place I discovered that the Communists had gone far out of their way to burn this ancient temple of religion. Such are the ravages of time and man.

Here is a poem in woods. This perforated wood carving is very close to Ming. If it is very early Ch'ing, it is still after the Ming style. This is a replica, and it speaks of the cycle of the seasons—magnolia, prunus, bamboo, wood-peony have such connotation. I first found examples of wood-carving in depth, finished on one side and left "selvage" on the other, near the Cave Mountains on the edge of the plain, some three years ago. I followed up this clue until I found these real pieces. These are so similar to the *ramma* of Japan that independent origin is extremely unlikely. There is a strong tradition back of such carvings. I suggest that there has been but little break in the carving or wood art from the days of the stone chisel that we looked at a little earlier down to the steel tools of today. The exploitation of iron not only gave China tools and chariots but stimulated the wood-workers craft. Now associated with these carvings of Ming are fine tile-ends which simulate the Imperial Flower of Japan in carved wood ends above streetdoors, in pottery. These are all found *in situ* within one hundred and twenty *li* of Chengtu. Whence came the chrysanthemum and the symbol. The carver's art has degenerated in Chengtu until today the best expend their energies upon carved bed panels, as on Mo Tsu Chieh 礪子街.

During the summer of 1916, Tai Kan 戴戡, a Kweichow soldier, burned a fifth of Chengtu City. June 11th, 1940, the Japanese burned by bombing, a small fraction of the city. Before the chairshop system was largely replaced, and opium smoking was at its height; say fifteen years ago, there were many small fires started by the chairmen as they smoked their

opium. Major fires in Kiating, Kwanhsien and in Yachow during these last five years have not been unique occurrences. Chengtu in its construction is a city of "contemporary ancestors," where we have patchwork and crazyquilts of building operations during these last three centuries; e.g., South Gold-beaters Street is about two hundred and fifty years old, while the First or Second Alley east of the South Gate is less than twenty-five years old.

I have introduced the preceding paragraph prematurely, so as to bring out the following principle: Do not invent magical explanations for the past, but extend present day forces and principles. Merely multiply these by slow time and broad space, by the ambitions and pride of men, by man's artistry, vanity and love of beauty. We understand the past by understanding the present.

Very recently I found a marvellously carved stone Buddha of the Sung tradition that had been beheaded and buried for many years, since the destruction of Chengtu by Chang Hsien-chong 張獻忠. At the South Gate one has seen many lotus pillar pedestals from stately Ming temples. I am suggesting that Chengtu under the Ming and under the Sung was a city of stately buildings, of undreamed of color (by most of us), of marvellous roof lines, of surpassing beauty. I have seen frescos in colors, I have seen drawings in monochromes, I have seen grace and expression that pierce "with the pain of beauty," beyond previous experience. These findings in Szechwan demand explanations in terms of contacts, in terms of religion, in terms of artistic heritage. We have to think in terms of a dynamic that we do not find in present-day Buddhism, in these regions.

Near the new south gate 復興門 of Chengtu are two sites of mounds in which are to be found several kinds of roof pieces, roof tiles, facades, of glazed materials that we just do not do today in Chengtu. The two-colored greens of the eastern mound are similar to the fresco on the Ming Temple that I found last summer. I also found a similar picture on silk with the two-green tile roof of the Sung. There have been at least four fine temples on these two sites, and besides a pagoda quite near by. Such monuments give a suggestion of the gloried past of Chengtu.

There have been other destructions in Szechwan besides that of Chang Hsien-chong in the early part of the 17th. century. The Taiping rebels cut a swath of destruction across Szechwan. The two robbers from Canton and Yunnan provinces made a last stand on the mountain of Tan Chin Shan 担經山 near Penghsien at that time. We can understand some of the local situation at Pailuting 白鹿頂 by reading of those recent times in the Penghsien gazetteer. There was the Red Invasion

of only a few years ago and some of us have seen the "scorched earth" which they left along the upper Min River, where one could hardly find an old roof, a goat, a chicken, a cow, a horse, or a potato in 1938. We must understand Szechwan history by making vivid some of the human cataclysms of previous dynasties. The real history of China's West must take cognizance of past migrations and past disasters and past freedoms from trouble. As we go up and down these Western Provinces we can find monuments of destructions and of freedom from destruction.

Here is a good working rule, that grows out of much observation in Szechwan: When one finds a rare thing, look further in the same vicinity, for good things do not come singly, or grow up in a void. There are fine rectangular lavers, with grotesques supporting them, but the small figures are usually broken. These are found in at least five regions of this province. There has been more than one period of iconoclasm in this province.

In April I shall show some carvings in depth as well as on the surface that I know will surprise you. They would have surprised me ten years ago. But I found some clues of such work and I followed up the clues until I have found these superb carvings in three regions. I finally found a man who could reproduce these with something that approaches the old technique, but even he falls short of the originals. Then there are colors and color contrasts that are rare. These bespeak the cardinal points, seasons, and an imagery that surpasses that of those who do not think in terms of symbolism.

Here is another good working rule: When a masterpiece is discovered in one medium, look for the same thing in another medium. Symbols and representation cuts across stone, bronze, clay, silk, bronze, and what not. An isolated fine art in China is an anachronism that is almost unknown.

Now the vacuum created, or rather the plenum destroyed by Chang Hsien-chong, was filled up by immigrants from Kwangtung, Fukien, Yunnan, Kweichow, and Hupeh around two hundred and fifty years ago, some earlier, some later. Mr. Liao Hsich-chang's people came in from the Hakka regions. This destruction and these immigrations explain many things in Szechwan's customs. If you go to Sinkaisze you will find the Lin family group with at least sixty families of the name within one compound wall. This is almost a unique phenomenon in Szechwan, although I have found it less pronounced in the Ching T'ang 金堂 area. If you follow the way to the southwest of Mount Omei you will find many patterns but you will scarcely find the swastica. Yet Chinese lattice in Chengtu is known as Swastica-character-flower 萬字花, because it is so common. Omei is largely octogon-square in pattern as its carpentry comes out of the Ming and before.

Here there was not the general destruction that Chengtu had in those times. In Chengtu we have had closer contacts with Persia via the Kansu Corridor. Mazdaism has left its mark in Szechwan symbolism more than once I am sure.

As one goes up and down the province of Szechwan one finds so many different kinds of burial. There are barrel graves, there are Canton "Arm-chair" graves, there are gravestones of Shensi type, there are graves in caves, there are graves on mountains, and graves on plains, there are coffins of tile, of stone, of wood, and within the year we have seen coffins of the Shanghai type, due to catering to the latest invaders of this province of immigrants.

We are too near the differential immigration of the intelligentsia, the in-school-students, the influx of capital, the migration of government, the survey-atmosphere, the project idea, the resistance-set-of-mind of 1940 A.D., to properly assess their implication and their eventuations; but we are not too near these to receive stimulation so that we can visualize such similar experiences with many variations in the past of these western provinces when we were the haven, or when we were the oppressed. To write the history of West China we must see the destructions in this province. When I go through the formal museums, the orthodox museums, in West China I always see the things and times that are missing.

I have not spoken of the gazetteers, of the temple-histories, of the stone monuments, of many things that the historian immediately turns to for his data. I have been speaking of the monuments largely that reinforce or modify fabricated history. I have not spoken of, or more than hinted at physical anthropology, of folk lore and cultural anthropology for these have been so recently mentioned by others, I have not more than suggested the complex and ever-changing contacts. I have not mentioned the startling changes due to the steamer-navigation of hardly more than forty years, and of this influence. I have not spoken of the Mohammedans. I have not spoken of the connotation of the word *yang* 洋 that has been so fateful these last years and which speaks of contact via the sea. I have not spoken of the *hu* 胡 That comes into the language with the Ming and contacts with Persia. Kerosene, 洋油 Irish potatoes 洋芋, foreign goods 洋貨 speak of the sea route during the Manchu Dynasty and of modern times; but turnips, 胡蘿卜 beans, 胡荽 pepper. 胡椒 speak of the overland route and Persian contacts during the Ming. We of today hardly realize that the "back tier" of China today, formerly was the "front tier." But a study of the monuments and of the glories of the past brings West China and its culture into a clearer perspective.

As I push back in imagination to early man in West China, I try to think in terms of tools and vegetation, in terms of

the "tooth and claw" era, in terms of angiosperms and gymnosperms, that substratified placental life, the almost necessary background before the higher life gained a foothold. How could early man with primitive tools gain the mastery over vegetation and the root that gripped the earth? How could man collect fish? How could he compete with the animals that preyed upon the herds of the grasslands? Why are more implements found in the high lands of Tibet? Why is the Chinese language so rooted in the animal-bird-agriculture radix? (To be sure we find the oracle bones largely in Honan.) Did early West China man avoid the rainforest region because he could not man-handle vegetation without good tools? Could he more easily follow the herds of sheep, horses, cattle on the grasslands and compete with the carnivores? Did he burn the plains and the Chengtu Region and then plant quickgrowing crops, even as the tribesmen today burn mountains up the upper Min River Valley so as to obtain a better stand of medicinal herbs? I am open to find ancient charred logs as evidence in these regions, along the river between here and Kiating. As I have talked around a big subject, as I have outlined in broad strokes a subject that is still beyond any man, I am merely whetting your appetites to cooperate in a task of writing history and prehistory so that we can dissect the past and so treat the body politic with a minimum of vivisection. This is not an escape psychology, so that we can stand aside from the wars and rumours of wars. We need to learn psychology, gregariousness and man's motives and their control that we may live a better and a more satisfying life. Can we cooperate? I hope and believe we can, but we have much to learn.

Let me suggest some studies of greater or lesser significance that have not been carefully done for West China, questions that may appeal to people of various talents and inclinations.

The modern culture map of West China, with peoples, provenance, and dates.

The language map of West China, with approximate numbers of users.

The folk lore map of the several provinces.

The pattern map of embroidery, thread work, silver ornaments, etc.

The map of architecture.

The map of destructions of West China, by pests, earthquakes, local wars, outside-imposed wars.

The map of refugee periods for various centers of West China.

The trade routes for West China for various periods of contacts, with explanations concerning the "doors," and their functioning.

The results of the various differential importations and evacuations of peoples at various times and periods.

The influence of the "barriers," "passes," "cities of refuge," and the trade routes.

The effect of the expulsion or the reception of political deportees.

The various influences of differential importation and exportation of peoples and, or classes—intellectual, political, financial, working classes.

Comparisons and contrasts between the immigrations into Szechwan after the destruction by Chang Hsien-chong and at the present time, and their integration.

The studies of spoiled blueprints of Utopias may help in the projection of better blueprints, and the elimination of the school of vivisectionists in political theory and practice, and the encouragement of the band of evolutionists in social practice and cooperation.

The movements of peoples in the past, the reasons therefor, and the effects thereof.

Another line of questions may appeal:—

What have been the crops of West China? When? Whence? Why?

What has been the time of the introduction of Irish potatoes, maize, peanuts, tobacco and sweet potatoes from America, and what have these done to millet, kaoliang, etc.? What has been the effect upon the population in Szechwan, for instance?

What have been the changes in crops in West China since 1900? Effects? Why?

What has become of Indigo? What are the new crops? What are the fruits? What are the grains? What are the animal changes?

Questions in art evolutions:

The changes in the dragon, the bat, or the four-petaled flower.

The place of lacquer in West China through two thousand years.

The place of iron in West China.

Fashions in bamboo.

The carver's art.

Color, its symbolism and its use.

The function of silk and its influence upon pattern.

The variations of the swastica in West China.

The evolution of the border pattern.

The cross-borrowings in the arts.

The evolution and the emergence of new art patterns.

Questions in thought moulds:—

Fashions in ideas.

The anatomy of ideas.

The genetics of ideas.

Philosophies.

Contacts and philosophical change.

The interactions of religions:—

Buddhism through the years in Szechwan.

The local modes of Mohammedanism.

Family and communal religion.

Local variations in religion.

All of these various questions should be studied in the light of today. These questions properly answered should help in the solution of modern questions. In projecting the future, all means for putting up guide posts are worth while.

Bear with me if I outline some generalizations and tentative conclusions that are not so far from the truth:—

Psychological development is genetically continuous.

Original and new ideas are few and far between.

The time element is important in the growth of ideas.

Man is an imitative animal.

Ideas are pervious and slip by customs in curious ways.

The transmission of items and ideas is horizontal across the space of the provinces, vertically across the centuries, and diagonally across the arts.

The outsider may borrow or adapt an idea or custom or art form, without the emotional content, but the insider accepts with an emotional adherence.

Continuity is more impressive than discontinuity.

Evolution in art motives, and in politics are more notable than saltation, or even revolution.

At the borders and at the intercontact zones there is the intermarriage of ideas and customs as well as of peoples.

In the change of conditions there is the speeding up of change in ideas.

In the psychological realm there is such a thing as the sowing of ideas, the cultivation of ideas, the harvesting of ideas.

Even in superstitions there are usually germs of truth.

An isolated art is a starved art, as arts grow *inter se*.

What is absent is as significant often times as that which is present.

The generations go by us, ideas and styles and bents of mind come in and go out of fashion as we live on. Life is forever persisting even as it dies. Life lives on and forms the mosaic of the years.

The losses during the interregna of dynasties have been appalling, even when the new dynasty brings in worthwhile things.

A borderland is a moving imaginary line that does not remain fixed. I state the below because the concepts sub-stratify practically everything in this paper:—

The grandest generalizations of the human mind have been: the cause-and-effect relation, the uniformity of nature, the space-time-matter-energy-continuum, the evolution of matter, the continuity of life, the genetics of thought, the intimacy of the character-action relation, individual growth, the incarnation of thought and ideals, continuity, from something develops something, from nothing comes nothing, and absolute independence of thought is classed with the perpetual motion fiction.

And it is from here that we must go on to study, to understand and really observe the West China Museum.

SOME MUMMIES FOUND IN WEST CHINA*

S. C. KUNG, S. W. CHEO, Y. T. BEH AND C. CHANG

As Egypt is famous for its mummies, a brief review of the ancient Egyptian art of mummification seems desirable as an introduction to this paper. Throughout a period of more than thirty centuries, during which time mummification was extensively practiced in Egypt, the embalmers had two definite objects in view: the preservation of the body from decay, and the perpetuation of the personal identity of the deceased.

In the prehistoric period naturally preserved mummies were probably exposed by grave-robbers in Egypt. This phenomenon may have been due to the hot, dry sand coming into direct contact with the corpse and thus arresting the process of decay. The discovery of such preserved bodies probably originated or strengthened a belief in the survival of the dead. The first real evidence of attempts at artificial mummification is afforded by a mummy from the Second Dynasty.

By the Fifth Dynasty the internal organs were entirely removed through an incision in the left flank. The corpse was wound in a series of bandages, previously saturated with a preservative, resin.

During the Middle Kingdom the method of macerating the corpse in salt solution was adopted. Till the Eighteenth Dynasty the brain was also removed through an opening in the skull. After evisceration the corpse was doubled up and placed in a container filled with a solution of salt or natron. The corpse was kept in this container for about two months. The body and skull cavities were then packed with a preservative, and the body surface was coated with a paste made of resin and fat, over which a series of bandages was applied. The eviscerated internal organs were kept in separate containers.

During the Twenty-first and Twenty-second Dynasties various kinds of incisions were practised on different parts of the body, and the introduction of sand or mud into the subcutaneous space was also tried. Thus the shrunken contour of the body was filled out to assume life-like form.

During and after the Twenty-sixth Dynasty the evisceration was sometimes performed through the anus. The mum-

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mies were then painted with different colours and artificial eyes were inserted. This method of embalming was described by the late G. Elliot Smith in 1906.

It is of interest to note that many of the details of the Egyptian procedure of mummification were adopted in other parts of Africa as well as in Australia and America, but no reference to similar practices among Europeans or Asiatics has been found. As far as our knowledge goes, the procedure for mummification practised in China was quite different from that practised in Egypt, although the Egyptian technique spread, together with various cultural elements, to other parts of the world.

The present paper deals with two series of mummies that were found in the vicinity of the West China Union University, Chengtu, Szechwan. The first series consists of the so-called "Flesh Bodies" of priests, Buddhists and Taoists, who had become "immortal" from the viewpoint of the Buddhism and Taoism. The second series includes five mummies now in the Anatomy Museum of the College of Medicine and Dentistry, West China Union University.

With regard to the first series, the so-called "Flesh Bodies" of priests, the first one, named "Tao Chen," died fifty-five years ago, and is now kept in the Chieh Yin Temple, 接引寺, North Lane, outside the old west city gate, Chengtu. The second one, named "Chung Shih Yeh," died forty-five years ago, and is kept in the Chung Ling Temple, 鐘靈寺, in the west suburb of Chengtu. The third, named "Fa Tung," died fifteen years ago, and is kept in the Kuan Yin Temple 觀音寺, in the north suburb of Chengtu. The fourth one is kept in the Shih Ching Temple, 石經寺, near the Dragon Spring Station of the Chengtu-Chungking Highway, the name of this mummy and the date of death being unobtainable. There are many of these "Flesh Bodies" in temples in other parts of China. Travellers who have visited Shantung may have seen Taoist Chen's "Flesh Body" in the temple at the foot of Mount Tai, 泰山 near Confucius' home. There is also one kept in the Pearl Cave of West Hill near Peiping.

Plate I is from the photo of the first "Flesh Body" of this series. The mud on the tip of the left thumb was removed by us so that the finger nail and the terminal phalanx came into view. As most of these "Flesh Bodies" are carefully kept in glass cases and located in the depths of a shrine, good pictures are very difficult to obtain since access to the corpse is difficult and because of the darkness in the temple and the lack of facilities to the photographers. From the appearance of this photograph one can say with certainty that it is quite different from temple images. Almost all of the latter are out of proportion; the big head, thick neck and short trunk



Plate 1. One of the so-called "Flesh Bodies" kept in Chien Yin Temple, West suburb of Chengtu.

are not balanced for the idol-makers lacked anatomical knowledge, especially knowledge of plastic anatomy so necessary for artists. Apparently it was formerly impossible to secure a scientific artist in a city like Chengtu to make artificial images as good as the mummy photographed by us.

A devoted priest to become "immortal" must go through a very hard task of "silent-sitting" and relative fasting for a long period. He is more or less in a state of hibernation, and the basal metabolism is probably reduced to the minimum. The body is extremely dehydrated and thinned to a skeleton. When a severely cold winter comes there is little chance for survival. The motive for this sacrifice is probably the belief that when a priest becomes "immortal" his body will not decay after death. A devoted priest has, therefore, the high ideal of leaving a preserved body to his successors in order to prove that he has become "immortal" and also to enhance his own prestige by leaving behind a visible sign of his achievement, the becoming of a god, a Buddha, who will no longer suffer from world bitterness and who, it is believed by the Buddhists, will never metamorphose in his next life to any animal that ranks lower than man. A devoted priest must follow the way adopted by his predecessors by silent sitting and fasting. If his life comes to an end, he will be placed in a porcelain container in a sitting position. The container is opened after three years. He is considered to be "immortal" if his body is well preserved when taken out. The body is modelled into a natural contour by applying externally some mud on the skin, and artificial eyes, eye-brows, moustache, and beard are added and decorated. Then the surface of the mud is painted in natural life colours. After dressing, the mummy is ready to be worshipped. As a rule, the temple where he died is considered a place of divine abode and, as stated above, he himself becomes one of the gods and is worshipped therein. Because of this enhancement of prestige the temple receives a great deal of incense and money by having such a "Flesh Body" to show to pilgrims and to the public.

A devoted priest often travels from one place to another, he may, therefore, die in any temple. Owing to the large income from contributions received either in the form of incense or in the form of money, from the display of a so-called "immortal," the possession of an "immortal" is of considerable importance from the economic standpoint. Either the place where he died or the place where he stayed for a long time or the place where he was enrolled as a priest may claim the corpse. Disputes therefore may arise in connection with the rightful ownership of the corpse and this may result in lawsuits. Over the one kept in the Kuan Yin Temple they had such a dispute. And for the one kept in the Chung Ling Temple they had the same trouble. This priest had been

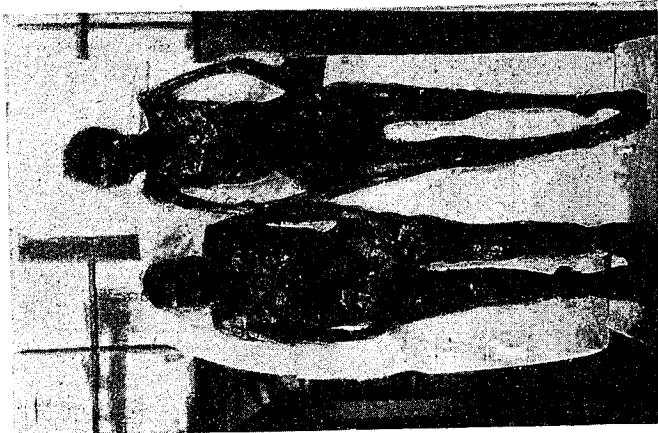


Plate III Mummies Nos. 3 and 4.

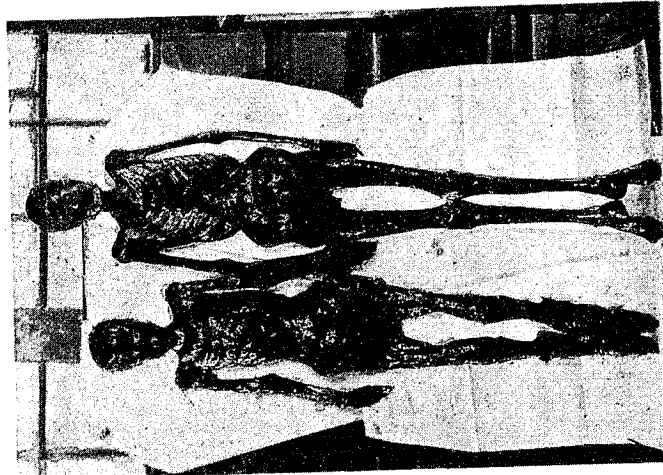


Plate II Mummies Nos. 1 and 2.

enrolled in the Chung Ling Temple but he died in the Small Fish Cave, Penghsien; and afterwards the people of the Chung Ling Temple robbed the latter of the corpse.

As to the second series of mummies, they were found accidentally in the vicinity of the campus of the West China Union University. Thousands of graves were removed by order of the municipal authorities in the early part of 1938. One of us (S.W.C.) has been interested in the study of Chinese teeth from the anthropological aspect, and was, therefore, engaged in the collection of skulls in the excavation area. In the excavated graves were discovered five mummies buried for a long time. These were brought to the Anatomy Museum of the College of Medicine and Dentistry, West China Union University.

Mummy No. 1 was found near Nan Tai Shih 南台寺 on the same level as the university campus. The coffin was made of the Hua Board 花板. This wood is obtained from fallen trees that had been buried in the earth for thousands of years and thus become semifossilized. People here consider it the best material for coffin making and believe that a body buried in such a coffin will never decay. It was very difficult for the excavators to open the coffin. On seeing the contents there was much alarm amongst the excavators as the face of the corpse and the clothes worn were all similar to the newly buried though 93 years had elapsed, according to the date in the inscription on the tomb-stone.

When one of us (S.W.C.) was approaching the coffin a peculiar odour was noticed. The face of the mummy looked orange yellow and oily. Both the eyebrows and the moustache were white. A glistening liquid was seen within the palpebral commissures. The hat, clothes and shoes were all in excellent condition; the green satin coat and blue silk quilt were shining. The clothing was removed with difficulty by the excavators. The coffin was packed with piles of bags of leaves of cedar and soft rush. Tiny white glistening crystals were found sticking to the under surface of the cover of the coffin. These were collected for analysis.

When the corpse was taken out of the coffin and the quilt underneath was lifted, a layer of charcoal about three inches thick was brought into view. The charcoal was somewhat moist. The coffin and the soil round about were all dry. Another coffin was found about 10 yards away from this mummy, the level of the ground was the same. Though the coffin was made of Hua Board, the same material as mummy No. 1, there was some water inside the coffin. The leakage was probably due to the inferior workmanship of the coffin. No odour came out of the coffin, the corpse was decayed and many insects were actively working.

Mummy No. 2 was found near Wan Jên Pei 萬人碑 (Ten Thousand People Tablets) on a level similar to that of No. 1. The coffin was made of ordinary wood. The contents were simple and dry; besides the corpse, only a pillow and a thin quilt were found which were in good condition.

Mummies Nos. 3 and 4 were found in ordinary coffins on a level slightly higher than that of mummy No. 1. The clothes and pillows were a little moist. Neighbouring dwellers said that they were buried recently.

Mummy No. 5 was found not far from mummy No. 1. The mummy was not in as good condition as the other four.

It was interesting to find a soft mummy about 25 yards from Mummy No. 1. According to the date on the tablet attached to the grave, this body had been buried for 75 years. The coffin material, the odour, the soft rush packing, the charcoal bottom lining were the same as those of mummy No. 1. For certain reasons the whole body of this mummy could not be obtained, only the head was removed. In doing so it was found that the muscles of the neck were reddish, the nerves and the blood vessels were similar to those of embalmed cadavers in the dissecting room. When the mummy was lifted, it bent at the loin.

The crystals collected from the coffin of mummy No. 1 were examined by Mr. D. R. Feng. His report reads:

The material examined consists of small, white, transparent, lamellar crystals, colourless and slightly alkaline in reaction. They are not soluble in cold water, nor in cold sodium hydroxide, but are slightly soluble in hot water and alcohol. No smell of ammonia is given off when heated. They dissolve in concentrated sulphuric acid yielding a yellow colour which becomes orange red when slightly heated. They do not char but melt away and sublime. The melting point is between 105°-106°C.

The substance does not contain nitrogen, arsenic or mercury. As the amount of the material sent for examination is very small further tests cannot be carried out. Therefore, its exact chemical nature has not been determined.

A further examination was carried out by Dr. K. Y. Yü, who has ascertained that the crystals were resin. His report reads:

The substance is insoluble in water and petroleum ether but is soluble in alcohol, ether, glacial acetic acid, oleic acid, and turpentine. On heating it gives off light yellow fumes with a turpentine-like odour. A known sample of resin was employed for making confirmatory tests at the same time. All the above tests conform to those given for resin in the Chinese Pharmacopoeia.

The small amount of crystals of resin found on the under surface of the cover of the coffin most probably came from the cedar leaves used for packing. It may help in preservation but only to very slight extent because it is used in thousands of coffins and only very few corpses became mummies. These five mummies were all clothed in ordinary costume except the fifth whose body was bandaged in a series of silk bandages which showed no presence of preservatives. A thorough examination for incisions in the flank, perineum, or scalp through which evisceration might have been done, was made but none of them revealed any such.

On autopsy of mummy No. 5 which was not as well preserved and considered to be valueless as a museum specimen, it was found that the internal organs were all clearly recognizable although the wall of the intestine was as thin as rice paper.

From a histological study Dr. H. J. Kang reported that the parenchymatous tissue of the intestines was no longer recognizable as such; nevertheless the connective tissue and the collagenous fibres were evident, although the nuclei of the connective tissue cells were recognizable.

It is evident that this mummy was not as well preserved as the Egyptian mummy, dated about 1490 B.C. and reported on by Shaw (1938). In his mummy the well preserved parenchymatous tissue had undergone so little change that the cytoplasm of unstriped muscles, liver cells, fat cells and the epithelial cells of the bronchi, intestines and gall-bladder was clearly visible although the disappearance of the nuclei in his specimen was just the same as in ours.

CONCLUSION

The so-called "Flesh Bodies" of priests in China were seriously dehydrated, artificially desiccated in our estimation, by taking very little if any food before death which as a rule took place in an intensely cold winter whereby the process of decay was completely arrested. The embalmers in China had the same idea as the Egyptians of making the body more life-like, but they applied the mud externally on the skin of the deceased to be mummified instead of introducing it subcutaneously, which was the Egyptian practice.

The mummies discovered in graves in China were not eviscerated as in the ancient days in Egypt. On one mummy of our series we found external bandaging which also was practised by some of the Szechwanese and the Mohammedans in other parts of China. This is the only procedure similar to those in Egypt. The bandage wrappings might prevent the body from being in direct contact with the air which might have some putrefactive influence in it. The deceased might

have suffered from some kind of chronic disease and become very much emaciated; and it is common for this kind of person to die in a severely cold winter, and the process of decay consequently be arrested to some extent.

The type of soil in the grave yard may also have something to do with a body in the process of mummification. In Szechwan Province the people use the following practical method for determining whether the soil is suitable for mummification purposes. A jar filled with eggs is buried in the proposed grave yard. In a year or so the jar is exhumed and if the eggs have undergone no change, the spot is considered to be good enough for burial.

As far as the available evidences goes these two series found in West China were naturally preserved.

SUMMARY

1. The mummies found in West China were not eviscerated.
2. As to the possibility of preservatives having been used a further study is necessary.
3. Dehydration of the body before death may have something to do with the natural preservation of the body. This may also be associated with a lack of putrefactives in the intestines from a relatively long fast.
4. The coldness of the weather, the fine Hua Board coffin, the charcoal laid on the bottom of the coffin and the soft rush packing (moisture absorbent) may play a certain role in the mummification.

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SOME CONTRIBUTIONS OF PHYSIOLOGY TO ANTHROPOLOGY*

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The science of anthropology has ambitiously included almost every aspect of man and his environment within its widespread domain. Social anthropology claims practically every phase of man's cultural life as its legitimate field of investigation. Art and architecture, language and literature, religious beliefs and practices, social customs, styles of dress and coiffure, methods of work, play and warfare are all called upon to contribute to its development. Physical anthropology derives its data from minute and exact measurements of almost every feature of man's body, and has accumulated an enormous amount of information regarding the physical similarities and differences among most of the races of mankind. It is peculiar, then, that physiology has made no important contribution to anthropology until very recently.

Although medical men have been widely distributed over the face of the earth for many years it has been seldom that they have noted any significant racial differences in physiology. It is true that physiological data are much more difficult to secure than are anatomical. The evidence for functional differences between races is more fluctuating and intricate, and it requires more patience to assemble. Such simple so-called constants as pulse rate, body temperature and blood pressure are subject to continual variation. All may be affected by the emotions so that the scientist who works among people who have not accommodated themselves entirely to his presence will be unable to secure reliable or constant results.

A few years ago I was interested in recording the degree of variability that obtained for blood pressure determinations made on healthy persons examined at different times. The physical examination records of fifty students were compared for four successive years. These students had been examined by the same person using the same instrument on all four occasions, and yet the average blood pressure varied considerably from year to year. An attempt was made to correlate the height of the blood pressure with the degree of nervous tension to which the students might have been exposed, and certainly it is not beyond the realm of possibility that such factors as the political situation, the proximity of academic examinations, the relaxation caused by the long summer

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vacation, may all affect the blood pressure of the student group as a whole. Alvarez in the United States found that the average systolic blood pressure of freshmen entering the University of California each year varied significantly. However, he made no effort to correlate the variation with any environmental factor. A few years ago one of my students kept a record for a month of five normal persons, each person being examined three times a day. In that case also a very considerable degree of instability was found. For example, one person showed a maximum of 128 mm. systolic and a minimum of 92 mm. For the same person the diastolic pressure varied from 89 mm. to 60 mm. of mercury.

Consequently we must bear in mind the variability of physiological constants as opposed to anatomical ones. Unless an observation has been repeated upon a sufficiently large number of people to rule out such transient fluctuations, or unless the experiment has been properly controlled by parallel observations on individuals of another race and made under identical conditions, we should hesitate to see significance in minor variations from an accepted norm.

In addition to psychic factors which may considerably alter body functions, the physiologically minded anthropologist has to consider, also the effects of the external environment. Climate, altitude, housing conditions, clothing, dietary habits, may all affect the physiology and the pathology of a race to such an extent that it may be exceedingly difficult to differentiate between racial features based on fundamental genetic structure and those which results from environment. In fact, even anatomical measurements may depend to a great extent upon such external factors. Who is to say that the Chinese of Shantung is inherently taller than the Chinese of Kwangtung? Were both living under the same environmental, dietary and social conditions it is quite conceivable that they might reach a common height. The extent to which environment may affect height is seen in the greater growth of Chinese and Japanese, born and brought up in California or in Hawaii, as compared with their ancestors and contemporaries who have remained at home. In fact, with our present understanding of nutritional requirements, practically every race that is applying the available knowledge is increasing its stature. The modern average Englishman cannot get into a suit of armor worn by the valiant knights of a few centuries ago, and each generation of Harvard students exceeds the stature of its parents. On the other hand a few years ago we found that the Hua Miao living in certain localities were shrunken and deformed with ankylosed joints and spines. Water samples were brought to Chengtu and analyzed for me by H. B. Collier. He found a high fluorine content wherever this condition prevailed. A further effect of fluorine, as is well known, is mottling of the enamel of the teeth.

Thus we see that the physiologist who wishes to investigate the racial aspects of his subject may find it very difficult to dissociate environmental effects from inherited characteristics. Physiology, therefore, has made relatively few contributions towards the solution of one of anthropology's main problems, viz. a suitable classification of the races of mankind. With a proper understanding of the difficulties involved it is probable that the physiologist will be able to contribute his share to the science of anthropology at an accelerating rate. The field of racial physiology can be approached from many different angles. We shall mention some of those which have been tried thus far, but describe in somewhat more detail the one or two problems that have interested us most in Chengtu.

It was natural that the pulse rate, a most easily measured physiological phenomenon, should have been the first in which any significant differences between races were discovered. Hrdlicka some years ago found that the North American Indian has a pulse of about 60 per minute. This is about ten beats less than the accepted average for the white race. Since then it has been shown that the Maya of Central America also have a slow pulse. The Hua Miao of Kweichow, as determined on one of our expeditions, similarly have a low pulse rate, averaging only 55 per minute under so-called basal conditions. This would be about the equivalent of 60 in the Indian recorded under ordinary circumstances. All other races are, so far as I am aware, equipped with hearts that beat at a more or less uniform rate, viz. in the neighborhood of 70 per minute.

The blood pressure is another easily measured factor, and it too has now been studied in various races for many years. By arterial blood pressure we mean the tension in the walls of the arteries occasioned by the contraction of the heart. This is at its maximum, or systolic pressure, when the heart is contracted, and drops to a minimum or diastolic pressure when the heart is relaxed between beats. The height of the diastolic pressure depends upon a number of factors, perhaps the most important of which is the elasticity of the arterial wall. In a perfectly rigid system of pipes through which water is being pumped the pressure falls to zero between strokes of the pump. This extreme drop is avoided in the arterial system by having the walls of the blood vessels elastic. In elderly people with hardening of the arteries much of the elasticity is lost, and consequently the difference between the systolic and diastolic pressures is greatly increased. In racial studies so far made not only have certain races been found to have lower blood pressures than have others, but what seems even more significant from the point of view of health, is that the blood pressure does not increase with age in some of these races. To what extent low blood pressure is the result of environment and to what extent it is an inherited racial characteristic is still an open question. For instance, it is generally believed

that the blood pressure of the Chinese is lower than that of the white race. However, it has been claimed also that the blood pressure of both westerners and Chinese is lower when living in China than it is when living in North America. Such conclusions are open to grave suspicion, for the conditions under which the blood pressures were recorded in America and in China were very different, and the variations found were not beyond the possible limits of those caused by emotional factors. To what extent diet, climate and other external environmental factors influence blood pressure has not yet been settled, but it does seem probable that they do play important roles. Possibly the social environment is even more important than the physical, for the nervous tension under which business and professional men live in our modern mechanized civilization is extremely great. It is now a widely accepted belief that during emergencies the sympathetic nervous system is called into generalized action, and that this action is further sustained by an increased rate of secretion of adrenalin. One effect of such action is arterial hypertension, and when the blood pressure is constantly maintained at the emergency level a permanent alteration in the physiology of the individual may be expected. When a whole race lives under a state of permanent physiological emergency we may come to recognize as racial, characteristics which have been produced by environmental factors. How long such characteristics may persist when the environment changes is unknown. But there are many who believe that westerners with high blood pressure who come to live in the interior of China do show a fall in pressure, even though they may be working hard and living under considerable tension. Is this decrease in arterial pressure due to a changed geography, or is it due to the lack of mechanized civilization with its attendant noise, speed and nervous strain? This question has not been settled.

In our studies in West China we find that all three races investigated, viz. Chinese, Nosu and Miao, have blood pressures that average distinctly below the accepted western standards. With the two primitive races, the Nosu and the Miao, not only is the pressure low but in the older age groups it actually tends to decrease to still lower levels with advancing years. Donnison has shown the same to be true of primitive races in Africa. It is stated that the fishermen of Cape Breton practically never have arterial hypertension. They live a strenuous life, but a simple one. Evidently then, the average height of blood pressure may depend more upon environment than upon race. But that environment is gradually making a permanent impress upon human physiology is also quite possible.

Vital capacity is another physiological measurement that has already been studied in numerous races. By vital capacity we mean the volume of air that can be forcibly expelled after

the deepest possible inspiration. Many textbooks place this at about 3700 cc. for the average adult white male. Comparative studies have shown that Negroes, Chinese, Siamese, Filipinos and the peoples of India and Syria all have smaller vital capacities. A study of the records obtained at the annual student physical examinations in Chengtu reveals the fact that the average vital capacity in the Chinese male student is nearly 500 cc. less than the so-called standard. Chinese women students show an even greater discrepancy, which is not only absolute but also relative to their height, weight, chest circumference, and surface area.

In recent years a considerable number of physiologists have turned their attention to the measurement of basal metabolism in different races. The Carnegie Nutrition Laboratory, under the direction of Dr. F. G. Benedict, has especially interested itself in this aspect of physiological anthropology, and has assisted a number of investigators to study the basal metabolic rates of different racial groups. By basal metabolism we mean the individual's minimum heat production measured about 15 hours after eating, with the subject in a state of complete physical and mental relaxation, but not asleep. It represents the energy expended to maintain necessary vital functions, such as respiration, circulation, peristalsis, muscle tone, body temperature, glandular activity, etc. Probably standard metabolism would be a better term than basal metabolism, for under the conditions defined the metabolism of the individual is not at the lowest possible rate consistent with life, for sleep lowers it by about ten per cent. The basal metabolic rate may be measured directly by enclosing the subject in a calorimeter and determining the actual heat output, or, as is more usual, it may be measured indirectly in terms of the oxygen consumed. From this latter value the energy output in calories may be calculated. For the most accurate type of work not only must the oxygen consumption be determined but also the carbon dioxide output. From the ratio between these two, which is known as the respiratory quotient, we may learn the type of fuel being consumed in the body, that is whether it be mainly carbohydrate, fat or protein. The heat value of each cubic centimeter of oxygen varies with the type of fuel being burned. But for all ordinary purposes we assume a mixed fuel consumption, and base our calculations upon it.

Many types of apparatus have been evolved for the estimation of the basal metabolic rate. However, in recent anthropological studies the field apparatus of Benedict has been widely used. It is readily portable, is sufficiently accurate, and is extremely simple. We have used it for most of our studies in West China.

Various standards have been worked out, mostly for the white race living in the north-eastern section of the United States. According to these standards the amount of energy required to sustain life is due either to the mass of active tissue in the body or to the extent of surface area of the body from which heat is lost. A good deal of controversy has gone on as to which is the more accurate way to arrive at a standard, and today probably most clinicians use the surface area standard. A rough average for the basal energy requirement is 40 calories per hour per square meter of body surface. Since, however, the body surface is not measured but is calculated from height-weight formula one does not see much meaning in the controversy. It would seem just as logical to base our standards directly upon a height-weight formula as to use this formula to first calculate the surface area of the body. And; in fact, much scientific work is based upon such a direct height-weight standard, the Harris and Benedict standard. Of course when a comparison is made between different species of animals whose body size varies enormously, as with the elephant and the mouse, it is obvious that heat production must be controlled to a great extent by the heat loss, which in turn depends upon the relative body surface area from which heat may be lost.

Other factors, in addition, are known to modify the basal metabolic rate. Among these are sex, age and disease. Only recently have race and climate been shown to be factors. Naturally it is difficult, if not impossible, to dissociate these two completely. Environment and heredity are so intimately bound together that to separate the man from his environment altogether is often to make a different man of him.

Since the publication in 1925 by MacLeod, Crofts and Benedict of a paper on "The basal metabolism of some Orientals" living in the United States, the question of the influence of race upon basal metabolism has attracted the attention of an increasing number of investigators. Earlier findings by de Almeida of low basal metabolic values in people of both native Indian and Spanish descent living in tropical South America were usually explained as due to climatic influence. That his results were contrary to those obtained at an earlier date by Eijkman was pointed out by the latter, who contended that the basal metabolism of both Malays and Europeans living in Batavia was not significantly different from that of the white race in Europe. Although these earlier observations were not in agreement, it soon became evident that climate does have a definite influence upon certain physiological processes. For instance, Hindmarsh reported that the average basal metabolic rate of white students in Sydney, Australia, was 7.6 per cent for men and 8.6 per cent for women below the Harris-Benedict standard. These low rates

were attributed to the effect of the warm climate in Sydney. Radsma measured the basal metabolism of Europeans shortly after arrival in the tropics, and again at later dates. He claims that shortly after arrival the basal metabolism is considerably depressed, but that a partial recovery later occurs, so that after complete acclimatization the average depression is only 3.0 per cent. Mason maintains, too, that about 5 per cent of the lowering in metabolic activity of the people of tropical India is due to climate, the remainder being presumably a racial trait. That climate is an important factor in modifying so-called physiological standards cannot now be doubted.

That race also affects physiological processes is undoubtedly true, and Benedict has pointed out in numerous publications that human metabolism is now a legitimate field of study for the anthropologist. A number of expeditions to Yucatan in Central America have established the fact that the Maya race has a higher normal basal metabolic rate than has the white race. A similar relatively high rate of basal metabolism has been reported for the Araucanian Mapuches of Southern Chile. Observations in other parts of the world show that various races living in India, the Philippine Islands, and Australia apparently have basal metabolic rates lower than the generally accepted standards. On the other hand, it is claimed that male Japanese possess a basal metabolic rate that is not significantly different from that of the white race.

Most of the published work on the Chinese indicates that they have a basal metabolic rate that is slightly lower than the Harris-Benedict standard. Earle reported that the basal metabolism of Chinese living in Hongkong and Shanghai was low. Necheles has also reported a low basal metabolism for Chinese living in Peiping and in the United States. Benedict and Garven in Manchuria and Benedict, Kung and Wilson in Peiping have also reported an average basal metabolic rates of approximately 4 per cent below western standards. Benedict and Meyer from a study of American-born Chinese girls living in the United States concluded that their basal metabolism averaged 9.2 per cent below American girls of the same age. Their conclusions have been challenged by Wang, who contends that a greater diversity exists in the basal metabolic values for white girls of different age groups and between white girls from different sections of the United States than appears between the two races.

Our observations have been carried out as a part of the worldwide survey of basal metabolism undertaken by the Carnegie Nutrition Laboratory. The apparatus used was supplied by the Carnegie Institution, and F. G. Benedict, director of the Nutrition Laboratory, carefully checked all results. The details of this work have been published elsewhere.

In our investigations the basal metabolic rates of 54 Chinese males, 14 Chinese females, and 26 Anglo-Saxons (5 males and 21 females), living in Szechwan, were determined at intervals from December 1928 to April 1935. The subjects, the majority of whom were students, were all volunteers. The average percentage deviations from the Harris-Benedict prediction standards obtained were: Chinese males, +1.9; Chinese females, -3.7; Anglo-Saxon males, -0.3; Anglo-Saxon females, +1.8. These results indicate that the Chinese living in Szechwan have a basal metabolic rate that differs but little from the accepted standards for the white race living in North America or in Szechwan. Chinese females of West China do appear to possess a basal metabolism that is slightly lower than that of white women living in the same region, but the difference is slight.

If it be accepted that the Chinese of Szechwan are of the same racial strain as those studied by others in North and East China an explanation of the different result obtained in West China is necessary. It is suggested that this may be found in the environment prevailing from 1928 to 1935. People living in what for years was the most unstable unit of the Chinese republic might conceivably have had their basal metabolic rates elevated through nervous tension and emotional strain. The excessive heat loss of the winter months may also be a factor, for in a highly humid climate the heat loss at temperatures below 60°F. becomes increased unless there is sufficient protection by adequately heated buildings or clothing. The scanty use of wool in clothing or bedding may result in excessive heat loss, and consequent increased metabolism to compensate and maintain body temperature. The rate of metabolism may become pitched at a higher level which might carry over into the warmer months of the year. It has been shown that rats which have been accustomed to living in the cold soon acquire a higher rate of basal metabolism, and this increased heat production continues even after the rats have been replaced in warm surroundings. The Chinese in Szechwan live in unheated buildings, and the high relative humidity must result in a high heat loss from the body through the greater conductivity of moist air. Whether the addition of wadded garments can entirely prevent this increased loss is doubtful. Also, how long the resulting elevated basal metabolic rate would persist is unknown. But certainly this greater heat loss during the winter months may be a factor responsible for the higher metabolism of Chinese in West China. Westerners studied in Chengtu did not show an abnormally high rate of basal metabolism. Since they would not be as subject to the effects of an unfavorable political environment, nor would they show increased heat loss in winter because they live in heated houses and use woolen

clothing and bedding, the determination of their basal metabolic rates is regarded as a control experiment. They give us a means of comparison, and so make our results much more significant than they otherwise could be. They enable us to state that the Chinese of West China exhibit a basal metabolic rate slightly higher than that found in other parts of the country, and assuming that no racial difference exists, this relatively high rate of metabolism must be due to environmental factors which have in this respect been able to affect the physiology of the race.

We now turn to our studies on the basal metabolism of the Hua Miao of Kweichow province.* This study was made in the summer of 1934. A field metabolism apparatus was taken from Chengtu to Shih Mên K'an 石門坎 in the province of Kweichow, and there set up in a house belonging to the English Methodist Mission. In all 24 Miao were studied, and an average basal metabolic rate of 15.8 per cent above the Harris-Benedict standard was obtained. No subject possessed a rate below the Harris-Benedict standard, even though the pulse rate was very low, averaging only 55 per minute under basal conditions. This condition is highly reminiscent of the Maya of Central America. Although these results were obtained under field conditions and are therefore less likely to be accurate they have in general been confirmed by more recent studies on a number of Ch'uan Miao carried out in the laboratory in Chengtu.

The question next arises as to whether this relatively high basal metabolic rate shown by the Miao is an inherent racial characteristic or the result of some environmental factor. It is possible that a relatively high rate of heat loss may be responsible for a part of the increased rate of heat production, for the Miao live under rather primitive conditions and sleep on the mud floors of their huts. At a relatively high altitude (approximately 7000 feet) the nights are cool, and the heat loss under these conditions must be considerable. However, it seems very unlikely that the raised rate of basal metabolism can be entirely the result of a compensatory effort to balance increased heat loss. It is much more likely that it is at least in part a racial characteristic.

We may find it interesting to speculate a little regarding the significance of a low or a high basal metabolism. If the basal metabolism truly represents the energy required to maintain life in the relaxed but waking state, then it may be

*It affords me real pleasure to record my gratitude to Dr. C. E. Tompkins of Suifu and to Rev. W. H. Hudspeth then of Chaotung for great assistance rendered in many ways, and also to Mr. H. C. Chu, Dr. Y. Yen, Dr. C. L. Ngan and Dr. W. R. Morse, my travelling companions in this expedition whose constant help and companionship were invaluable.

taken as an index of the efficiency of the human machine when the engine is idling. The lower the rate of metabolism the less the cost of living. Possibly the reputed low metabolism of the Chinese is but evidence of their efficiency, of the ability to keep body and soul together on less than other races. Perhaps this is one reason why they have triumphed over the less efficient Miao who required about 15 per cent more fuel to survive. Did the Maya of Central America also fall behind in the race for survival at a time when population pressure had made economy a necessity? It has been stated that the low basal metabolic rate of the Chinese is due to the fact that he can relax completely during the experiment, that in fact without falling asleep he can so closely approximate the sleeping state that his metabolism falls to the sleeping value. That there is no significant difference between the sleeping and relaxed but awake Chinese it is impossible to believe. The results of some experiments carried out here by D. F. Pen have failed to confirm this interesting hypothesis. Mason in India, has also proved that the Indian woman, who has a very low normal basal metabolic rate, nevertheless relaxes still further when she falls asleep.

If we allow our imagination to take flight into the realm of uncontrolled speculation we might suggest to the would-be world conquerors of today that they should first survey the basal metabolic rates of their prospective victims and then confine their attentions to those races who have less efficient bodies than their own, as indicated by higher basal metabolism. Otherwise, even though a temporary victory might be won they must expect to be displaced eventually by the race that is physiologically more efficient. Of course it is not suggested that the mechanical efficiency of the body is the only factor, nevertheless it is an important one. So far psychologists have failed to discover that any one of the major races of mankind is intellectually notably superior to any other. Hence, with practical intellectual equality, survival value might be more closely related to physical efficiency than we might imagine.

Of the various physiological constants so far discussed we have noted that we cannot entirely dissociate environment from heredity as factors in their control. However, there are a number of other biological approaches to the racial problem in which we can restrict ourselves much more closely to the measurement of hereditary characteristics. One of these is color-blindness. This condition shows a decided difference in its incidence among the peoples of different races. For European and white American males the average incidence is about 8.1 per cent. A few years ago Y. T. Beh made a survey for me of a large number of students in Chengtu. The results of this survey combined with a similar one in North China indicate an average color-blind incidence of 6.4 per cent for

male Chinese. For American Jews the figure falls to 4.0 per cent, for American Negroes to 3.5 per cent, for Mexicans to 2.3 per cent and for North American Indians to 1.8 per cent.

Turning to another of the special senses, taste has been made the subject of racial comparison in a few cases. For instance, the substance known as phenyl-thio-carbamide tastes bitter to most people, but is tasteless or even sweet, salt or sour to a certain proportion. It has been shown by Blakeslee and Salmon and also by Snyder that the failure to taste this substance as bitter is inherited as a Mendelian recessive characteristic. The investigation of this type of taste-blindness has been undertaken by a number of workers who have shown in racial surveys the following order of decreasing acuity of taste for phenyl-thio-carbamide among some of the races investigated: Chinese, Indians, Negroes, Egyptians, Jews, American Whites, Arabs.

Other sensory deficiencies should be sought, and if found, applied to racial studies. For instance, Blakeslee has indicated a variety of odors, chiefly from flowers, toward which different individuals react differently. It has been pointed out that a realization of these sensory peculiarities makes one more tolerant and as Parr has said "Spinach may actually taste as badly to some children as they pretend, and the finicky husband who at the table is the despair of his wife may be not merely stubborn after all."

The question of racial odors is one which has as yet received but little scientific attention, although numerous allusions to the subject have existed in general literature for hundreds of years. In any scientific investigation of this delicate subject, popularly known as B. O., careful distinction must be made between odors which are truly racial and those which result from special habits such as the use of soaps or cosmetics, dyes in clothing, careless hygiene, squalid living conditions, articles of diet or even disease. Since the detection of a true racial odor must be a subjective matter it will be difficult. Possibly use might be made of the dog's greater ability to distinguish odors, and so arrive at a canine classification of mankind. I recall the statement of McGovern that one of his greatest difficulties in avoiding detection when he travelled to Lhasa in disguise was that he could not deceive the Tibetan dogs even though he had the people completely hoodwinked.

Races also differ functionally in their reaction to some drugs in addition to those already mentioned which act upon the sense of taste. This problem has not been investigated very extensively although it has been a long-held popular belief in certain quarters that Eastern peoples react to such narcotics as opium and hashish differently from the white race, quantitatively if not qualitatively. I am aware of only one

scientific publication on the subject of racial pharmacology. Chen and Peth have demonstrated quite conclusively that the white, yellow and black races differ in the extent of their reaction to certain mydriatics, and that the difference is roughly inversely proportional to the degree of skin pigmentation, pupillary dilatation being greatest in whites, least in negroes and intermediate in members of the yellow race.

Finally we may mention another phase of physiological investigation that has been applied rather widely in recent years to racial studies, and that is blood grouping. In general, mankind falls into four great types depending upon the ability of the blood serum of one individual to agglutinate the blood cells of another. To explain the reactions obtained when the blood of two individuals is mixed Landsteiner postulated the existence of two specific substances in serum, which he called iso-agglutinins, and two substances in the corpuscles, which he termed iso-agglutinogens. The two former are usually represented by the Greek letters alpha and beta, and the two latter by the capitals A and B. A given serum may contain one, both or neither iso-agglutinin. Similarly the corpuscles may contain one, both or neither iso-agglutinogen. For agglutination to occur when two bloods are mixed alpha and A must both be present or beta and B. Thus we have four groups, as follows:—

Group I, now usually designated as O, in which neither A nor B is present in the corpuscles, but the serum contains both alpha and beta. The corpuscles of this group cannot be agglutinated by any serum, but its serum agglutinates any corpuscles containing either A or B.

Group II, which may be designated as A since its corpuscles contains A, but its serum contains beta.

Group III, or B, since its corpuscles contains B, but the serum contains alpha.

Group IV, or AB, so-called because the blood cells contain both A and B, but the serum contains no isoagglutinin.

These four groups are now well-known because of their usefulness in blood transfusions and also through application to medico-legal problems. The blood types are fixed biochemical entities, not subject to change once formed in the child. They are the result of known hereditary laws, and thousands of tests have now been performed the world over. Racial studies indicate that pure American Indians fall into Group O. Relatively high concentrations of A exist in north-west Europe and of B in Hunan, China. One hypothesis is that America separated off from Eurasia before the mutations A and B occurred. However, in 1933, Matson reported results on a hitherto untyped group of Indian tribes which demonstrated a high value for group A. Apparently then there was

a mutation of A in America as well as in Europe, or a second migration. About 1000 Chinese were typed a few years ago by one of my students, R. C. Lo, and the following distribution found: O, 37.4 per cent; A, 29.9 per cent; B, 20.3 per cent; AB, 12.4 per cent. C. H. Yang, working under W. R. Morse, has also typed a number of Ch'uan Miao and obtained a considerably lower percentage of A and a higher percentage of B. Since the Miao were once inhabitants of Hunan they may have left their impress upon that province.

Some other interesting results have been obtained elsewhere from blood group surveys. For instance Parr states that it is now more accurate to speak of the Jews as a religion than as a race. This is extremely interesting in view of the widespread anti-Semitic agitation in certain countries today. It seems to be based on a myth. On the other hand blood-typing tests show that the Gypsy has retained his original racial identity, although he has been centuries separated from his ancestral home.

This review has entirely neglected certain comparative studies that have been made in the realm of immunology, in the comparative resistance of different races to disease. Such observations are still in their infancy. However, we may remind ourselves that the early medical missionaries to China were greatly impressed by the relatively high immunity of the Chinese to pyogenic infection. The Arabs are reported to be infected almost universally with a spirochetal disease called bejel. Whether this is syphilis modified by race or syphilis modified by environment or whether it is syphilis at all are questions that do not seem to have been finally settled. But we must admit that by analogy with different species of animals we should expect that men of different races might present quite different pictures of pathology. Our concentration of attention for the past several decades upon bacteria and other parasites as the cause of much disease has made us lose sight of other, and perhaps very important, factors in the distribution of the ailments to which the flesh of man is heir.

Anthropology then from being the private preserve of the anatomist and the sociologist is broadening out. The physiologist, the biochemist, the pathologist and also the general medical practitioner each has a part to play before we can hope to solve the riddle of man and arrive at a proper classification of the races of mankind.

SZECHWAN FISH

CORA D. REEVES*

A. Introduction.

In trying to present so interesting a Natural History topic as the Fishes of Szechwan, I would at once call attention to the extent of the area indicated and especially to the diversity of conditions its waters offer as types of environment for aquatic forms. Fish, as is the case for all other animals, only live where conditions are fit, or said differently, under those conditions to which they are adapted or to which they may be able to adapt themselves. Whether we consider the "Fitness of the Environment" as does Henderson or the "Adaptation of Fishes" we come to the same need for agreement of life with its surroundings, and to that major problem which all the world has to face, the adapting of life to the conditions of existence, be those conditions need for oxygen, or food, or need for nesting sites, need for means of locomotion, or for protection from enemies, we will give our attention. I shall not be able to present these larger topics of the learning and of habits of fish about us as I may sometime do, because time in the field requires more leisure from other duties than teachers under present conditions can hope to secure.

As to what fish are here to be studied—H. J. Shih of The Science Institute of West China has compiled for this province a list of fish:

2	sturgeon	Ganoids.
2	sardine or herrings	Clupeidae.
102	carps and minnows	Cyprinidae.
22	loaches	Cobitidae or Homalopteridae.
24	catfish in 4 families.	
1	sucker	Catostomidae.
2	Cyprinodontes	
2	rice field eels	Flutidae.
2	eels	Anquillidae.
1	snake head	Ophicephalidae.
4	mandarin fish	Epinephelidae.
2	gobies	Gobiidae.

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This list necessarily will change with further study for new or rather undescribed forms will be found and in other cases the same fish will be found to have several names.

*Ginling College, Chengtu.

B. Fish of various orders.

Among the ganoids with not the usual type of scales but with a set of bony plates on dorsal surface and sides, is the sturgeon. We all know this large river fish with mouth on ventral surface, with tentacles, and with well developed tail fin on the dorsal face of the caudal peduncle, so that the tail fin is very asymmetrical. These are fast swimmers, bottom feeders, well protected by their bony scutes. The sturgeons are in Szechwan; they range from Western Europe to Eastern Siberia and south to Canton. They cross Canada and Northern United States and extend south to Florida. The spoon bill, paddle fish, is also found in this province. It is a ganoid with small teeth in both jaws, with small imbedded scales. It has a long spoon or paddle-shaped snout which thins and narrows as it extends out in front of the small eyes to a distance half the length of the fish. This mud colored species is a most unwieldy shark-like looking fish with its curved ventral mouth ready to close upon shrimps or other things, which its long sentive paddle-like snout disturbs as it roots about in the mud. The small eyes would be quite useless in a cloud of bottom mud stirred up while seeking food. As to where its eggs are laid or of its breeding habits I have found no note. Its nearest relative occupies the Mississippi River as it inhabits the Yangtse River.

Snake heads are so called for the tops of their heads look like those of a snake. They have reticulated brown-patterned bodies and often an ocellated spot at the base of the caudal. One easily appreciates how a rattle-snake or a snake-head is protected by the short broken lines of the pattern on the body but until one has put a stick into the water on a sunny day to note the sun spot made by its shadow where the water surface is broken one can hardly appreciate the ocellated spot on the fish which lies quietly at the bottom awaiting a tender mouthful.

While many from Canada or the United States rather expect the black bass of their home fishing days to appear, it is true none of the family of Centrarchidae, to which black bass and perch belong, are found here. Instead the river fish, the so-called mandarin fish (*Siniperca*), are the delicacies among the freshwater food fish. There are several species. The swifter, more slender forms, are found in mountain streams. One recent author has found two such in Kwangsi for which I have no material to check while the form he describes as new from Szechwan may easily belong to the species *Scherzeri* described by Steindachner in 1892.

Rice-field eels, *Fluta alba*, are too common to need description save to call attention to their yellow or orange color and swollen posterior half of the head which so quickly separates them from true eels which are also reported here but have the

head nearly the same diameter as the body below the head and have less yellow on the ventral surface.

The great fresh water order of the Osteriophysi has been separated out from all other fish forms by a peculiar modification of the anterior vertebrae. The processes from these bones make a connection with the ear capsule and lie against the air-bladder. Changes of pressure of air in the air-bladder are thought thus to effect changes in the nervous system to help the fish adapt to such pressure changes. There are five groups belonging here which all have representatives in Szechwan.

C. Order Osteriophysi.

a. There is the peculiar sucker, a very compressed fish, which fishermen say springs or jumps through the water. It probably does not lug stones for its meat as does its industrious American cousin in the breeding season. It lives in rapid water and its habits we wish we knew.

b. There are twenty-two loaches. Among the slender, roundbodied ones we have some the size and shape of a person's finger which I have found in very foul water and perhaps breeding there. These have the habit of standing with the tips of their snouts above the water, and by their swallowing air, the vascular walls of the intestine absorb oxygen into the blood while they live where the water passing over the gills has too little oxygen to aerate the blood.

c. On the other hand there are the very flattened homalopterids which live in swift water. Their pectoral and ventral fins are flattened out so as to make an extended ventral surface. Even after a fish is dead it takes a little pull to raise it from the dish or table it is lying upon, so nicely do these fins form spread out suction discs to keep the fish from being washed off the stony bottom of swift streams where they live. I bought one in the market one day and taking it home in a big glass bottle was surprised to see it climb the side of the bottle and remain with its snout just sticking out above the surface. Another day one brought in from the irrigation ditch was breathing frightfully hard though the diameter of the dish gave a considerable surface for aeration of the water; it was only half a day until it was dead. Pressed against the glass one had a good view of the heart since it beats in its small sac and has a transparent area of skin covering it.

d. The catfish are our familiar friends in any land. We know them at a glance by their flattened be-whiskered heads. They are usually scaleless and have a ventral mouth and a fatty second dorsal fin and *teeth in the jaws*. They live on the muddy bottom of our streams. From their small eyes one knows vision is not the principle means for securing food. These night feeders moving over the bottom using one tentacle

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(whisker) and then another to feel or taste the tender larva, or waiting patiently waving their tentacles like worms as bait for other fish, make a picture for one's imagination. Experiments have shown that when a ball of cotton is dropped on the tail of a sluggish catfish nothing happens but when the cotton is dipped in meat juice a quick reaction brings the head to the place where the cotton is and it is picked up. In other words, the catfish may get tastes with their tails.

There are four or five genera in our collection. Shih of the Science Institute of West China has searched the literature and records 24 species for Szechwan. Some of these are doubtless duplicates.

e. Then there is the great family of the carp-minnow group, the *Cyprinidae*. While in other countries only the carp become big fish, here one may find among other genera of these fish three or four or five feet in length. That there are over a hundred species here in this province and nearly three hundred species recorded for China gives a notion of the variety and abundance of this family and adds weight to the claims of students of geographic distribution that here is the original family home from which forms have become distributed to Europe and North America and Africa. *Cyprinidae* show relative uniformity of body form, a carp, a bream, or a gudgeon are spindles of only slightly varying height and width. The fauna of this family here includes a series of Gobies whose special modification of elongated after-body adapt them to the hard up-stream navigation of flood waters, but while body form shows less variability than among the loaches, the sucking disk of the so-called "ink fish" of Kiating region is a quite unique structure for a fleshy frill extends behind the lower lip to form a nearly circular area which can be applied to the surface of a stone and then by the lifting away of the included cushion make a vacuum behind the mouth which fastens like a leech's sucker the long slender fat-rich body of one of Szechwan's delicacies to stones in swift currents.

The slender cylindrical forms with long after body which can push the fish up stream when freshets come are more common than in the fish fauna of other regions I have known.

While the catfish have teeth in the jaw like other vertebrates, these fish of the *Cyprinids* have all their teeth in the throat on the pharyngeal bones to grind against a pad on the base occipital. A recent study by Y. T. Chu presents his findings that elongated, very narrow pharyngeal bones are carnivorous or predaceous forms while certain herbivorous forms tend to have shorter wider pharyngeal bones. Some of these fish have conical teeth, a few even may have molars.

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2. One day in the spring one of the men who sells fish from baskets near the South-gate bridge handed me a fish of rather dull grey green which when I looked at it more closely reminded me of a brook trout. Its body was about right in shape, the flecks of bright red over the body, the yellow green margins of scales and purple spots among the duller body color were beautiful; a gorgeous emerald green beneath the edge of the operculum, a sheen of mauve on the whole tail, besides glistening gold lines on the center rays of the caudal fin and spots on the top of the head made it one of, if not the handsomest fish, I had ever seen. Its pharyngeal teeth were a high cluster in three rows 5, 4, 2. Some were enlarged at the top. According to Chu one would expect it to feed on vegetable material. Its name is probably *Labeo diptostoma*. I doubt whether it has been described, perhaps not before seen, by any ichthyologist in its chaste yet lovely breeding dress.

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There are interesting discoveries one is continuously making as one day when following a key which separated two species by the number of points on the first gill arch, the gill-rakers, I found that one species was recorded as having five, the second as eight, gill-rakers, but one arch examined was found to show five if one looked at its head or anterior face while looked at from the back there were eight. There is much to be learned as to the variability of anatomical structures in order for work to be standardized and of value.

F. Nesting and Breeding Habits.

We have seen the nesting habits of a plain fish which by its habits is not exposed as are those which breed in open water. The little plain brown male fish, "wheat ear," *Pseudorasbora parva*, is often seen standing with only the tip of its head sticking out a little bit from beneath the under surface of a rock or board. The snout has a series of pearl organs, that is, pearly points about the size of a large pin-head. As one watches its behaviour the fish is seen to run under the stone and rub it smooth with its horny head. Then with further watching one sees the male sally forth and by swimming beside a female or by bumping her side he directs her into his nesting area. Once beneath the polished stone ceiling the female is thrown onto her side while eggs and milt simultaneously leave the bodies of the breeding pair, float up and the eggs adhere to the smooth stone or board surface. For a time the male lurks about this area but after a time leaves it and the young fish must shift for themselves as they hatch.

One of the catfish has been watched and seen to bury its head beneath a stone or pebble in a depression of the stony bottom of the river that is the sign for the male to pair with the female while the rock holds her from drifting and in this case the eggs settle to the bottom among the sand and gravel, their rapid vibrating stirs up during the spawning.

A third case of the habits of egg laying one wished to see is one adapted by some of the group of *Rhodine*. I have read of a fish with a long ovipositor that stealthily inserts it into the open shell of a clam. Then the eggs, being sticky, adhere to the gills of the clam. The water currents in the gill chamber must furnish well aerated water for the fish egg to develop in. I have found a big clam with the fish eggs in the gills and I saw last year the inch long extended ovipositor of two Chinese forms of this fish. But this story of symbiosis does not end here for you know the clam eggs hatch into small motile forms which later became fixed. When these first free swimming embryos pass out it is into the fish gill chamber. Their small hooks fasten into the gills. There they feed and grow until ready to settle to the bottom as young clams. Of course the fish may have taken them some distance from the

clam bed where the egg originated. So here are mutual benefits to both members of this symbiotic pair.

While I have not worked out the breeding ground of the Chinese eels, it is interesting that the European, American, and Asiatic eels are thought to be one genus or very closely related. It has been known in Greece from time of Aristotle no eels in fresh water have mature eggs in their bodies. Young forms are found in streams and older ones in bays and lakes and rivers prying around among stones seeking food but only recently were the breeding habits of eels established, when the flat glass-clear larval forms were found in the Caribbean Sea. Adult fish set off from their European or American coastal or inland homes and on reaching the deep ocean area between Bermuda and the West Indies lay their eggs. The transparent larval forms of the European species spread from this spawning place. After a year they may reach miles north and east toward their parents' home, the second year they have reached the Azores and beyond, while the third or fourth year they begin to ascend the rivers of their respective continent, for American eels will be found going up the Delaware, or Potomac, or St. Lawrence, while the European will enter the Rhine, or Po, or Swedish streams. But what has this to do with Szechwan eels, only this, that we have found young elvers among fish from Po Yang Lake or other breeding grounds along the Yangtse. The Gorges are no obstruction to their arrival here but where are their breeding grounds? Do they go to deep water in the region of the Philippines or near Java?

G. Public Health Values.

Some of you may want to ask about *Gambusia*, the small viviparous fish so successfully introduced to control mosquitoes in Hawaii and the Philippines. These have been brought to China but I know of no place where they have been introduced and are not found free in ponds. What seems a better attack is to protect young *Pseudorasbora parva* so as to raise them for they are good mosquito destroyers, the small *Rhodeus* or an *Acanthorhodes* eat mosquito larva lustily. It may take a little time to work out their habits. I have seen in China the clam shells with fish eggs in the gills and from the mirror pond of West China University we have secured the *Acanthorhodes* which we tested for their rate of feeding on mosquito larvae and found them exceedingly active. More than one specimen had an inch long ovipositor when brought in the day the pond was being emptied in the spring of 1938.

The paradise fish, *Macropodus chinensis*, well known as the "fighting fish" has been collected in Szechwan. Only two specimens have been secured by me. It is an excellent form for mosquito control but lives only in green ponds. The two other forms can seemingly survive in more kinds of environment.

SHORTER ARTICLES AND NOTES

NOTES ON FRESH-WATER MEDUSAE FOUND IN KIATING

H. ZANYIN GAW and L. H. KUNG

Dept. of Biology, National Wuhan University, Kiating, Sze.

L. A. Lovegren reported in this journal (1930) the occurrence of fresh-water medusae (jellyfish) in Kiating. As pointed out in one of our papers (Gaw and Kung 1939), Lovegren made no study of it and no description was given except the approximate diameter of the bell. Recently the editor of this Journal has asked us to write a summary of our work on this interesting Coelenterate in order to give a more accurate and definite description of these animals for this Journal. This, we are glad to do.

The fresh-water medusae were found in great abundance, especially on sunny days, from February to April, in a large pool along Tatu River 大渡河 or Tung River 銅河 as the natives call it. From the description given by Lovegren, it appears that it is the same pool where he too found the medusae. As a matter of fact, as pointed out by Lovegren, it is the only pool around Kiating where these animals appear.

It is perhaps not out of place here to give a brief description of the medusa for the benefit of those who may not be familiar with its general structure. The medusa is generally bell-shaped, the clapper of the bell being formed by a projection (the manubrium) at the end of which is the mouth. The bell itself is often termed the umbrella; its oral or concave face is styled subumbral and its aboral or convex face, the exumbral surface. From the margin of the bell a shelf (the velum) projects inwards and the tentacles (Lovegren's 'threads') hang downwards. The mouth opens through the manubrium into an expanded space (the gastrovascular cavity). From this four perradial canals (the radial canals) lead to the margin of the bell and there open into a circular canal (the circumferential canal) which runs round its circumference. Four reproductive glands (the gonads) are situated at the junction of the gastrovascular cavity and the four radial canals. When sexually matured, they appear to be pocket-like outgrowths hanging down freely and sometimes colored green or brownish yellow, etc. Located at the margin of the bell and in small canals are the sense organs. They are spherical bodies with pyriform capsules and are supposed to be the site

of the sense of equilibrium. The small canals are blind at the proximal end and are in direct connection with the circumferential canal. Although the fresh-water medusa, as we all know, is a simple multicellular animal, the main part of the body material is non-cellular jelly and hence the popular name "jellyfish."

Biologically speaking, there are two species of fresh-water medusae found in Kiating (in the same pool). One is undoubtedly a variety of *Craspedacusta kawaii* (Oka 1907) and the other is a new species which we named *Craspedacusta sinensis* (Gaw and Kung 1939). These two species can be readily differentiated. *C. kawaii* is relatively larger and possesses greenish gonads, while *C. sinensis* is smaller and has brownish yellow gonads. What Lovegren saw is difficult to determine. He described the color as golden yellow which ought to be *C. sinensis* but his measurement of the bell up to about 6 cm. is far too large for this species.

C. kawaii measures (diameter of the bell) from 0.5 to 2.2 cm. during expansion. The height of the bell, of course, varies with the length of the diameter and also the activity of the animal, whether it is in expansion or in contraction. The number of tentacles varies from 259 to 272. They are of seven kinds, in respect to their length, and are arranged with more or less regularity around the margin of the bell. The four largest ones are always situated perradially. The sense organs vary from 129 to 146 in number. The four gonads, as mentioned above, are characteristically greenish when they are sexually matured.

C. sinensis measures from 0.48 to 1.8 cm. during expansion. The same sort of relationship exists between the height of the bell and the length of the diameter and the activity of the animal but in this form, when it contracts, it becomes characteristically bell-shaped, very different from that of *C. kawaii*. The number of tentacles varies from 136 to 217 but they are of only four kinds, in respect to their length and are arranged irregularly. The largest ones are not necessarily situated perradially. The sense organs number from 78 to 178. The four gonads are brownish yellow in color.

For detailed description of these two species, together with preliminary study of some physiological problems, the readers are referred to the series of papers which appeared as Science Reports of the National Wuhan University (Biological Science number 1, 2 and 3, published by the Wuhan University Press).

Before concluding this note, it must be mentioned that these animals are not so abundant this year as they were last year. The ecological aspects; such as, the nature of the pool, temperature and hydrogenion concentration of the water,

the aquatic forms associated with them, etc. as far as we are aware, are very much the same. Last year the largest number appearing in the pool was around the end of March and the beginning of April, but this year they disappeared entirely before the end of March. The reason for such a change is difficult to explain.

Again, this year, we failed to find the hydrozoid stage. Of course, these animals may not have this stage at all but develop directly from the fertilized eggs. Of great interest, however, are the small specimens of *C. sinensis* that we found which measure about 0.1 cm. The tentacles are hardly developed and they look as if they have just become free from the blastostyle of the hydrozoid stage. We are looking forward to investigating the life cycle of these animals next year if they should appear again.

A FURTHER NOTE ON THE COUVADE

DAVID CROCKETT GRAHAM

In previous issues of the Journal the existence of the couvade in China has been mentioned.¹ It is practiced among the Hua Miao of Kueichow Province and was customary centuries ago among the Liao people in central China.

In a recent lecture before the West China Border Research Society Prof. Hsü-I-T'ang told of finding the couvade among the Yao tribes in Hsiang Hsien 象縣 and P'ing Nan Hsien 平南縣 in Kwangsi province.

It can therefore be asserted with certainty that the couvade existed centuries ago among the Liao people of central China, and that at the present time it is practised by the Hua Miao in Kweichow and some of the Yao tribes of Kwangsi. Further research may bring to light its existence in other parts of eastern Asia.

1. See this Journal, Vol. VII, p. 126, Vol. VIII, p. 180, and Vol. IX, notes.

SOME RECENT EVENTS IN THE SIKANG REGION*

DAVID CROCKETT GRAHAM

During the year 1935 the Communists of northern Szechwan marched through Wei Chou 威州, Li Fan 理番, and Tsakunao 雜谷腦 into the Sikang region. When they first

*Note:—This article does not aim to throw light on the righteousness or unrighteousness of the Communist cause, but to relate briefly and with some degree of accuracy the story of their experiences and actions in the Sikang region in 1935 and 1936.

entered this territory the tribes people and the Tibetans were somewhat unfriendly to the Chinese, and could easily have been won over as allies of the Reds if the latter had used tact and diplomacy. The Communists destroyed many of the best lamaseries, executed the leaders of the aborigines, and in different places slaughtered from a few to several hundred of the people. The result was that the Communists incurred the enmity of the aborigines of the Sikang region.

In the fall of 1935 the Communists came down to within gunshot of Yachow and remained there until the following spring. Hundreds of the Szechwan soldiers went over to the Communists, and many others laid down their arms and ammunition when they retreated. The statement was made that the Communists gained five thousand rifles by their drive towards Yachow. They also gained food and a warmer climate into which to pass the winter months. At that time there were tens of thousands of Central Government troops in Szechwan province, and it is quite likely that if they had not been present Szechwan would have been taken by the Reds.

With the coming of spring the Szechwan and the Central Government troops assumed the offensive, and the Communists retreated farther in Tibet. At various centers they killed tens of thousands of Tibetan yak and sheep drying much of the meat so that it could be used on their future expeditions. Then, in the late spring and the early summer, the political disturbances in southeast China caused the Central Government to withdraw most of its troops from Szechwan. It seemed to be the opportune time for the Communists to make a final attempt to secure possession of Szechwan Province.

About the first of August they began to move. One army planned to go eastward and northward through Tsakunao, Lifan, Weichow, and Wen Ch'wan into northern Szechwan, possibly taking Chengtu. Another Communist army was to travel through the grasslands north and west of Sungpan, later uniting with the first army in northern Szechwan.

When the advance was begun, the Lifan-Tsakunao region was held by Major Li of the forty-fifth regiment, who probably commanded about a thousand Szechwan soldiers. His men were stationed at Ma T'ang, at Tsakunao, and at intermediate points. Cooperating with Major Li were the Jia Rung aborigine soldiers, with the arrangement that the Jia Rung were to be the advance guard and the Szechwan soldiers were to bring up the rear.

There were battles with the Communists at Fu Pien 撫邊 and at Ma T'ang. The Jia Rung and the Chinese soldiers were at first defeated and retreated to Lo Kan Ch'iao, which is one hundred and eighty li from Tsakunao. Here the Communists feared further attacks from the Jia Rung, and destroyed the

bridge across the river so the Jia Rung could not cross the river and attack them. They changed their plans and proceeded north towards Sungpan through the country of the Hehshui and the Luhua aborigines.

In the region of the Hehshui and the Luhua the Communists began to help themselves to the provisions of the aborigines. Then the Hehshui and the Luhua attack the Communists and killed several thousand of them giving no quarter even to those who surrendered their arms. Major Li gave orders to his aborigine allies that the Communists who gave up their arms and surrendered should not be killed, but should be taken prisoners and handed over to the Chinese authorities. Several hundred Communists who surrendered were turned over to Major Li's soldiers and were brought out to Kwanhsien and Chengtu. Most of the Communists fled to the grass lands north of Sungpan where they united with the other Communist army that had been approaching from the west. It is reported that hundreds of Communists (some say thousands) perished in the grasslands of hardships, sickness, or starvation, or were killed by the dogs or aborigine soldiers of the grasslands. What might have been a triumphal advance of the Communists into a promised land was turned into a defeat because, a little over a year before, they entered the Sikang region destroying the lamaseries, executing the native rulers, and killing hundreds of the common people. And if the Communists had conquered Szechwan the *coup* of December, 1936, if it had taken place at all, would probably have occurred in Chengtu instead of at Sian.

A LECTURE ON THE ORACLE BONES

SHANG CHENG-TSU

INTRODUCTION

The progress of the civilization of a country is commonly judged by its thought, language, literature, and arts. That the Chinese civilization began more than ten thousand years ago is well proved by the discovery of the so-called oracle bones. This will form the subject of our talk this afternoon and will be discussed under the six following heads: (1) their discovery, (2) their names, (3) their value for history, (4) Institutions of the time, (5) economic conditions of the time, (6) the arts of the time.

I. The discovery of the Oracle Bones.

In 1899 some farmers of An Yang, Honan, while plowing their fields found some remains of shells and bones, which were largely rotten, indicating their long stay under the earth. These were sold to a native drug-store to be used as a sort

of surgical medicine. It happened that the owner of an old curiosity shop, passing by this place, came upon them. He was so attracted by them as to bring with him to Peking a number of these bones with characters inscribed on their face. These were presented to Mr. Wang Ih Jong 王懿榮 for identification. Mr. Wang, a well-known scholar and then one of the Councillors at the Imperial Court, discovered on these bones some names of the emperors of the Shang Dynasty and therefore greatly prized them, and ordered the man to secure many more for him. This is the beginning of the Bone Writings being valued by the learned circle in China. After the death of Mr. Wang in the next year, these bones went to Mr. Liu Ou 劉鷗, who enlarged the collection to several thousand pieces by purchasing the newly unearthed ones from Honan. Assisted by Mr. Lo Cheng-yu, he produced the first book on the Bones, entitled "The Bone Collection of Pieh Yui," 劉雲藏龜. At present there are more than a dozen of these books and over one hundred articles written on the subject. And the number of bones found has come up to tens of thousands, especially as the result of the excavating work done by the Academia Sinica in recent years. These form an invaluable collection of material for the study of the history and civilization of the Shang Dynasty.

II. Names by which these bone writings are known.

The writings on these bones are referred to in Chinese literature by at least four different appellations. First, they are called "The Shell and Bone Writings," after the material used, because these writings were inscribed on the shells of the tortoise and the bones of oxen. Bones of other animals were also used. Secondly they are known as "Writings from the Ying Sites," after the place of discovery; for they were found at the ruined sites of the capital of the Shang Dynasty which is otherwise known as Ying. Thirdly, they are known as "The Inscriptions of the Ying People," after the method of writing; for the characters were not written with pen and ink but inscribed on the bone with a knife. And lastly they are known as "The Writings of the Oracle Bones," after the use in which the bones are put, because they recorded the results of divination before the gods. These four names are practically synonymous.

III. Their collaboratory value for history study.

In historical records, there are thirty emperors of the Shang Dynasty. Of these, twenty-nine were found in the writings of the Bones. In a few cases, the characters for the names do not agree with the traditional record. We may safely infer that the difference is due to a mistake in the transmission of the record. For example, in the Bone Writings, there is the name 唐 which is evidently the same as 湯 the present form of the name of the first emperor of the

Shang Dynasty. This is apparently due to the difference of pronunciation in different dialects. Also we have found among the Bone Writings, 王亥 one of the ancestors of T'ang, which in other books is corrupted into 王該, or 王核, evidently because of the similarity of the sounds. But in the case of 王恆, 王季 and many others, they are the same as in other books. Among the names of great officials of the Dynasty, we find the name of 伊尹, the first Prime Minister, and many others whose names had been lost from the present written history. Thus the Bone Writings are a great aid in our study of ancient history.

IV. Institutions of the Period.

The name 天邑商, the Heavenly City Shang, or the Great City Shang, are found to indicate the Capital of the reigning dynasty. The characters "天" and "大" appeared interchangeable for two reasons: (1) the Capital is the residence of the Son of Heaven and at the same time the leading or the greatest of all cities, and (2) in archaic writings, these two characters mean the same, just as 太乙, Yi the great, is also written as 天乙, Yi the Heavenly. The ranks for the nobles of the Shang period are 公侯伯子男 Duke, Marquis, Count, Viscount and Baron. And there are many titles of officers, which are not only in agreement with the records in the books but also with the inscriptions of the Chou Dynasty, which were adopted from the Shang, just as Confucius once remarked that Chou inherited her institutions from Ying.

Festivals were held in honor of Heaven, the Earth, Mountains, Rivers, Ancesters, and Spirits. Offerings were made in each case with cattle, sheep, dogs, swine, and fresh meat; and the wine used might be from barley or from rice. Quite detailed records may be found of these ceremonies. Many were found in substance or in modified form in later times.

V. The Economic Conditions.

It is often said that the Shang people were still in the pastoral age, or at least a sort of semi-agricultural age. We know from these Bone Writings that the former conjecture is a mistake, while the latter is not entirely true to the facts. We have found numerous references to the agricultural industry. The king plowed the field himself and "looked" after harvest in each Spring. He very frequently attempted to divine before the gods the results of the harvest. These are also recorded in the bone writings. Unless agriculture formed the essence of the economic system of the period, such grand ceremonies would never have been performed in its favour. Moreover, there are in the bone writings characters for the names of farm implements, for the names of various sorts of

grains and cereals, for the names of harvesting tools and storage of rice, for the names of different kinds of land, and many other names of this kind. All these appear to indicate that the Shang Dynasty has entered into a well-developed stage of agriculture as the foundation of her economic structure.

VI. Arts of the time.

The written language, especially in China, had its natural beginning in picture-drawing. It was developed through a long and complicated evolution from the forms of the written language. There are over twenty-five hundred 'single' characters in the Bone Writings. And the number of characters not yet unearthed or already destroyed by the ignorant farmers, must far surpass these. These characters must have had their origin several thousand years before the Shang Dynasty, and have been gradually perfected by that time. They were very finely engraved; every stroke is clear and forceful. The whole character forms a very pretty design. Most of these characters, such as names of animals, plants, tools and implements, and sometimes even of action, are in the pictorial form. But quite a number of them do belong to the category of 指事, 會意, 形聲 and 假借, which indicates a higher and later stage in the evolution of the Chinese language.

VII. Conclusion.

The above is a very brief and sketchy discussion of a very broad subject. The discovery of the bone writings is sufficient to prove to us that the Shang Dynasty was well along in the agricultural age of history, with quite detailed and well organized institutions and well developed artistic tastes, sufficient to serve as examples for a later age. We have been able to mention only the most outstanding facts this afternoon.

SOME EARLY ENGLISH REFERENCES TO SZECHWAN AND OTHER PARTS OF CHINA

LESLIE G. KILBORN

When I was last in Canada I chanced to come upon an old book in the library of the University of Toronto, which apparently possessed the title of "A Description of China, taken by the Author M. John Neuhoff in his Journeys with the Batavian Ambassadors from Canton to the Emperours Court at Peking." This was inscribed in the corner of the map forming the frontispiece of the book. But the title page bore the following heading: "An Exact Relation of the Embassy sent by the East India Company of the United Provinces to the Grand Tartar Cham or Emperor of China, Delivered at Peking the Imperial City, etc." by John Ogilby. However,

this apparently referred only to Part I of the four parts into which the book was divided. Part I consisted of the first 139 pages.

Part II (pages 141—298) bore the title of "A General Description of the Empire of China." Part III (pages 299-317) consisted of "A Narrative of the Success of an Embassy sent by John Maatzuyker de Badem, General of Batavia unto the Emperor of China and Tartary, the 20th of July 1655. Soliciting a Licence of Trade in the Ports of his Empire." This was written by a "Jesuit in those Parts." Part IV was an appendix of six parts, and bore the title of "Special Remarks taken at large out of Athanasius Kircher's Antiquities of China." Part I (pages 319—340) included a description and translation of the Nestorian inscription found in Sianfu in 1625. Part II (pages 341—392) dealt with "Various Voyages and Travels undertaken into China." Part III (pages 393—400) was entitled "The Idolatry of the Chinese" Part IV (pages 401—420) was descriptive of China, as was Part V (pages 421—428). Part VI (pages 429—431) was given to a consideration "Of the Hieroglyphical Characters of the Chinese."

The following quotations are recorded because of their historical interest to those concerned with West China, or because of the quaint descriptions of some of China's customs or institutions.

I. An Early Description of Szechwan (pages 12—14)

The sixth Kingdom of Sucheu.

This Territory of *Sucheu* is very large and fruitful, which Eastward bordereth upon *Huquang*, Southward upon *Queicheu*, North-East and by North upon *Xensi*, North-West upon *Prestor-John's Country*, Westward upon *Tibet*, and Southward upon the Province of *Junnan*.

In this whole Province are eight chief Cities, a hundred and twenty four great and little Cities, four Garison Cities, beside several other Towns and Places.

The eight Capital Cities are *Chingtu*, *Paoning*, *Xungning*, *Siucheu*, *Chungking*, *Queicheu*, *Luggan*, and *Mahu*:

1. *Chingtu* Commands over 30 little Cities, *Chingtu*, *Xaunglieu*, *Veukiang*, *Sinfan*, *Sinlu*, *Kintang*, *Ginxeu*, *Chingping*, *Pi*, *Cu*, *Nuikiang*, *Quou*, *Peng*, *Cungning*, *Gan*, *Kien*, *Cuyang*, *Cungking*, *Sincin*, *Han*, *Xefan*, *Miencho*, *Teyang*, *Mien*, *Changning*, *Lokiang*, *Mieu*, *Vencheuen*, *Guei*, and *Pao*.

2. *Pagning* Commands over 10 Cities, *Pagning*, *Cunglei*, *Nanpu*, *Quangyven*, *Pa*, *Chaobou*, *Tungkiang*, *Kien*, *Cutung*, and *Mankiang*.

3. *Xungking* has under its Command 9 Cities, *Xungking*, *Sike*, *Jungwan*, *Ylung*, *Quanggan*, *Kin*, *Tacho*, *Gochi*, and *Linxui*.

4. *Siucheu* Commands likewise over 10 Cities, *Siucheu*, *Kingfu*, *Fuxun*, *Nanki*, *Huiguen*, *Changning*, *Junlien*, *Cung*, *Cao*, and *Lukehang*.

5. *Chungking* Commands over 18 Cities, *Chungking*, *Kiangem*, *Changxau*, *Taco*, *Jungcheuen*, *Kikiang*, *Nancheuen*, *Kiukiang*, *Ho*, *Tungleang*, *Tingguen*, *Piexan*, *Chung*, *Fungtu*, *Tienkiang*, *Fen*, *Fulung*, and *Pinxui*.

6. *Queicheu* Commands over 13 Cities, *Queicheu*, *Coxan*, *Tachang*, *Taming*, *Junyang*, *Vau*, *Cai*, *Tai*, *Sinning*, *Leangwan*, *Kieuzi*, *Tunchiang*, and *Taiping*.

7. *Luggan* Commands over three Cities, *Luggan*, *Kiangyeu*, and *Xeciven*, and also over several Forts.

8. *Mahu* is alone, without having any City under its Command.

The great Cities are six, *Tungcheuen*, *Muicheu*, *Kiating*, *Kiung*, *Lincheu*, and *Yacheu*. Though these six great Cities might very well deserve the Name and Dignity of Capital Cities, in regard to their largeness, and number of Inhabitants, yet they do not enjoy that Dignity, because this Province is to have no more Capital Cities then Peking and Nanking.

The first great City *Tungcheuen*, Commands over 8 other Cities; the second *Muicheu*, over four; the third *Kiating* over seven; the fourth *Kiung*, over three; the fifth *Lincheu*, over four; and the sixth *Yacheu* Commands likewise over four.

The four chief Garison Cities are *Tinchnen*, *Uniung*, *Usa*, and *Chinhiung*; beside which there are 35 small Garison Cities and Forts.

This Province produces much Silk, and other rich Commodities. It is very large and fruitful, having the great River of *Kiang* running quite through it: in some places it is Mountainous, but wants neither for Trees nor Valleys. From hence only come the right *Radix-China* or *China-Root*; for that which grows in other Places of *China* is wild and good for nothing. From hence comes likewise that incomparable Root call'd *Rhubarb*, which the People of *Tibet* and *Mogar*, who drive the Trade in this Province, send from thence into *Europe*. Here are likewise found two sorts of Amber Stones, namely the red and the yellow; which last is found also upon other Coasts. The People here are very cunning in counterfeiting of Amber, which they do with so much skill, that they sell it sometimes for the right, it being impossible to discern it, being not much inferior unto it either in sight or goodness. Iron, Tin, and Lead, are likewise fetch'd from the Mountains in great quantities; among which (the wonder is) are great

store of Salt-pits, that produce so much Salt, that the Inhabitants know not how to spend one third part of it.

The Toll-Book wherein the number of the People of the Country is set down, mentions no less than 4 hundred 64 thousand 1 hundred 29 Families, and 22 hundred 4 thousand 1 hundred and 70 Fighting Men, without reckoning the Soldiers, who are very numerous in the Country.

That which this Province pays in Taxes to the Emperor yearly, consists of 61 hundred 6 thousand 660 Bags of Rice, 6 thousand 3 hundred and 39 Pounds of Cottons, 1 hundred 49 thousand 1 hundred 77 Weight of Salt, beside other Taxes paid to his Imperial Majesty in some parts of this province.

II. Lacquer as Described in the 17th Century (page 211)

There is also in divers Places throughout the whole Empire, a certain sort of Lime, which they press from the Bark of a Tree, being tough and sticking like Pitch; of this, which I suppose I may call a Gum, they make a certain sort of Paint, wherewith they colour all their Ships, Houses, and Household-stuff, which makes them to shine like Glass; and this is the reason that the Houses in *China* and *Japan* glitter and shine so bright, that they dazzle the Eyes of such as behold them. This Paint also lays a shining colour upon Wood, which is so beautiful and lasting, that they use few or no Tablecloths at their Meals; for if they spill any Grease, or other Liquor upon the Table, it is easily subb'd off with a little fair Water, without loss or damage of Colour.

III. How Tea Affected Us in the 17th Century (page 408)

There is also the Plant call'd *Cha*, which not being able to contain it self within the Bounds of *China*, hath insinuated it self into Europe: It aboundeth in divers regions of *China*, and there is great difference, but the best and more choice is in the Province of *Kiangnan*, in the Territory of the City *Hoeichen*. The Leaf being boil'd and infus'd in Water, they drink very hot as often as they please; it is of a Diuretick Faculty, much fortifies the Stomach, exhilarates the Spirits, and wonderfully openeth all the Nephritick Passages or Reins; it freeth the Head by suppressing of fuliginous Vapors, so that it is a most excellent Drink for studious and sedentary Persons, to quicken them in their Operations; albeit at the first it seemth insipid and bitter, yet Custom makes it pleasant; and though the *Turkish Coffee* is said to produce the like effect, and the *Mexican Chocolate* be another excellent Drink, yet Tea, if the best, very much excelleth them, because *Chocolate* in hot Seasons inflameth the Blood more than ordinary, and *Coffee* agitateth Choler; but this Liquor in all Seasons hath one and the same effect. Concerning this Plant, see more in *Martinius*, his *Atlas Sinicus*.

IV. An Early Description of Szechwan's Dark Age.

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A General Description of

Thus far have I spent in setting forth particularly, how and in what manner the Robber *Licungzus* first over-ran *China*, and after his Expulsion how the *Tartars* at last conquer'd the same: Now you are to remember, that contemporary with *Licungzus* was another Thief call'd *Changlianchus*, the remaining Transactions of whose Villany, whereof we have already in part made mention, I shall now relate: And indeed when I call to mind the Cruelties committed by this Monster in Mans shape, I am as one deprived of his Senses; for his Actions were so dismal and horrid, that whoever hears of them, will be fill'd with stupefaction and amazement.

This Robber *Changlianchus* plunder'd and ruin'd several Provinces, putting the Inhabitants to unspeakable Torures, to make them confess where they had hid their Wealth and Goods; he was greatly delighted to put out Peoples Eyes, and to see Men die in misery. His Design was really to have depopulated the whole-Country of *China*, that so being alone, there might be none left to oppose him, or be his Competitor: And although the barbarousness of his Nature appear'd every where, and upon all occasions, yet did he give a proof of his Cruelty in no Place more than in the Province of *Suchuen*, where he took upon him the Royal Title, and put most of the Inhabitants to death. He would frequently cause a whole Family to be utterly destroy'd, if any one of them had not obey'd his Orders according to his will and mind. He abound'd so very much in Feral Barbarism, that oftentimes if by chance any one had offended him, he would cause all the Inhabitants residing within the same Street to undergo the Fury of his inhumane and bestial rage.

He was civil and kind to none but his Soldiers, with whom he would Converse and Drink as if he had been but their Companion; and many times would bestow great Presents upon them, if they had perform'd any thing well, and according to his mind; yet on the other hand, for the least Offence or Neglect, he made nothing to put multitudes of them to death. And which is yet more, this bloody Caitiff's Butchery extended to very Magistrates, but in special manner to those of the Chief City of *Chingtu* of the Province of *Suchuen*, so that of six hundred, in the space of three years were hardly twenty left that escap'd with their Lives; and it was a Recreation to see and cause People to be flay'd alive.

When this Blood-thirsty Tyrant endeavor'd to take the Chief City of the Province of *Xensi* (which in regard of its Strength is call'd *The Key of Suchuen and Xensi*) he came in the Year 1645. before it with a very great Army of at least a hundred and eighty thousand Natives of the Province only, beside a vast number of others out of several other Provinces. When the Siege had continu'd a long time, (for the Inhabitants defended themselves with wonderful Courage) there ran over to the Besieged at least forty thousand Men out of his Camp, which trouble'd and provoked the Tyrant so much, that he caus'd the remainder of a hundred and eighty thousand Men of *Suchuen* to be cruelly massacred and murder'd by their other Fellow Soldiers, before his Face.

When he heard that the *Tartars* in the Year 1646. were fall'n with their Forces into the Province of *Xensi*, he found himself necessitated, to prevent such an unquiet and troublefom Neighborhood, to march against them; but left the Inhabitants of *Suchuen*, to many of whom he had been so cruel, should conspire against him in his absence, he caus'd them all to be put to death, except such as live toward the North-East: Then he march'd first to *Chingtu*, the principal Chief City of the Province of *Suchuen*, and caus'd all its Inhabitants

both

the Empire of CHINA.

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both Rich and Poor, being above six hundred thousand in number, to be bound by his Soldiers, and afterwards miserably slain; by the effusion of whose Blood the *Chineses* write, that the Water of the great River *Kiang*, which runs before the City, was extraordinarily swell'd and rais'd. The dead Bodies that they might not taint or infect the Air, were flung into the River, which being carried down with the Stream, soon brought this mournful news to the neighboring Cities and Places, viewing what they were like to expect, if they resisted not the fierceness of that merciless Beast; which though they did with all their Might, yet it was not long before the same cruel usage reach'd many of them. And after this manner was this Province, which formerly abounded with People, laid waste and made desolate both of People and Habitations.

These Villanies perpetrated, and being now to march against the *Tartars*, he encourages his Soldiers to behave themselves valiantly, for that he had Silver enough to reward such as did well; but in regard the Women (as he suppos'd) would be a trouble to them, not only upon their March, but in the Battel, he caus'd them to be put to death, therein shewing them the way; for of three hundred beautiful Women which he us'd for his own lustful Pleasure, he reserv'd only twenty to wait upon his three Queens, all the other being massacred in view of the whole Army: whereupon the Soldiers following his barbarous and bloody Example, did the like, either by Shot or Sword killing their Wives in a most wretched manner.

Having destroy'd all the Inhabitants of the Province, and no more left to exercise his Cruelty upon, he fell upon the Cities and Houses, laying them waste, and not leaving any one Place standing wheresoever his ruining Feet trod; nay, more to shew his hatred to Posterity, he caus'd all the Trees to be fell'd and cut down, that so no body for the future should have any benefit by them after him; such as were sick and not able to follow the Camp, he caus'd likewise to be hang'd up, to prevent them (as he scoffingly said) from living or dying in pain and misery.

After all this barbarous Havock and Desolation made, this Enemy of Mankind pass'd with his Army into the Province of *Xensi*, whither the General of the *Tartars* follow'd him at the Heels with an Army of fifty thousand Men, until the residue of the whole Army could get up to him. When the news was brought him, that the *Tartars* were in sight of him with a great Army, he laugh'd at those that reported such a Fable (as he thought it) not believing it possible that such a thing could be, till going out of his Tent himself, to make the discovery, the first Object that he met with, was the sight of five *Tartars*, who, according to the Custom of those People, were sent out before to discover and demand whether he would have Peace or War; but in stead thereof they presently fell upon him, and the first Arrow that was shot pierc'd him quite through the Heart; wherewith falling down dead upon the Place, it struck so great a fear into all his Followers, that they were soon overthrown. The news of this Victory was quickly spread abroad, upon the report of which such *Tartars* as were left alive, and had escap'd the bloody Hands of the Traytor in the Province of *Suchuen*, came out of their Holes, and cry'd up the Victors as their Deliverers: And thus at length the Province of *Suchuen* fell under the Subjection of the *Tartars*, who putting Garrisons into the chiefest Places, march'd back with their Army to the Imperial City of *Peking*; where upon their Arrival the General of the Army, though he return'd victorious, yet so slippery are the Stations of Great Men, was very unworthily receiv'd by

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A General Description of CHINA.

his Brother, who accus'd him of Neglect, in that he had not well perform'd his Charge. The faithful General with this disgraceful Affront was put into so violent a Passion, as being conscious of his own Merit, and knowing that he had deserv'd the greatest Thanks imaginable for what he had done, he flung his *Tartar* Hat upon the Ground, which is taken by them for a sign or token of great Disrespect; and therefore (O base Reward for Fidelity!) he was condemn'd to perpetual Imprisonment; but this valiant and generous Spirit prevented it, by hanging himself beforehand in his Palace.

The *Tartars* having clear'd the Kingdom of the two great Robbers, *Licung-zus* and *Changliancbus*, they immediately endeavor'd by all fair means to settle the Kingdom in Peace and Quietness; which they shortly to their great satisfaction and content brought to pass, and enjoy the same at this time without any further disturbance.

F I N I S.

PROCEEDINGS

of the

West China Border Research
Society

1938—1939

REPORT OF THE TREASURER

May 1938 to May 20, 1939

RECEIPTS:

Balance from Last Statement	\$ 842.97	
Repayment of Fixed Deposit	365.00	
Interest	35.09	
Harvard-Yenching Research Fund ...	300.00	
Sale of Journals	82.72	
Membership Dues:		
Arrears	\$ 65.00	
1938	322.00	
1939	288.61	
In Advance	50.00	725.61

EXPENDITURES:

Postages, Mailing Journals	\$ 38.72	
Printing Journal, Vol. IX, on account	500.00	
Advertising Meetings	16.00	
Case for keeping Journal cuts	20.00	
Filing Cards	2.10	
Research Work on Porcelains	150.00	
Balance in Hands of the Treasurer:		
Fixed Deposit, Shanghai		
Commercial & Savings		
Bank	\$ 400.00	
Bank of China	1,224.57	1,624.57
	<u>\$2,351.39</u>	<u>\$2,351.39</u>

Balance in U.S.A. Currency from Last Statement	\$306.00
Interest	9.24

U.S.A. Currency in Hands of Treasurer \$315.24

Audited and found correct.

(Signed) Ernest Hibbard (Signed) Robert L. Simkin,
Treasurer.

May 23, 1939.

REPORT OF THE EDITOR

Due to the war the printing of Volume IX, 1937, was greatly delayed. But it finally made its appearance in the early Spring of 1939. Thanks to the very great assistance of Rev. W. H. Hudspeth and the staff of the British and Foreign Bible Society in Shanghai, who did most of the proof-reading, the delay was no worse. Although we have received acknowledgments of the receipt of Volume IX from several foreign countries, no copy has yet reached Chengtu! The Shanghai post office refused to accept it for delivery to any West China city!

The manuscript for Volume X, 1938, is now in the hands of the printers, and we are hoping that it will make its appearance soon after the summer. Volume XI, 1939, is now almost complete. We expect to mail the manuscript to our printers in the early Autumn.

Again we wish to record our sincere thanks to the West China Union University for its financial assistance. This has made possible the printing of a journal whose quality we hope worthily represents our Society. Volume IX includes one colored plate, and Volume XI will include several. Such expensive items could not have been contemplated without the university's generous assistance.

L. G. Kilborn.

THE EDITOR'S ASIDES (or annual pleas for mercy)

Once more we would remind our authors that spelling may be learned from a dictionary, we are not particular which one, English or American, colour or color, but not collar *please*. Wade's system of romanization may be found in Gile's and other dictionaries, and that system contains no *dj*, *g* or *b*. The Post Office is quite willing to supply information regarding the official spelling of place names, and Szechwan is *not* spelled Szechuen, nor Szechuan, nor even Ssüch'uan. Punctuation is more difficult for some of us, but if you don't know what should be done with commas, please leave them out. We have one contributor who apparently uses the spatter brush technique. The result may be artistic, but the editor finds the reading difficult. It is easier to insert commas than to delete them. As for the dash, please remember that it looks very much like a hyphen to the average Chinese type-setter. Usually a comma serves the purpose just as well, and is much less likely to be misunderstood by the compositor. Nuff sed.

L. G. K.

REPORT OF THE SECRETARY

The open meetings of the year have been acceptably received. Only two failed to appear on the scheduled program. Almost all of the speakers had previously appeared before the Society.

Oct. 15: "Some Aspects of China's Religious Heritage" was worked over by F. A. Smalley in such a way as to present the layman something of the inner motivations in religion in this part of the world.

Nov. 19: "The Legends of the Ch'uan Miao" were collected and presented by D. C. Graham in much detail. He had checked and cross-checked these stories as to marriage, and birth, and harvest, and death, etc., and he presented many lunettes of life as it is lived among this group of the Miao people.

Dec. 17: "The Natural Dyes of West China" were presented and demonstrated by W. G. Sewell with the assistance of Miss S. H. Wei. This paper was the result of long and assiduous investigation by Professor Sewell and his students as they had worked over native methods used locally. The lecture was of real interest and it is of more practical benefit in raising the standard of dyeing in this city and in the neighboring places of Szechwan.

Jan. 21: "The Music of the Ch'uan Miao" was demonstrated by R. G. Agnew from several years of study and compilation of native music. The piano execution of some of the tunes was well performed by Mrs. F. O. Stockwell.

Feb. 18: "The Aborigines of Southwest China" by Hsü I T'ang was presented after many weeks of study among these border peoples. This subject is most intriguing to all who have met some of these people at home or in the provincial capital.

March 18: "The Chinese Oracle Bones" and their characters were treated by Shang Chen-tsu. A somewhat rounded picture of the life of the Shang people was sketched by the speaker. The talk but whetted the appetite for further investigation into the life of that period.

April 13: "Playthings of an Ichthyologist" were exhibited by Cora D. Reeves, and a most humorous and most instructive lecture with running comments was enjoyed.

May 20: "The Identification of Szechwan Porcelains by the Chemical Analysis Method" was a paper read by Y. L. Kao, of a thesis done under his direction by a senior student. This work gave corroborative evidence of the high place of Chiung-

chow porcelain art in T'ang and Sung Dynasties. "The Spirit of Adventure" was the title of President T. E. Plewman's paper, read by Dr. H. J. Mullett. It challenged to "high" adventure as it took up experiences in the Upper Ming River country of the "Black Water People and of the Grass Lands."

D. S. Dye, Acting Secretary.

LIST OF MEMBERS

Any change of address or correction in the following list should be forwarded without delay to the Secretary of the West China Border Research Society, West China Union University, Chengtu, Szechwan, China.

HONORARY MEMBERS

<i>Date of election</i>	<i>Name and Address</i>
1935	Chiang Kai-shek, Generalissimo. The National Government of China, Chungking.
1935	Chiang Kai-shek, Madame. The National Government of China, Chungking.
	Cunningham, Robert. China Inland Mission, Kangting, Sikang.
1935	Smith, Prof. Harold D. Upsala University, Upsala, Sweden.
	Torrance, Thomas. 25 Warrender Park Rd., Edinburgh, Scotland.

MEMBERS

**Indicates Life Members*

1935	Abrey, F.E.L., 128 Castleton Ave., Toronto, Canada.
1928	Agnew, Dr. R. G., W.C.U.U., Chengtu.
1930	Agnew, Mrs. R. G., W.C.U.U., Chengtu.
1933	Albertson, Rev. W. B., 299 Queen St., W. Toronto, Canada.
1934	Allen, Dr. Stewart, Canadian Mission, Chungking.
1934	Allen, Mrs. Stewart, Canadian Mission, Chungking.
1938	Alley, Mr. Rewi, c/o L. T. Chen, The Central Bank, Chungking.
1931	Anderson, Dr. H. G., c/o C.M.S., Salisbury Square, London, E.C. 4, England.
1932	Argetsinger, Miss W., Baptist Mission, Chengtu.
1931	Arnup, Rev. Jesse, 299 Queen St., W., Toronto, Canada.
1935	Bacon, Rev. R. L., Canadian Mission, Kiating, Sze.
1938	Bannon, Mr. Peter L., University of Nanking, Chengtu.
1937	Barker, Mr. Kenneth C., Leeds University, Leeds, England.
1931	Bassett, Miss B. E., Baptist Mission, Kiating Sze.
1924	Beech, Chancellor J., W.C.U.U., 150 Fifth Ave., New York, U.S.A.
1937	Beh, Dr. Y. T., W.C.U.U., Chengtu.
1936	Behenna, Miss D. A., Friends Mission, Chengtu.
1932	Bell, Rev. G. S., Canadian Mission, Chengtu.
1934	Billington, Dr. J. G., 14 Pritchatt's Edgbaston, Birmingham, England.
1934	Bookless, Mr. A., National Salt Administration, Chungking.
1934	Bookless, Mrs. A., National Salt Administration, Chungking.
1936	Bothner-By, Mr. Aksel, Salt Inspectorate, Santai, Sze.
1922	*Brace, Rev. A. J., 299 Queen St. W., Toronto, Canada.
1938	Brodbeck, Miss L. E., Baptist Mission, Yaan, Sikang.
1938	Brown, Miss Isabel, Chengtu, Sze.
1923	Brown, Rev. H. G., Canadian Mission, Chengtu.

- 1935 Cairncross, Mr. A. T. Canada.
 1937 Cammann, Mr. Schuyler, Merrick, Long Island, N. Y., U.S.A.
 1937 Campbell, Dr. W. G., W.C.U.U., Chengtu.
 1937 Campbell, Mrs. W. G., W.C.U.U., Chengtu.
 1934 Cavaliere, Mr. E. A., Postal Commissioner, Kaifeng, Honan.
 1937 Chan, Dr. Eugene, W.C.U.U., Chengtu.
 1939 Chang, Mr. Carson. Chungking.
 1936 Chapman, Mr. B. B., Methodist Mission, Kunming, Yunnan.
 1936 Chapman, Mrs. B. B., Methodist Mission, Kunming, Yunnan.
 1938 Chen, Dr. Chia-chi, Chengtu.
 1935 Chen, Dr. Hsi-sung, c/o Tan See Giam, Tegal, Java.
 1937 Cheng, Prof. T. K., c/o Harvard-Yenching Institute, Cambridge, Mass., U.S.A.
 1937 Chu, Dr. C. K., Provincial Health Administration, Kweiyang, Kweichow.
 1931 Collier, Prof. H. B., MacDonald College P.O., Quebec, Canada.
 1929 Cook, Mr. Thomas. China Inland Mission, London, England.
 1926 Crawford, Dr. Wallace, W.C.U.U., Chengtu.
 1938 Crawley, Miss M., Canadian Mission, Chengtu.
 1938 Cressy, Dr. Earl, 169 Yuen Ming Yuen Rd., Shanghai.
 1935 Criswell, Dr. Marion. Baptist Mission, Ipin, Sze.
 1932 Crook, Dr. R. L., Baptist Mission, Yaan, Sikang.
 1931 Cunningham, Dr. E. R., W.C.U.U., Chengtu.
 1931 Cunningham, Dr. G. S., W.C.U.U., Chengtu.
 1931 Darby, Miss L. W., Canadian Mission, Tzeliutsing, Sze.
 1930 Dickinson, Dr. F., W.C.U.U., Chengtu.
 1932 Dickinson, Mrs. F., W.C.U.U., Chengtu.
 1930 Donnithorne, Rev. V. H., C.M.S., Mienchu, Sze.
 1930 Downer, Miss S. B., W.C.U.U., Chengtu.
 1922 *Dye, Prof. D.S., W.C.U.U., Chengtu.
 1930 Dye, Mrs. D.S., W.C.U.U., Chengtu.
 1936 Endicott, Rev. J. G., Canadian Mission, Chungking.
 1936 Endicott, Mrs. J. G., Canadian Mission, Chungking.
 1938 Eriksen, Miss A., Methodist Mission, Chungking.
 1933 Feng, Prof. D.R., W.C.U.U., Chengtu.
 1938 Fenn, Dr. Wm. P., University of Nanking, Chengtu.
 1931 Fong, Prof. S. H., W.C.U.U., Chengtu.
 1939 Fortune, Prof. R. F., Chartered Bank, Hanoi, French Indo-China.
 1939 Fortune, Mrs. R. F., Chartered Bank, Hanoi, French Indo-China.
 1932 Fosnot, Miss P. B., Davenport, Neb., U.S.A.
 1932 Foster, Miss B.L., West China Theological College, Chengtu.
 1928 Frank, Mr. G. M. P. O. Box 446, Dundas, Ontario, Canada.
 1934 Gentry, Dr. Max, c/o M.E.M., 150 Fifth Ave., New York, U.S.A.
 1922 Graham, Prof. D. C., Fairport, N.Y., U.S.A.
 1932 Graham, Mrs. D. C., Fairport, N.Y., U.S.A.
 1938 Gunn, Mr. Wm. G. D., English Baptist Mission, Sian, Shensi.
 1936 Haenisch, Dr. E., Saxonian Academy of Science, Berlin, Germany.
 1936 Hansing, Dr. Ovidia, W.C.U.U., Chengtu.
 1937 Harmon, Mr. W. G., Salt Inspectorate, Tzeliutsing, Sze.
 1931 Hartwell, Miss L. G., Canadian Mission, Tzeliutsing, Sze.
 1936 Hayward, Dr. R. Canadian Mission, Kiating, Sze.
 1922 Helde, Mr. G. G., Y.M.C.A., 131 Museum Rd., Shanghai,

- 1936 Hensman, Miss B., W.C.U.U., Chengtu.
 1938 Hewes, Mr. G. W., 2125 Woolsey St., Berkeley, Calif., U.S.A.
 1929 Hibbard, Rev. E., Canadian Mission, Chengtu.
 1939 Hickson, Miss G. M., Cheeloo University, Chengtu.
 1934 Hockin, Mrs. L., Canadian Mission, Kiating, Sze.
 1934 Holder, Mr. R. R., Kangting, Sikang.
 1936 Hotchkis, Miss A. M., 10 Hsieh Ho Hutung, Peiping.
 1934 Hudspeth, Rev. W. H., British and Foreign Bible Society, 58 Hongkong Rd., Shanghai.
 1937 Hughes, Mr. A. L., Imperial Chemical Industries, Chungking.
 1934 James, Dr. H. E., 2070 N. Bush St., Santa Ana, Calif., U.S.A.
 1934 James, Mrs. H. E., 2070 N. Bush St., Santa Ana, Calif., U.S.A.
 1935 Jarvis, Mr. R. Y., American Consulate, Hankow.
 1937 Jeffrey, Dr. J. Howard, China Inland Mission, Mowkung, Sze.
 1937 Jeffrey, Mrs. J. H., China Inland Mission, Mowkung, Sze.
 1937 Jenner, Dr. Harley, Canadian Mission, Junghsien, Sze.
 1936 Jenner, Mrs. Harley, Canadian Mission, Junghsien, Sze.
 1936 Jensen, Rev. Joshua, Baptist Mission, Ipin, Sze.
 1937 Johnson, Mr. Floyd, S.D.A. Mission, Takoma Park, Washington, D.C., U.S.A.
 1937 Kennard, Dr. J. S., W.C.U.U., Chengtu.
 1937 Kennard, Mrs. J. S., W.C.U.U., Chengtu.
 1935 Kilborn, Miss Cora, 549 Jarvis Street, Toronto, Canada.
 1925 *Kilborn, Dr. L. G., W.C.U.U., Chengtu.
 1939 Kirk, Miss F. A., Ginling College, Chengtu.
 1939 Kirk, Miss L. J., Ginling College, Chengtu.
 1930 Lechler, Dr. J. H., Edinburgh Medical Missionary Society Edinburgh, Scotland.
 1932 Lewis, Mrs. S., 902 Lincoln St., Evanston, Ill., U.S.A.
 1938 Li, Prof. H., W.C.U.U., Chengtu.
 1938 Li, Prof. S. Y., University of Nanking, Chengtu.
 1922 Liljestrang, Dr. S. H., W.C.U.U., Chengtu.
 1931 Liljestrang, Mrs. S. H., W.C.U.U., Chengtu.
 1924 *Lindsay, Dr. A. W., W.C.U.U., Chengtu.
 1938 Liu, Prof. H. R., University of Nanking, Chengtu.
 1934 Lovegren, Mr. L. A., Baptist Mission, 154 Madison Ave., New York, U.S.A.
 1936 Lousley, Dr. H. M., 299 Queen St. W., Toronto, Canada.
 1935 MacNair, Mrs. H. F., University of Chicago, Chicago, Ill., U.S.A.
 1937 May, Rev. K. W., Methodist Mission, Chao-Tung, Yunnan.
 1937 Miao, Mr. C. C., Salt Administration, Tzeliutsing, Sze.
 1938 Molgaard, Mr. V. B., Ecole Francaise d'Extreme-Orient, Kunming, Yunnan.
 1930 Morse, Mrs. W. R., Lawrencetown, N.S., Canada.
 1938 Mueller, Dr. F., The German Embassy, Peiping.
 1936 Mullett, Dr. H. J., W.C.U.U., Chengtu.
 1936 Mullikin, Miss M. A., 397 Elgin Ave., Tientsin.
 1936 Nelson, Miss E., 154 Madison Ave., New York, U.S.A.
 1937 Owen, Rev. A. E., Canadian Mission, Chungking.
 1937 Perry, Mr. H.G.B., Standard-Vacuum Oil Co., Shanghai.
 1933 Peterson, Mrs. R. A., Methodist Mission, Chengtu.
 1937 Petro, Mr. Hanoi, French Indo-China.

- 1937 Petro, Mrs. Hanoi, French Indo-China.
 1922 *Phelps, Prof. D. L., W.C.U.U., Chengtu,
 1933 Phelps, Mrs. D. L., W.C.U.U., Chengtu,
 1937 Pickens, Mr. C. L., American Church Mission, Shanghai.
 1938 Pinney, Mr. E. S., 15 Broadway, New York, U.S.A.
 1922 Plewman, Mr. T. E., 26 Parkview Gardens, Toronto, Canada.
 1935 Plumer, Mr. J. M., 4018 Museums Building, University of
 Michigan, Ann Arbor, Mich., U.S.A.
 1934 Pollard, Prof. R. T., University of Washington, Seattle,
 Wash., U.S.A.
 1934 *Porter, Prof. Lucius, Yenching University, Peiping.
 1939 Reeves, Prof. Cora D., Ginling College, Chengtu.
 1938 Richardson, Prof. H. L., University of Nanking, Chengtu.
 1938 Richardson, Mrs. H. L., University of Nanking, Chengtu.
 1936 Robertson, Miss M., W.C.U.U., Chengtu.
 1938 Rouselle, Prof. E., University of Heidelberg, Germany.
 1930 Russell, Miss L. E., Canadian Mission, Penghsien, Sze.
 1936 Russell, Miss Maud, 133 Yuen Ming Yuen Rd., Shanghai.
 1935 *Sage, Mr. Dean, Am. Mus. of Nat. Hist., New York, U.S.A.
 1936 Salfeld, Dr. Hans, Gottingen University, Gottingen, Ger-
 many.
 1934 Sargent, Rev. D. N., C.M.S., Chengtu.
 1939 Sawyer, Miss M., United Hospital, Chengtu.
 1938 Schroeder, Dr. P., Luhsien, Sze.
 1938 Schroeder, Mrs. P. Luhsien, Sze.
 1937 Schuster, Dr. Carl, Pennsylvania Museum of Art, Philadel-
 phia, U.S.A.
 1927 Sewell, Prof. W. G., c/o Friends Service Council, Euston
 Rd., London, N.W., 1, England.
 1933 Sewell, Mrs. W. G., F.S.C., Euston Rd., London, N.W.1,
 England.
 1937 Shearer, Miss M. C., Methodist Mission, Tzechow, Sze.
 1933 Simkin, Mr. R. L., W.C.U.U., Chengtu.
 1939 Slocum, Pry. B. A. University of Nanking, Chengtu.
 1926 Small, Mr. W., W.C.U.U., Chengtu.
 1934 Smalley, Rev. F. A., c/o C.M.S., Salisbury Square, London,
 England.
 1935 Smalley, Mrs. F. A., c/o C.M.S., Salisbury Square, London,
 England.
 1934 Smith, Rev. F. N., Yaan, Sikang.
 1938 Smythe, Prof. Lewis S. C., University of Nanking, Chengtu.
 1928 Sparling, Rev. G. W., West China Theological College,
 Chengtu.
 1938 Spencer, Dr. J. E., c/o International Red Cross, Kweiyang,
 Kweichow.
 1932 Spooner, Prof. R. C., W.C.U.U., Chengtu.
 1932 Spooner, Mrs. R. C., W.C.U.U., Chengtu.
 1937 Stewart, Miss E. L., c/o C.M.S., Salisbury Square, London,
 E.C.4, England.
 1934 Stewart, Miss J. L., 135 St. Clare Ave. W., Toronto, Canada.
 1938 Stinson, Rev. John, Canadian Mission, Tzeliutsing, Sze.
 1936 Stockwell, Rev. F. O., Methodist Mission, Chengtu.
 1936 Stockwell, Mrs. F. O., Methodist Mission, Chengtu.
 1936 Streeter, Miss M. E., W.C.U.U., Chengtu.
 1934 *Teichman, Sir Eric, c/o Barclay's Bank, 1 Pall Mall, London,
 England.
 1938 Therolf, Miss F., Baptist Mission, Yaan, Sikang.
 1930 Thexton, Miss A. G., 299 Queen St. W., Toronto, Canada.

- 1934 Tomkinson, Mr. L., F.S.C., Euston Rd, London, N.W.1,
 England.
 1935 Tong, Mr. Hollington K., China Information Service,
 Chungking.
 1938 Trotter, Miss C., Methodist Mission Chengtu.
 1938 Tsai, Prof. Chiao, National Central University, Chengtu.
 1938 Uphaus, Mrs. W. E., 304 Crown St., New Haven, Conn.,
 U.S.A.
 1930 Vichert, Rev. C. G., Baptist Mission, Yaan, Sikang.
 1930 Vichert, Mrs. G. G., Baptist Mission, Yaan, Sikang.
 1937 Vittaly, Mr. M. E., Associated Drug Co., Shanghai.
 1934 Votaw, Mr. M. E., St. Johns University, Shanghai.
 1930 Walmsley, Mr. L. C., Canadian School, Jenshow, Sze.
 1935 Ward, Miss A. I., W.C.U.U., Chengtu.
 1938 Ward, Miss Imogene, c/o Methodist Board, 150 Fifth Ave.,
 New York.
 1938 Ward, Bishop R. A., M.E.M., 150 Fifth Ave., New York,
 U.S.A.
 1939 Webster, Rev. R. E., Canadian Mission, Penghsien, Sze.
 1939 Webster, Mrs. R. E., Canadian Mission, Penghsien, Sze.
 1938 Weiss, Dr. Ruth, W.C.U.U., Chengtu.
 1935 Wellwood, Miss C., Canadian Mission, Chengtu.
 1937 Wen, Prof. Tsai Yiu, Yunnan University, Kunming, Yunnan.
 1934 Wheeler, Surg. Lieut.—Commander, The Admiralty, London,
 England.
 1925 Wilford, Dr. E. C., W.C.U.U., Chengtu.
 1934 Wilford, Mrs. E. C., W.C.U.U., Chengtu.
 1929 Williams, Dr. T. H. W.C.U.U. Chengtu,
 1932 Willmott, Mr. L. E., W.C.U.U., Chengtu.
 1937 Wolfenden, Mr. S. N., Security First National Bank, Beverly
 Hills, Calif. U.S.A.
 1930 Yang, Mr. S. C., W.C.U.U., Chengtu.

SUMMARY

Honorary Members	5
Life Members	8
Ordinary members, resident in Chengtu	72
Ordinary members, resident elsewhere in China	64
Ordinary members, resident abroad	58
	199
Counted twice	8
Total net membership, Dec. 31, 1939	191

Will members please note that those whose dues are two or more years in arrears are not included in the above lists. This includes a considerable number who probably believe themselves to be active members of the Society.

During the year the Society has suffered heavy loss through the death of the following members:

Life member Sir Joseph Flavelle
 Life member Dr. W. R. Morse
 Ordinary member Dr. Robert A. Peterson
 Ordinary member Dr. Spencer Lewis

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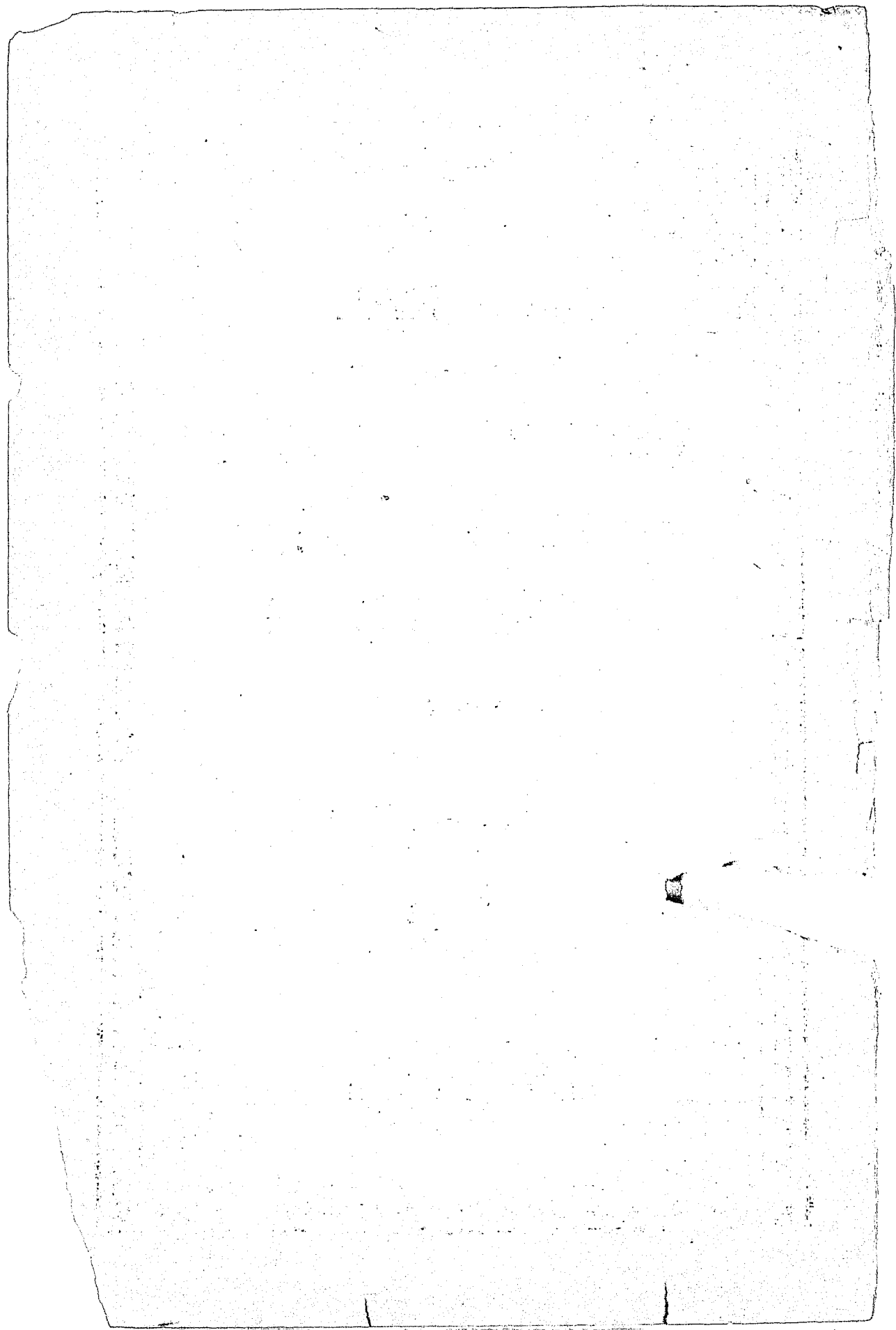
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EDITOR'S FOREWORD.

This volume marks a new departure in the publication of the Society's Journal. Following the example of more distinguished bodies, we are bringing out the Journal in two parts, Series A, General, and Series B, Natural Sciences. It is felt that this will not only be a convenience to members of the Society whose bent lies more particularly in one direction or the other, but that it will also facilitate the exchange of journals with other scientific societies. It is a welcome sign of the interest taken in our work that sufficient papers of a biological nature have been received to permit of the publication of the present number, and it is hoped that in future it will be possible to continue the practice.

Most of the papers in the present volume are of a technical nature. We trust that there will continue to be a supply of such works, and that the journal may be considered a worthy organ in which the results of professional scientific work may be published, and that our journal may form a valuable repository for information of an authoritative nature about the fauna and flora of the border countries. Nevertheless, it would be a great pity if the amateur naturalist were to be deterred from submitting the results of his own research and observations, since these, if accurately made and carefully recorded, are often important in extending, and sometimes correcting, the work done in laboratories. It should never be forgotten that the entire science of Biology was begun by amateurs; indeed, had it not been for the devoted work of the old "naturalists" of the seventeenth and eighteenth centuries, it is improbable that it would ever have reached the development that we see to-day. And the modern professional scientific worker is not only still indebted to the workers of the past, but also to present-day amateur naturalists, who collect in their spare time information which is of the utmost value to all.

Phenological studies, that is the recording each year of the first appearance of common birds or insects, or of the flowering of wild plants, may be of the greatest value when continued over a number of years. The working out of the connection between weather records and the arrival or departure of migrant birds, etc., is not only of great intellectual interest, but may be of value to the agriculturalist. In the section headed "NOTES AND OBSERVATIONS", this journal will always be glad to report such facts as: the date on which the various local cuckoos are first heard (the "brain fever" bird, etc.), the appearance of the hoopoe or other occasional visitors, notes on years of unusual prevalence or scarcity of

insect species, migrations of butterflies or moths seen in West China, or such other notes as may interest readers and contributors.

The present writer once had occasion to look through European biological journals of the past hundred and fifty years for records of the appearance of a moth which, very rare in the British Isles, sometimes occurs as a minor pest in southern Europe. (*Celerio livornica*). From the sum of many years of such observations, almost wholly those of amateurs, it was possible to draw some extremely interesting conclusions as to the nature, and even, tentatively, the causes, of the intermittent appearance of this moth, and to find parallels with the appearance of a very closely related species in the United States. It is certain that the early naturalist, when he wrote to the editor of his favoured Journal to tell him of his "interesting experience in catching a slightly damaged specimen of that attractive rarity, *C. livornica*, as far north as Gloucestershire" did not imagine that he would, long after his death, be helping to throw light on such a subject as insect migration. Perhaps the Biologists of a century from now, while being slightly amused by the theories popular in our time, may still be very glad to find the facts, carefully recorded, by the amateur contributors to our columns.

K.J.F.R.

TADPOLES OF WEST CHINA SALIENTIA

CH'ENG-CHAO LIU 劉承釗

Biology Department

West China Union University

The Salientia, the order of Amphibia that includes the frogs and toads, is the smallest group among the vertebrates, but the young stages are not at all well known, especially in those species which inhabit mountainous regions. Yet study of the tadpoles is of value in the elucidation of species problems of relationship, since the tadpoles vary less within the species than do the adults. As the tadpoles of various species are confined to different bodies of water, and differ from one another in their feeding habits, the external morphology, and particularly that of the mouth parts, is usually rather distinctive. Tadpoles are also more easy to find than the adults, since they are limited to an aquatic habitat, at least in the Chinese forms; since the adults are usually found not far from their breeding places, recognition of the species by their tadpoles is of great help in field study and collection.

The present paper gives results of three summers' investigations. Between June and September, 1938, the author had his first chance to study the amphibians and reptiles of Mont-omei; in that summer only a preliminary investigation was carried out. During the summer of 1939 Pao-hsing-hsien (Mupin) 寶興縣 in Sikang was the center for field study and collecting specimens. In order to make a thorough investigation of Salientia of Mont-omei, the author spent another summer (1940) on the mountain. Besides these summer collecting trips, a special investigation was carried out at Ching-cheng-shan (青城山), Kwan-hsien (灌縣) and Nan-yueh-miao (南嶽廟) of Wen-chuan-hsien (汶川縣) between April 26 and May 1. For the vicinity of Chengtu, tadpoles as well as adults of Salientia were collected and studied.

Altogether 25 species of adults were collected, but only 21 species of tadpoles were secured and the young of 19 species just after metamorphosis. They belong to five families

and nine genera. Two species from Mupin are new forms. One is a new toad, *Bufo bufo wrighti*, another is an unknown *Scutigera* tadpole. One new species of *Scutigera* tadpole was obtained from Mont-omei and a new species of *Staurois* tadpole was collected from a mountain near Nan-yueh-miao. The identity of species has been checked in three ways. First by direct observation in their natural habitats by frequent visits until the tadpoles had four legs fully developed and the process of metamorphosis was begun; such tadpoles were brought back to the work room and they metamorphosed there. The second method was to collect paired adults and have their eggs laid in jars. After the eggs were laid, they had to be transferred into pools or ponds near the temporary laboratory for hatching. Then these tadpoles were raised in jars of water until their characters were fully developed and some species were kept until after metamorphosis. The third method was to study well preserved tadpoles with literature.

Tadpoles under natural conditions and those kept in an aquarium vary greatly especially in size, body form and coloration. For the present study, coloration was carefully described from newly collected living specimens using a color key. For the study of size and form, tadpoles were killed and fixed in 10% formalin in the field, just after taking them out of their natural homes, so the characters are much more reliable than if they were described from tadpoles raised in the laboratory or kept in an aquarium for some time without proper feeding. For measurement, field fixed specimens were used. Some species of tadpoles vary even in their own homes. Different tadpoles were collected in different places for comparative study.

In order to identify a tadpole, the mouth part is a good character as it varies but slightly. The general body form, the position of mouth, anus and spiraculum also may be used as characters to ascertain a given species. The mouth in general is an opening only, without any bony upper and lower jaw. The opening consists of the upper and lower lips, named labia papillae, and mandibles. These two lips are continuous and usually folded at the corners which separate them into upper and lower lips. In some forms, there is no demarcation

of upper and lower lips. The papillae surrounding the labial margins in different degrees, may be uniformly arranged or varied according to the species, and additional papillae or rows of papillae may be found inside the marginal row. At the two innermost margins of the lips, are the upper and lower hard horny mandibles with saw-tooth projections directly continuous with the mandibles proper. The prominent labia are lined with rows of minute teeth which are uniformly arranged like the hairs of a brush. They are attached to the labium by fleshy bases. The rows of teeth may be continuous, and form a complete row from the right to the left side; this is indicated in the tooth formulae by the symbol I. They may however be interrupted in the middle, and so separated into right and left halves; this is indicated by 1:1. The number of rows of teeth varies in different species and even with a given species. The rows of teeth indicated in the tooth formulae are counted from the outermost rows on both upper and lower lips toward the inner rows. For instance, a tooth formula reads I:5-6/II:1-1. This means that the upper lip has one continuous outermost row; the inner rows are interrupted, there being 5 such half rows on the left, and six on the right side, the ornamentation being unsymmetrical. In the lower lip, the two outermost rows are complete, and only the single inner row is interrupted. Labial teeth are rod-like segmented structures with claw-like tips. When highly magnified they show the segmentations; thus they may be brushed away layer by layer. At the terminal end they have the hook shaped structure. This structure evidently has something to do with ingestion of food. Some minute teeth may be found on the separated papillae at corners of the mouth.

The spiraculum is an opening for the exit of the water by which respiration is accomplished. It may be ventrally located or at the left side of the body, with or without a tube. The vent is a structure at the joint between the body and base of the tail. The anal orifice may be directed ventrally to the base of tail or at one side. It varies according to species. The tail of the tadpole is the only locomotive organ, which has an axial segmented musculature and is provided with upper and lower tail crests. The general form of the body and tail vary greatly according to the habitat of the species in question.

Key for Identification of Tadpoles

- I. Mouth terminal; without labial teeth and mandible
- A. With a funnel like projection, formed by the prolongation of upper and lower lip; spiracle sinistral*Megophrys boettgeri*.
- AA. With simple terminal oral opening, lower lip forming a horseshoe shaped fold; spiraculum median
- B. Size small, body nearly transparent, dirty greenish white in color, with a very delicate pointed tail*Microphylax ornata*.
- BB. Size medium, body dirty brownish in color, tail not pointed*Kaloula rugifera*.
- II. Mouth subterminal, with rows of labial teeth; mandible present; spiraculum sinistral
- A. Nostrils enclosed by papillae
- Rows of teeth very short and faintly indicated on high fleshy ridge; nostril enclosed by four papillae*Megophrys pelodytoides*.
- AA. Nostrils not enclosed by papillae
- B. Lower labial teeth normally three rows
- C. Papillae only at the two corners of the mouth
- D. T. F. I:1-1/III; mouth rather small*Bufo bufo bangaricatus*.
- DD. T. F. II/III; mouth rather large*Bufo bufo wrighti*.
- CC. Papillage at the ventral lip and corners of the mouth
- D. T. F. III:4-4/I:2-2; mouth large with ventral adhesive disc
- E. Lower lip with a row of small papillae on posterior margin, and a row of large papillae on anterior margin, ventral poison glands round and widely separated*Staurois* sp.
- EE. Lower lip only with a row of small papillae on posterior margin
- F. Only one row of papillae on lateral side of upper lip, ventral poison glands united*Staurois cheungensis*.
- FF. Extra-papillae within the regular row of papillae on the lateral side of the upper lip, ventral poison glands large, oval, and narrowly separated*Staurois jugans*.
- DD. Mouth opening in normal condition, without ventral adhesive disc
- E. Row of papillae notched at middle part of lower lip
- F. Eye lateral, T. F. 1:3-3/I:2-2, tail with a delicate pointed end*Pelypedates leucomystax*.
- FF. Eye dorso-lateral in position
- G. T.F. I:5-5/II:1-1, body black*Pelypedates davidi*.
- GG. T.F. I:1-1/III, black marks on margin of tail crest*Rana imnocharies*.
- EE. Row of papillae not notched
- F. Lower lip with a single row of papillae only
- G. T.F. mostly I:2-2/II:1-1, body and tail finely spotted with fuscous and olive brown*Rana japonica*.
- GG. T.F. mostly I:1-1/II:1-1, a dark and a light colored band on basal dorsal part of muscular portion of the tail*Rana nigromaculata*.
- FF. Lower lip with more than one row of papillae
- G. Outer layer of papillae few in number and prolonged, T.F. I:2-2/II:1-1*Rana adenopleura*.
- GG. Papillae all alike
- H. Two distinct and uniformly arranged rows of papillae, T.F. mostly I:3-3/II:1-1*Rana boulengeri*.
- HH. Outer row of papillae complete; inner row of papillae not continued to the middle part of the lower lip; T.F. I:1-1/III*Nanorana pleski*.
- BB. Lower labial teeth more than three rows
- C. Papillae notched only at mid-dorsal side of upper lip
- D. Body color uniform, no spots on tail, T.F. mostly I:6-6/I:6-6*Scutiger sibiricus*.
- DD. Body color not uniform, tail with spots
- E. Light brown Y-shaped mark from dorsal posterior of the tail, T.F. normally I:5-5/I:5-5*Scutiger* sp. (Mt. omei).
- EE. Dark spots on body, T.F. I:5-5/I:4-4*Scutiger* sp. (Lungtung).
- CC. Papillae absent from upper lip, T.F. I:4-4/III:1-1*Rana andersoni*.

Scutigera sikkimensis (Blyth)

Scutigera sikkimensis is a mountain form. At Mont-omei tadpoles of this species were collected from pools behind large stones, under cascades or in side pools of a small mountain stream under Ch'ang-shou-ch'iao (長壽橋) between Chiao-lao-tung (九老洞) and Yu-hsien-sze (遇仙寺) with an altitude 5920 feet. On August 18, 1939 a large number of different staged tadpoles were found in pools behind large stones or under cascades of a very small mountain stream near Lung-tung (龍東), Mupin (3400 ft.) and three adults were obtained from the stream. On July 21, 1940, a few tadpoles of this species were secured from Shih-sun-kou (石笋溝), Mont-omei, and on August the first and ninth, many tadpoles in different stages and young adults were collected from the same stream under Ch'ang-shou-ch'iao where tadpoles of the same species had been found during the summer of 1938. The tadpoles of this species are a bottom feeding form with strong mouth parts. Without disturbance, they may swim singly or in small groups from place to place. When disturbed, they get into cracks between stones to hide themselves, also under stones, so it is rather hard to collect them in stony places. They can swim in the current of the stream as their tails are strongly built, especially the muscular portion.

The coloration of the tadpoles varies greatly in different stages. Young tadpoles are black on the dorsal and sides of the body. The pupil is black and round, enclosed by a thin whitish golden ring, which in turn is enveloped by a wide iris; this is black below and marked with golden dots on the anterio-dorsal side. The muscular portion of the tail is light gray and the tail crests are very light yellowish gray. Above the muscular portion, but below the dorsal crest, there are two lines, the upper being a light yellowish brown, and the lower a dark gray or black. These two lines start from the base of the tail and run beyond the middle portion of the tail where they become indistinct. The belly is light gray in color.

When the leg buds are well developed the body becomes umber in color above, and on the sides this colour darkens to bluish black lower down, and then fades to dark gray on the belly. The hind limb buds are grayish blue above and yellowish gray below. The tail is yellowish gray with the muscular portion and dorsal tail crest darker in color, while the ventral tail crest is lighter. The yellowish brown and dark gray lines in between the dorsal tail crest and the muscular part of the tail have disappeared at this stage but their area is still darker in color than the other parts of the body. When the fore limbs come out, the body is greenish gray above with many round or oval warts enclosed by black rings. The dorsal sides of the limbs have the same coloration as the body, but with a number of discontinuous black strips.

The tadpole of this species is very large, as individuals with hind-legs reach 75 mm. in length from snout to tip of tail. Twenty tadpoles were measured their hind legs averaging 5.2 mm. long. Their average body length from snout to base of tail was 25.17 mm., ranging from 22.5 to 28.7 mm. The width of the head was 54.2% of the body length while its depth was only 36.2%. The body is nearly cylindrical with height 51.0% and width 56.4% of its length. The length of the tail is about twice that of the body, and its depth more than half of the body length.

The snout is rounded; the nostril, enclosed by a light colored ring, is nearer to the snout than to the eye (fig. 1). The eyes are latero-dorsal in position but more dorsal than lateral, with an average space in between the eyes of 9.14 mm. which is 36.2% of the body length from snout to base of the tail. The spiraculum is sinistral, ending in a tube, directed upward and backward, visible from above and below. It is 15.82 mm. from snout to spiraculum which is nearer to the base of the tail than to tip of snout as the distance from snout to spiraculum is 62.8% of the body length. The vent is dextral with a large oblique opening under a large skin fold which overlies it and is continuous with the ventral fin crest. The tail is thick, with the muscular part strongly developed. The tip of the tail is blunt with tail crest better developed dorsally. The dorsal crest is thickened at its base but not continued onto the body.

The mouth is ventral, with an average width of 7.07 mm., which is 28.1% of the body length. There is a single row of different sized papillae all round the mouth except for a small free space on the mid-dorsal part of the upper lip. Additional papillae with or without teeth are found at the corners of the mouth especially at the latero-dorsal corners of the lower lip. There are seven rows of teeth on the upper lip. The outermost row is short and continuous partly filling up the gap where there are no papillae. The remaining six rows are all interrupted and the inner row is the shortest. On the lower lip, there are seven rows with the outermost row continuous and longer than the outer row of the upper lip. The other five rows on the lower lip, are all interrupted the innermost row being the shortest (fig. 2). Teeth are also found on some of the additional papillae at the corner of the mouth. The mandibles are thick and heavy with sharp strong teeth on the edges of both upper and lower mandibles. The number of rows of labial teeth varies greatly in the tadpoles of this species. Twenty tadpoles were collected from Lung-tung, Mupin, in Sikang by random selection and twenty two from Mont-omei were also studied. For the Mupin group, the teeth formulae are as follows: 10 have I:5-/I:5-5; 5 have I:6-6/I:5-5; 1 has I:5-5/I:6-6 and 1 has I:6-6/I:6-6; for the Mont-omei group, 10 have I:6-6/I:6-6; 4 have I:5-5/I:5-5; 2

have I:7-7/I:7-7; 2 have I:4-5/I:4-5; 1 has I:7-7/I:6-6; 1 has I:6-/I:7-7; 1 has I:6-7/I:6-7 and 1 has I:4-4/I:4-4. The majority of the Mupin *sikkimensis* tadpoles have a teeth formula I:5-5/I:5-5; and for Mont-omei the common type is I:6-6/I:6-6.

Scutigera sp. of Mont-omei

During the summer of 1938, on August 10th two tadpoles with hind limb buds were collected from a small side pool of Hei-lung-kiang (黑龍江) at Mont-omei where we tried to catch some small loach. From June 26 to August 5, 1940, a few young tadpoles were collected from pools and ponds beneath or by the side of cascades, from behind the large stones of a swift mountain stream in front of Ta-ngo-sze (大嶺寺) (3590 ft.). A giant tadpole with hind leg buds was obtained from a deep side pool of Shih-sun-kou on July 20, 1940. Two big ones were secured from a side pool of Hailung-chiang on July 11, 1940. These tadpoles were found singly at the bottom of the water; slight disturbance, made them hide themselves in cracks between stones, in holes beneath them; thus they were rather hard to catch.

These tadpoles vary in coloration at different stages of growth. Until the hind-leg buds are visible they are dark fuscous on the back and side of head and body, with a light cinnamon brown on the tail, which is darker on the muscular part and stippled with fuscous. An inconspicuous pale yellowish Y-shaped mark which is characteristic of the species lies over upper hind part of the body and the upper fore part of the tail. The belly is colorless. As the hind-limb buds become visible, the body grows rufous on back with close brown stipplings, and is darkened on the sides by fuscous. The tail is rufous at its base shading to ochraceous buff at the tip and on the margins. It is coarsely stippled with cinnamon brown. A pale brown Y-shaped area lies over the tail base, extending to the upper side of the body behind (fig. 3). The color of the snout is like that of the base of the tail, shading to body color; the ventral surface is colorless with the viscera showing through the thin body wall. The pupil is round and black, enclosed by a wide dirty golden iris. As soon as the fore-limbs appear the top and lateral sides of the head and the upper back acquire a golden tan color while the middle of the back of the body is olive behind. Rows of black round or linear warts are visible behind the eye to the level of hind legs. Pearl gray spines or fine warts are developed on the dorsal side of limbs, especially on the hind legs. The limbs are clay colored without bars of any kind. The coloration and shape of warts are absolutely different from those of *Scutigera sikkimensis*.

Just after metamorphosis, the top of the head and upper back are golden in color with at times an olive green area in the middle of the back. While the posterior third of body

is from a golden tan to a yellow clay color. Five rows of black round or linear warts extend from behind the eye to the level of the hind legs. The side of the body has a brown line from the axilla to the groin, punctuated with round or linear whitish spots. The first spot in the axilla is much larger and more distinct. There are four dark vertical bars on each side of the head. In between these bars there is a slender light one. Two wide dark bars on the snout are separated by a narrow one of golden tan; a dark bar lies below the anterior region of the eye, and another broader one is found behind and below it. A dark mark from posterior border of the eye runs back obliquely to the angle of the jaw. The belly is light gray without any spot. The dorsal side of the leg is clay colored with many fine clay colored elevations. There are three inconspicuous dark cross bars on the dorsal side of femur, and ventral another with a very conspicuous white dot enclosed by the dark color. Bars on the tibia corresponding to those of the femur are even more inconspicuous. The dorsal sides of the digitis have distinct dark cross bars. The ventral sides of the limbs are plain light gray in color.

As it is not so abundant as the last species and is rather hard to collect, the following measurements are taken from a single well preserved specimen. This tadpole is very large with a total length of 107 mm. from tip of snout to tip of tail. The length of the body, from tip of snout to base of tail, is 33 mm. The height of the head is 12 mm. with a ratio of 36.3% to the length of the body, while the width is 16.5 mm., which is half the body length. The width of the body is greater than the height, as the former is 21 mm. and the latter is 17.5 mm. The tail is strongly built, and is two and a quarter times as long as body, its height is about equal to the width of the body. The muscular part is strongly developed, as it is 11.5 mm. thick near the base, that is, about 34.8% of the body length.

The nostril of the tadpole is enclosed by a ring of papillae, three or four of them at the upper hind corner of the nostril being distinctly larger than the others. The nostril is nearer to the tip of the snout than to the eye. Eyes are dorso-lateral with a space in between the eyes (10 mm.) about 33.6% of the body length (from tip of snout to the base of the tail). The spiraculum is sinistral and nearer to the base of the tail than to the tip of the snout; it has no free tube but an oblique pouch bearing a small opening at the tip which is directed upward and backward, and visible from above as well as from below. The vent is an oblique opening directed to the right and covered by a flap of membrane which is continuous with the base of the ventral tail crest. The tail is bluntly pointed, with a deeper dorsal and a shallower ventral crest. Both crests decrease in height anteriorly, and near the base of the tail they become very much thickened.

The mouth is ventral in position and its width is 9 mm. from one corner to the other. A single row of papillae surround the mouth, except for a small space in the middle of the upper lip; these papillae are larger toward the dorsal side. There are a few irregular scattered papillae in the lower lip inside of the marginal row and also some additional papillae at the corners of the mouth. Labial teeth and mandibles are remarkably developed in the tadpoles of the genus *Scutigera*. The labial teeth are raised on a conspicuous fleshy base. The number of rows of teeth varies but normally there are six rows above and six below. For this study, twenty tadpoles were observed, and seventeen of these have six rows above and six below. Only the outermost row above and below is continuous and is also the shortest, the outermost row on the upper lip being shorter than that on the lower lip; the other rows are all interrupted with second and third rows the longest. The mandibles are very strong, and have serrated edges. The lower mandible is enormously developed (fig. 4).

The rate of growth for the tadpoles of this species is very slow since those collected July 11 with hind leg buds did not extrude their fore limbs until September. These tadpoles were carefully brought from Mont-omei to the Biology department of West China Union University, and were kept in an aquarium and fed with aquatic plants. This was checked by field observation under natural conditions. For this study two tadpoles were observed in the original pool from which the tadpoles brought back to Ch'engt'u, were collected; they were all in the same stage of development. From July to August 10, C. W. Chang, H. C. Chang and the author visited this pool several times. Even to the last visit on August 10, these two tadpoles were larger in size but the hind legs are still very short.

The process of metamorphosis as indicated by the absorption of the tail crest from dorsal and ventral sides of the tail, began on September 10. Small creamy spots were found on the dorsal sides of the limbs and larger granules on the head and dorsal side of the body. Dark color is found surrounding a longitudinal row of such small warts. The color change starts from the head and gradually continues backwards. Metamorphosis goes on very slowly, for until 5.30 p.m. on September 26, the tail was still as before and with only the tail crest near the base of the tail absorbed. Next morning (7.30 a.m., Sept. 27) two thirds of the tail was gone. This abrupt change does not go on very long as indicated by a slow down of the process of absorption for Oct. 1, it still had a stump. The metamorphosis was completed Oct. 7.

Scutigera species from Lung-tung, Mupin

Two tadpoles were collected from a mountain stream northwest of Lung-tung (3400 ft.) on August 19, 1939. One was obtained from a side pool of a small mountain stream and a smaller one was found in a ditch leading to a mill. This also is a bottom feeding form.

The coloration of the living tadpole is much lighter than that of *Scutigera sikkimensis* tadpoles and the *Scutigera* tadpole of Mont-omei. The background color of the body and the tail is light brown, with scattered irregular dark spots. The tail crest is light gray without dark spots. At the base of dorso-lateral side of the tail, there is a more conspicuous and larger dark spot; smaller dark spots are found on the muscular part of the tail.

The tadpole is rather large, its total length being 78.5 mm. at the stage when the hind leg bud is 5.6 mm. long. The body length from tip of snout to base of tail is 23.5 mm. The width of the head is much greater than its height as the former is 12.6 mm. and the latter is only 8.0 mm. The height of the body is about half of its length and about equal to width of the head. The width of the body is greater than the height with a percentage of 58.7 to the body length. The tail is two and one third times as long as the body. The height of the tail is very nearly the width of the body and its ratio to body length is 57.7%, the muscular portion being similar in height to the head.

The snout is rounded and broad. The nostril is nearer to the tip of the snout than to the eye and is enclosed by light colored papillae. Four papillae at the median side are much larger than the rest. Eyes are latero-dorsally located the space between them being 6 mm., which is about one fourth of the body length. The spiraculum is sinistral, with its opening directed upward and backward, without an independent tube. It is barely visible from above and below and it is nearer to the base of the tail than to the tip of the snout as it is 62.9% of the length of body from the tip of the snout to the spiraculum. The vent is an oblique slit open on the right side of a fold continuous with the ventral tail crest. The tail is bluntly pointed with its muscular part strongly developed. The dorsal tail crest is deeper than the ventral crest. Both diminish their height near the middle region of the tail with the anterior part thickened especially in the dorsal tail crest (fig. 5).

The mouth is rather large, about one third of the body length. It is ventral in position. The lips are bordered by a single row of papillae with a notch at mid-dorsal side where the outermost row of upper labial teeth are developed. At the corners of the mouth and latero-ventral parts of the lower

lip, additional papillae are irregularly scattered. There are five rows of teeth in upper lip with the outer row the shortest and continuous while the other rows are interrupted. For the lower lip, there are also five rows of teeth, the outermost row being the shortest and continuous; the other four rows are all interrupted. Additional teeth are found on additional papillae at the corners of the mouth. The mandibles are heavily developed, with sharp strong serrated edges (fig. 6).

Megophrys boettgeri (Boulenger)

Megophrys boettgeri is here first recorded from Szechwan; it is already known to occur in Kiangsi, Chekiang, Fukien and Kwangtung provinces on the Chinese main-land, as well as on the Island of Hongkong. Adults as well as tadpoles are commonly found on hillsides in Szechwan and Sikang. Tadpoles of this species were collected from pools beneath cascades of small mountain streams in the vicinity of Ta-ngo-sze on Mont-omei from July to August of 1938. From June to the end of August, 1940, different staged tadpoles of this species were found in small mountain streams around Ta-ngo-sze, in large mountain streams near Hei-lung-kiang and Shih-sun-kou and in small mountain streams in between Hung-chun-ping (洪椿坪) (3700 ft.) and Cha-pung-tzu (茶棚子) (5330 ft.). From the present study, the vertical distribution of this species on Mont-omei seems to be from 3000 ft. to 5000 ft., as indicated by the croaking of males for which the author made two trips.

Tadpoles of this species were studied by du Bois-Reymond (1910) who secured them from Lushan (廬山), near Kiukiang (九江), Annandale (1917) and Smith (1927) found this tadpole at the Peak at Hongkong; Mell (1922) collected a specimen in the mountains of the Kwangtung-Hunan border; Wilder found tadpoles on Mokanshan north of Hangchow; and Pope (1926) collected a large number of specimens from Futsing Hsien (延平) and Yenping (福興縣) region of Northern Fukien. Pope (1931) gave a detailed account of its adaptation. The author made field observation and laboratory study of living tadpoles. The results of the present study mostly agree with Pope's description. Tadpoles are most often found in pools under the cascades of small mountain streams with their funnel mouth parts directed obliquely toward the current. If they are found in large mountain streams, they do not live on the stream bed or in pools of the main current but in side pools behind large stones or in bends of the streams where the current is very slow. Young tadpoles swim in schools floating on the surface generally along the edge of the water. When disturbed they may scatter and go down into the water with the funnel mouth folded posterio-dorsally. If one tries to catch them, they hide themselves in the cracks

of stones or burrow into sand with just the head regions exposed. When slightly disturbed, they try to escape by darting against the current. The cylindrical body, and long powerful tail with low thick crests are perfectly developed in adaptation to mountain streams. Tadpoles with hind-legs fully developed, change their group spirit and are usually found singly or a few together on the margins of pools and resting against different kinds of objects. Young and advanced tadpoles do not willingly stay on the bottom for long, and the former will again group together on the surface of the water within a minute after disturbance. I agree with Smith and Pope that surface feeding is the direct function of the funnel-mouth but not the only direct function; the funnel proper also acts as a floating apparatus. The author noted in the field and in the laboratory, that when floating on the surface of the water, only the dorsal triangular portion of the funnel is under the surface of the water and the bottom of the funnel, or the mouth proper, is filled with water. The lateral wings and the ventral triangular portion of the funnel are on the surface. In this manner, food particle can only reach the mouth with the water current from the submerged portion of the funnel if there is no strong water current or wave. The real apparatus for food selection is the three pairs of projections and a median leaf-like one at the entrance of the mouth (fig. 9). A row of hair like bristles on the lower margin of the mouth opening may be the sense organs for, tasting and for selecting the food (fig. 9). On the upper margin is a wide hard border. It was noticed that the tadpole will not take every thing which is by chance forced to the bottom of the funnel. In case an unfavorable object gets into the funnel the tadpole will eject it by closing up the mouth and withdrawing the snout into the water. Pushing and preventing actions may be produced by these projections, not only to prevent the object from getting into the mouth but also to push the object out of the funnel through their combined action. Histological study of the special structures of the mouth may throw some light on this suggestion.

Coloration of the advanced tadpoles varies greatly. Before the hind legs are well developed, the color is rather uniform. Head and body are closely stippled with fuscous color through which a pale rufous brown and a pink shade from the blood can be seen. The eye has a round black pupil encircled by a golden iris spotted with fuscous. The color of the tail is similar to that of the body but with irregular patches of whitish brown on the dorsal part of the muscular portion which extends posteriorly to about the middle of the tail and then disappears. The tail crest, especially at the caudal region, has a much paler color than the body. The funnel is yellowish and the papillae are fuscous in color. The belly is nearly colorless with silver white stipples. One type of the advanced

tadpole has similar coloration to that described above and another type is quite different from this. It is rufous all over the body; the funnel and the tail crest only are lighter in color. Head, body, tail and hind limbs are all stippled with amber or fuscous. Papillae in the funnel are light amber and the bottom of the funnel is light yellowish rufous. Different grades between fuscous and rufous are commonly found.

The tadpole of *Megophrys boettgeri* is rather large in relation to the size of the adults. Five tadpoles with average hind legs 7.6 mm. long ranging from 6-10 mm. were measured. The total length from snout to the tip of tail was found to be 45.82 mm., with body length 12.92 mm., and the tail 32.9 mm. The head and body are somewhat flattened. The height of the head is nearly one third of the body length and the width is very near to half of the length of the body. The height of the body is slightly greater than the width of the head while its width is 55% of the body length. The tail is next longest of any tadpole, and only the tail of *Megophrys pelodytoides* exceeds it. It is about two and half times as long as the body. The height of the tail is similar to the width of the body and its muscular part is nearly equal to the height of the head.

The mouth is terminal with a large funnel which has two long lateral wings, a short ventral wing and a comparatively narrow convex flap above. (fig. 8). The tips of the lateral and ventral wings are bluntly pointed. The width of the funnel is 74.4% of the body length. The funnel can be divided into dorsal and ventral parts by a fold or furrow through the lower middle part of the mouth opening. There are four rows of large, oval, obliquely arranged papillae on the dorsal part of the funnel, the number of rows decreases toward the lateral tips of the funnel. Small round papillae are found near the margin and above the mouth opening. There are three rows of oval shaped and obliquely arranged papillae on the lower part of the funnel, but the number decreases from three to two and at last to one, toward its lateral tips. A row of small round papillae lies near the margin of the funnel. There is a ventral groove from the middle of the mouth to near the tip of the ventral wing of the funnel and a long groove going transversely between the tips of the lateral wings of the funnel. There are three or more papillae on the bottom of the transverse groove on either side of the mouth with some extra papillae near the tip of the ventral wing. The structure of the mouth proper is quite complicated. Above the mouth opening, the inner margin of the upper lip has a soft semicircular raised border, with a large papilla at each end. Within this semicircle is a second, harder, semilunar structure, notched at the mid-dorsal side. On its margin there is a wide colourless border, with a sharp edge. Inside, behind the last ring, four verticle leaf like projections are

located, one pair by the mid-dorsal notch, and the other pair, one on each end of the semicircle. A more complicated structure is developed in connection with another semilunar ring on the ventral side of the mouth opening. The free margin of the lower semilunar curve has a row of papilla-like elevations and a row of delicate hair-like structures (fig. 9), with a triangular elevation in the middle. Connected with each corner of the lower semilunar curve, is a spoon shaped projection. Its free end is rounded with a pouch facing forward; downward, and inward. Mid-ventral to this pair, there is another pair with the free ends pointed toward the midline of the mouth; their bases are united to the bases of the lateral pair. The concave surface is not conspicuous. There is another pair of projections posterior to the second pair with the concave surface facing forward and inward; their bases are connected with those of the first and second pairs. Behind and between the third pair, there is a single rounded projection shaped like the bowl of a spoon with the concave surface forwards; the base is connected with floor of the mouth cavity. This complicated mouth part will be studied in detail in a separate paper. For our present purpose a general description is enough. From observation in the field and morphological study of its mouth, it is wonderfully constructed for surface adaptation in mountain streams. When they are not taking food, beside the labial expansion, the other structures close up and so only water can get through. Any larger particle will be prevented by the semilunar curve and the projections in connection with the upper and lower semilunar folds and the floor of the mouth cavity. Hair like structures on the margin of the upper and lower semilunar folds are possibly sense organs for selection of food beside preventing fine particles from escaping.

Megophrys pelodytoides (Boulenger)

Tadpoles of *Megophrys pelodytoides* were collected from a side pool of Hei-lung-kiang, Mont-omei, in August 1938. From June to August, 1940, tadpoles were secured in the pools of small mountain streams, and in pools beneath cascades near Ta-ngo-sze. *Pelodytoides* tadpoles are elongated, somewhat flattened, eel-like forms, and are found on the bottom of pools, in cracks between stones or hiding in vegetation or roots of bamboos and trees at the margin of the water. They like to stay in shallow running water with the head directed upstream and the tail curved like an eel. It is very hard to get a large number of them as they are rather rare and scattered in different parts of small mountain streams. They are good swimmers in running water as their bodies are elongated and flattened with very strong long tails which are provided with low thick crests (fig. 10). If there is any disturbance they hide themselves beneath stones or vegetation.

It is very hard to observe their presence as their color is so much like that of the red earth or stone in the pools where they live. They have a habit of resting the body against some object, especially the head region. They are not active and generally lie flat on the bottom with the tail curved and rarely swim around as often as other mountain forms. One of the species characters is the enlarged lip correlated with its cascade habitat, a point brought out by Smith who said that the lips serve as an adhesive disc.

In order to find out the real function of the enlarged lips, the author (August 1940) brought one living tadpole back to the Biology department of West China Union University. This tadpole is still in a very healthy condition even as late as March 1941. The function of the lips can be observed with a hand lens by keeping the tadpole in a clean glass jar with clear water. When the tadpole is going to move, the first indication is the withdrawing of the protruded lips. During swimming the lips are usually folded posteriorly but sometimes they are extended. When the tadpole stops swimming, the head and body lie flat on the substratum but immediately or after a few seconds, the lips begin to extend. Extending the lips raises the head. When the lips are fully extended, the papillae on the lateral sides just touch the bottom of the jar, just as one might stand on the tips of one's toes. There are two notches, a small shallow one on the median dorsal side of the upper lip, and a large deeper one on the median ventral side of the lower lip. When lateral and lateral posterior sides of the lip are fully extended, the anterior median area of the lip curves dorsally. The water can get into the mouth through the two notches and the curved area. From the results of the present study, I conclude that the enlarged lips are not functional as an adhesive disc but form a structure to raise the head for respiration as this is an absolute bottom form. Another species character is the nostril which is enclosed by four papillae. They are not moveable and so they can not close the nostril for protection. But observation in the laboratory, indicates the function is to prevent objects from easily getting into the nostril. This may also be closely correlated with a bottom habitat.

The body has a pale rufous background color, stippled coarsely with fuscous. The sides and lower half of the sides are lighter in color with less stippling. The eye has a round black pupil encircled by a golden iris stippled with black. The tail has a thin rufous brown background color with fuscous stipplings, especially on the muscular part; the lower crest is much lighter in color. The belly is colorless.

The body of the tadpole is long and somewhat flattened with a long tail. Two tadpoles about the same stage with hind leg buds 6.8 and 7.0 mm. long, were measured, and their

average total length from snout to tip of tail was 60.15 mm. with a body length 19.0 mm. and tail length 41.1 mm. The head is dorso-ventrally flattened and its height is only 27.1% of body length while its width is 42.6%. The width of the body is much greater than its height, as the former is more than half of the body length while the latter is only about one third. The tail is rather long as it is more than twice as long as the body and has a height only 43.2% of the body length; the muscular part 30.3% of the body length.

The snout is rounded, with the nostril nearer to it than to the eye. Each nostril is bordered by four colorless conspicuous papillae. The eyes are dorsal-lateral in position with a space between the eyes 28.4% of the body length. The spiraculum is sinistral, ending with a short tube directed upward and backward and visible from above and below. It is near the middle of the body. The skin posterior to the spiraculum on the left side, and on the corresponding part of the right side, is loose and elevated; histological study may throw some light on the function of this modified skin. The vent is dextral with its opening overlapped by a fold which is continuous with the ventral tail crest; on the ventral side the crest extends to vent but on the dorsal side it does not reach the tail base (fig. 10).

The mouth is more ventral than anterior and its width is 25.8% of the body length. I was unable to find any demarcation between the upper and lower lips such as that figured by Pope (1931). The lip is greatly extended laterally and latero-ventrally. A shallow and a deep notch are located on dorso-median and ventromedian part of the lip, respectively (fig. 11). There is only one row of papillae on the margin of the lip and no additional ones in the corners of the mouth. Teeth in short rows are weakly developed and are located on high, fleshy ridges. For variation of rows of teeth, twenty-nine tadpoles were studied; twenty of them have the tooth formula 1:3-3/1:2-2; four have 1:3-3/1:3-3; two have 1:3-3/1:2-3; one has 1:4-3/1:2-2; one has 1:4-3/1:4-3 and one has 1:2-2/1:2-2. The outermost row on the dorsal side is the shortest and is complete; the other three rows are interrupted the third row being the longest. For the lower lip, the outermost row is complete and is the longest, the second and third rows are widely interrupted. The mandibles are strongly developed, with large mandibular teeth.

Bufo bufo gargarizans Cantor

This toad is widely distributed in China and is very abundant on the plain of Szechwan. It is much more abundant on the plains than it is on the lower levels of mountains. Tadpoles are found mostly in independent ponds and pools with large amounts of vegetation. Sometimes a few are also

found in slow running water. They are always in schools, led by some tadpoles swimming in one direction going from place to place. This phenomena is very much like the migration of fishes or birds. It is not unusual to find a few swimming in a different direction, but very soon they will come back to the school again and follow the group. While feeding, many tadpoles will gather together on some dead animal or decayed vegetation in the water looking very much like a mass of cow's excrement. They like animal diet better than plant. If a dead cat is put into the water, many of them will come to it very quickly with mouth parts sucking the animal and tails swimming vigorously to help the tadpoles to get some meat or juice from the dead organism. Throwing vegetation into the water the reaction is very slow and generally a limited number of tadpoles go to it. Schooling of the tadpoles is much better shown when the tadpoles have the hind legs well developed.

Twenty tadpoles (average of hind leg-length 3.6 mm.) were measured from snout to tip of tail, the average length was found to be 30.10 mm., the average body length being 11.9 mm., ranging from 11.3-12.5 mm. The width of the head is half of the body length while its height is little more than one third of the body length. The width of the body is 63.8% and its height 53.0% of the average length of the body. The average tail length (18.23 mm.) is about one and a half times the body length and the height of the tail crest is about one third of the tail length and half of the length of the body. The muscular part of the tail is only 13.4% of the body length. It has the weakest tail among the tadpoles of West China.

The body is black and the belly dark gray to black. The dorsal side of the hind leg buds and the muscular part of the tail have the same color as the dorsal side of the body. The pupil is round and black and enclosed by a thin golden ring, surrounded by a black iris. The tail crest is white and translucent with some scattered fine gray granules. Each nostril, enclosed by a light colored ring, is nearer to the eye than to the snout. The eye is latero-dorsal in position, is nearer to snout than to spiraculum, and the interorbital space is about one third of the length of body from snout to the base of the tail. The spiraculum is sinistral and without a free tube; its opening faces upward and backward. It is not visible from above, and can barely be seen from below. It is near to the middle of the body. The vent, with a very short tube, is at the base of the tail with the opening directly under the ventral tail crest. The tip of the tail is rounded, and the dorsal and ventral tail crests are more or less equally developed. The dorsal tail crest low near the base of the tail (fig. 12).

The mouth is anterior ventral with an average width (from corner to corner) of 2.83 mm. which is 23.8% of the body length. Papillae are only found at the corners of the mouth.

There is a single regular row of papillae on the margin of the corners of upper and lower lips; and inside of these some extra irregularly scattered ones. The end of each row is continuous with the end of the outermost rows of the upper and lower labial teeth. There are two rows of teeth in the upper lip; the outer row is continuous and the inner row is interrupted. In the lower lip, there are three continuous rows of teeth, the outermost row is a little shorter than the rest and the innermost row is the longest. There is no variation in rows of teeth. A beak is moderately developed and has a serrate edge.

Bufo bufo wrighti Schmidt and Liu

This new species was recently described by the author and Mr. K. P. Schmidt, the description being based upon the characters of adults as well as those of tadpoles. It is a mountain form whose tadpoles are found in the side pools of large and small mountain streams around Mupin (8100 ft.), Lungtung (3400 ft.) and Tu-pa-kou (土巴溝) (6700 ft.) in Sikang. Large numbers of tadpoles were collected from these places on July 22, July 28 and August 5th, 1939. On April 27, 1940, young tadpoles of this species were found in side pools and small streams of rapid water near Nan-yuh-miao (南嶽廟), in Wen-chwan-hsien (汶川縣), near Kwan-hsien (灌縣). Tadpoles in pools are generally found on the bottom of the water and those in streams may be attached to stones by their large mouths. They are occasionally found in schools swimming from place to place like an army like those of *Bufo bufo gargarizans*. They are found singly in running water.

The body is uniformly black above and the belly is dark gray. The muscular part of the tail has the same color as that of the dorsal side of the body, and the tail crest is dark gray or nearly black, especially in the basal region. The nostril is slightly nearer to the eye than to the tip of snout, and is enclosed by a light colored ring. The eyes are latero-dorsal in position, and much nearer to tip of snout than to spiraculum; this is sinistral and without a tube, just an opening directed upward and backward, with an elevated base. It is visible from above and below and the opening is nearer to the hind leg bud than to the tip of snout. The vent is at the base of the tail, and has a long tube. The tail is blunt at the tip and has equally developed dorsal and ventral tail crest. The dorsal tail crest is highest some distance from the tail base. The body is slightly flattened. When measured, twenty tadpoles with hind leg buds well developed (3.2 mm.), showed from snout to base of tail, an average of 9.8 mm. body length, ranging from 9.0-10.8 mm. The width of the head is much greater than its height, being about 49.4% of the body length while the height is only 35.0%. The space between the eyes

is about one third of the body length. The width of the body is also greater than its height, but both are greater than the corresponding dimensions of the head. The tail is about one and half times the length of the body. The tail height is very near to that of the body, as the former is 45.5% of the body length and the latter is 47.7%. From snout to spiraculum is 67.7% of the body length, so the latter is nearer to the base of the tail (fig. 14). The muscular part of the tail is slightly stronger than that of *Bufo bufo gargarizans*, being 14.9% of the body length.

Mouth is a little more ventral than anterior and its average width is 3.18 mm. with a ratio of 32.3% of the body length. The corners of the mouth are provided with one row of papillae and inside this there are some irregularly scattered ones. The ends of the papillary rows are continuous with the margins of the dorsal and ventral lips, but they are not continuous with the ends of the outermost rows of teeth in either upper or lower lips as in *Bufo bufo gargarizans*. In the upper lip, there are two continuous rows of teeth curved downward at either end (fig. 15). Three continuous rows of teeth are present in the lower lip; of these the middle row is the longest and the outermost row is slightly shorter than the rest. There is no variation in rows of labial teeth within the species. The mandible is moderately developed and has finely serrated edges.

Tadpoles of *Bufo bufo wrighti* and *Bufo bufo gargarizans* are not only different in habit and habitat; they also differ in morphology. The former are found in side pools of large mountain streams and small mountain rivers and the latter found in ponds and pools and sometimes in ditches on the plain. *Bufo bufo wrighti* tadpoles are distinctly smaller than those of *Bufo bufo gargarizans* but the mouth is much larger. There are two complete rows of labial teeth in the upper lip. *Bufo bufo gargarizans* has two rows of teeth in the upper lip but the second row is interrupted. The papillary row is continuous with the outermost row of labial teeth in *Bufo bufo gargarizans* but not in *Bufo bufo wrighti* (fig. 13, 15). The spiraculum of *Bufo bufo wrighti* is much more posteriorly located on the left side of the body, but in *Bufo bufo gargarizans* it is mid-way between the snout and the base of the tail. In relation to habit and habitat, the shape of the body, the length of the tail and its crest they are quite different from each other. The body of *Bufo bufo wrighti* is slightly flattened and slender while in *Bufo bufo gargarizans*, it is slightly longer but the tail crests are much thinner and wider with a very light gray color or a white color with scattered gray granules. The dorsal tail crest reaches the base of the tail in *Bufo bufo gargarizans*, but in *Bufo bufo wrighti* it decreases in height from the proximal quarter to the base (figs. 12, 14).

Microhyla ornata (Dumeril and Bibron)

Microhyla ornata is commonly found on the Ch'engt'u plain and also on the hills and mountains; many specimens were collected from Sinkaisze (新開寺) (4920 ft.) near Mont-omei; Kia-ting (嘉定) Chang-chia-shan (張家山) near Ya-an. Tadpoles are numerous in small, temporary rain water pools round Ch'engt'u from the end of May to July. On July 23, 1939, different staged tadpoles were collected from a small artificial pool behind Chang-chia-shan, Ya-an. These tadpoles are not easily noticed as they are transparent, very light greenish gray in color, and of small size, so they are easily concealed by any small object. During a clear day they usually avoid the direct rays of the sun by grouping and hiding themselves under shadows thrown upon the water by overhanging leaves, or under the leaves of aquatic plants. If there is any disturbance, they will scatter themselves more or less evenly in the water. Annandale recorded similar behavior in *Microhyla butleri* in 1917 and Pope also in *Microhyla ornata* in 1921 when he suggested that the behavior is protective in function. When it rains or is cloudy, they may be more or less evenly scattered under the surface of the water. The development of this species is much faster than in the other forms of West China and it is no wonder they are so abundant, although they breed in small temporary pools which could not possibly remain for more than a limited number of days.

The body and the tail are transparent; the former is light greenish gray and the tail is pearl gray. Both body and tail are finely dotted with brown, except the distal part of tail which is colorless and absolutely transparent so it is difficult to see. Dorsal and ventral sides of the muscular part and the free margins of the tail crest are richly dotted. The eye is small with a round black pupil enclosed by a yellowish golden iris. The belly is colorless.

The tadpoles are small in size. Twenty tadpoles taken at random with average hind leg length 4.2 mm. ranging from 2.3-6.0 mm. were measured. The average total length from snout to tip of tail is found to be 22.34 mm. the average body length 7.09 mm. with a range from 6.5-8.2 mm. and the tail 15.34 mm. long ranging from 12.0-19.0 mm. The head is dorso-ventrally flattened as its height is 46.3% of body length while its width is 58.8%. The height of the body on the other hand is much greater than its width as the former is 60.8% of the body length and the latter is only 48.9%. The spiraculum is median ventral its position being near the base of the ventral crest of the tail. From snout to spiraculum is 96.2% of the body length. The tail is more than twice as long as the body, with a height 60.9%, but the thickness of the muscular part is only 18.4% of body length. From the habitat one would expect the tail to be shorter than this, but as the base of the

body is very oblique from dorsum to vent. this percent is due to the way of measuring. If it is measured from ventral base of the body, the tail will be much shorter (fig. 16, 17).

The mouth is terminal, lacking horny beak, labial teeth and papillae. Under natural conditions, the upper lip is broad and slightly curved. At the corners of the mouth, it folds medially and slightly dorsally to form the lower lip. Toward the mid-line of the body, the lower lip turns backward and then forward again so that a U-shaped structure is formed projecting forwards and upwards. This is a characteristic structure of the *Microhyla ornata* tadpole (fig. 18). The nostrils are medial and in front of the eye and are connected with each other by a distinct lachrymal canal. The nostrils are nearer to the tip of the snout than to the eye. The eyes are lateral in position with a space more than half of the length of the body between them. Spiraculum is median ventral in position lying near the base of the ventral tail crest. It is covered ventrally by a concave transparent membrane which can be seen from the side and which overlaps the basal part of the ventral tail crest. The opening is large and directed backwards. The vent is dextral with a long curved tube embedded in the ventral tail crest with its opening near the margin of the crest. The tail is very delicate and has a pointed tip. The ventral crest is deeper than the dorsal one. The crest reaches its highest point in the region where the tip of the anal tube is embedded.

Kaloula rugifera Stejneger

Kaloula rugifera is a common narrow mouthed toad of Szechwan occurring on the plain as well as on the mountains. Adults and tadpoles were collected from Ma-lien-wuan (馬連灣) (3000 ft.), Ching-yin-ko (清音閣) (3300 ft.) and Sinkaisze (4920 ft.), Mont-omei, in August, 1938. During the end of May, 1940, eggs, tadpoles and adults were collected on the campus of West China Union University. More specimens were obtained around Ta-ngo-sze, Mont-omei, from July to the end of August, 1940. Tadpoles inhabit small shallow artificial pools, and small temporary rain water bodies. Tadpoles are generally found on the bottom and at the margin of the water.

Size and color vary according to the condition of the pool. Tadpoles living in dirty and shaded water are dark in coloration, and light colored specimens are found in clear water. The body is olive brown dotted with fine rufous brown spots especially toward the tail. The eye has a round black pupil enclosed by a light fuscous iris which is spotted with gold. The tail has a light olive brown back-ground and is richly marbled with dark grayish brown on the crests. A characteristic dark band extends backwards from the base (of the muscular part) to about the middle of the tail where it becomes

inconspicuous. Outside this band the tail is heavily dotted with umber and olive green. The belly is pinkish gray. Some tadpoles collected from Ch'engt'u have another vinaceous band running from tip of snout to the basal part of the dorsal tail crest (fig. 19).

Ten tadpoles randomly selected, with average hind leg buds 3.01 mm. long, ranging from 2.0 to 3.8 mm., were measured. The average length from snout to tip of tail was found to be 31.07 mm., with average body length 11.23 mm. and tail length 19.84 mm. The head is very much flattened; its height is about one third of the body length while its width is about two thirds of the length of the body. The height of the body is half of its length and its width is similar to that of the head. The tail is rather short with poorly developed musculature. Its length is 177% of body length with height 60.0%; the muscular part is only 18.5%.

The mouth is terminal and has no horny beak or labial teeth. The upper lip folds at the lower sides where it turns medio-dorsally and then ventro-anteriorly to form the lower lip. Inside of the lower lip on the floor of the oral cavity a U-shaped elevated mucous membrane connected in front with the lower lip (fig. 20). As the head is greatly flattened dorso-ventrally, the nostrils are close to each other on the dorsal side of the head. They are nearer to a line joining the anterior corners of the eyes than to the tip of the snout. The lacrymal canal is conspicuously developed. The eyes are lateral in position and with a space between them more than half of the length of the body. The spiraculum is median, at the base of the anal tube. It has a large curved slit-like opening covered by a transparent sheath. The anus is median and has a short broad tube which is continuous with the thickened base of the ventral tail crest. The tail is pointed, and the crest is thickened near the base.

Nanorana pleskei Günther

Nanorana pleskei is a high mountain form. A large number of specimens of adults, young and a few tadpoles were collected by Mr. M. C. Chang on the top of Keta-liang-tze-shan (格大梁子山) at an altitude about 12,000 ft. It is near Taiming (泰寧) which is about a hundred miles north west of Kang-ting (康定), Sikang. Tadpoles are found in the small pools that form temporary reservoirs for the water which runs through the meadows to feed very small slow-running streams. They are very abundant and easy to collect. Individuals of different stages of metamorphosis are commonly found among the grasses on the margin of pools and streams. This is not an active species as the body is rather stout and the tail is weak and short.

The tadpoles are rather poorly preserved and the coloration is not clear; the general shape of the body is also slightly deformed. For the present study only a single better preserved specimen was measured. The total length of this tadpole from snout to tip of tail is 36 mm., and the legs are 8.7 mm. long. The body is 15 mm. while the tail is 21 mm. in length. The height of the head is much less than the width, the height being 4 mm. and the width 6.8 mm. In proportion to body length, the height is 26.6% and the width is 45.3%. The height of the body is 40.0% of the body length while the width is 61.3%. The tail is rather short as it is only 21 mm. long, which is 140% of the body length; its height is about half of the length of the body and the muscular part is only 16.6% of the length of the body. Just after metamorphosis it is 10 mm. from snout to vent.

The body is stout, with a rather pointed snout. The nostril is midway between the tip of snout and the eye. It is enclosed by a thick elevated ring. The eyes are dorso-lateral in position and the distance from eye to eye is equal to the height of the body. The spiraculum is sinistral; it has a broad pouch and its opening is directed upward and backward without a free tube. It is about in the median line of the body and barely visible above and below. The vent is also sinistral and has a short broad pouch and very large opening which is continuous with the ventral tail crest (fig. 21). The broad anal pouch and the large opening are correlated with the thick intestine which is visible through the belly. The tail is weakly developed with delicate crests and the muscular part is thin. The stoutness of the body, caused by the thick intestine, and the weakly developed tail, are closely correlated with the adaptation of the species to small pools with water running through grasses.

The mouth is anterior ventral in position and is rather small, its width being only 19.3% of the body length. There is a row of papillae on each side of the upper lip and along the whole margin of the lower lip. These papillae have pigmented cords. Papillae, generally without pigmented cords, are irregularly scattered inside of this row, except below the middle of the outermost row of lower labial teeth. The labial teeth vary greatly. Seven tadpoles were studied; of these three have the tooth formula I:2-2/II:1-1, two I:1-1/II:1-1, one I:1-2/II:1-1 and one I:2-2/III:0-0. In most cases, the upper lip has three rows of teeth with the outermost row complete and two inner rows interrupted; the innermost row is very short and the two halves widely separated. In the lower lip, three rows of teeth are developed with innermost row narrowly interrupted. All rows of labial teeth are located on fleshy bases. The mandibles are rather weak and have fine serrate edges (fig. 22).

Staurois jugans (Stejneger)

Staurois jugans is distinctly a swift mountain stream form. The breeding place is also in those streams where the adults are found. Tadpoles were collected from a mountain stream outside Muping city in Paohsing-hsien (寶興縣) (3000 ft.), July 22 to 25 of 1939, and a few tadpoles of the same species were obtained from a mountain stream near Lung-tung (3400 ft.) on August 19th of the same year. Some tadpoles were also secured from a mountain stream outside of Yang-t'sun (楊村) (3200 ft.) August 20, 1939. The tadpoles are found singly, adhering tightly to the surface of slippery rocks, at the margin of the water below cascades. Each tadpole adheres tightly by means of a well developed sucker beneath the front of the body with the tail swimming sideways, forced so by the current of the water. The sucker is adjacent to the mouth. Sometimes the tadpoles may be found adhering to boulders near the margin of the water. If there is any disturbance, those under cascades just release themselves and drop into the bubbling water at a moment's notice, and those on boulders also release themselves and disappear with the swift current of the stream. It is very hard to collect them as after releasing themselves they hide under or in cracks between stones. They feed on algae or other organisms which grow on the surface of the stones. The tadpole slides from place to place by means of the sucker which produces vacuum. As the animal slides along, the strongly developed head and labial teeth scrape off and suck in the food from the surface of the stones.

The coloration of these tadpoles varies slightly on the body but greatly on the posterior half of the tail. The body is olive to olive brown; a round black pupil is enclosed by a golden iris; in turn this ring is bordered by olive brown. The tail has the same coloration but the crest and near the tip is much lighter in color. There is a dorsal and ventral irregular ashy patch. In a few cases, the larger tadpoles have a light grey wash on the tail with scarlet color near the posterior half of the tail. It is darker on muscular part and toward the tip of the tail. The crest in this region is much lighter in color. The belly is colorless.

The average body length from snout to base of tail in ten tadpoles with hind-limb buds averaging 3.1 mm. long, is 14.86 mm. ranging from 12.3-18.8 mm. The width of the head is about half the length of the body while its height is about one third of the body length. The height of the body behind the ventral disc is 43.8% of the body length and its width is more than half of the length of the body. The length of the tail is more than one and half times the body length, and its height, including crest, is 52.4% the length of the body. The muscular part is about a quarter of the body length.

The body is dorso-ventrally flattened with the snout region depressed. The snout is rounded from above. The nostril, enclosed by a light colored ring, is much nearer to the eye than to the tip of snout. The eye is latero-dorsal in position and the space between the eyes is very nearly one third of the body length. The spiraculum is sinistral, directed upward and backward, ending in a short tube which is visible from above and below. It is less than one third of the body length from the spiraculum to the base of the tail. There are two pairs of poison glands. The upper pair is symmetrically placed behind and below each eye, and the ventral pair is found at the base of the belly. The latter are larger, oval in shape and narrowly separated. The vent is ventral median in position and tubular at the base, it is continuous with the ventral tail crest, but has a short pointed free part (fig. 23).

The mouth is ventral in position and its width is nearly half of the length of the body. The upper lip is narrow and horse-shoe shaped, its long sides turning backwards and interlocking with the corners of the lower lip which is straight, broad, much thicker, and notched in the middle. This lower lip also functions as the forward margin of the ventral disc. There are two rows of rounded papillae on the upper lip. The outer row is very regular on the margin of most of the lip and the inner row is more or less irregular, and with additional papillae in between the outer and inner rows. Again there are some additional papillae at the corners of the mouth. There is only a single row of smaller papillae on the posterior free margin of the lower lip. Labial teeth are well developed in *stauroids* tadpoles. For this species, there are seven rows of teeth on the upper lip; the first row is weakly developed on its mid-anterior margin, but is continuous; the second and third rows are also continuous but more strongly developed; and the remaining four rows are all interrupted with the innermost row the shortest. There are three rows of teeth on the lower lip, with the innermost row interrupted and the two outer rows continuous. The mandible is moderately developed and has a serrated edge (fig. 24). There is no variation in rows of labial teeth among the tadpoles of this species. An adhesive ventral disc is well developed behind the mouth. It is U-shaped with a wide rim which is used as the lip of a vacuum; the lower lip of the mouth forms its anterior part. The anterior tips of the rim are partially covered ventrally by the posterior ends of the upper lip. It is broader than long as its width is 59.9%, and its length from tip to posterior edge of the rim, 53.6%, of the length of the body.

Stauroids chunganensis (Pope)

Rana chunganensis was collected by Pope, in August 1926, from Kuatun village, northwestern Chungan Hsien, Fukien Province, at 4500 to 5000 ft. altitude. It was described as a

new species *Rana chunganensis* by Pope 1929. Study of the ontogeny of the tadpole forces the present author to put it into the genus STAUROIS instead of RANA as the tadpole has a large adhesive ventral disc and poison glands. Pope (1931, p. 558) stated that "the larva of this genus (*Stauroids*) is at once distinguished by its very conspicuous, ventral sucking disc". In 1931, Noble stated that the ventral sucking disc of the tadpole is an important character of the genus. Pope and Boring (1940, p. 43-45) stated that the tadpole of *Stauroids* has a large adhesive ventral disc. The vomerine teeth and the transverse groove across the lower surface of the digital disc are not generic characters was proved by the study of this species and *Stauroids jugans*. Noble, 1931, gives a detailed discussion about the generic characters of *Stauroids*. He states that this transverse groove is subject to individual variation and therefore useless as a generic character. Therefore we have strong reasons to change *Rana chunganensis* to *Stauroids chunganensis*.

Tadpoles are found in mountain streams attached to the free surfaces of large stones, or hiding themselves in between or beneath small stones in comparatively shallow running water. When they adhere to a stone below a cascade, their snouts face the cascade and their tails wiggle sideways in the force of the current. If there is any disturbance they release themselves and drop into the water current and disappear. The tadpole can slide from place to place on the surface of the stone without releasing the body. This action is performed by the large ventral adhesive disc in cooperation with the toothless part of the broad lower lip. The tadpoles are found in He-lung-chiang and Shih-sun-kou (3500 ft.) on Mont-omei and one tadpole was collected by H. W. Chang from a mountain stream near Nan-yueh-miao in Wen-chuan-hsien about twenty miles northwest of Kwan-hsien. Adults of this species have also been found near Tsao-kia-ying (曹家營) in T'ien-chuan-hsien (天全縣), Sikang. Even though it is a rather common frog found near mountain streams, there is no former record of this species from Szechwan or Sikang.

The coloration of the tadpoles varies greatly. There are two common types, one varying from light to dark gray and the other from light to dark brown. Besides these there are some peculiar combinations and patterns. Some of the gray tadpoles have a reversed white V-shaped mark from the nostril region to the eyes; and brown tadpoles occur with a similar brilliant brown mark. There is another type of pattern found on the back of some of the tadpoles. The pupil is round and black and is enclosed by a thin golden ring which is surrounded by a wide iris whose color corresponds to the color of the body. Brown or gray tadpoles may have a wide black band behind the eye and a

similar band at the base of the tail. The tail may be marbled near the middle by light colored patterns in between the dorsal crest and the muscle; in a few cases this may extend the whole length of the tail. This character is rather rare in uniformly coloured tadpoles but common in those with reverse V-shaped mark on the head. The throat and front of the belly are pinkish gray giving way to whitish gray behind, the former being due to abundant blood and the latter to the color of the intestine.

Tadpoles with hind legs well differentiated are much smaller than those of same age of *Staurois jugans*, the total length including body and tail being only 36.6 mm. long. The body length (snout to base of tail) is 12.6 mm. and the tail is 22 mm. long. The height of the head is less than its width being 5.4 mm. while the width is 7.8 mm. In proportion to the body length, the height is 42.8% and the width 61.9%. The height of the body is nearly half the length of the body while its width is 63.4% of the body length. The length of the tail is about one and three fourths times the body length and its height is more than half of the length of the body; the muscular portion is 29.3% of the body length.

The front of the body is flattened below where the adhesive disc is developed. The snout is more or less square, and it is much more conspicuous in young tadpoles. The nostril is nearer to the eye than to the snout tip and is enclosed by a light colored ring. The eyes are more dorsal than lateral and nearer to the snout than to the base of the tail; the space between them is about one third of the body length. In very young tadpoles it is separated into two glands, which grow until they reach each other and fuse together as one. The spiraculum is sinistral, ending with a tube directed upward and backward, which is visible from above and below. It is nearer to the base of the tail than to the snout being 73.7% of the body length from the tip of snout. The vent is median and tubular about one third of its total length being free (fig. 25).

The mouth is ventral in position and its width is 5.4 mm. which is 42.8% of the body length. There is a single interrupted row of papillae on the upper lip which is continued along the free margin of the lower lip. Seven rows of teeth are developed in the upper lip, the outer three rows continuous, and the inner four rows interrupted; the outermost row is weakly developed on the free margin of the upper lip. On the lower lip, there are three rows of labial teeth. The innermost row is interrupted and the other two rows are continuous. The mandible is moderately developed and has a fine serrate edge. Posterior to the mouth is the large adhesive ventral disc which is horse-shoe shaped, with a central depression and a broad rim-fold of skin which forms the posterior and

lateral margins of the disc. Anteriorly the rim ends at the mouth with its inner edge overlapped by the corners of the upper lip. The broad free part of the lower lip closes the front of the disc. This disc is used by the tadpoles as a shallow vacuum with cup with which to adhere to the stones in swift mountain streams. The length and the diameter of the disc are slightly more than half of the length of the body (fig. 26).

Staurois species

One tadpoles was collected by H. W. Chang from a mountain stream near Nan-yueh-miao in Wen-chuan-hsien, Szechwan. It was found under a stone in slow running water by the side of the main stream. The tadpole is rather large with a total length (snout to tip of tail) of 52.3 mm. The body length from snout to base of tail is 17.6 mm. which is about half of the length of the tail. The head is flattened ventrally and its height is slightly more than one third of the body length while its width is 59.0% of the length of the body so the head is dorso-ventrally depressed. The height of the body is nearly half its length and its width is much greater than its height being 62.5% of the length of the body. The tail is rather long, that is nearly twice as long as the body, with a height equal to the width of the head; the thickness of the muscular part is equal to the height of the head. The tail crest decreases in height toward the base of the tail and there is no crest dorsally or ventrally for about 5 mm. from the tail base (fig. 27).

The body is dorso-ventrally flattened especially at the head region. The nostril is in a concave area, nearer to the eye than to the snout. The eyes are more dorsal than lateral in position and the space between them is about one third of the body length. The spiraculum is sinistral, directed upward and backward and ending in a tube which is visible from above and below. It is nearer to the base of the tail than to the snout. There are two pairs of poison glands. One pair are small rounded glands (2 mm.) each located behind the eye. Another pair of conspicuous poison glands (3 mm.) lies one on each side of the belly, at the base of the leg, and widely separated from one another (fig. 28).

The mouth is ventral in position and its width is nearly half of the length of the body. There are two curved rows of papillae on the sides of the upper lip. The papillae of the inner row are longer than those of the outer row, and there are a few extra ones in between these two rows near the tips of the upper lip. On the broad lower lip there are also two widely separated rows of papillae. The papillae of the outer row are small and lie on the free margin of the lip; those of the inner row are longer and located just posterior

to the outermost row of labial teeth; near the corners of the mouth the papillae of the inner row have disappeared. Seven rows of teeth are present in the upper lip, the outermost row being continuous and weakly developed on the margin of the lip. The next two rows are continuous and four inner rows are interrupted. On the lower lip, there are three rows the innermost being interrupted. The mandible is moderately developed and has serrated edges. Behind the mouth is a large adhesive disc which is enclosed behind and at the sides by an elevated wide rim formed by a modification of the integument. In front the free ends of the rim are overlapped by the posterior corners of the upper lip. The broad lower lip forms the anterior rim of the disc (fig. 28).

Rana nigromaculata Hallowell

Rana nigromaculata is the most widely distributed and common pond frog of China. It is found on the plains, on low hills, and at base of large mountains. Tadpoles of this species are inhabitants of pools, ponds, ditches and rice fields, feeding on vegetation and dead animals. If there is no favorable food, they may take mud on the bottom of the water where unicellular organisms or other organic matter can be taken in with earth. Although a bottom feeding species they may swim singly or in groups in the water and now and then come up to the surface for oxygen. Many egg masses are found in rice fields and shallow waterbodies but tadpoles are not so abundant as they should be. This is due to the fact that a lot of eggs are eaten by birds especially herons which are commonly found on the plains of Szechwan. Secondly a large number of eggs and tadpoles are spoiled by farmers when they work in their rice fields. Ducks may be another enemy as they search for food in rice fields, ponds, pools and ditches.

The coloration of living tadpoles varies slightly. They are bluish olive green on the body with fine brown and umber spots. Color is lighter near the snout and head region. The sides of the body are gradually changed by golden red spots mingled with black pigments. The pupil is round and black with a wide pigmented golden iris. The base of the tail above is very much like the head region in colour except that it is lighter and uneven. A dark colored band is developed on the dorsal muscular part of the tail and this band diminishes backwards, disappearing beyond the first third of the length of the tail. Ventral to this band is a light colored band of greenish ochraceous buff and next to it is a diffused ill-marked dark colored band. Most of the muscular part is light ochraceous buff with scattered fine fuscous spots mingled with golden dots. The tail crest is light cream buff finely spotted with golden and fuscous dots. The throat region is flesh colored and around the heart is bluish green; the belly is iridescent white with a little red color.

The size of the tadpole varies greatly according to the food supply. For the present study twenty tadpoles with an average length of hind leg buds 5.1 mm. ranging from 3.7 to 7.4 mm. were measured. The average body length from snout to tip of tail is 47.88 mm. (body length 17.34 mm., tail length 30.54 mm.). The width of the head is greater than its height, as the former is 55.0% of body length while the latter is only 41.1%. The height of the body is slightly greater than the width of the head, being very nearly two thirds of the body length. The tail is short in comparison with the tail of other *Rana* tadpoles found in Szechwan or Sikang, as it is only 176.1% of the body length. The tail crest is deeper than that of other *Rana* tadpoles of West China being 62.1% of the length of the body, but its muscular part is poorly developed and its thickness is only 20.7% of the body length. Just after metamorphosis, the body is 23.4 mm. long from tip of snout to vent. The body is stout with bluntly pointed snout. The nostril is nearer to the snout than to the eye. The eyes are dorsolateral in position with the eye ball facing sideways. The distance from one eye to the other is 46.2% of the body length. The spiraculum is sinistral and has no free tube. The opening directed dorsally and posteriorly is visible from above and below. The vent is dextral and is continuous with the ventral crest. The tail is pointed and weakly developed; its dorsal crest is deeper in the middle and is continuous in front with the basal region of the body (fig. 29).

Mouth is more ventral than anterior in position, and its width is 22.2% of the body length. There is only one row of papillae on the sides of the upper lip. One row of papillae is found all along the margin of the lower lip. Inside this row at the sides of the lower lip are two irregular rows of papillae which are much more irregular toward the corners of the mouth. Three tadpoles out of twenty have a notch on the ventral middle portion of the lower lip and a gap without papillae. In order to study the variation of the labial teeth, twenty tadpoles taken by random selection were studied. Thirteen tadpoles have the tooth formula I:1-1/II:1-1; four have I:2-2/II:1-1; one has I:1-1/I:1-1; one has I:2-1/I:2-2. Two rows of labial teeth in the upper lip with the outer row complete and the inner row widely interrupted; and three rows in the lower lip with the two outer rows complete and the innermost row very narrowly interrupted, are the normal condition for the tadpole of *Rana nigromaculata* as 70% of the individuals have such a tooth formula. When there are three rows of teeth in the upper lip, the innermost row may be extremely short and just indicated by a group of teeth on the small base of a papilla. When two inner rows of teeth in the lower lip are interrupted, the middle row is generally abnormal with some small groups of teeth in the interrupted

space. The mandible is rather strongly developed and has a finely serrated edge (fig. 30).

Rana limoncharis Grauenharst

Rana limoncharis is one of the most common frogs found in China. Tadpoles are found mostly in rice fields, and in small ponds and pools. It is very abundant on the low lands of Szechwan from May to August. Tadpoles were also collected from a pool near Sinkaisze (4920 ft.) near Mont-omei, July 28, 1938. Tadpoles as well as adults are commonly found around Ling-kwan (憲關) (2310 ft.) in Sikang.

The body is olive brown to olive green marbled with patches of fuscous. The snout and sides of the head are marked with light cinnamon brown. The pupil of the eye is round and black, enclosed by a narrow golden ring outside which is a wide dirty golden ring. The coloration of the muscular part of the tail is similar to that of the body but it is lighter toward the tip. The tail crest is ochraceous buff pigmented with brown to black. On the periphery of the crest black bars are conspicuously developed; they are very characteristic of the tadpole of this species. The belly is colorless.

The size of the tadpole is rather small. Twenty specimens with average hind-leg bud 5.15 mm. long, were measured. The total average length from snout to tip of tail is 33.54 mm. (body length 11.28 mm., tail length 22.26 mm.) ranging from 30.4 to 37.3 mm. The head is slightly depressed; its height is 37.2% of the body length while width is about half of the length of the body. The body is also somewhat depressed with its height 47.2% of the body length and its width is 58.2%. The tail is twice as long as the body, and the depth of tail crest is about half of the body length; the muscular part is one fifth of the body length (fig. 31).

The snout is bluntly pointed, with the nostril nearer to its tip than to the eye. Eyes are latero-dorsal in position, and the space from eye to eye is about one third of the body length. The spiraculum is sinistral and has a very short free tube directed upwards and backwards and visible from above and below. It is nearer to the base of the tail than to the snout, as it is 65.4% of the body length from snout to its opening. The long, broad, tubular vent is attached just to one (the right) side of the lower tail crest; only its distal part is free.

The mouth is antero-ventral in position. There is a single row of papillae on the sides of the upper lip, and another row on the lower lip interrupted in the middle. Some additional papillae are found on the lower lip. Rows of labial teeth are constant within the species. Two rows of teeth are

present in the upper lip, the outer row complete and the inner widely separated. The lower lip has three complete rows of teeth. The mandible is moderately developed and its edge is serrate (fig. 32).

Rana japonica Gunther

This wood frog is commonly found near or on hills or mountains. Tadpoles as well as adults were collected from Kiating (嘉定) by P. L. Luh, March 23, 1939. The author collected some adults from Mont-omei, outside of Pilutien (毗盧殿) August, 1938. Tadpoles were collected in small pools by the side of a mountain stream near Nan-yueh-miao in Wen-chwan-hsien April 27th, 1940, and from a large pool by the side of a large mountain river near Kuan-hsien, April 28 and May 10 of the same year. They are bottom feeding forms and may be found among masses of algae which are their main food. They are not very active and one can easily get a large number of them with a dip-net. A large number of different staged tadpoles were collected from a pool on a hillside outside of Mupin city, July 21 August 20, 1939.

The coloration of the living tadpole is rather uniform. It is dark brownish on the body and the muscular part of the tail but is lighter toward the belly and the tip of the tail. It is finely spotted with fuscous and olive brown. The eye is small, with a round dark pupil enclosed by a reddish golden iris. The tail crest is greatly marbled and spotted by dark vinaceous and pearl gray. It is dark gray on the sides of the belly and the throat, with the center of the belly lighter. There are two white spots on the belly antero-lateral to the base of the vent.

The tadpole is medium sized. Ten tadpoles with an average length of hind-leg buds 4.2 mm. were measured. The average is 51.09 mm. in length from tip of snout to tip of tail, 17.08 mm. is the average length of the body and 34.0 mm. of tail. The width of the head is much greater than its height as the former is 47.9% of the body length and the latter is only 37.2%. The body is much thicker than the head as its height is more than half the body length while the width is about two thirds. The tail is long, about twice as long as the body, with a height 60.1% of the body length; the muscular part is only 25.1%. Tadpoles collected from Mupin are smaller in size and the tail crest is not so deep as that of tadpoles of Kaiting and Kwan-hsien. Just after metamorphosis the length of the body from snout to vent is 20 mm. for Kiating specimens and only 14 mm. for Mupin individuals.

The body is oval in shape, rounded at the snout, and slightly depressed dorso-ventrally. In a depressed area rather nearer to the snout than to the eye, lie the nostrils, directed

forwards and outwards, and surrounded by a lighter coloured, elevated ring. The eyes are located at the sides of the head about one third of the body length apart. The spiraculum is sinistral; it has no free tube but the opening is directed upward and backward and is visible from above as well as from below. It is nearer to the base of the tail than to the tip of the snout as it is 69.9% of the body length from snout to spiraculum. The vent is dextral with a short broad tube which is connected with the tail crest. The tail is rounded at the tip, and has a slightly deeper dorsal crest which is thickened and lower in height near the base of the tail (fig. 33).

The mouth is ventral in position and its width is about one fifth of the body length. There is one row of papillae at the side of the upper lip and on the whole free margin of the lower lip. Additional papillae are found at the corners of upper and lower lips. Rows of labial teeth vary greatly in the tadpoes collected from the same pond as well as in those from different localities. Such variation is mostly found in the upper lip. The outermost row of the upper lip is always complete but the number of inner rows varies greatly. For the lower lip, it is rather uniform as there are four rows, with the innermost two interrupted and the two outer rows complete in 53 tadpoles; one tadpole has two inner rows interrupted and only the outermost row complete. Twenty tadpoles from Kuan-hsien selected at random were studied. The labial tooth formulae are as follows: one I:2-2/I:2-2; one I:2-3/II:1-1; one I:3-2/II:1-1; one I:3-3/II:1-1; sixteen I:2-2/II:1-1; fourteen tadpoles collected from Kai-ting were observed, the tooth formulae varies greatly as three I:2-2/II:1-1; two I:3-2/II:1-1; seven I:3-3/II:1-1; one I:4-3/II:1-1; and fourteen tadpoles from Mupin: four I:2-2/II:1-1; one I:3-2/II:1-1; two I:2-3/II:1-1; and seven I:3-3/II:1-1. From the facts above, it is clearly indicated that the number of rows of labial teeth is not a good character for identification of wood frog tadpoles. Pope (1931) stated that the *Rana japonica* tadpole has teeth I:2-2/II:1-1. Okada (1938) gave the same tooth formula for the *japonica* tadpole. The result of the present study of 54 tadpoles collected from three different places shows that the tooth formula varies greatly. The majority of the tadpoles from Kuan-hsien have tooth formula as I:2-2/II:1-1 while the majority of the tadpoles from Kiating and Mupin, have tooth formula as I:3-3/II:1-1. A comparative study of large number of *Rana japonica* tadpoles as well as adults collected from different parts of Asia may straighten out this puzzle. The mandible is moderately developed and has a serrated edge (fig. 34).

Rana andersonii Boulenger

Tadpoles of *Rana andersonii* are found in large mountain streams behind large stones where there is no direct swift water current. They are bottom forms feeding among dead leaves or twigs. Sometimes few tadpoles may be found in side pools which are poorly connected with the main stream. Very rarely one can see the tadpoles in their hiding places. By chance with a dip net one can get some tadpoles, but as they are scattered and not so abundant as other forms it is rather hard to collect a large number of them. Tadpoles of this species are very active in eating. In August, 1938 a few tadpoles were collected from Hei-lung-chiang Mont-omei. A large number of tadpoles were collected (July 19 to August 5, 1940) from Shih-sun-kou (3500 ft.). Although *Rana andersonii* is a large mountain-stream form, the tadpoles can live in a jar for a long time, and some of the above tadpoles were brought back to Chengtu in good condition. The author has kept them in a small aquarium from end of August of 1940 to March of 1941; they are still in good condition.

The coloration of the tadpole is very characteristic of the species. The body and head are pale olive brown covered with very fine fuscous marblings. The eye is moderately developed with a round black pupil enclosed by wide dirty-golden iris. The tail is pale and has a nearly colorless crest, but with fine black or fuscous marblings all over it. The belly is nearly colorless with a large pink liver showing clearly though it; this may be used as a field character to identify the species.

In proportion to the size of the adult (female 100 mm. male 60 mm.) the tadpole is rather small. Without tracing out its life history it is hard to believe that it is the tadpole of the large mountain stream frog, *Rana andersonii*. From snout to tip of tail, it is 38.5 mm. long. The average body length is only 12.27 mm. while the tail is more than twice as long as the body as its ratio to body length is 214.0%. The width of the head is much greater than its height as the former is half of the length of the body and the latter is about one third. The body is more or less cylindrical as its height is 44.8% of body length and the width is 58.4%. The tail is long with a rounded tip and the dorsal crest is slightly deeper than the ventral crest (fig. 35). Just after metamorphosis it is 17 mm. from snout to vent.

The snout is rounded, with the nostrils nearer to the snout than to the eye. The eyes are dorso-lateral in position and there is a space about one third of the body length from one eye to the other. The spiraculum is sinistral, directed upward and backward, and ends with a pointed tube which is barely visible above and below. It is nearer to the base of the tail than to the snout being 74.7% of the body length from the

snout to the spiraculum. The vent is dextral with the posterior half as a free tube and the anterior half continuous with the ventral crest of the tail. The tail is strongly developed with the muscular part about one third of the length of the body. The crest is rather low and thick especially near the base of the tail.

The mouth is antero-ventral in position, slightly less than one third of the length of the body in width. There is one close row of papillae in lateral posterior margin of the upper lip and some additional ones lateral to the tips of rows of upper labial teeth. On the lower lip, there are two rows of papillae but the bases of these papillae originate in the same line. There are no extra papillae at the corner of the mouth. Normally there are five rows of teeth in the upper lip. The outermost row is always continuous; the second row is narrowly interrupted and the other three rows are broadly interrupted. The number of rows of teeth in the upper lip is variable; in twenty specimens studied, the frequency of tooth formula is as follows: fifteen tadpoles have the t.f. I:4-4/III:1-1; two I:3-4/III:1-1; two I:3-3/III:1-1 and only one specimen has I:2-2/III:1-1. For the lower lip, it is always true that there are three complete rows of teeth plus an innermost interrupted row. The mandible is weakly developed with a fine serrated edge.

As soon as the fore-limbs come out, cross bars on the legs are characteristic of adult *Rana andersonii*. Just after metamorphosis, it is 16.7 mm. in length from tip of snout to vent. It is gray on the back and marbled with dark brownish gray. The limbs are lighter in color with dark cross bars. Four days after metamorphosis uneven green patches are developed on the back especially towards the head. The throat is finely dotted with dark gray and the belly is nearly colorless. The skin is granulate on the dorsal side. One can easily recognize the young frog just after metamorphosis as *Rana andersonii* by digital discs, cross bars on limbs and digits, and the general shape of the body.

Rana tadpoles described by Pope (1931, p. 556) may belong to this species as the measurement of different parts of the body, coloration, general shape of the animal, labial teeth and papillae are very like the tadpoles of *Rana andersonii*. I failed to find any papillae at the corners of the mouth in between the upper and lower lips, as figured and stated by Pope (fig. 36).

Rana boulengeri Günther

Tadpoles of *Rana boulengeri* are found singly or a few in a group on the bottom of pools beside or below cascades or in side water-bodies of mountain streams with very little current. They are rather inactive, not moving around so often as other

tadpoles. When one tries to catch them they get into the cracks of stones or in decayed vegetation for protection on the bottom of the pool. They are bottom forms feeding on decayed vegetation or other organisms. If such food is wanting they will take mud with a lot of its organisms as food. During the summer of 1938, tadpoles as well as adults of this species were collected from Mont-omei between 3000 and 5000 feet. From April 28 to May 1940, tadpoles were secured from small mountain streams of Ching-cheng-shan (青城山), Kwan-hsien and Nan-yueh-miao, Wen-chuan-hsien in Szechwan. During the summer of 1940, eggs, different staged tadpoles and adults were collected from small mountain streams around Ta-ngo-sze of Mont-omei.

The coloration of tadpoles varies according to the stage of development and the condition of the environment. Before the hind-leg buds develop, the tadpoles have a greenish gray coloration on the back and light brownish tail marbled with dark gray spots and a dark gray pattern on dorso-basal portion of the tail followed by two or three similarly colored areas. Color of belly depends upon the food stuff in the intestine and the blood of large vessels and heart in the throat region. After the hind legs are well developed the body, legs and the tail have a yellowish brown ground color, but the dorsal and lateral sides of the body are much darker because of a large amount of gray and black granules. Patterns in the tail region are not as conspicuous as before. The muscular part of the tail is brown spotted with gray or dark gray. The tail crest is nearly colorless. The throat is pinkish gray while the belly is gray. In this stage, a dark gray bar appears across the interorbital space. At about the time the fore-legs appear the color on the back is brown with ridges enclosing black pigments and the interorbital bar is conspicuous. Limbs have black or dark gray bars developed on a brown back-ground. Marks on the tail are quite indistinct. Belly more or less transparent with a light silver gray color; the viscera, especially the fatty bodies, can be clearly seen. Individuals collected from different places are different in coloration, depending upon the condition of the ponds. When there is a dark background, tadpoles have a darker coloration; otherwise it is lighter in color. The form of the body is greatly influenced by food stuff in the water. If there is no decayed matter, the tadpoles eat mud and become thinner than otherwise. Thus both size and form of the tadpoles vary according to the condition of the pools they inhabit. If food stuff is rich the tadpoles will be larger in size and with stouter body otherwise they will be smaller and slender in shape. It takes at least five days from the appearance of the fore legs to complete metamorphosis. Just after metamorphosis, the young frog's body is 18 mm. in length with all the adult characters except secondary sex modifications. There are two pairs of white spots on the ventral sides of

the body. The anterior pair lie one on each side, just in front of the intestinal coils, and latero-ventral to the internal gills. The posterior pair is postero-lateral to the intestinal coils near the base of the body. These spots are characteristic of the species. Ten tadpoles with average length of hind leg 4.08 mm. ranging from 2.3-6.0 mm. were taken at random and measured. The total average length from snout to tip of tail is 55.2 mm. with an average body length 18.19 mm., ranging from 17.0-19.4 mm., and an average tail length 37 mm. with a range from 34.0 to 39.6 mm. The head region is flattened dorso-ventrally as its height is only 32.9% of the body length while its width is 49.5%. The body is broader than deep but the difference is not so much as for the head. The height of the body is very near to half of the body length and its width is slightly more than half. The tail is long, i.e. slightly more than twice as long as the body with a height 60.2% of the body length. The muscular part of the tail is rather strong as it is 29.4% of the body length.

The head is dorso-ventrally depressed. The nostril, enclosed by a dark colored ring which is thickened above, is mid-way between tip of snout and eye. The lachrymal canal from nostril to eye is much more conspicuous in tadpoles with hind legs well developed than in young specimens. Eyes are more lateral than dorsal with a space between the eyes, 34.4% of the body length. The spiraculum is sinistral in position ending with a short free tube pointed upwards and backwards which is barely visible from above but clearly shown from below. It is slightly nearer to the snout than to the base of the tail. The vent is dextral covered by a skin fold which is continuous with the ventral crest of the tail. The tail is long and bluntly pointed. The dorsal crest is deeper than the ventral (fig. 37).

Mouth is antero-ventral in position and its width is 26.1% of body length. On the sides of the upper lip, there is a single row of papillae; larger ones are near the ends of the outermost row of labial teeth. Toward the corner of the mouth there are a few additional papillae latero-ventral to the ends of the innermost row of labial teeth. The lower lip is bordered by two rows of papillae. The papillae of the outer row are close together and smaller in size than those of the inner row; they have blunt or rounded tips like those of the upper lip. In the inner row, they are widely separated each with a larger base and pointed tip; at the middle of this row they are close to the papillae of the outer row. Between the outer and inner rows there are some additional papillae similar in size and shape to those of the inner row. The demarcation between upper and lower lips is not so clear and definite as in other *Rana* tadpoles. Rows of labial teeth vary in the

tadpoles of this species. For this reason thirty tadpoles with hind legs well developed were carefully studied; normally there are four rows on the upper lip and three rows on the lower lip. Twenty individuals have four rows of labial teeth on the upper lip, the first continuous, the second the longest and very narrowly interrupted in the middle; the remaining two rows are widely interrupted. The lower lip of these twenty specimens has three rows of teeth, the outer is the shortest and the inner row is narrowly interrupted. The mandible is moderately developed, has serrated edges and is black in color. Four tadpoles out of thirty have three rows of teeth in the upper lip, the first row being complete and the other two rows interrupted. The labial teeth of the lower lip in these four are the same as in the normal ones. There are two tadpoles with upper labial teeth normal in development but with only two complete rows of teeth in the lower lip. The other four individuals out of the thirty tadpoles, fall into three new combinations in the development of labial teeth in upper lip but their lower labial teeth are normally developed as in the other twenty individuals. For the upper labial teeth, two have the first row complete, two short rows on the right side of the lip and three on the left side; one has the first row complete, three short rows on the right side and two on the left; the last has the first rows complete, four short rows on the right side and three on the left. According to the results of this study, there are five combinations besides the normal one. The modifications are mostly on the upper lip, there being only one case of variation on the lower lip. The upper mandible is moderately developed while the lower one is rather strong and both have a serrated edge (fig. 38).

Rana adenopleura Boulenger

Rana adenopleura is a mountain form found in pools near or even inside temples on Mont-omei, or in unused artificial manure pools on hill sides; the vertical range of distribution is from 3000 feet to about 5500 feet altitude. Tadpoles of this species are naturally found in the same pools. It is easy to notice the presence of such tadpoles when they are living in clear water. But in most cases they inhabit pools with a large amount of decayed matter and a lot of dead vegetation, thus without trying by a dip-net it is very easy to overlook their presence. They are a bottom feeding form and good consumers of decayed vegetation.

Coloration varies slightly according to the condition of the environment. If the water is clear without very much dead vegetation, the color is lighter, otherwise it is much darker. On the dorsal and lateral sides of the body, it is olive brown to dark olive brown. The pupil is round and black with a rufous golden iris which is darker at its periphery. The background color of the muscular portion of the tail is light

cinnamon brown; near the base of the tail, it is spotted with olive; toward the tip the color is lighter. For the crest of the tail, the background is an even color lighter than the tip of the muscular part. The tail as a whole is strongly marbled with fuscous. The sides of the body are greatly marbled below with cinnamon brown and creamy gray. The throat is also much marbled with smaller patches of fuscous. The ventral part of the belly is nearly colorless.

The tadpole is rather large in comparison with the adult. In dirty pools, especially unused manure pools where there is a lot of decayed matter, tadpoles are larger in size; in clear water, they are smaller. From snout to tip of tail, the average length of ten tadpoles with average hind leg length 12.3 mm., is 47.42 mm. with the body length 16.69 mm. and tail length 30.73 mm. The size of the tadpoles varies slightly according to the conditions where one finds them. With hind leg fully developed, the total length reaches 57 mm. As they are mostly found in old feces pools, their size varies not as much as in *Rhacophorus davidi* tadpoles. The head is much broader than high as its width is about half of the body length while its height is one third. The height of the body is slightly less than half its length and its width is more than two thirds of the body length. The tail is moderately developed with its length 184.1% of the body length and its height slightly greater than the height of the body. The four legged tadpoles have more or less the same coloration as described above. As the tadpole approaches metamorphosis, at the mid-dorsal part of the body two distinct lines appear from eye to base of the tail; the color is lighter than in two legged individuals, and two tubercles develop on the dorso-basal region of the tail. It takes two days to complete the process of metamorphosis. An individual just after metamorphosis is 21.4 mm. in length. Even after metamorphosis these two tubercles are still to be seen.

The body is stout and clumsy. The nostrils nearer to snout tip than to the eye and are very small, located in a depressed area which communicates with eye by a conspicuous lachrymal canal. The eyes are more lateral than dorsal with an interorbital space 41.9% of the body length. The dorsal side of head is somewhat flattened especially between the eyes. The spiraculum is sinistral and large but not ending with a free tube. It is visible from above and below, and much nearer to the base of the tail than to the snout. The vent is dextral with a short tube which is continuous with the base of the ventral tail crest. The tail is thick with the dorsal crest the better developed; both dorsal and ventral crests, especially the dorsal one, decrease in height and increase in thickness forwards. The tail is bluntly pointed at the tip (fig. 39).

The mouth is antero-ventral in position, and rather small, as it is only 20.4% of the body length. There are no papillae on the dorsal side on the upper lip; near the corner of the mouth only few large papillae form a single row. The lower lip has two rows of papillae developed. The outer row consists of large long papillae and the number varies in different specimen. But it has many fewer than the papillae of the inner row, which are small and low and generally two are found at the base of one long papilla of the outer row. Usually two large papillae are present at each corner of the mouth inside the outer row. There are two rows of teeth in the upper lip, the first is continuous and the inner row is interrupted, with two short oblique portions located at the dorso-lateral corner of the mouth. Three rows of teeth are found on the lower lip, only the innermost row being interrupted. Twenty tadpoles selected at random, were studied; there was no variation in labial teeth. The mandible was moderately developed and had fine serrated edge (fig. 40).

Rhacophorus leucomystax (Governharst)

Tadpoles of this species are found in artificial pools or in unused and even used manure pools near houses on parts of the plain which are very near to the hills, or up on mountain sides. They are generally found together with tadpoles of *Rana adenopleura* and sometimes with tadpoles of *Rhacophorus davidi* on Mont-omei. *Rhacophorus leucomystax* is very abundant around Ta-ngo-sze. *Leucomystax* tadpoles are also found in pools near Chin-ting, Mont-omei, Szechwan; Yaan, Tien-chuan-hsien (天全縣), and Pao-hsing, Sikang. No tadpole is ever found in running water of any kind or in a large pond. They feed on decayed vegetation or dead animals in the pools.

The coloration varies greatly according to the condition of the pool. If there is no living or dead vegetation in the pool and the water is rather clear, the tadpole will have a greenish yellow color on the body and the base of the tail. This color is lighter toward the latero-ventral side of the body and the tip of the muscular part of the tail. The tail crest is light yellowish gray especially toward the tip of the tail. The crest and the posterior region of the muscular part of the tail are finely marbled with gray. Near the tip the tail crest is free from marbling. The belly is opaque creamy white. A tadpole collected from a pool with a lot of dead or decaying vegetation, or with dirty water, will be darker in colour. The back and sides of the body are olive green shading lower down through greenish yellow to creamy yellow, and finally to creamy white on the belly. Near the base, the tail is dark brownish, ashy, or olive green, getting lighter toward the tip. The tail crest is a light purplish brown, dark buff colour at the base, and also lighter towards

the tip. In the middle, the tail is much marbled with amber. The latero-ventral sides of the body have a creamy yellow color and the belly is creamy white. The eye has a round black pupil ringed with a reddish golden iris. A small creamy round spot on the tip of the snout is characteristic of the tadpoles of this species. This is especially conspicuous in the young tadpoles; in the older tadpoles it is not so distinct; but it can still be seen when carefully examined.

The size and form of the tadpoles are greatly influenced by the condition of the water bodies where they live. If food stuff is rich, the size is much larger and the abdomen will be very large and clumsy. For the present study, twenty tadpoles unselected but collected from the same pool, were measured at a stage with average hind-leg buds length 4.9 mm. ranging from 3.2-7.0 mm. The total average length from snout to tip of tail is 37.64 mm. The average body length is 13.2 mm. with a range from 12.6-13.7 mm., and the tail length is 24.44 mm., ranging from 20.5 to 27.0 mm. The head is broader than deep, its width being 60.7% of the length of the body while its height is only 38.5%. The height of the body is very near to its width, which is slightly greater than that of the head. The length of the tail is 185.1% of the body length while its height reaches 72.0%, which is the highest tail crest among the tadpoles of West China. The muscular part of the tail is moderately developed. Just after metamorphosis, the young frog is 27.0 mm. from snout to vent.

The head region is dorso-ventrally depressed with the nostril nearer to the snout than to the eye. It is directed forward and sideways and connected with the eye by a very conspicuous lacrymal canal. The eyes are lateral in position with an interorbital space more than half the body length. The spiraculum is sinistral, directed upward and backward without a tube and barely visible from above and below. It is nearer to base of the tail than to the tip of snout, as from snout to spiraculum is 66.1% of the body length. The vent is dextral with the anal opening at the inner side of the right hind leg and at the base of the ventral tail crest. The tail is weakly developed with a delicate pointed tip. The tail crest is very thin especially near the tip of the tail (fig. 41).

The mouth is antero-ventral in position and its width is 26.4% of the body length. There is a single row of papillae at lateral corner of the upper lip and on the free edge of the lower lip except at a small ventero-median area which is free from papillae. Three or more extra papillae are located at the ventral border of the upper lip inside the outer row. At the latero-ventral sides of the lower lip there is a somewhat irregular row of papillae inside of the outer row. In

some specimens, there are few additional papillae in between the outer and the inner row. Above the lateral ends of the innermost row of lower labial teeth, there are two oblique folds with indistinct separated papillae at each side of the corner of the mouth. Every papilla has a pigmented core. For the upper lip, there are normally four rows of labial teeth, the outermost row being complete while the other three rows are all interrupted. The number of rows of labial teeth on the lower lip is constantly three, the innermost being narrowly interrupted and two outer rows complete with the middle row the longest. Twenty eight unselected tadpoles were studied for variation of rows of labial teeth, and the result is as follows: 23 individuals with tooth formula I:3-3/II:1-1; two I:4-4/II:1-1; one I:3-4/II:1-1. The upper mandible is moderately developed but the lower mandible is much the stronger; both have serrated edge (fig. 42).

Rhacophorus davidi (Sauvage)

Rhacophorus davidi is a mountain tree frog of Szechwan. The tadpoles are found in clear pools with dead leaves; they rarely occur in the old manure pools which the tadpoles of *Rana adenopleura* and *Rhacophorus leucomystax* inhabit. Tadpoles of *Rhacophorus davidi* are a bottom feeders eating decayed vegetation in the pools, but they come up to the surface of the water now and then for oxygen and immediately go back to the bottom of the water. They are very sensitive to disturbance. If there is any, they hide themselves under vegetation immediately. The size, color and general shape of the body are greatly influenced by the environment.

Adults as well as tadpoles were collected from Mont-omei. During the summer of 1938, tadpoles were found in the very small basin of a spring by the side of the road near Hui-ting-sze (慧澄寺) at an altitude about 3850 ft. on 15th of July, and some tadpoles were collected from an artificial pool by the side of a house near Sinkaisze (4920 ft.) on July 28th. On the way to Chiao-lao-tung (九老洞) (6130 ft.), a large number of tadpoles were secured from a very small spring by the side of the road near Cha-pung-tzu (茶棚子). Again some tadpoles were found together with tadpoles of *Rhacophorus leucomystax* and *Rana adenopleura* in an old unused manure pool near Chung-feng-sze on 3rd of August. During the summer of 1940 *davidi* tadpoles were collected from different places on Mont-omei from Ta-ngo-sze (3590 ft.) up to Chin-ting (10695 ft.). Tadpoles and adults were also collected from Chin-cheng-shan (about 2000 ft.) near Kuanhsien and Nan-yueh-miao in Wen-chuan-hsien. Thus the vertical distribution is from 2000 ft. to 10,695 ft.

The coloration of the tadpoles is greatly influenced by the condition of the water where they live. Tadpoles found

in clear water and in springs where a lot of dead leaves cover the bottom, have a moderately dark coloration. Such tadpoles have a black color on the body with many small golden spots. The tail crest is purplish black and the muscular axis brown in color. The belly is dark gray. Tadpoles found in old manure pits where the water is very dirty and with a lot of decayed matter, have the body and tail totally black. In case the tadpole lives in clear water with little or no dead vegetation, it is not only much smaller in size, but also much lighter in coloration. Such a tadpole is light yellowish green or grayish green on the back, and the tail is a very light grayish green; the belly is a light gray.

The condition of the water body influences a great deal the size and shape of the tadpole. Tadpoles of this species were collected from three types of pools. One, an unused old manure pool with a lot of decayed matter had tadpoles much larger in size; the second, a clear water pool but with a lot of dead vegetation, had tadpoles moderate in size; the smallest light colored tadpoles were found in clear water pools with very little or no dead vegetation. For the present study, twenty tadpoes selected at random were collected from the second type of pool which is the commonest place to find *dauidi* tadpoles. For the tadpoles of the first and third types of pools, one specimen of each picked up at random was measured for comparison. The average length, from tip of snout to tip of tail of the twenty tadpoles, with hind legs averaging 4.93 mm., is 44.86 mm. ranging from 40.5 to 47.7 mm. The average body length is 14.51 mm. with a range from 13.3 to 15.3 mm. The head is not so much depressed as that of *Rhacophorus leucomystax*, as its height is 40.3% of body length, its width is 53.4%. The body is thicker than the head region. The height is about half the length of the body and the width is 60.0% of the body length. The tail is rather long, slightly more than twice as long as the body, with a height more than half the length of the body, while the muscular part is only 32.9% of the length. Tadpoles from unused manure pools were much larger with a total length (snout to tip of tail) of 53 mm., a body length 18 mm., and tail 35 mm. The ratio of different parts of the body is much higher than those of tadpoles collected from ponds or pools with less food stuff. It indicates that not only the body length is much greater than other groups but that different parts of the body are far better developed. The height of the tail crest is 76% of the body length while for tadpoles collected from ponds or pools it is only about 60%. Tadpoles from clear water ponds without vegetation or other food stuff were much smaller, with a total length of only 38 mm., of which 13 mm. was body length and 25 mm. the length of the tail.

After the fore limbs come out, the color of the tadpole begins to change. The dorsal side of the body becomes green in color. The tail and belly remain the original color except for the adhesive discs, which are yellowish. Near the time of metamorphosis, the tail crest becomes black and absorption begins. From hatching to metamorphosis takes 42 days; after metamorphosis it is green on the back of body and limbs, and yellowish green on the upper jaw. A black line runs from the tip of the snout through the nostril to the anterior border of the eye, then from hind corner of the eye, passing through dorsal side of the tympanum to the groin. Ventral to this line from the head region to the base of the arm, the color is light bluish green. The throat is yellowish gray. A light gray color is found on the ventral side of the body and limbs. Adhesive discs are yellowish in color and occasionally some discs show a blood color which is due to accumulation of blood in this region. It is easy for young adults of this species to be mistaken for *Hyla*. The young just after metamorphosis have a body length 17.0 mm. A young adult with a body length of 18 mm. may be grayish green to dark green above, the coloration varying according to the condition of its surroundings. A creamy bluish green is found on the upper jaw from the tip of the snout to the posterior angle of the mouth. It is very narrow in front but widens behind. There is an ill-defined black or dark gray band from the tip of the snout through the nostril and the eye to just above the base of the arm. The tympanum is dark gray. Black pigments are accumulated on the margin of marbling on this animal. The sides of the body are purplish gray, the color decreasing in intensity toward the belly which is light gray. The dorsal sides of the limbs are of the same color as the back; the limbs beneath resemble the sides of the body in colour. There is a light or pinkish yellow on the adhesive discs. Until the young frog is around 23 mm. in length, there is not very much change in coloration except that the black marks on the margin of the upper and lower jaws become much more conspicuous and a creamy bluish-yellow-green band develops at the vent and at the external lateral sides of tibia and tarsal regions. The head is larger in proportion to the body, which is considerably elongated, so that at this time it is much more like a *Rhacophorus dauidi* than before. When the young adult reaches about 27 mm. long, the green back is greatly marbled by black and this is also true for dorsal sides of the limbs. The black band from tip of snout to the middle part of the body is more conspicuous. The black mark from jaw to eye is complete and the margin of the jaw is yellowish white. Ventral sides of limbs are yellow; the belly is grayish with well developed granules. The throat, near the margin of the jaw is yellowish green. Adhesive discs are yellowish green in color.

The snout is rounded. Each nostril is enclosed by a light colored ring. The nostrils are directed antero-laterally, and lie about midway from eye to snout. The eyes are dorso-laterally located with a space 40.3% of the body length between them. The spiraculum is sinistral and without a free tube. It is directed upwards and backwards and is not visible from below. The vent is dextral in position and located near the base of the inner side of the right leg. The tail is long and bluntly pointed with the ventral crest slightly deeper than the dorsal crest (fig. 43).

The mouth is antero-ventral in position. The average width is 39 mm. which is 26.7% of the body length. The sides of the upper lip are provided with one row of papillae; these are much larger than the rest of the papillae. Inside this row there are six or more additional papillae distributed in between the first and fifth rows of labial teeth. There is a small space free from papillae at the ventral middle region of the lower lip. On the free margin of the lower lip there is a row of papillae which are close together. Inside of this row there is another row of papillae extending latero-dorsally to the tips of the outermost row of labial teeth of the lower lip. At each corner of the mouth there is a fold with indistinctly separated papillae. For labial teeth, twenty-five unselected tadpoles were studied. Twenty specimens have the tooth formula I:4-4/II:1-1; two I:5-4/II:1-1; one I:4-5/II:1-1 and two I:5-5/II:1-1; so the rows of teeth on the lower lip are constant but those of the upper lip vary slightly, eighty percent of the individuals having five rows. The outermost row of the upper lip is complete and the other four rows are interrupted. For the lower lip, the innermost row is narrowly interrupted and the two outer rows are complete with the middle row the longest. The mandible is moderately developed and has a serrated edge. The lower mandible is much stronger and shorter than the upper mandible (fig. 44).

Discussion

According to their larval habitats, tadpoles of West China can be divided into two main groups. One is the plains group and the other is the mountain group. For the first group, there are seven species namely *Bufo bufo gargarizans*, *Microhyla ornata*, *Kaloula rugifera*, *Rana japonica*, *Rana limnocharis*, *Rana nigromaculata* and *Rhacophorus leucomystax*. There are twenty-one mountain forms, among which seven species are also found in different water bodies of both mountains and plains. Tadpoles of *Bufo bufo gargarizans*, *Microhyla ornata*, *Rana limnocharis*, and *Rana nigromaculata* are much more abundant in water bodies of the plains than on the mountains, while *Kaloula rugifera*, *Rana japonica* and *Rhacophorus leucomystax* are much more abundant on mountains. *Kaloula rugifera* and *Rana*

japonica have a higher vertical distribution and *Bufo bufo gargarizans* and *Rana nigromaculata* have the lowest vertical range, especially the latter. As for the mountain forms, they also can be divided into two groups. One group is found both on the mountains and on the plains, i.e. the seven species mentioned above, and the others are purely mountain fauna. The adaptation of the plains group is rather uniform. The tadpoles of this group inhabit ponds, pools, flooded rice fields and ditches, though some may occasionally be found in running water, for example *Bufo bufo gargarizans* and *Rana nigromaculata*. The tadpoles of mountain forms are adapted in various ways. Arbitrarily they can be divided into four groups. The first group contains the quiet water forms such as *Bufo bufo gargarizans*, *Bufo bufo wrighti*, *Microhyla ornata*, *Kaloula rugifera*, *Nanorana pleskei*, *Rana nigromaculata*, *Rana limnocharis*, *Rana japonica*, *Rana adenopleura*, *Rhacophorus leucomystax*, and *Rhacophorus davidi*. Those of the second group are found in slow running water; such are the tadpoles of *Bufo bufo wrighti*, *Rana boulengeri* and *Rana andersonii*. Tadpoles found in the swift running water of mountain streams make up the third mountain group. It consists of tadpoles of *Scutiger* and *Megophrys* groups, *Rana boulengeri* and *Rana andersonii*. Tadpoles of *Staurois* can be considered as belonging to a cascade group. The above facts show the difficulty of drawing absolute lines between habitat groups. Certain forms may be found in both quiet and running water; i.e. *Bufo bufo wrighti*, and *Rana nigromaculata*. Other species are only found under limiting conditions, as are *Kaloula rugifera*, *Microhyla ornata* and *Rhacophorus* in quiet water *Scutiger* tadpoles, *Rana boulengeri* and *Rana andersonii* in running water, and *Staurois* tadpoles in cascades.

The form of the body, the shape of the tail, the mouth parts and other modifications are different in different species of tadpoles of Salientia. These variations are developed chiefly for adaptation to the different conditions under which they are going through metamorphosis. Tadpoles in quiet water of plain and mountain as in *Rhacophorus leucomystax* and *Microhyla ornata* have a stout body with its height much greater than those forms found in running water. In *Megophrys pelodytoides* the height of the body in proportion to its length is just about half that of the first two species. There is no correlation between the width of the body and the habitat as this is much more influenced by the amount of food stuff in the water. Generally the body of tadpoles in running water is not so clumsy as that of those in quiet water in order to survive and get through metamorphosis.

The tail is the only locomotive organ in tadpoles, so its adaptation to different water bodies is very important. If there is no other modification for adaptation to running water,

the tail is longer than that of quiet water forms. The tadpoles of *Megophrys boettgeri* has the longest tail in the present study; it is a surface form in running water, so a long tail is much more necessary than it is for those running water forms living on the bottom. The tail of the *Microhyla* tadpole is rather long but this is due to the long slender pointed tip, which is very weak and delicate. Tadpoles of the *Staurois* group have a shorter tail than other running water forms and even than some of the quiet water individuals, because they have adhesive discs developed as an adaptation to cascades and swift water. The height of the tail is different according to the need of the tadpole in its environment. Tadpoles of quiet waters have their tails much higher than those of running waters if there is no other specialization. The tadpole of *Rhacophorus leucomystax* has the highest tail while the *Megophrys pelodytoides* tadpole has the lowest tail; the former is a quiet water form and the latter is a running water species. The height of tail of a *Scutigera* tadpole is similar to that of a *Microhyla* or a *Kaloula* tadpole but the muscular part of the tail of the former is far better developed than the latter, in adaptation to running water. Even among the tadpoles of *Rana*, the muscular part of the tail is better developed in tadpoles of *Rana boulengeri* and *Rana andersonii* than in those of *Rana adenopleura*, *Rana limnocharis* etc., the former being adapted for life in running water and the latter for quiet water. Another conspicuous character in connection with the adaptation of the tail is the tail crest and the tip of the tail. Quiet water forms have delicate tail crests and some have a very delicate pointed tip as *Microhyla ornata* and *Rhacophorus leucomystax*. Tadpoles adapted to running water, especially those in swift water, have thick low tail crests and blunt thick tail tips. It is possibly true that a tail with a high thin crest and a delicate pointed tip is very easy to break in swift running water and also offers too much resistance to the current.

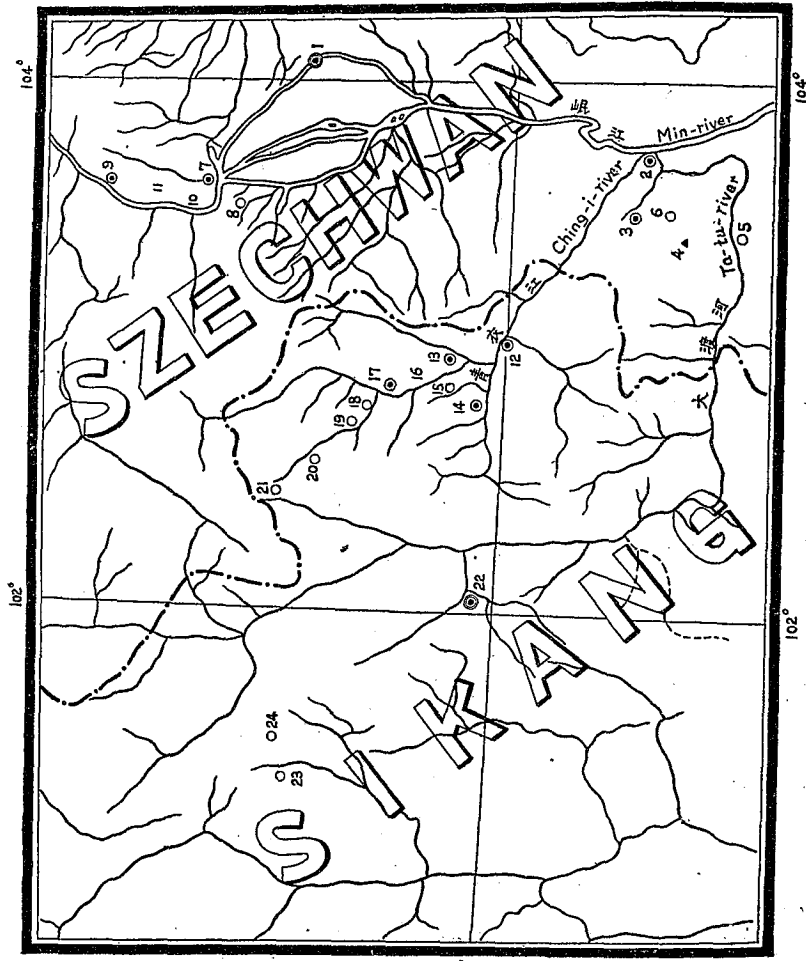
The adhesive ventral disc of the tadpoles of the *Staurois* group is undoubtedly correlated with life in swift flowing water. It is used as a vacuum cup to adhere to stones, under cascade and in swift water. The funnel mouth part of *Megophrys boettgeri* is a modification for floating on the surface of running water and for food gathering, while its cousin *Megophrys pelodytoides* has a tube-like lip which is used to support the head as it is a bottom form in running water. Both have slender, depressed bodies and powerful tails as well, and certainly thrive in swift water. In connection with adaptation to running water, mouth parts of tadpoles of *Scutigera* are strongly developed principally for scraping food from the surface of stones in mountain streams. Mouth parts of *Kaloula* and *Microhyla* are of the simplest types, as they are only found in small temporary pools.

Summary

1. Twenty-one species of tadpoles are described in the present study; of these there are only three without description of the young just after metamorphosis.
2. It is difficult to draw absolute lines between certain habitats, but the tadpoles can be divided into two groups, the plains forms and the mountain forms.
3. The group of forms from the plain are nearly all adapted to quiet water; the mountain group, may be divided arbitrarily into quiet, slow running, and swift water groups, but some forms may be found in more than one environment.
4. Running water tadpoles generally have slender bodies, and strong tails with low thick crests and blunt tips, while quiet water forms have a stouter body and weaker tail.
5. Mouth parts may be modified for adaptation to running water, as in *Scutigera*, *Megophrys* and *Staurois* or it may be simplified in quiet water forms, as in *Kaloula* and *Microhyla*.
6. The number of rows of labial teeth varies even within the same species, so it cannot be used as an independent character to identify tadpoles.

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- 1 Chengtu 成都
- 2 Kiating 嘉定
- 3 Omei-hsien 峨眉縣
- 4 Mont-omei 峨眉山
- 5 Sha-ping 沙坪
- 6 Sinkaize 新開寺
- 7 Kwan-hsien 灌縣
- 8 Ching-Cheng-Shan 青城山
- 9 Wen-chwan-hsien 汶川縣
- 10 Lung-Si 龍溪
- 11 Nan-yueh-miao 南嶽廟
- 12 Ya-an 雅安
- 13 Lu-Shan 廬山
- 14 Tien-Chuan 天全
- 15 Tsao-Chia-ying 曹家營
- 16 Ling-kwan 靈關
- 17 Pao-hsing (Muping) 寶興 (牟坪)
- 18 Yang-tsun 楊村
- 19 Lung-tung 龍東
- 20 Tu-pa-kou 土巴溝
- 21 Liang-ho-kou 兩河口
- 22 Kang-ting 康定
- 23 Tai-ning 泰寧
- 24 Ke-ta-liang-tzu 格太梁子

Gekko japonicus

Females			Eggs		Newly hatched individuals					
No.	Length in mm. (Snout to vent)	No.	Length in mm.	Diameter in mm.	Time of egg-laying	Time of hatching	Body length in mm.	Tail length in mm.	Ratio of body length to mother's body length	Duration of incubation
I	67mm	1	13	10	May 19	Egg injured				
		1	13.5	11	Night	4:30 p.m. July 31	26.8	25.4	40.00	66 days
II	67	2	13	10	May 26	6:30 a.m. Aug. 2	27.3	25.8	40.74	67 days
		1	13.9	10.5	A. M.	3:35 p.m. July 31	28.3	26.0	44.21	65 days
III	64	2	13.3	10	May 28	6 a.m. Aug. 1	27.8	23.5	43.43	66 days
		1	12	9.6	Night	2:30 p.m. Aug. 3	26.2	21.8	42.95	63 days
IV	61	2	12	9.4	June 1	6 a.m. Aug. 6	26.5	24.4	43.44	66 days
		1	13	10	Night	6:15 a.m. Aug. 4	25.3	21.2	40.80	64 days
V	62	2	12.5	9.8	June 1	No development				
		1	13	9.6	Night	5 p.m. Aug. 3	25.4	22.6	39.31	64 days
VI	64.6	2	12.8	9.7	June 1	Embryo preserved				
		1	14	10.7	Night	Embryo preserved				
VII	62.3	2	13.2	9.8	June 1	2:30 p.m. Aug. 3	27.5	24.0	44.14	63 days
		1	13.9	10.4	Night June 1	1 p.m. July 31	28.8	27.0	46.90	60 days
VIII	61.4	1	13.6	9.5	Noon	No development				
		2	12.7	9.7	June 2	No development				
IX	60	1	14.3	10.4	Night	2:30 p.m. Aug. 3	26.8	24.6	40.36	62 days
		2	13.8	10.7	June 2	p.m. Aug. 4	29.2	28.8	43.97	63 days
X	66.4	1	13	10.2	2-4 p.m.	6 a.m. Aug. 7	26.2	23.8	39.81	63 days
		2	13.2	10.4	June 4	6 a.m. Aug. 6	27.1	24.9	41.18	62 days
XI	65.8	1	13.9	9.7	2-4 p.m.	Egg injured				
		2	13.6	9.7	June 4	Egg injured				
XII	67.9	1	13.2	10.3	Night	Embryo preserved				
		2	13	9.9	June 6	Embryo preserved				
XIII	67.8	1	13	10.4	Night	6 a.m. Aug. 8	27.2	23.7	41.97	63 days
		2	13.3	10.2	June 6	6 a.m. Aug. 9	27.1	24.7	41.82	64 days
XIV	64.8	1	14.2	9.4	Evening	Embryo preserved				
		2	12.6	9.6	June 7	6:30 p.m. Aug. 7	28.2	24.6	44.76	61 days
XV	63	1	13.5	9.1	Night	Egg injured				
		2	13.6	8.9	June 7	Egg injured				
XVI	53.8	1	14.8	9.3	Night June 8	6 a.m. Aug. 7	26.6	24.4	42.42	60 days
		1	13.5	9.6	Night	1 p.m. Aug. 9	26.6	22.2	45.46	60 days
XVII	62.7	2	11.5	9.5	June 10	6 a.m. Aug. 10	26.7	27.2	45.64	61 days
		1	11.4	9.6	Night	No development				
XVIII	58.5	2	11.8	9.1	June 11	No development				
		1	11	10.4	7-9 p.m.	No development				
XIX	64	2	11.6	9.6	June 12	No development				
		1	11.9	9.2	Night	No development				
XX	60.6	2	11.6	9.6	June 12	No development				
		1	11.9	9.2	Night	No development				
XXI	57.8	1	11.9	9.2	Night	No development				
		2	—	9.3	June 12	Egg injured				

		Scutigera Sikkimensis	Scutigera Sp. (of Mont-omei)	Scutigera Sp. (of Mupin)	Megophrys boettgeri	Megophrys pelodytoides	Bufo bufo gargarizans	Bufo bufo wrighti	Microhyla ornata	Kaloula rugifera	Nanorana pleski	Staurois jugaris	Staurois chunganensis	Staurois Sp.	Rana nigromaculata	Rana limnocharis	Rana japonica	Rana andersonii	Rana boulengeri	Rana adenopleura	Rhacophorus leucomystax	Rhacophorus davidi
		20	1	1	5	2	20	20	20	10	1	10	1	1	20	25	10	3	10	10	10	20
BODY LENGTH Snout to base of body	Range	22.5-28.7			12.0-14.3	19.0-19.0	11.3-12.5	9.0-10.8	6.5-8.2	10.5-12.0		12.3-18.8			16.3-19.8	10.4-12.3	15.0-19.0	12.0-12.5	17.0-19.4	16.0-17.3	12.6-13.7	13.3-15.3
	Average	25.17	33.0	23.5	12.92	19.0	11.9	9.8	7.09	11.23	15.0	14.86	12.6	17.6	17.34	11.28	17.08	12.27	18.19	16.69	13.2	14.51
BODY HEIGHT At highest place	Range	11.4-14.5			5.8-6.9	6.8-8.0	5.7-6.8	4.0-5.2	3.9-5.0	4.5-6.4		5.3-7.8			8.8-11.5	4.5-6.2	8.3-10.5	5.4-5.6	8.2-9.0	8.3-11.0	8.2-9.1	7.0-8.5
	Average	12.84	17.5	12.0	6.38	7.4	6.3	4.69	4.29	5.74	6.0	6.53	6.0	8.3	9.8	5.32	9.67	5.5	8.65	9.21	8.61	7.67
BODY WIDTH	Ratio	51.0%	53.0%	51.0%	49.5%	38.9%	53.0%	47.7%	60.8%	51.1%	40.0%	43.8%	47.4%	47.1%	56.5%	47.2%	56.6%	44.8%	47.6%	55.2%	65.2%	52.8%
	Range	10.8-16.0			6.0-8.0	10.3-11.7	7.0-8.2	4.5-6.2	3.0-4.0	7.0-7.8		6.8-9.7			10.0-13.0	5.7-7.5	9.0-12.4	7.2-7.7	9.0-12.8	9.7-14.3	7.6-9.5	7.8-9.5
HEAD HEIGHT At orbital region	Average	14.19	21.0	13.8	7.1	11.0	7.58	5.6	3.47	7.32	9.2	8.27	8	11.0	11.14	6.57	11.12	7.17	10.35	12.24	8.42	8.7
	Ratio	56.4%	63.6%	58.7%	55.0%	57.8%	63.8%	57.1%	48.9%	65.2%	61.3%	55.6%	63.4%	62.5%	64.2%	58.2%	64.8%	58.4%	56.9%	75.3%	63.8%	60.0%
HEAD WIDTH At orbital region	Range	8.4-10.2			3.4-4.4	4.6-5.7	3.7-4.7	2.8-4.0	3.0-3.7	3.7-4.6		4.4-6.4			6.0-7.8	3.4-4.8	5.4-7.0	3.9-4.0	5.6-6.4	4.4-5.7	4.6-5.5	5.0-6.4
	Average	9.12	12.0	8.0	3.96	5.15	4.22	3.44	3.29	4.3	4.0	5.39	5.4	6	7.11	4.2	6.33	3.97	5.98	3.09	5.08	5.84
MOUTH WIDTH	Ratio	36.2%	36.3%	34.0%	30.7%	27.1%	35.4%	35.0%	46.3%	38.3%	26.6%	36.3%	42.8%	34.0%	41.1%	37.2%	37.2%	32.3%	32.9%	30.5%	38.5%	40.3%
	Range	12.0-15.5			5.4-6.0	7.7-8.5	5.6-6.8	4.0-5.9	3.7-4.5	7.0-8.0		8.2-10.3			9.0-10.5	5.0-6.2	6.6-9.1	6.0-6.7	8.2-9.7	8.0-10.0	7.5-8.6	7.2-8.1
SPACE BETWEEN EYES	Average	13.64	16.5	12.6	5.7	8.1	6.03	4.85	4.17	7.43	6.8	8.98	7.8	10.4	9.54	5.58	8.18	6.23	9.0	8.84	8.01	7.76
	Ratio	54.2%	50.0%	53.6%	44.2%	42.6%	50.7%	49.4%	58.8%	66.1%	45.3%	60.3%	61.9%	59.0%	55.0%	49.4%	47.9%	50.7%	49.5%	52.9%	60.7%	53.4%
SNOUT TO SPIRACULUM	Range	6.4-8.2			8.0-10.7	5.0-4.8	2.6-3.2	2.8-3.6		1.9-2.1		6.0-8.5			3.4-4.3		3.9-4.2	3.7-3.9	4.6-5.0	3.3-3.6	3.2-3.7	3.7-4.0
	Average	7.07	9.0	7.0	9.6	4.9	2.83	3.18		2.0	2.9	7.1	5.4	8.0	3.85		4.0	3.77	4.75	3.42	3.49	3.9
TAIL HENGTH Base to tip	Ratio	28.1%	27.3%	29.8%	74.4%	25.8%	23.8%	32.3%		17.9%	19.3%	47.6%	42.8%	45.4%	22.2%		23.6%	30.7%	26.1%	20.4%	26.4%	26.7%
	Range	7.6-10.7			4.8-5.4	5.2-5.6	3.3-3.9	2.8-3.2	3.7-4.5	7.0-8.0		3.7-5.2			7.0-9.0	3.2-4.6	4.5-6.4	4.0-4.4	5.9-6.5	6.7-7.3	7.5-8.6	5.6-6.5
TAIL HEIGHT At highest place	Average	9.14	10.0	6.0	5.02	5.4	3.62	2.96	4.17	7.43	4.0	4.42	4.5	5.0	8.0	3.8	5.67	4.2	6.23	7.0	8.01	5.95
	Ratio	36.2%	33.6%	25.5%	38.9%	28.4%	30.4%	30.2%	58.8%	66.1%	26.6%	29.6%	35.7%	28.4%	46.2%	33.7%	33.3%	34.2%	34.4%	41.9%	60.7%	41.0%
THICKNESS OF TAIL MUSCLE Near base of tail	Range	14.3-18.0			7.0-7.7	10.7-10.8	6.5-8.0	6.0-7.2	6.0-7.7	11.4-12.7		9.4-13.5			11.3-13.4	6.7-8.2	10.2-12.8	9.0-9.5	9.7-11.2	11.4-12.8	8.2-9.4	8.8-10.0
	Average	15.82	21.0	14.8	7.4	10.75	7.49	6.64	6.84	11.88	8.5	11.14	9.3	11.0	12.46	7.38	11.94	9.17	10.49	12.28	8.73	9.62
LENGTH OF HIND LEG	Ratio	62.8%	63.6%	62.9%	57.3%	56.5%	62.9%	67.7%	96.2%	10.6%	56.6%	74.9%	73.7%	62.5%	71.9%	65.4%	69.9%	74.7%	57.7%	73.5%	66.1%	66.3%
	Range	41.4-56.4			30.5-35.5	41.0-41.3	16.6-19.0	12.5-16.8	12.0-19.0	18.0-21.7		21.0-28.5			28.6-33.3	20.0-25.0	26.8-40.0	25.0-27.0	34.0-39.6	24.0-36.4	20.5-27.0	27.2-32.4
BODY LENGTH OF YOUNG Just after metamorphosis	Average	49.32	74.0	55.0	32.9	41.15	18.23	14.6	15.34	19.84	21.0	23.95	22.0	34.7	30.54	22.26	34.0	26.27	37.0	30.73	24.44	30.35
	Ratio	196.0%	224.2%	234.0%	25.5%	216.6%	153.0%	149.0%	216.3%	177.0%	140.0%	161.2%	174.5%	197.1%	176.1%	200.0%	199.0%	214.0%	203.4%	184.1%	185.1%	209.1%
BODY LENGTH OF YOUNG Just after metamorphosis	Range	12.5-18.4			6.6-7.6	8.0-8.4	5.2-6.6	3.7-5.0	3.4-5.5	6.3-7.2		5.8-9.0			9.5-12.0	5.2-6.7	7.5-12.1	7.0-7.5	10.0-12.0	8.3-10.2	8.9-10.0	8.0-9.3
	Average	15.14	20.5	13.6	6.92	8.2	6.01	4.46	4.32	6.73	6.8	7.79	6.7	10.4	10.76	5.89	10.36	7.17	10.95	9.58	9.5	8.68
BODY LENGTH OF YOUNG Just after metamorphosis	Ratio	60.1%	62.1%	57.7%	54.4%	43.2%	50.5%	45.5%	60.9%	60.0%	45.3%	52.4%	53.1%	59.0%	62.1%	52.2%	60.1%	58.4%	60.2%	57.4%	72.0%	59.8%
	Range	5.5-8.5			3.2-4.0	5.6-5.9			1.0-1.6	2.0-2.4		2.8-5.2			3.0-4.4	1.8-2.8	2.6-6.0	3.5-3.7	4.2-6.0	3.3-3.8	2.8-4.4	4.3-5.3
BODY LENGTH OF YOUNG Just after metamorphosis	Average	6.7	11.5	8.0	3.8	5.75			1.34	2.08	2.5	3.77	3.7	6.0	3.58	2.37	4.29	3.57	5.34	3.58	3.41	4.77
	Ratio	26.6%	34.8%	34.4%	29.4%	30.3%		14.9%	18.4%	18.5%	16.6%	25.4%	29.3%	34.0%	20.7%	21.0%	25.1%	29.1%	29.4%	21.5%	25.9%	32.9%
BODY LENGTH OF YOUNG Just after metamorphosis	Range	4.0-6.7			6.0-10.0	6.8-7.0	2.7-5.0	2.3-4.1	2.3-6.0	2.0-3.8		1.9-6.0			3.7-7.4	4.3-6.8	2.3-6.0	5.5-6.8	2.3-6.0	11.4-12.8	3.2-7.0	3.5-6.8
	Average	5.2	4.0	5.6	7.6	6.9	3.6	3.2	4.2	3.01	8.7	3.1	3.5	13.5	5.1	5.15	4.2	6.0	4.08	12.3	4.91	4.93
BODY LENGTH OF YOUNG Just after metamorphosis	Ratio	34.7	25.3		19.2	21.3	12.0	11.3	6.7	13.0	10.0		15.2		23.4	15.8	20.0	16.7	19.0	21.4	27.0	17.0

Explanation of Figures

Plate I.

- Fig. 1. *Scutigera sikkimensis*, lateral view.
- Fig. 2. *Scutigera sikkimensis*, mouth part.
- Fig. 3. *Scutigera* sp. (Mont-omei), lateral view.
- Fig. 4. *Scutigera* sp. (Mont-omei), mouth part.
- Fig. 5. *Scutigera* sp. (Lung-tung), lateral view.
- Fig. 6. *Scutigera* sp. (Lung-tung), mouth part.
- Fig. 7. *Megophrys boettgeri*, lateral view.
- Fig. 8. *Megophrys boettgeri*, mouth part with funnel.
- Fig. 9. *Megophrys boettgeri*, mouth part showing projections.

Plate II.

- Fig. 10. *Megophrys pelodytoides*, lateral view.
- Fig. 11. *Megophrys pelodytoides*, mouth part.
- Fig. 12. *Bufo bufo gargarizans*, lateral view.
- Fig. 13. *Bufo bufo gargarizans*, mouth part.
- Fig. 14. *Bufo bufo wrighti*, lateral view.
- Fig. 15. *Bufo bufo wrighti*, mouth part.
- Fig. 16. *Microhyla ornata*, lateral view.
- Fig. 17. *Microhyla ornata*, dorsal view.
- Fig. 18. *Microhyla ornata*, mouth part.
- Fig. 19. *Kaloula rugifera*, lateral view.
- Fig. 20. *Kaloula rugifera*, mouth part.
- Fig. 21. *Nanorana pleskei*, lateral view.
- Fig. 22. *Nanorana pleskei*, mouth part.

Plate III.

- Fig. 23. *Staurois jugans*, lateral view.
- Fig. 24. *Staurois jugans*, mouth part and ventral view of the body.
- Fig. 25. *Staurois chunganensis*, lateral view.
- Fig. 26. *Staurois chunganensis*, mouth part and ventral view of the body.
- Fig. 27. *Staurois* sp., lateral view.
- Fig. 28. *Staurois* sp., mouth part and ventral view of the body.
- Fig. 29. *Rana nigromaculata*, lateral view.
- Fig. 30. *Rana nigromaculata*, mouth part.
- Fig. 31. *Rana limnocharis*, lateral view.
- Fig. 32. *Rana limnocharis*, mouth part.
- Fig. 33. *Rana japonica*, lateral view.
- Fig. 34. *Rana japonica*, mouth part.

Plate IV.

- Fig. 35. *Rana andersonii*, lateral view.
 Fig. 36. *Rana andersonii*, mouth part.
 Fig. 37. *Rana boulengeri*, lateral view.
 Fig. 38. *Rana boulengeri*, mouth part.
 Fig. 39. *Rana adenopleura*, lateral view.
 Fig. 40. *Rana adenopleura*, mouth part.
 Fig. 41. *Rhacophorus leucomystax*, lateral view.
 Fig. 42. *Rhacophorus leucomystax*, mouth part.
 Fig. 43. *Rhacophorus davidi*, lateral view.
 Fig. 44. *Rhacophorus davidi*, mouth part.

PLATE I

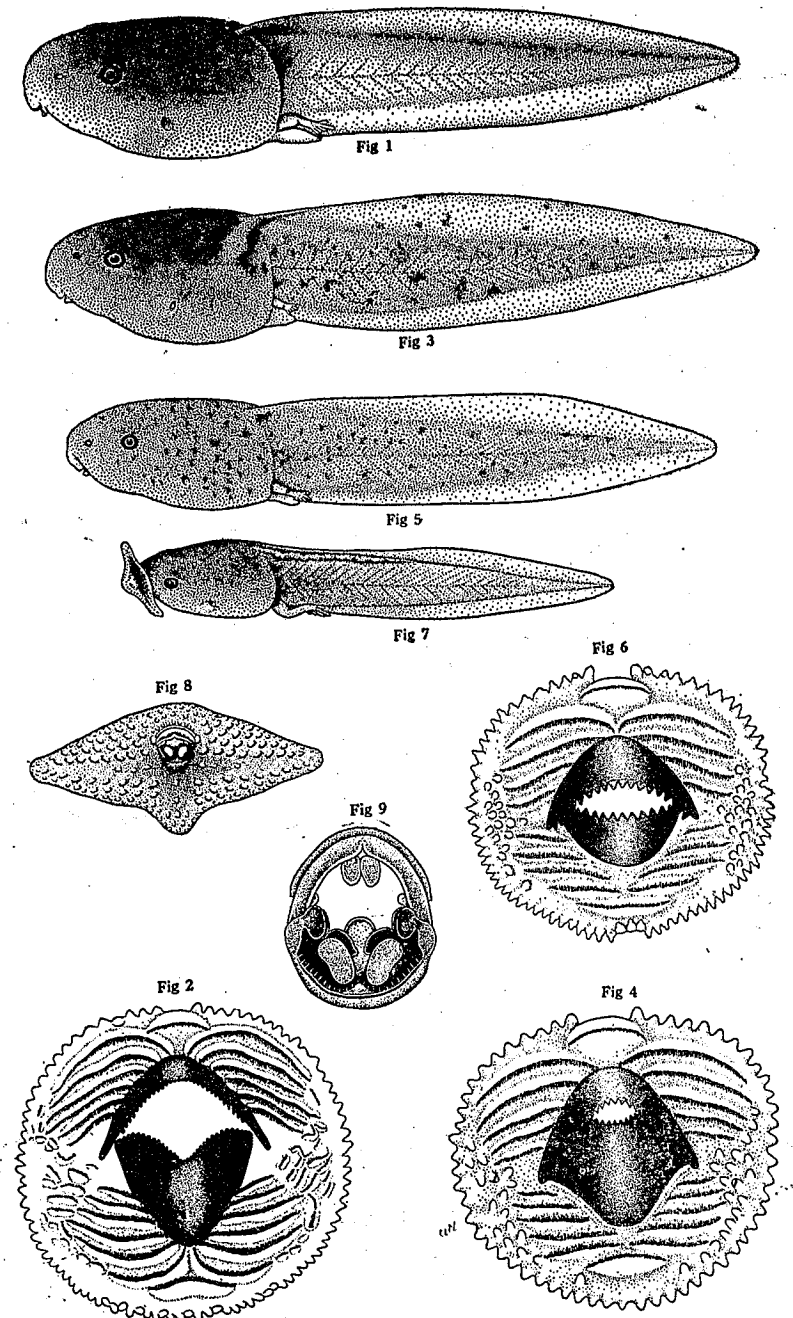


PLATE II

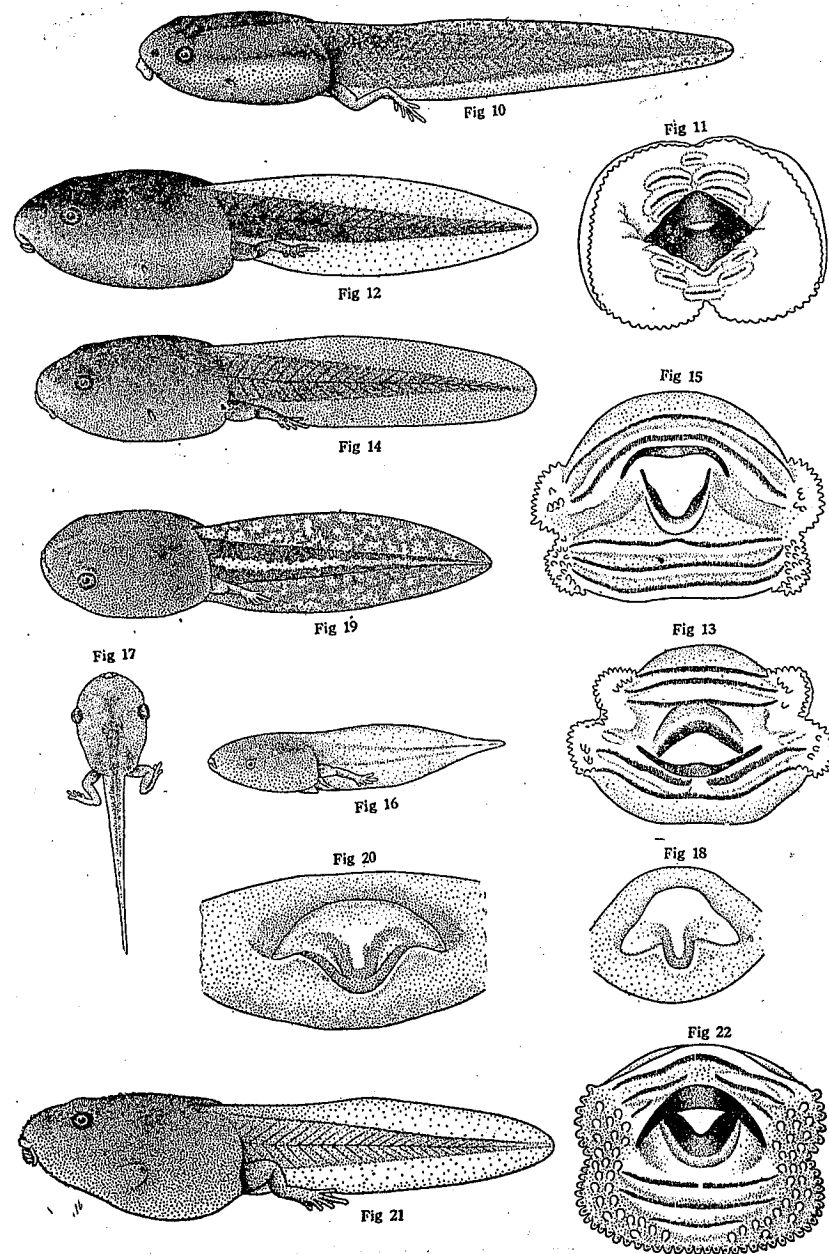


PLATE III

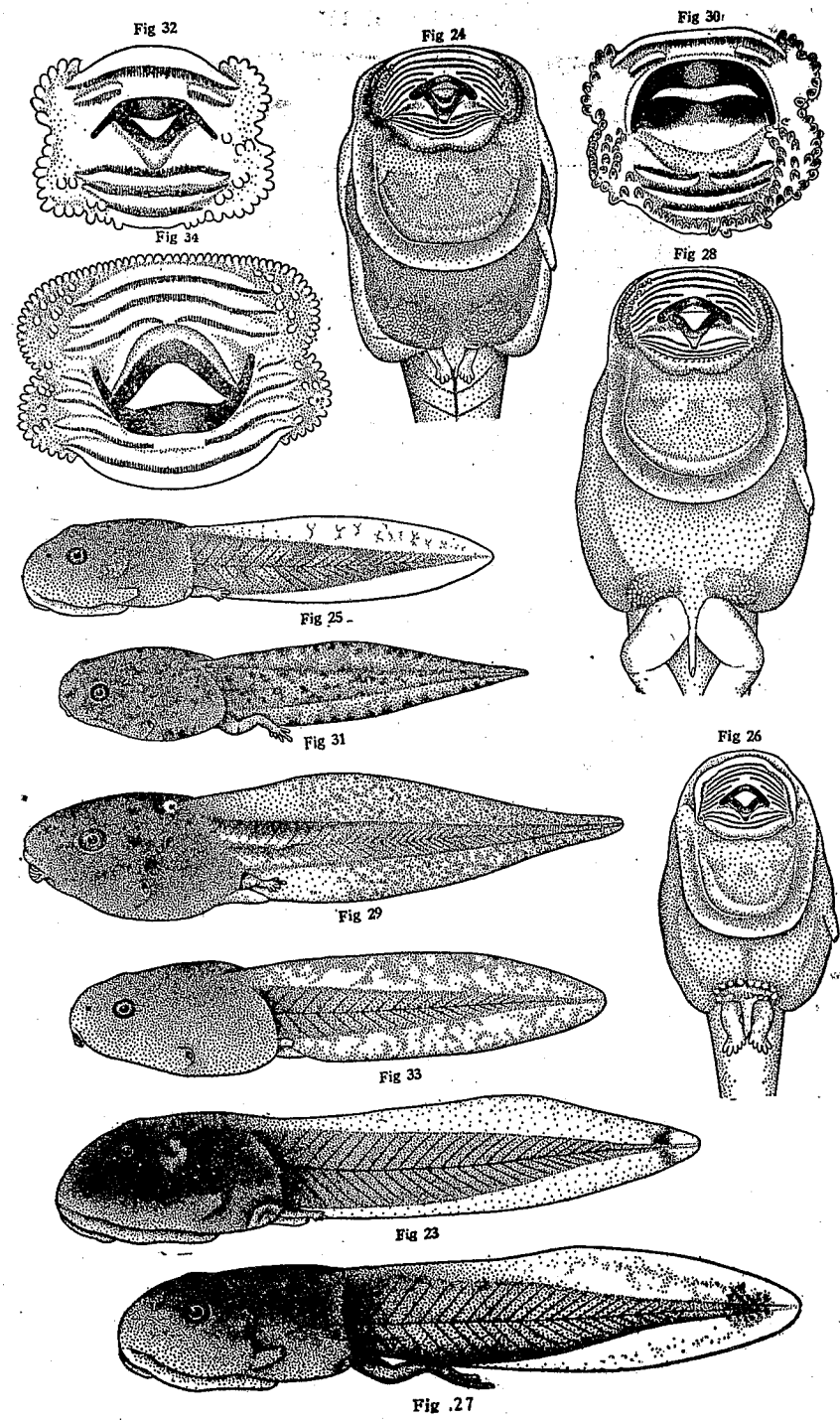
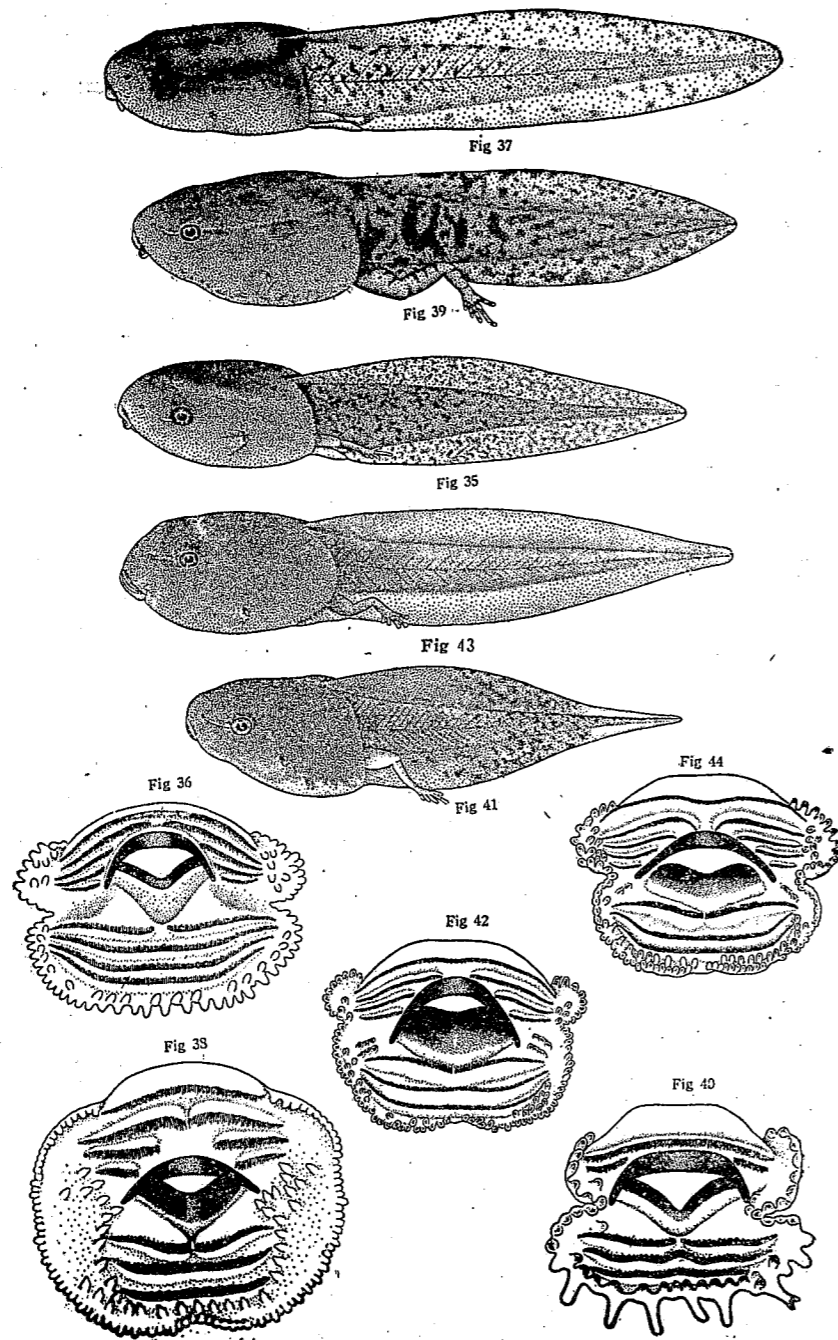


PLATE IV



NOTES ON THE LIFE HISTORY AND BREEDING
HABITS OF GEKKO JAPONICUS AND
GEKKO SUBPALMATUS

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For the investigation of melanophoral changes in the wall lizard, *Gekko japonicus*, 450 living specimens were collected (1937) from old houses and temples near Seven-sons Hill 七子山, which is about seven miles away from Soochow City, Kiangsu. Twenty-one females with eggs developed were selected for the present study as the eggs were clearly visible through the skin near the groin region. These twenty-one individuals were separated from the others, and each individual was kept in a separate jar five inches in diameter and nine inches in depth. The jars were numbered and covered by a movable screen. The animals were fed once every other day with small living insects which were collected by sweep-net. A watch-glass of water was placed in the jar as a water supply for the animal, so physiologically the females were in a good condition. The same experiment has been tried in Chengtu, Szechwan, June, 1939, with *Gekko subpalmatus* which is a common wall lizard found on the walls of old houses and temples around this region. This species is also commonly found on Mont-omei where a large number of eggs were obtained (Aug. 19, 1939) from under tiles of old houses near Ching-yin-ko 清音閣 (3300 ft.), and in cracks between large stones on hill-sides. *Gekko japonicus* is used as the essential material for the present study and *Gekko subpalmatus* as a supplementary part; thus most of the description and discussion is based upon the study of the former species.

I. *Gekko japonicus*.

As time goes on, the eggs become larger and larger, and the white eggs and the blood vessels of the uterus over the eggs can be seen through the skin of the belly of the mother. The shape of the egg in the uterus is changeable as the female presses her abdomen on the wall of the jar. Approaching the time of egg-laying, the female seems to feel uneasy, as is indicated by her restless movements. Near the time of egg-laying, the animal becomes quiet and rests, sometimes with

the vent toward the sky and the head toward the bottom of the jar. This may go on for a day or more, the animal changing her position now and then. Immediately before the egg-laying, she becomes restless again. Unfortunately, most of the eggs are laid during the night, so the egg-laying could not be repeatedly observed.

Only one case of the egg-laying was observed by Miss S. M. Shun at 5:40 P.M. June 20, 1937 in the laboratory of Biology department of Soochow University. After more than fifteen minutes restless movement, the animal at last came to rest in a position with the tail parallel to the bottom of the jar but leaving a space between the bottom of the jar and the basal part of its tail. The femur was horizontal in position and at a right angle to the body and the tibia. Fingers and toes adhere strongly to the jar. Before the egg was visible

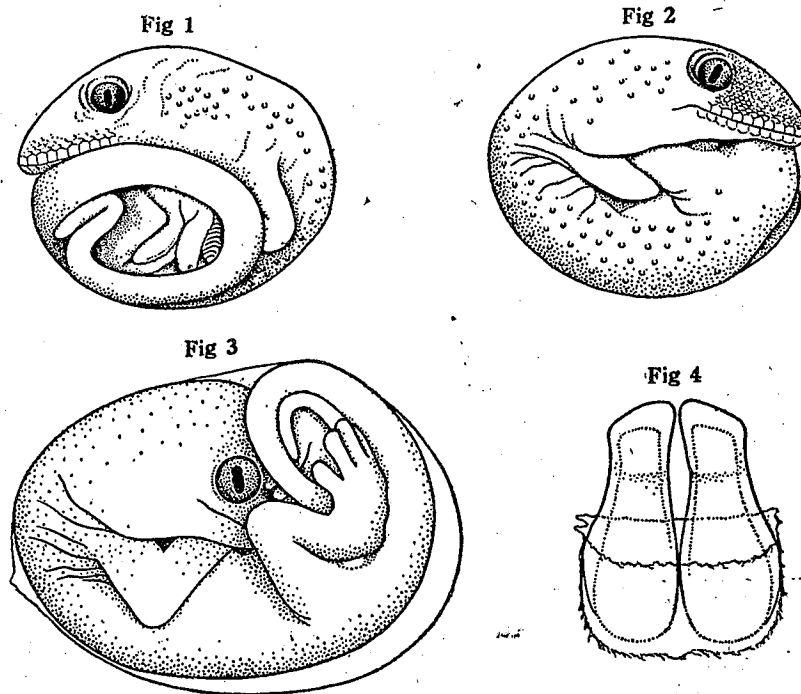


Fig. 1. *Gekko japonicus*, left side.

Fig. 2. *Gekko japonicus*, right side.

Fig. 3. *Gekko subpalmatus*, right side with yolk cup removed.

Fig. 4. *Gekko subpalmatus*, egg-teeth.

through the anal opening, a small amount of mucous excretion came out, then the egg came out very slowly. The whole process of egg-laying covered from 8 to 10 minutes. As the shell of the egg is very soft and leathery at time of laying, its shape is very much elongated and rod like and very soft and delicate looking. The egg is covered by a layer of mucous and it has an opaque creamy color. The shape of the eggs changes as drying goes on, and finally it becomes oval like a chicken egg. The surface of the egg attached to the jar is flattened, which is a common condition of the eggs laid either in jars or under natural conditions.

Sixteen of the twenty-one pregnant females, laid their eggs during the night, two in the evening, and only three in the day time. The number of eggs laid by each individual was one or two and never more than two. Three animals laid one egg and eighteen laid two eggs. In sixteen out of eighteen cases, the two eggs were close together in the jar; only in one case were two eggs narrowly separated. This indicates that, during the process of egg-laying, the female did not move from place to place.

The color of freshly laid eggs is creamy white and the shell is leathery, which is due to the presence of a thin mucous coat. After drying the shell becomes white, hardened and as brittle as the egg shell of a pigeon. During the incubating period the color of the blood vessels of the embryo shows through the shell and gradually the white shell becomes pink from the development of these blood vessels.

The size of the eggs varies greatly but there is no correlation between the size of the mother and the number of the eggs. Thirty-nine eggs laid by twenty-one females were measured with an average length 13.02 mm. ranging from 11.0-14.8 mm., and an average diameter 9.85 mm. with a range from 8.9-11.0 mm. As the number of eggs laid by each animal is only one or at most two, the size of the egg is rather large in proportion to the size of the mother. The average length of the egg is 20.6% of the average body length (snout to vent) of the female, while its diameter is 15.6%. There is no change in size during the incubation period.

The incubation period is different even for different eggs laid by the same female. It ranges from 60 to 67 days. The process of hatching takes place in the day time and is very brief and simple. It is very easy for the young animal to make a cut on the shell at the larger end with its egg teeth, as it is very thin and brittle. It takes about half a minute for the head to come out, with eyes opened. Then the whole

body of the young rushes out from the shell. Just after hatching, the young is covered up by a layer of slimy secretion so it has an opaque coloration. The young animal is very active; the mark of umbilical cord is visible and in some cases the umbilical cord and some blood may be seen on the skin and also inside the shell. After the slimy secretion is partly dried, the first molting takes place.

The process of molting is similar in different individuals; the mouth and fore-limbs are the essential apparatus for sloughing. Every piece of the molted skin is eaten up. The sloughing starts from the fore-limb, then the hind-limbs, and next the head and body and finally the tail. In most cases, sloughing begins at the fingers of the right arm. First the animal bites the skin of the fingers and then pulls it to the proximal region of the arm and sometimes to the shoulder region. After it eats up the skin of the right arm, it will turn its attention to the left arm and skin it in the same manner as the right arm. After eating up the skin of the fore-limbs, the animal will try on the hind limbs but the direction of skinning is opposite to that of the arms as it bites a little bit of skin from the base of the femur of right leg by bending the body upwards and the head backwards beneath the belly. Then the skin is peeled off from the base of the leg to the tips of the digits. It skins the left leg in the same manner, then tries to skin its head by rubbing the snout against the wall of the jar until the skin rolls back to the eye. Then the animal will use its fingers pulling back and forth the skin on the head region. At the same time, the young animal tries to rub and twist its body so the skin comes off as a whole or in parts; and then it eats it up with the help of the fore limbs. During or after this process, the young animal may bend its head and body to bite the skin at the base of the tail which curves upward near the base. Pieces of skin come off and are eaten up by the young. Thus the first molting process is accomplished. In some cases, here and there, some small pieces of skin may not completely come off from the body. It takes about 40 minutes to finish up this process.

Just after hatching, the color is rather dark but after the slimy film partly dries up, it becomes opaque gray. After molting, it is fleshy gray with dark brown bands on the dorsal side, which are especially conspicuous and distinct on the tail. The color becomes much lighter about half an hour after molting.

Thirty-nine eggs were laid by twenty-one females, eight eggs without embryonic development, and six injured; five

embryos of different stages before hatching were preserved and twenty young hatched out. These twenty individuals were measured after molting, the average length of their bodies being 27.08 mm., ranging from 25.3 to 29.2 mm.; the length of the tails was 24.53 mm. with a range from 21.8 to 28.8 mm. The total average length from snout to tip of tail was 51.61 mm., ranging from 46.5-58.0 mm. In nineteen out of twenty cases the tail is shorter than the body, but in only one case the tail is slightly longer than the body. It is remarkable to know that the ratio of the average body length of the young to the average body length of their mothers is 42.66 mm., ranging from 39.31 to 46.90% so the young just after hatching are nearly half as long as the females producing the eggs.

It is remarkable to know that just after hatching the young reach 51.61 mm. in length. How can such a small egg have so large an animal inside? In order to determine this fact, an egg of *Gekko japonicus* with the young inside just before hatching, was preserved in 7% formalin and then the fully developed embryo was dissected out to study the way of coiling its body within the limited space of the egg-shell. In this dissection, the young animal was coiled inside the shell with the head pointed toward the larger pole of the egg. Posterior to the base of the arm (fig. 1, 2). The body bends ventrally and then turns forward. The snout rests on the right side of the base of the tail. As the base of the tail reaches the snout, it bends upwards and backwards (fig. 1). Then near the angle of the elbow of the left arm, the tail turns downwards and then forwards towards its own base where it loops backwards for a short distance until the tip lies near the vent (fig. 1). Within the circle formed by the bending of the tail region, are the second, fourth and fifth, basal and distal parts of the third digits of the right hind-limb and parts of the femur and tibia of the left leg. The bending of the fore and hind limbs crossing each other with the digits of the left leg under the throat; those of right leg are exposed in the circle of the tail; the fore-limbs and their digits lie above and before the crossing of the hind-limbs.

There is a pair of egg-teeth connected to the premaxillary bone by muscle and projecting anterior-dorsally. They are similar to the egg-teeth of *Gekko subpalmatus* except that the head is larger with a sharper edge and tip.

From the facts as indicated by the table and graph, it appears that there is no positive or negative correlation between the size of the females, the size of the eggs and the length of newly hatched individuals. The size of the eggs laid by a female (number XVI) of 53.8 mm. in length, is larger than that of the eggs laid by a female (number XIX) 64 mm. long. Eggs laid by the same individual may be conspicuously different

in size, one egg laid by number XVIII female being 13.5 mm. in length and the other 11.5 mm. A newly hatched animal from an egg (13.8 mm. long) is 29.2 mm. from snout to vent; another hatched from an egg (14.8 mm.) has a short body, as it is only 26.6 mm. in length from snout to vent.

II. *Gekko subpalmatus*.

Sixteen females with eggs developed were selected and had the same kind of treatment as those females of *Gekko japonicus* in Soochow. Six of them were killed before egg-laying for examination of eggs and embryos and ten laid their eggs in the jars. One out of ten laid one egg and the rest laid two eggs. The eggs were laid at night from June 13 to 27, 1938. The eggs have flat surfaces for attachment to the jars in a similar manner to those of *Gekko japonicus*. Nineteen eggs were measured with average length 14.2 mm. ranging from 14.0-14.3 mm. and with an average diameter 10.8 mm. ranging from 10.3 to 11.2 mm. Six eggs with embryos fully developed, collected from Mont-omei, August, 1938, were measured. The average length is 15.1 mm. with a range from 14.0 to 15.8 mm. while the average diameter is 10.4 mm. ranging from 10.0 to 10.7 mm.

It has been noticed that eggs near time of laying were smaller than the eggs after laid, so ten eggs were dissected out from five females for the study of changes in size shape and hardening of shells. The first measurement was done just after they were dissected out. The average length of these ten eggs is 13.3 mm. with a range from 12.4-13.8 mm. and the average diameter is 9.6 mm., ranging from 8.7-10.5 mm. After the egg-shells hardened, the second measurement was made. Seven out of the ten eggs (three opened for embryos) have an average length 14.0 mm., ranging from 13.4-14.9 mm., and an average diameter of 9.9 mm., with a range from 9.0-10.6 mm. Shells become hardened after being exposed to air for about 15 minutes. Embryos are developed before egg-laying.

The length of the young just after hatching is 55 mm. from snout to tip of tail. The body length (from snout to vent) of the young is 42.9% of the body length of the mother. It is remarkable to have such a big embryo inside the limited space of the shell. The way of coiling of different embryos varies greatly. One type is similar to that of *Gekko japonicus* as described above with the body, tail and the left limbs coiled at the left side of head and anterior region of the body. In another type the coiling takes place at the snout region (fig. 3). The body bends ventrally and turns forwards at the base of fore limb. Near the tip of the snout the body bends ventrally and then turns to the left at the base of the tail. The tail coils on the upper side of the anterior region of the head

Forelimbs are concealed under the throat. The right leg bends dorsally and medially on the top of the tail coil with the left leg under this coil on the top of the head. Yolk material forms a cup-like structure to hold the embryo at lateral and dorsal sides.

The apparatus for opening the shell at time of hatching, consists of a pair of egg-teeth visible at the tip of snout of the premaxillary region. The distal portion of the teeth curve slightly toward the dorsal side with a sharp point at the inner tip of each tooth (fig. 4). The basal portion is imbedded in muscles by which the teeth are connected to the premaxillary bone.

Summary :

1. Number of eggs laid by an individual of *Gekko japonicus* or *Gekko subpalmatus* is usually two and rarely one.
2. Time of egg-laying in both species is mostly during night and rarely in the afternoon or morning.
3. Eggs are attached to the substratum by a flat surface which is due to the softness and stickiness of the shell just after being laid.
4. Eggs of *Gekko japonicus* are smaller than the eggs of *Gekko subpalmatus*.
5. Duration of incubation of *Gekko japonicus* under laboratory condition is from 60 to 67 days.
6. The way of coiling of the embryo inside the shell varies but with the yolk material forming a cup-like structure to hold the embryo on latero-dorsal side.
7. Young of *Gekko japonicus* just after hatching are from 39.8 to 46.9% of the body length of their mothers, but there is no correlation between the size of mother animals and the eggs and between the size of the eggs and the newly hatched young.

Explanations of Figures

- Fig. 1. *Gekko japonicus*—left side.
 Fig. 2. *Gekko japonicus*—right side.
 Fig. 3. *Gekko subpalmatus*—right side with yolk cup removed.
 Fig. 4. *Gekko subpalmatus*—egg-teeth.
 Fig. 5. *Gekko subpalmatus*—egg teeth in their original place.

ON THE CHINESE MEMBERS OF THE GENUS CLOVIA
(CERCOPIDAE, HOMOPTERA)

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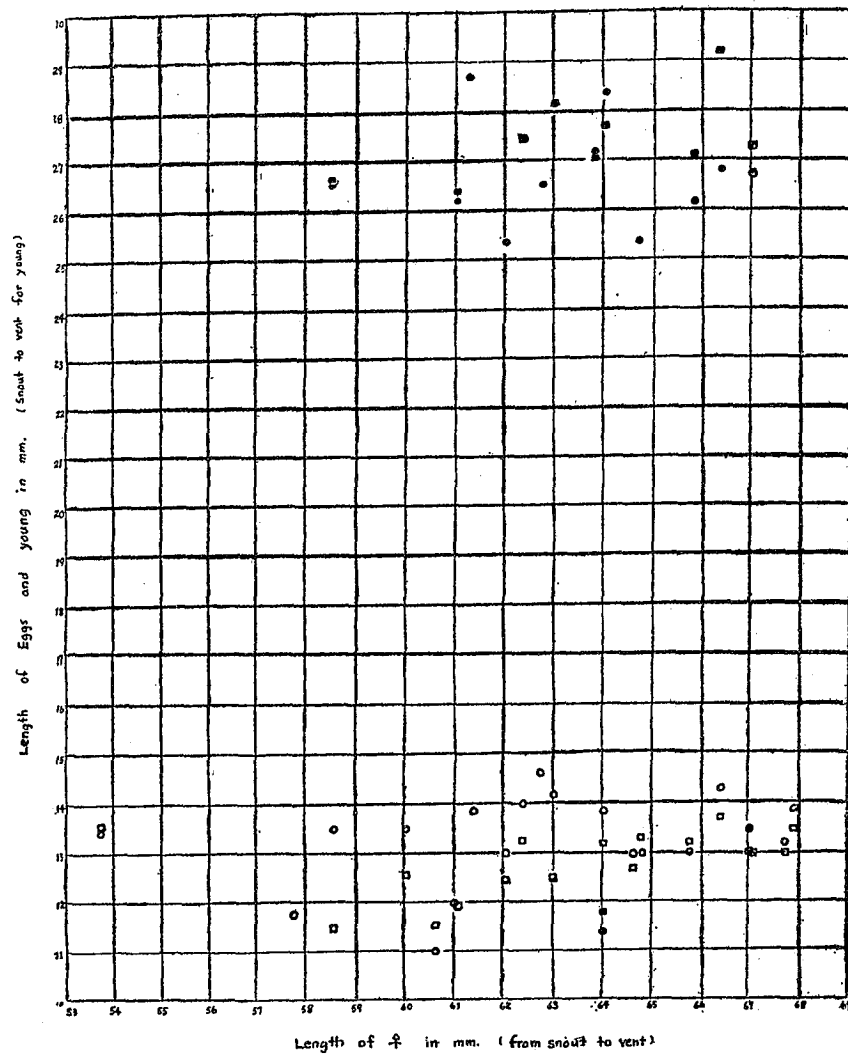
The genus, *Clovia*, was first established by Stal from Signoret's African species, *bigoti*, (Stal, *Hem. Afr.*, IV, 1866, p. 75), which is now generally considered as its type. It is a fairly large genus with more than forty species known at present from the Ethiopian, the Australian, and the Oriental region. There are ten species in this paper.

The insects are generally small. Head as broad as the pronotum, rounded or subangularly rounded on the anterior margin, and varying in length. Vertex with its length shorter than the width between the eyes and with the anterior margin of its lobes not furrowed but acute. Ocelli about equidistant or nearer to the eyes than to each other. Face more or less flattened and the non-carinate clypeus moderately produced at the apex but not extending beyond the apex of the anterior coxa. Pronotum sexangular and with the antero-lateral margins usually very short, parallel, or very slightly diverging backward. As a rule, both head and pronotum not carinate. Scutellum longer than broad. Tegmina with the clavus pointed, the commissural margin beyond the apex of the clavus subangulate or a little rounded, and with not more than three longitudinal veins. Posterior tibiae bispinose.

For the study of this genus, the work of Melichar (*Hom. Fauna Ceylon*, 1903, p. 135), Distant (*Fauna British India Rhynchorta*, IV, 1908, p. 93), Lallemand (*Gen. Ins.* fasc. 143, 1912, p. 42), and that of Metcalf and Horton (*Ling. Sci. Journ.*, 1934, p. 421) will be found very useful.

Key To The Chinese Species

1. Head with the vertex distinctly ridged; tegmina with a large blackish quadriangular spot in the whitish translucent apical area *Quadriangularis*
Head with the vertex not ridged 2
2. Body beneath without an inverted V-shaped white vitta extending backward from the apex of the head 3
Body beneath provided with such an inverted V-shaped vitta 4
3. Scutellum decorated with two longitudinal fasciae; general color pale ochraceous with six longitudinal black fasciae on head and pronotum *Signata*.



○ □ eggs produced by the ♀
● ■ corresponding length of the young produced by the ♀
○ □

If there are two females with same length, one would be like this ~.

- Scutellum not fasciate; general color almost uniformly pale brownish both above and beneath; pronotum with the anterior part distinctly sulcate in the middle *Alineata*
4. Tegmina maculate only 5
Tegmina both maculate and fasciate 7
5. Tegmina with only one small black spot at the posterior angle of the inner margin; general color almost uniformly pale tawny brown; size 6 mm. *Puncta*
Tegmina with more than one spot; size 8 mm. 6
6. Tegmina provided with a large median and a larger apical, costal, hyaline spot; head triangularly rounded in front with the vertex sometimes longitudinally fasciate and sometimes not (In some specimen, there is a slender longitudinal vitta in the apical region) *Conifer*
Tegmina with two black spots on the inner margin just after the clavus; head rounded in front with two dark sharp small spots on the disk *Orientalis*
7. Scutellum provided with two longitudinal fasciae 8
Scutellum either with only one longitudinal fascia or none 9
8. Tegmina with two longitudinal ochraceous fasciae (one costal and one central) on the apical region and two spots on the costal margin *Lineaticollis*
9. Body above with a broad longitudinal fasciae from the apex of the head to the scutellum; tegmina marking with two spots on the inner margin and three oblique fasciae from the costal margin *Unifasciata*
Body above with six longitudinal fasciae from head to pronotum; tegmina with three transverse fasciae *Variegata*

The present paper includes all those species which have been known to occur in China up to 1940. But in using the above key, the students should keep in mind that the coloration of these insects is variable and that the key is only suggestive. Our knowledge of this genus in China is still too fragmentary and much solid work is needed before we can expect to have a satisfactory classification.

1. CLOVIA ALINEATA, sp. n.

The small *Clovia* is almost uniformly pale brownish both above and beneath with a faint variegation of paler fasciae on the tegmina as *variegata*. The inverted V-shaped white fascia on the underside absent or very indistinct. The pronotum with its anterior region distinctly longitudinally sulcate in the middle.

It may be a variety of *variegata*, to which it is very close, but the shape of the head is distinctly different, being not so angulate.

Body length 6.5 mm.

Holotype male from Pingloo (Kwangsi). Paratype male from Kweiling (Kwangsi).

The types are in the author's collection.

2. CLOVIA CONIFER WALKER

Walker, *List Hom.*, III, 1851, p. 711.

Distant, *Fauna Brit. India, Rhyn.*, IV, 1907, p. 93, fig. 72.

Flavescent, testaceous or fuscous, subsericeous; vertex and pronotum in some specimens with distinct darker longitudinal lines, in others these are obsolete; face castaneous with ochraceous margins; lateral areas of the sternum castaneous, with a longitudinal ochraceous fascia; legs ochraceous, annulated with dark castaneous, in some specimens nearly wholly castaneous with the tarsi ochraceous; tegmina with a large median and a larger apical, costal, hyaline or subhyaline spot; head between the eyes subtriangularly rounded, its length almost as long as center of pronotum, which is posteriorly angularly sinuate; tegmina about two and a half times as long as broad.

A variable species in color and markings. When the tegmina are dark in hue the pale spots are very conspicuous, and sometimes are pale ochraceous and not hyaline; in pale colored specimens, the spots are much more indistinct.—Distant.

Body length 8 mm.

Distribution: Sikkim, Burma, Java, Philippine, Kien-tchen (Fukien), Hoa-binh (Indo-China).

This species is known for the first time to occur in China. The materials I have studied belong to the Heude Museum, Shanghai, and were collected in Fukien and Indo-China. In these specimens (one male and seven females), the color is fuscous and the apical region of the tegmina is somewhat translucent with a slender fuscous vitta straight to the apex. The genitalia seem to agree with the figure given by Metcalf for their *quadriangularis* but not only the markings of the body above are different but there is no ridge on the vertex and the anterior part of the pronotum.

3. CLOVIA LINEATICOLLIS MOTSCH

Motschulsky, *Etud. Ent.*, 1859, p. 110.

Melichar, *Hom. Fauna Ceylon*, 1903, p. 135.

Distant, *F.B.I.R.*, IV, 1907, p. 95, f. 74.

Above chestnut-brown, thickly shortly finely pilose, with fine slender longitudinal ochraceous fasciae between the eyes and an outer one on each side interrupted by the eyes, continued posteriorly through the pronotum, scutellum, and basal area of the tegmina; tegmina with the base of the costal margin, a large costal spot before middle, the veins, and two longitudinal fasciae on apical area (one costal, the other central) ochraceous; a large oblique subapical pale ochraceous or subhyaline spot commencing on costal margin and adjoining the inner apical fascia; body beneath and legs pale ochraceous; lateral margins of face and prosternum, a large spot occupying central base of face and disk of prosternum, stripes (variable) to legs and tarsal claws, dark castaneous or piceous; head about as long as the median length of pronotum; tegmina about two and a half times as long as broad.—*Distant*.

Body length 10 mm.

Distribution: Ceylon, Tienmushan (Chekiang).

This species is also known for the first time to occur in China. There is a large number of specimens from Tienmushan in the Huede Museum, Shanghai. In these Chekiang specimens, the costal margin of the tegmina is not ochraceous at base and the subapical spot is divided into two. The female is in general larger than the male.

Among the males, the June form is smaller than the May form. The arrangement of the two genital plates resembles the anal appendages of the Dermaptera. Anal style prominent. Markings on body above very distinct.

4. CLOVIA MULTILINEATA STÅL

Stål, *Ofv. Vet.-Akad. Förh.*, XXII, 1865, p. 154 (*Ptyleus*).
Melichar, *Ann. Mus. Zool. St. Petersburg*, VII, 1902, p. 117.

The following is an English translation of Melichar's German description of this species as it appears on page 117 of the *Annals of the Museum of Zoology*, St. Petersburg, volume XII, 1902:

Body brownish-yellow, covered thickly with greyish hairs. Vertex as long as the pronotum, flat, produced, rounded on the anterior margin. The vertex part of the face is marked off by fine lines and takes in almost half of the vertex. Head beneath dark brown to black, face moderately convex, oval, transversely striated. An inverted V-shaped white vitta extending from the apex of the head backward to the sternum. Eyes, antennae, clypeus, and rostrum dark brown to black. Pronotum sexangular, produced in front, obtusely indented behind, with the lateral margins very short and straight. Disk flat and decorated with numerous brownish longitudinal stripes which extend backward to the vertex. Scutellum short, triangular, with two parallel brownish longitudinal stripes.

Tegmina elongate, parallel until after middle from where suddenly attenuate, pale brownish-yellow, with brown transverse stripes and a brown spot near the base, two oblique stripes meeting in the middle of the costal margin. Between these two oblique stripes, there are numerous brown lines. In the apical area, there is a black longitudinal stripe to the apex, from the open end of which, a weaker one running to the costal margin. Clavus with a black spot at the apex and the marginal vein frequently black. Wings hyaline, slightly smoky with darker veins. Abdomen brown. Legs dark brown with longitudinal stripes on femora and tibiae. Posterior tibiae bispinose.

Body length (female) 7.5 mm. Szechuan.

According to Wu's Catalogue, the species also occurs in Canton, Yunnan, North China, and Formosa.

5. CLOVIA ORIENTALIS STÅL

Stål, *Freg. Eug. Resa, Hemiptera*, 1859, p. 287.

Pale yellow, pilose, with two small black spots just behind the clavus on the inner margin and mesosternum shining black.

Head about as long as the pronotum, rounded in front, a little broader than the pronotum (including eyes), uneven, and with two dark spots on the disk which is thickly covered with grey hairs. Ocelli about equidistant from the eyes as from each other.

Pronotum rounded in front, rather moderately angulate behind, with the antero-lateral margins very short and the postero-lateral margins straight. The disk pilose and with five more or less distinct sulcations on the anterior region. Scutellum convex, more or less longitudinally sulcate near the lateral angles.

Tegmina concolorous with head and thorax and with two black spots on the inner margin just after the clavus. Costal margin slightly convex.

Front rather flat, gradually dilated toward the apex. The disk is pale yellow with a series of pale brown oblique stripes on the lateral areas. Clypeus much darker and with its apex extending between the anterior coxae. Rostrum just reaching the posterior coxae. Mesosternum shining black. There is an inverted V-shaped vitta extending from the apex of the head backward to the thorax. Legs pale brownish. The rest of the body pale yellow with the abdomen beneath darker. Marginal area of abdomen beneath yellow. Posterior tibiae bispinose.

Body length 8—9 mm.

The above description is based upon Chinese materials from Wuchang and Foochow in my collection. The species is reported originally from Hongkong.

Since Atkinson made the suggestion that Stål's *orientalis* might be a synonym of Walker's *puncta* (*Journ. Asiatic Soc. Bombay*, IV, 1886, p. 196), most students of this group have accepted the arrangement. With the materials in my collection, I am inclined to think that for the time being these two species should be kept separate. For reference, Stål's original Latin description for his *orientalis* is given below:

Dilute testaceoflavous, fronte disco utrimque transversim fuscilineata; tegminibus apicem versus ad commisuram callo parvo fusco ut et prostethio nitide nigro fuscis. Male and female. Patria China Hongkong. Long. 5—7, Lat. 3—4 millim.

P. lineata subsimilis, sed tegminibus absque vitta fusca et posteriorius angustioribus.

Syn. *P. bipunctipennis* Stål—*Öfv. Vet-Ak. Förh.*, 1854, p. 250.

6. CLOVIA PUNCTA WALKER

Walker, *List Hom.*, III, 1851, p. 718 (*Ptyleus*). Distant, *F. B. I. R.*, IV, 1908, p. 94. Lallemand, *Gen. Ins.*, 1912, p. 44, pl. 2 fig. 5, 5a. Metcalf and Horton, *Ling. Sci. Journ.*, 1934, p. 423, figs. 137, 141.

Pale tawny brown, thickly, shortly and finely more palely pilose; face with the disk more or less piceous, its lateral margins and lateral margins of sternum continuously greyish; sternum with a piceous spot behind each anterior coxa; tegmina with a small black spot at posterior angle of inner margin; head a little shorter than the median length of pronotum; anterior central area with three pale longitudinal lines; anterior margin of the face pale ochraceous, with a black spot on each side; pronotum with some very indistinct darker longitudinal lines. Length 6 mm. Hab. Sikhim.

A very distinct species by its almost uniform pale coloration above with the black spots near the apex of the inner margin to tegmina.

Atkinson (*Journ. Asiat. Soc. Bombay*, IV, 1886, p. 196) states that his species includes apparently *Ptyleus orientalis* Stål from China, which seems a well found suggestion.—Distant.

There are a large number of specimens of this species from Canton, Chusan, Ihing, and Shanghai in the Heude Museum. The color may vary but, as rule, there is always a black spot at the inner angle of tegmina. There is also a black dash at the base. The spots on mesosternum fused. Otherwise the markings are variable. Metcalf, whose specimen came from Hainan, states that the pronotum is carinate. But in the Heude materials, the pronotum is distinctly, although not always, sulcate without any carination.

7. CLOVIA QUADRIANGULARIS METCALF and HORTON Metcalf and Horton, *Ling. Sci. Journ.*, 1934, p. 422, figs. 138, 142.

This species has a general resemblance to *Clovia lineaticollis* and *Clovia margheritae* but is much smaller; the lineation on the head and pronotum are less distinct; and the crown is somewhat shorter.

Crown spatulate, elongate, parabolic, slightly shorter than the median length of the pronotum, distinctly longitudinally ridged; tylus elongate, about half as long as crown; face somewhat inflated for the genus. Pronotum broader than long, somewhat longitudinally ridged, median sulcus distinct; distinctly foveate on the anterior margin, obtusely incised. Whole dorsal surface including tegmina minutely setigerous punctate.

General color tawny olive. Lineation on crown, pronotum, scutellum, and clavus sepia. Corium sepia, marked with black, white and tawny; markings on tegmina variable with a translucent triangular whitish spot on the costal margin, with the apex directed cephalad and continued as an irregular broken fascia to the first claval vein; apical area largely translucent white with a distinct blackish, elongate vitta extending from the apical angle toward the costal margin; between the whitish translucent areas there is formed a large squadrangular spot which is sepia or blackish in color, irregularly marked with tawny-olive; a distinct blackish dash on the sutural margin beyond the apex of the clavus. The anterior margin of the head marked with a pair of short black dashes at the median line; lateral margins of the face including the eyes blackish; central area of the face blackish shading to brown, leaving conspicuous yellowish white vittae from the apex of the face across the pro- and mesopleurae. Legs and abdomen largely tawny brown, spines and claws black.

Length to apex of tegmina 7.5 mm (male), 8.5 mm. (female).

Holotype male Hainan. Paratype male Yachow, Mt. Omei.

8. CLOVIA SIGNATA DISTANT

Distant, *F. B. I. R.*, IV, 1908, p. 96. Metcalf and Horton, *Ling. Sci. Journ.*, 1934, p. 428.

Pale ochraceous, with longitudinal black fascia. Head and pronotum with six longitudinal fasciae. Scutellum with two fasciae; tegmina with two longitudinal fasciae on claval area, the inner-most broken, remaining tegminal area largely black; two spots on costal margin (one at end, the other beyond the middle), three longitudinal fasciae on apical area, and two discal irregular spots near claval margin ochraceous; body beneath black; face (excluding base), two lateral spots on prosternum, posterior margins of abdominal segments, and the

legs ochraceous, finely pilose; head about as long as median length of pronotum; tegmina two and a half times as long as broad.

Length 9 mm. Hab. Nilgiri Hills.—Distant.

Metcalf's specimen of this species is from Mt. Omei.

9. CLOVIA UNIFASCIATA, sp. n.

Pale yellow with a broad longitudinal median brownish fascia running from head to scutellum, and with transverse fasciae and two spots on tegmina.

Head including eyes as broad as pronotum, spatulate, thickly pilose, anterior margin black, and with a broad longitudinal fascia extending back to scutellum. Pronotum as long as head broader than long, obtusely sulcate longitudinally in the middle and rather moderately angulate behind. Posterior portion of the disk greenish. The brown longitudinal fascia on scutellum becoming much narrower than it is on pronotum and head.

Tegmina pale yellow, setigerous; costal margin convex; inner margin straight after the middle of clavus, near the apex of which there is a fuscous stripe followed by a dark fuscous spot on the corium. There are three transverse fasciae; the apical one is curved from the costal margin to the apex and the median two are opposite in direction and meeting in the middle of the costal margin. Wings hyaline. Abdomen above piceous.

Body beneath much darker with an inverted V-shaped white fascia as in *variegata*. Mesosternum shining black. Intermediate femora annulate. Posterior femora pale brown with the base and the coxae paler. Posterior tibiae ochraceous with the apex piceous. Abdomen brown with the genital segment paler. Lateral margins of prothorax piceous both above and beneath. Posterior tibiae bispinose.

Body length 8 mm. Holotype male from Taiping (Anhwei) in my collection. The species is close to *variegata*.

10. CLOVIA VARIEGATA, sp. n.

Small Clovia with tegmina variegated and the head and pronotum marked with longitudinal pale stripes. Body beneath with an inverted V-shaped white fascia extending backward from the apex of the head.

Head, pronotum, and scutellum concolorous, yellow, thickly pilose, and decorated with slender longitudinal stripes. Head including eyes as broad as pronotum, rounded in front, as long as pronotum, with two small black spots on the middle of the anterior margin. Ocelli about equidistant. Pronotum broader than long, antero-lateral margin straight, postero-lateral margin

straight, posterior margin rather deeply curved in. The pronotal stripes (four long ones on the disk and two short ones on the margins) are more distinct than those on the vertex. Scutellum with the central portion darker.

Tegmina dark brown with three white transverse fasciae: one before middle from costal margin to clavus and two on the apical region running from the costal margin to the apex. The central portion on the inner side variegated. A darker spot at the apex of the clavus and a dark longitudinal line situated between the two apical fasciae. Wings hyaline with dark venation. Abdomen above pale brown with the marginal areas darker.

Body beneath pale brown with an inverted V-shaped white vitta from the head to the metapleura. The central region between this vitta is much darker on the front and the clypeus. Rostrum just reaching the intermediate coxae; the apical joint piceous. Prosternum shining black. Meso- and metasternum ochraceous. Legs pale brown with the tarsi, the tibiae, and the bases of femora paler. Posterior tibiae bispinose. Abdomen beneath brown.

Body length 7 mm. Holotype male from Wuchow (Kwangsi). Paratypes males and females from Taiping (Anhwei), Chungking and Kuanshien (Szechuan). All these types are in my collection.

This species, the general color may vary from soiled brown to dark brown, can be easily separated from others by the bipunctation and variegation on the tegmina. It seems to be near Distant's *margheritae* (*F. B. I. R.*, IV, 1908, p. 95) from Assam, and, judging by description, allied to Metcalf's *quadriangularis*. But the absence of carination on the vertex and the lineation on the clavus make it easy to separate.

March 7, 1941.
Chungking, China

CHINA-ROOT—FU-LING 茯苓 OR TU-FU-LING 土茯苓
A PROBLEM IN CHINESE MEDICINAL PLANTS

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INTRODUCTION

The writer's attention was first called to this problem in 1936 when she undertook a research on the "Plant esculents used for the conservation of health."¹ In reviewing literature concerning the above mentioned subject, the writer came upon the following statement in *Stuart's Chinese Materia Medica* "Tu-fu-ling 土茯苓 (*Smilax pseudo-China*) is the principal substance known as CHINA-ROOT, although *Pachyma cocos* (*fu-ling* 茯苓) is also included under this name and it is sometimes difficult to separate the two products or distinguish them on the market. The *Smilax* root is exported to India and Burma. . . ." Concerning *fu-ling* Stuart goes on; "The Chinese confound them with the genuine root of the *Smilax pseudo-China* and the two substances are exported to India or elsewhere as CHINA-ROOT." These statements are pretty confusing. Botanically *Smilax* is a liliaceous plant highly ranked in the evolution of the plant kingdom and *Pachyma* is a low saprophytic or parasitic fungus. They can hardly produce something of similar appearance and property. Then, is the exported China-root a product of one thing or of two things as Stuart stated? If one, then is it *fu-ling* or *tu-fu-ling*? And, in practice, do Chinese doctors prescribe *fu-ling* and *tu-fu-ling* indiscriminately? In their business do the drug dealers confound them together or do the drug collectors mix them together in their collections? With these questions in mind, investigations were started immediately in Canton and its vicinity. Specimens of the China-root from the Maritime Customs were examined. A survey of the China-root industry was made. Different materials were collected from the drug dealers, and a trip with the cooperation of drug collectors, was made over Loh-fau Mountain. As a result of this trip fresh materials producing the drug were collected for comparison. Each of these efforts threw some ray of light on the confusion. And the findings are confirmed by investigations recently made in Szechwan by the writer.

The writer wishes to take this opportunity to thank Dr. Cora D. Reeves, Head of the Department of Biology, Ginling College, for her helpful criticism in the preparation of the

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manuscript. Her gratitude to Dr. Reeves for guidance and inspiration is ever growing. To her professor, Dr. P. A. McClure, Curator of Economic Botany, Botanical Survey, Lingnan University, she wishes to express her appreciation for his direction in the planning and the execution of the investigation and the preparation of the photographs. The larger portion of specimens and the negatives of the photographs are deposited in the Economic Botany Collection, Botanical Survey, Lingnan University, and the specimens collected in West China are deposited in the Department of Biology, West China Union University.

FU-LING 茯苓 (see Stuart p. 298; Chen p. 1056; Read and Liu p. *Poria Cocos* (Schw.) Wolf.—*Peronosporaceae*. Hu. No. 67, 67a; Fig. 1.

Brief description of the plant: A Basidiomycete found in nature as a parasite on the root, or a saprophyte on the wood, of the common pine (*Pinus Massoniana Lamb.*). Mycelium colorless, capable of forming sclerotia. Sclerotia irregular in shape and size, generally 5-8 cm. in diameter, the surface soft in texture and pink in color when fresh, hard and black when dry, the interior white, starchy. Sexual stage seldom seen in nature.

Description of the product: *Fu-ling* is found in the market in three forms. (1) Material obtained from the retail drug dealer is in the form of an irregular tuber-like structure, with a blackish wrinkled surface. The inside is bony and starchy, white in the interior and tinged pale yellow and pink towards the cortex. They are called yün-ling 雲苓 meaning *fu-ling* from Yunnan Province. These are the dry entire sclerotia of the fungus. (2) Material obtained from drug shops is in the form of grayish or pinkish white irregular slices with the cortex removed. Each slice is about 1 cm. thick and 3-5 cm. in diameter. These have been prepared from the smaller or inferior sclerotia and are called *fu-ling* 茯苓. Smiliar slices with the woody root of the host tree passing through the center are called *fu-shên* 茯神. (3) Material obtained from China-root manufacturing and selling houses is in the form of either pure white or pinkish and pale yellow slices about 1 mm. thick and 2-5 cm. in diameter. These have been prepared from large, select sclerotia. After the cortex has been removed they are cut into slices by means of a plane-like tool. These slices are then trimmed with scissors and sorted into two grades, the white slices constituting the superior grade and the colored ones the inferior. In Canton this product is sold under the name *fu-shên-p'ien* 茯神片, and is exclusively the China-root of the Customs. It is packed in cardboard boxes and shipped to Hong Kong and then to the South Sea coast cities.

Distribution: *Fu-ling* has been reported from Hopeh, Shensi, Shantung, Honan, Hupeh, Anhwei, Chekiang, Fukien, Kwangtung, Yunnan and Szechwan. (see Tai and Wei, 1933, pp. 121-125). *Fu-ling* collected in Szechwan is called *Wu-ling-tsü* 烏苓子, the cortex it said to be darker than the imported ones. *Fu-ling* s cultivated in Honan and Anhwei but drug dealers all claim that their commodity comes from Yunnan.

Cultivation, collection and preparation: The sclerotia are occasionally collected in the wild, but the market is supplied chiefly from the cultivated product. *Fu-ling* is a minor crop in southern Honan and Anhwei, being cultivated on the wood of *Pinus Massoniana* Lamb.

The pine trees are felled, trimmed and cut into sections about 1 meter long. After the bark has been removed, they are dried in the sun. Late in the spring, sections of the dry wood are inoculated with the slices of fresh sclerotia. They are then buried in pits about a meter square and a meter deep. In July and August of the same year, they are dug out and cut into pieces 5-7 cm. long and these are used to inoculate another lot of wood. Stocks from this second culture are in turn used as inoculants for the main crop which is started in the following spring. The culture is allowed to remain untouched until the following summer when the crop is ready to harvest. After the sclerotia are collected, they are dried in the shade. (Tai, 1934, pp. 205-206).

Uses and supposed virtues: Thin slices of *fu-ling* are cooked with dry *lung-an* meat 龍眼肉 (the arils of *Luphoria longana* Lam.—Sapindaceae), dry fruit of jujube (*Zizyphus Jujuba* Mill.—Phamnaceae) and rice (Polished grains of *Cryza sativa* L.) to make a sweet congee which is considered to be very nutritious. Anybody can take it but is especially recommended for nervous disorders of children. In Central China, where *fu-ling* is cultivated, the inferior sclerotia are ground up and mixed with rice flour and made into small square cakes. The thick slices (*fu-ling*) obtained in drug shops are mostly used with other drugs to prepare a decoction which is taken as tonic. It is recommended for dysentery and is supposed to be effective in the regulation of water (利水) in the body. When water is excreted naturally, it won't be passed with the feces, thus the dysentery is stopped. The thick slices with woody centers (*fu-shên*) are also used as a tonic. It is specially recommended to patients who feel weak and have special heart trouble. It is believed to be effective in the setting of the heart so that it should beat normally.

TU-FU-LING 土茯苓 (see Stuart pp. 410-411; Chen p. 51; Read and Liu p. 51) *Smilax glabra* Roxb.—Filiaceae. Hu. Nos. 7, 35; Fig. 2, 3, 4.

Brief description of the plant: Climbing shrub. Stem unarmed, branchlets slender, terete. Leaves alternate, 14 cm. long and 5 cm. wide on old wood, 7-10 cm. long and 2 cm. wide

on young wood, lanceolate, acuminate, shining, primary veins one on each side, the secondary veins reticulate; petiole sheathing, with two long slender tendrils. Flowers deoecious; inflorescence an axillary, subsessile umbel with numerous flowers, pedicils 8-10 cm.; perianth white, small, free, incurved; staminate flowers with 6 stamens at the base of the perianth, anthers didymous; pistillate flowers with 3 staminodes, ovary 3-angled and 3-celled.

Description of the prout: *T'u-fu-ling* is found in the market in two forms. (1) Material obtained from retail dealers is in the form of irregular tuberous enlargements of the rhizome of the plant, arranged at short intervals on the slender fibrous axis. These enlargements knotty, somewhat shiny and brown in color. Those found in South China are more or less discolored with black spots indicating drying over fire after collection. Those found in West China are uniform in color with clay on the surface. This indicates preparation by sun-drying. This form of wholesome rhizome is common in South China markets and scarce in West China. Their identity as modified stems is confirmed by the presence of triangular scales, more or less symmetrically placed and representing modified leaves. The material, as sold by the retail dealers, is usually hard and bony in texture; but when it is first collected from the wild, it is fleshy, especially at the growing points. The interior is compact and chalky white. Collectors always claim its similarities with sweet potato. (2) Material obtained from drug shops is in the form of slices 2-4 mm. thick and 3-5 cm. in diameter. They are oblique cross sections of the rhizome. The grain of the wood is distinct. They are hard but not bony, white but not starchy.

Distributin: Wang (pp. 112-113) indicates the known distribution of *S. glabra* as Chekiang, Anhwei, Kiangsi, Kiangsu, Hunan, Szechwan, Yunnan, Kwangsi and Kwangtung. Wang and Tang (pp. 417-418) add Kweichow. Books dealing with Chinese *Materia Medica* all credulously assert the presence of *t'u-fu-ling* in Shensi and Honan. Concerning these localities, Wang writes: "This common species has not been found in Kansu, Shensi, Honan and Shantung in North and Northwest China."

Collection and preparation: The rhizomes are dug in the spring and in autumn, and dried in the sun or over a fire. The collectors are said to identify the plants by means of the relatively long, lanceolate leaves and by the twining habit of the vine. They are very specific to the one species of *Smilax*. The rhizomes usually develop at a depth of 40-60cm., but are sometimes as deep as 1-2 meters. So it needs much digging for each rhizome. Along the East River districts of Kwangtung, the tuberous rhizomes are ground when fresh to make a starch out of the mass. In West China, they are customarily cut into slices by collectors and dry on mats or on the ground in the sun.

Uses and supposed virtues: *T'u-fu-ling* is considered to be tonic, cooling, carminative and poison-dispelling. It is prescribed as a decoction to patients with boils and other inflammations. It is especially recommended in the form of a decoction for the treatment of syphilis. In South China, slices of *t'u-fu-ling* are boiled with the meat and bone of turtle and some other plants into a grayish jelly called *kuei-ling-kao* 龜苓膏 (meaning turtle and *t'u-fu-ling* jelly). Sugar is added just before eating. This can be found in special shops at any time of the year but most commonly during the hot seasons especially in early summer when it is used for its cooling and poison-dispelling virtues. Anybody may take it, but in the shops one finds that consumers are mostly from the laboring class. The starch made by grinding the fresh rhizomes and recovering the starch by decantation, is used in the same way as *pai-ho-fen* 百合粉 (meaning the starch of lily bulbs) a tonic.

DISSUSSION

1. *Fu-ling* and *t'u-fu-ling* have been synonymously classified by the Maritime Customs under the name China-root and are indiscriminately described by writers on Chinese economic plants as China-root. Through a careful investigation made in Canton and its vicinities, the writer found that the CHINA-ROOT of the Customs is exclusively the product of *fu-ling*, the sclerotium of a fungus—*Poria Cocos* (Schw.) Wolf.

2. *Fu-ling* and *t'u-fu-ling* are both tuber-like growths. Though they sound almost alike, they are two distinctly different things to drug collectors, drug dealers and Chinese doctors who make prescriptions. Their distinguishing characters are:

	FU-LING	T'U-FU-LING
To drug collectors	1. attached to the root or connected with pine tree. 2. obtained incidentally in the wild.	1. at the base of and connected to a vine with broad lanceolate leaves. 2. collected at will.
To drug dealers	3. entire object not knotty, surface black, much wrinkled 4. slices bony, starchy.	3. entire object knotty, often with slender connections, surface brown not wrinkled. 4. slices hard, not bony. grain of wood distinct.
To doctors	5. tonic, diuretic	5. tonic, cooling, poison-dispelling.

3. *T'u-fu-ling* has been variously identified by different authors. Stuart in *Chinese Materia Medica* (1911, p. 410) gives *Smilax pseudo-china*, Read and Liu in *Plantae Medicinalis Sinensis* (1927, p. 51) give *Smilax china* Linn. and the most recent publication, the *Chinese Materia Medica* (中國藥學大辭典, 1933, p. 51) uses *Smilax chinensis*. Some of these names are not valid in botanical nomenclature. *Smilax china* Linn. is a very common plant. Its rhizome was collected and compared with the commercial form. The rhizome is bony, even in fresh material. Its numerous roots give the rhizome a centiped appearance. Its stem is armed with hooked prickles, (see fig. 2. c, S. Y. Hu No. 7a). The enlargement of the fresh material (see fig. 3.) is identical with the *Smilax glabra* Roxb. (see fig. 4), as determined by F. T. Wang and T. Tang, who have made a special study of the genus *Smilax* in China. It is evident that the commercial *t'u-fu-ling*, of southern China at least, is *Smilax glabra* Roxb.

4. As to the morphological origin of the product, scale leaves are still distinguishable, especially on the growing region of the tubers, which would indicate that they are rhizomes rather than modifications of the root as assumed by former writers.

5. *Fu-ling* and *fu-shên* are used interchangeably by drug dealers and Chinese doctors who make prescriptions in different parts in China. In West China *fu-shên* is used for the sclerotia that cling to the root of the host. In South China it is used for the best grade of *fu-ling* slices exported. Though, these terms are never applied to the rhizome of *Smilax*.

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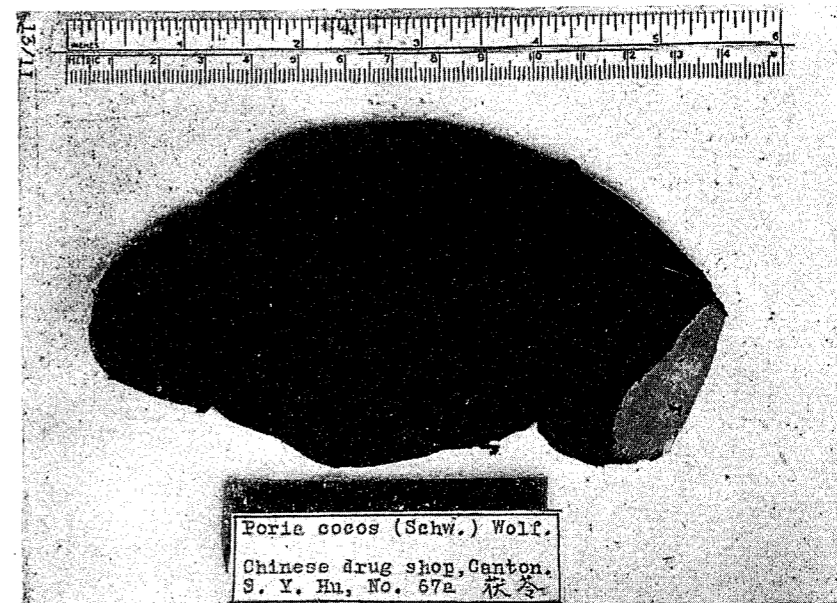
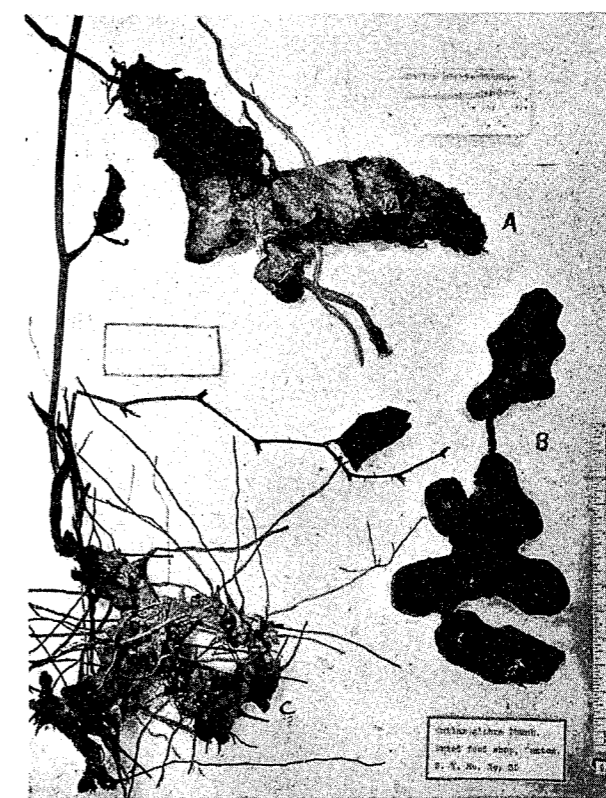
1935. 中國藥學大辭典 } 全三冊 (世界)
中國藥物標本圖影 }Fig. 1. *Poria Cocos* (Schw.) Wolf. (entire sclerotium) FU-LING.

Fig. 2 a. The true T'U-FU-LING, (*Smilax glabra* Roxb.) a rhizome collected on Loh-fau Mountain.
 b. The true T'U-FU-LING, (*Smilax glabra* Roxb.) a rhizome purchased in a food shop in Canton.
 c. The T'U-FU-LING of most authors fresh material of *Smilax china* Linn.



Fig. 3 *Smilax glabra* Roxb.
Collected under the name T'U-FU-LING 土茯苓

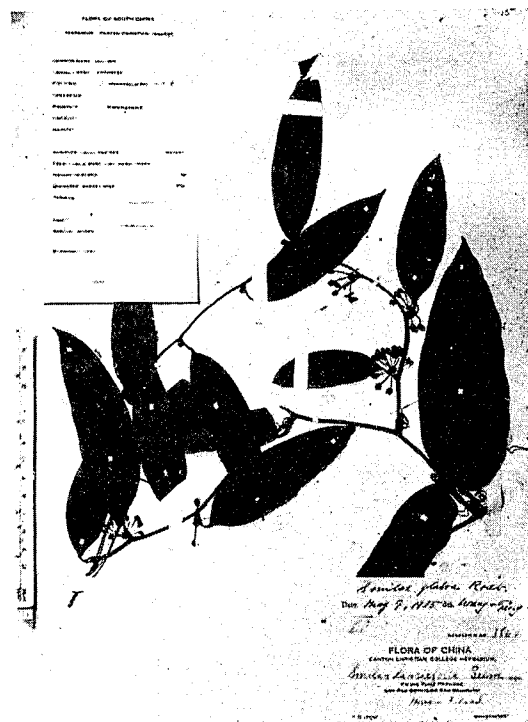


Fig. 4 *Smilax Glabra* Roxb.
as determined by Wang and Tang.

A PRELIMINARY LIST OF FRESH WATER PROTOZOA OF KIATING, SZECHWAN

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Hitherto a comparatively small amount of study has been given to the fresh water protozoa of China. The most extensive contributions to the studies of our protozoa, particularly around the Nanking region, have been those of Wang and his associates (1925-1935) of the National Research Institute of Biology, Academia Sinica. Apart from these there are only a few scattered papers, such as *Protozoa of Peiping* by Tai (1931), *Euglena of Tsinan* by Chang (1934), *Fresh Water Rhizopoda of Suchow* by Fielde (1887) and *Some Flagellates from Manchuria* by Skvortzow (1919, 1925).

The protozoan fauna of the fresh waters of Kiating and its vicinity is entirely unknown. The present account gives a preliminary list of the species found around this region during the past two or three years. It is, of course, preliminary in its nature, as it is perfectly evident that it will require years of continued study before a local fauna can be completely worked out. Even this preliminary list, it must be admitted, is not yet complete, but it is thought worth-while to publish it at the present time in order to stimulate the study of the group by other microscopists in the Province.

During the course of observation and study, several types of Protozoa were found sometimes in considerable abundance, which do not seem to agree with any described species. They might be described as new, but it is preferable to reserve the final identification till more detailed studies are made and more literature can be consulted. In such cases, therefore, only the generic names are given. Forms whose generic positions are uncertain are not included in this paper.

The water samples were collected from pools, ditches and streams in Kiating and its vicinity. Observations were generally made from the living specimens. No chemical reagents such as cherry tree gum, nicotine, chlorotone, magnesium sulphate, etc. were applied to retard the movements of the animals under examination. Instead, as previously pointed out by Tai, evaporation of the mounted slide for a few minutes until the coverglass gradually settled down and slowed down the locomotion of the organisms was found to be very effective for measurement, and for studying certain structures without killing the animals. Sometimes a single specimen was picked out and a hanging drop preparation was made. For detailed

cytological structures, such as, flagellation, nuclear apparatus, ciliation, etc., dilute solutions of iodine, neutral red, methylene blue, acetic carmine were applied. In rare cases, permanent slides were prepared.

Drawings and descriptions of the species are not given in this preliminary paper since most of them are common forms, easily accessible in monographs and papers already published.

PROTOZOAN SPECIES FOUND IN KIATING, SZECHWAN

The arrangement of the species has been made mainly according to the classification adopted by Kudo in his "Handbook of Protozoology" (1930). In identifying, however, various other sources of materials were consulted.

Subphylum Plasmodroma Doflein

Class Mastigophora Diesing

Subclass Phytomastigina Doflein

Order Crypomonadida Stein

Family Cryptomonadidae Stein

Genus Chilomonas Ehrenberg

Chilomonas paramecium Ehrenberg

Chilomonas sp.

Order Dinofalegellida Bustchli

Family Peridiniidae Bergh

Genus Peridinium Ehrenberg

Peridinium bipes Stein

Peridinium sp.

Family Glenodiniidae Lebour

Genus Glenodinium Ehrenberg

Glenodinium sp.

Order Phytomonadida Blochmann

Family Volvocidae Ehrenberg

Genus Gonium Muller

Gonium sociale Dujardin

Genus Pandorina Bory

Pandorina elegans Ehrenberg

Family Chlamydomonadidae Butschli

Genus Chlamydomonas Ehrenberg

Chlamydomonas monadina Stein

Family Polytomidae Poche

Genus Polytoma Ehrenberg

Polytoma uvella Ehrenberg

Order Euglenoidida Blochmann

Family Euglenidae Stein

Genus Euglena Ehrenberg

Euglena viridis Ehrenberg

Euglena acus Ehrenberg

Euglena gracilis Klebs

Euglena spirogyra Ehrenberg

Genus Phacus Nitzsch

Phacus pyrum Ehrenberg

Phacus pleuronectus Nitzsch

Family Astasiidae Butschli

Genus Astasia Dujardin

Astasia contorta Dujardin

Genus Petalomonas Stein

Petalomonas sp.

Genus Peranema Dujardin

Peranema trichophorum Ehrenberg

Peranema granulifera Penard

Family Heteronemidae Calkins

Genus Heteronema Dujardin

Heteronema acus Ehrenberg

Heteronema sp.

Genus Anisonema Dujardin

Anisonema truncatum Stein

Genus Notosolenus Stokes

Notosolenus orbicularis Stokes

Notosolenus sp.

Subclass Zoomastigina Doflein

Order Protomonadida Blochmann

Family Monadidae Stein

Genus Monas Ehrenberg

Monas elongata Stokes

Family Bodonidae Butschli

Genus Bodo Ehrenberg

Bodo ovata Stokes

Bodo sp.

Genus Cercomonas Dujardin

Cercomonas longicaudatus Dujardin

Family Trypanosomatidae Doflein

Genus Oikomonas Kent

Oikomonas termo Ehrenberg

Order Polymastigida Blochmann

Tribe Monozoa Calkins

Genus Tetramitus Perty

Tetramitus pyriformis Klebs

Class Sarcodina Butschli

Subclass Rhizopoda Siebold

Order Amoebae Ehrenberg

Family Amoebidae Doflein

Genus Amoeba Ehrenberg

Amoeba limax Dujardin

Amoeba sp.

Amoeba proteus Pallas

Amoeba fluida Gruber

Amoeba villosa Wallich

Genus Pelomyxa Greeff

Pelomyxa sp.

Genus Vahlkampfia Chatton and Lalung-Bonnaire

Vahlkampfia limax Dujardin

Genus Dactylosphaerium Hertwig and Lesser

Dactylosphaerium radiosum Ehrenberg

- Order Testacea Schultze
 Family Arcellidae Schultze
 Genus Arcella Ehrenberg
Arcella vulgaris Ehrenberg
- Family Diffugiidae Taraneck
 Genus Diffugia Leclerc
Diffugia sp.
- Subclass Actinopoda Calkins
- Order Heliozoa Haeckel
 Suborder Aphrothoraca Hertwig
 Genus Actinophrys Ehrenberg
Actinophrys sol Ehrenberg
- Genus Actinosphaerium Stein
Actinosphaerium eichhornii Ehrenberg
Actinosphaerium sp.
- Suborder Chalarothoraca Hertwig and Lesser
 Genus Acanthocystis Carter
Acanthocystis aculeata Hertwig and Lesser
- Subphylum Ciliophora Doflein
 Class Ciliata Butschli
 Subclass Euciliata Metcalf
- Order Holotrichida Stein
 Suborder Gymnostomina Butschli
 Family Holophryidae Schouteden
 Genus Coleps Ehrenberg
Coleps hirtus Muller
Coleps sp.
- Genus Lacrymaria Ehrenberg
Lacrymaria sp.
- Genus Chaenia Guennerstedt
Chaenia teres Dujardin
- Genus Spathidium Dujardin
Spathidium spathula Dujardin
- Family Tracheliidae Kent
 Genus Dileptus Dujardin
Dileptus monilatus Stokes
Dileptus sp.
- Genus Lionotus Wrzesniowski
Lionotus fasciola Ehrenberg
- Family Chilodontidae Butschli
 Genus Chilodon Ehrenberg
Chilodon cucullatus Muller
Chilodon caudatus Stokes
Chilodon sp.
- Suborder Trichostomina Butschli
 Family Urocentridae Schouteden
 Genus Urocentrum Nitzsch
Urocentrum sp.
- Family Ophryoglenidae Kent
 Genus Uronema Dujardin
Uronema marina Dujardin
- Genus Frontonia Ehrenberg
Frontonia sp.

- Genus Colpoda Muller
Colpoda campyla Stokes
Colpoda helia Stokes
- Genus Colpidium Stein
Colpidium striatum Stokes
- Family Parameciidae Grobben
 Genus paramecium Hill
Paramecium aurelia Muller
Paramecium caudatum Ehrenberg
Paramecium bursaria Ehrenberg
- Family Pleuronematidae Kent
 Genus Cyclidium Ehrenberg
Cyclidium galucoma Ehrenberg
- Order Heterotrichida Stein
 Suborder Gymnoheterotrichina
 Family Plagiotomidae Poche
 Genus Blepharisma Perty
Blepharisma undulans Ehrenberg
- Genus Spirostomum Ehrenberg
Spirostomum ambiguum Ehrenberg
- Family Stentoridae Claus
 Genus Stentor Oken
Stentor sp.
- Order Oligotrichida Butschli
 Family Halteriidae Claus
 Genus Halteria Djuradin
Halteria sp.
- Order Hypotrichida Stein
 Family Oxytrichidae Kent
 Genus Oxytricha Ehrenberg
Oxytricha sp.
Oxytricha bifaria Stokes
- Genus Stylonychia Ehrenberg
Stylonychia pustulata Ehrenberg
Stylonychia sp.
- Genus Kerona Ehrenberg
Kerona pediculus Muller
- Genus Uroleptus Ehrenberg
Uroleptus dispar Stokes
- Genus Gastrostyla Engelmann
Gastrostyla steini Engelmann
- Family Euplotidae Claus
 Genus Euplotes Ehrenberg
Euplotes patella Muller
- Family Aspidiscidae Stein
 Genus Aspidisca Ehrenberg
Aspidisca costata Dujardin
- Order Peritrichida Stein
 Family Vorticellidae Fromental
 Genus Vorticella Linnaeus
Vorticella campanula Ehrenberg
Vorticella striata Dujardin
Vorticella picta Ehrenberg

Vorticella nebulifera Muller
Vorticella microstoma Ehrenberg

Genus *Epistylis* Ehrenberg
Epistylis flavicans Ehrenberg

Genus *Cothurnia* Ehrenberg
Cothurnia sp.

Class Suctorina Butschli

Family Podophryidae Butschli

Genus *Podophrya* Ehrenberg
Podophrya fixa Muller

Genus *Sphaerophrya* Claparede and Lachman
Sphaerophrya magna Maupus

SUMMARY

This preliminary list of fresh water Protozoa of Kiating, Szechwan includes eighty seven species. Among them, there are thirty species of flagellates, fourteen species of Sarcodina and forty three species of ciliates. Several of the species were not identified.

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CYTOLOGICAL STUDIES OF A HAPLOID WHEAT PLANT

C. H. Li and H. W. Li*

Haploids in the flowering plant are frequently found either naturally or artificially produced (see literature citation in the summary by the Imperial Bureau of Plant Genetics, 1936). In *Triticum*, since the first haploid plant was found by Gaines and Aase (1926) in the F₁ of an intergeneric cross, *T. compactum Humboldtii*, *Aegilops cylindrica*, a number of cases have been reported. Kihara and Katayama (1933) and Chizaki (1933) reported the occurrence in *T. monococcum*; Katayama (1934 and 1935) found haploid plants in *T. monococcum* in nature and by using X-rayed pollen on normal pistils; in *T. dicoccum* and *T. persicum*, Yefeikin and Vasilyev (1934 and 1935) also obtained haploids by using the X-rayed pollen; Kihara found haploid *T. durum* in twin seedlings (Kihara, 1936); Nakajima (1935) reported the occurrence of a haploid plant along with a hybrid in the intergeneric cross *T. turgidum* and *Secale cereale*; in *T. vulgare*, Yamasaki (1934) found the first haploid plant in strains derived from varietal crosses, and in the same year, Namikama and Kamakami (1934) observed haploid plants in twin seedlings. Finally, Krishnaswamy (1939) also found a haploid plant in twin seedlings.

Material and method

The haploid plant reported in this paper was obtained from the F₃ progeny of a varietal cross of *T. vulgare*, var. Quality and a selected strain of Chinese wheat 18-3874. As the cross gave segregation for sterility, cytological study revealed the occurrence of asynapsis in the meiotic division (the cytogenetics of sterility will be reported in detail elsewhere). It was also found that some plants in the progeny were exceedingly small and weak, and it was therefore expected that some aneuploid plants might be in existence. To our surprise, more than a dozen of the small plants examined were found to have the normal chromosome number. But among these, a haploid plant was found. The cytological aspects of this particular plant are reported in this paper. Throughout the study, aceto-carmine smear was used.

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Description of the plant

From the photograph (Fig. 1), it can be seen that the haploid plant at the left is about half the height of the normal sub-diploid plant at the right. The tillers of the haploid plant are few in number, with slender and weak stems. The spikes are small and shorter than those of the diploid plant. The leaves are much narrower and paler green in color. The stomata, as can be seen from the photomicrograph 1, are much smaller than that of the normal diploid plant. In general, this haploid plant appears to be so very weak and palid looking a specimen that it is barely alive at all. The plant is practically sterile. Only two very shrivelled seeds were obtained by the application of normal pollen from a diploid plant.



Cytological observations

The somatic number of the plant was not determined. In microsporogenesis, 21 chromosomes were observed in diakinesis and subsequent stages. In our material, we found that the cells from any one single anther are approximately alike in development. This differs significantly from what Krishnaswamy (1939) described for his material. We had no difficulty in finding the early prophase stages. The leptotene stage is shown in photomicrograph 2. The chromosomes that can be differentiated appear to be single. The chromosomes in the diplotene stage as shown in photomicrograph 3 are also single. The only paired chromosomes are loosely connected, with an end-to-end association. In the diakinesis stage (Plate 1 Fig. 1 and photomicrograph 4) the bivalents and the univalents can be differentiated with certainty. These two bivalents in Plate 1 Fig. 1 are quite separate from each other and are connected by fine chromatic threads. The topmost one is even disconnected in the middle. We are not sure whether these two bivalents as found in this stage will remain so or not, in the subsequent stage. In the course of this study, where over one thousand cells were under observation, one bivalent association is the highest number we ever encountered. However, this might be a chance variation.

In the metaphase, the univalents are usually scattered all over the cell. But in photomicrograph 5, it can be seen that the univalents are lined up more or less on the equatorial

CYTOLOGICAL STUDIES OF A HAPLOID WHEAT PLANT

C. H. LI and H. W. LI*

Haploids in the flowering plant are frequently found either naturally or artificially produced (see literature citation in the summary by the Imperial Bureau of Plant Genetics, 1936). In *Triticum*, since the first haploid plant was found by Gaines and Aase (1926) in the F₁ of an intergeneric cross, *T. compactum* *Humboldtii*, *Aegilops cylindrica*, a number of cases have been reported. Kihara and Katayama (1933) and Chizaki (1933) reported the occurrence in *T. monococcum*; Katayama (1934 and 1935) found haploid plants in *T. monococcum* in nature and by using X-rayed pollen on normal pistils; in *T. dicoccum* and *T. persicum*, Yefeikin and Vasilyev (1934 and 1935) also obtained haploids by using the X-rayed pollen; Kihara found haploid *T. durum* in twin seedlings (Kihara, 1936); Nakajima (1935) reported the occurrence of a haploid plant along with a hybrid in the intergeneric cross *T. turgidum* and *Secale cereale*; in *T. vulgare*, Yamasaki (1934) found the first haploid plant in strains derived from varietal crosses, and in the same year, Namikama and Kamakami (1934) observed haploid plants in twin seedlings. Finally, Krishnaswamy (1939) also found a haploid plant in twin seedlings.

Material and method

The haploid plant reported in this paper was obtained from the F₃ progeny of a varietal cross of *T. vulgare*, var. Quality and a selected strain of Chinese wheat 18-3874. As the cross gave segregation for sterility, cytological study revealed the occurrence of asynapsis in the meiotic division (the cytogenetics of sterility will be reported in detail elsewhere). It was also found that some plants in the progeny were exceedingly small and weak, and it was therefore expected that some aneuploid plants might be in existence. To our surprise, more than a dozen of the small plants examined were found to have the normal chromosome number. But among these, a haploid plant was found. The cytological aspects of this particular plant are reported in this paper. Throughout the study, aceto-carmine smear was used.

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Description of the plant

From the photograph (Fig. 1), it can be seen that the haploid plant at the left is about half the height of the normal sub-diploid plant at the right. The tillers of the haploid plant are few in number, with slender and weak stems. The spikes are small and shorter than those of the diploid plant. The leaves are much narrower and paler green in color. The stomata, as can be seen from the photomicrograph 1, are much smaller than that of the normal diploid plant. In general, this haploid plant appears to be so very weak and palid looking a specimen that it is barely alive at all. The plant is practically sterile. Only two very shrivelled seeds were obtained by the application of normal pollen from a diploid plant.



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In the metaphase, the univalents are usually scattered all over the cell. But in photomicrograph 5, it can be seen that the univalents are lined up more or less on the equatorial

plate. We found a number of cells that behaved in this way. It is suggested therefore, that the univalents must come to the equatorial plate before they move or while they are being moved to the poles. Of course the movement is haphazard and will result an irregular distribution. This suggestion would be in contradiction to the hypothesis as held by Kihara's school, who maintain that the univalents remain as they are in the polar region and will be included in the daughter cells as a matter of course.

When bivalent chromosomes occur with the univalents (Fig. 2) the bivalent is, as a rule, located on the equatorial plate, while the univalents are scattered all over the cell. We are not certain whether the bivalents move to the poles ahead of the univalents or vice versa. We did however, find cells in the late anaphase wherein the univalents were already assembled at the poles, but the chromatids of the bivalents were just approaching the poles. Since we have just argued that the univalents must come to the equatorial plate, it seems therefore that they move to the poles ahead of the bivalents, for the latter are held together by chiasma and are apt to lag behind. This is in accord with our former observation on a wheat and rye hybrid (Li, Li and Meng in press).

Bipolar spindles are regularly formed. However, many of them are bent and occupy one side of the cell only. Extremely curved spindles will assume a tripolar appearance (Figures 3 and 6). But a regular tripolar spindle was observed in the pro-metaphase with all the univalents lined up in the center of the plate. The telophase of the same tripolar spindle is shown in photomicrograph 10.

As a general rule the univalents do not split in the first metaphase. In a few cases, however, splitting might occur as shown in Fig. 3. What factor or factors govern the split of the univalents at this stage is not known.

In the anaphase, the univalents are distributed to the poles at random (photomicrograph 6). Table 1 shows the chromosome distribution at this stage.

Table 1. Distribution of chromosomes in anaphase.

Chromosome constitution	10+11	9+12	8+13	7+14	6+15	5+16	4+17	3+18	Total
observed	31	25	14	9	6	1	3	1	90.0
calculated	30.3	25.2	17.5	10.1	4.7	1.7	0.5	0.1	90.1

$$P = 0.02$$

This would be a random distribution as expected. However, P is only 0.02. Possibly a small observation like this would explain such a wide variation. Theoretically a 0+21 distribution would possibly occur, had the number of observa-

tions been large enough. This is indeed of great importance. As the haploid plant is highly sterile and the few seeds obtained are diploid (Gaines and Aase, 1926), the possibility of getting a viable pollen grain or egg must occur in this way with all the 21 chromosomes going to one pole only.

Besides the regular haploid cells, there are some others with 42 or more chromosomes (Fig. 8 and 9 and photomicrograph 7, 8 and 9). The frequency and the chromosomal association of these cells are shown in Table 2.

Table 2. Percentage of haploid, diploid and polyploid cells together with the chromosome association in each respective cell.

	Chromosome constitution	No. of cells	Percentage
Haploid cells	{21I	205	84.0
	{19I+1II	13	5.4
Diploid cells	{42I	19	8.5
	{40I+1II	2	
Polyploid cells	{63I	1	1.2
	{59I+2II	1	
	{26I+17II+1III	1	
	{63I+	2	
Total		244	100.0

It is interesting to note that the chromosomes of the diploid and the polyploid cells still continue to be univalent except those in Fig. 10 wherein there are 26 univalents, 17 bivalents and one trivalent. These polyploid cells might be the result of the fusion of the neighboring cells. This fusion must have taken place rather late in cell ontogeny, possibly just prior to the meiotic division. Consequently, the univalent chromosomes remain as they were before they had time for finding their respective homologues to pair with. However, there are some other explanations for the same phenomenon even though the fusion of the cells might have taken place much earlier than that just hypothesized. A triploid cell is shown in Fig. 10 with 63 chromosome complements. It is triploar, with the bivalents and trivalent lined up on the equatorial plate and the univalents scattered in a conventional way at the poles. The number of bivalents found in this cell exceeds greatly what is expected in this haploid plant. An explanation for such peculiar behavior is still lacking at the present time. In general, when diploid cells are found in the haploid plant even with chromosomes remaining unpaired, the chances of obtaining a haploid pollen or egg are very great. Thus it opens another channel for the haploid plant to produce $2n$ seeds.

The number of bivalents formed in the haploid plant is one. This is only comparable to the haploid plant found in

T. monococcum, a species with the basic chromosome number 7 (Kihara and Katayama, 1933). Table 3 is a summary of the percentage of bivalents for the haploid plant for different wheat species as reported by different authors.

Table 3. Percentage of bivalents in haploid plant of different wheat species.

Species	n.	percentage of bivalents									author
		0	1	2	3	4	6	9	III		
<i>T. monococcum</i>	7	98.0	2.0								Kihara and Katayama, 1933
<i>T. durum</i>	14	84.8	13.9	11.2	0.08						Kihara, 1936
<i>T. vulgare</i>	21	47.7	37.1	2.4	2.4	0.4					Taken as 1 bivalent Yamasaki, 1936
..	21	86.1	10.5	1.8	0.1				0.1		Yamamoto, 1936
..	21	59.3	19.7	13.9	5.3	0.3	0.3	0.1	1.0		Krishnaswamy, 1939
..	21	94.0	6.0								Li & Li

The possibility of pairing between the 21 chromosomes of the 3 genomes of the *vulgare* group either inter- or intra-genomically is rather great when the homologous chromosomes of each pair is not in existence in the haploid plant and the chromosomes are free to pair with any one, should they have, say, a common homologous end. Yet our results differ greatly from the theoretical standpoint or from the results obtained by other authors. As stated, this haploid plant was found in the progeny of a cross between an American variety and a Chinese strain, and this cross also segregates for asynaptic chromosomal behavior. As the line, in which this haploid plant was found, does not segregate for sterility, this does away with the gene or genes for asynapsis that would prevent the pairing of the chromosomes. In the course of evolution since *vulgare* wheat came into existence, these two parental varieties have grown separately at two diversified places. Through inversion, translocation, deletion and others, their chromosomes might come to have a different constitution, no matter how slight. For instance number one chromosome of genom A and B would have a homologous end in common and would pair when their respective homologous chromosomes are absent. Suppose by deletion, the homologous end of the number one chromosome in the genom B is lacking. Thus, these two chromosomes will not pair at all. Consequently, a mixture of the chromosomes that differ in their constitution from these two parents would reduce the chance of pairing. Had there been haploid plants of both parents, a comparison would show the validity of our hypothesis.

Of all the haploid plants reported previously in *T. vulgare*, they have either come from a variety, or from the progeny of a cross between varieties which originated in the same locality. This seems to help in testing the validity of our hypothesis. The pairing of the chromosomes in our haploid plant seems not to be confined to a particular pair alone, for, as shown in Fig. 11, the paired chromosomes seem to vary in size, spindle insertion point and the formation of chiasma.

None of the bivalents found is ring shaped except the few shown in Fig. 10. This is an exception, of course. Almost every bivalent is an end-to-end pairing even in the diplotene stage (photomicrograph 3). This shows, of course, a weak homology between the paired chromosomes. There are, however, bivalents with interstitial chiasma as shown in Fig. 11, c & e. Some of the bivalents differ morphologically in the two chromatids as shown in Fig. 11, d & e. All these seem to validate the hypothesis, i.e. the chromosomes of the two distinct varieties might differ in some way from one another, and a mixture of these chromosomes reduced the number of bivalents found in this haploid plant.

Krishnaswamy (1939) found two satellite chromosomes and one chromosome with an achromatic portion in the sub-terminal position. We were able to find in our material only one satellite chromosome and this is attached to the nucleolus in the prophase stage (Fig. 11, a & b and 12 photomicrograph 4).

The second division has no striking feature to be mentioned except that there are many cells with irregularities as shown in Fig. 4, 5 and 7. The result is a quartet with poly- and micro-nuclei as shown in photomicrograph 11. However, there are many quartets that are regular. Owing to the unbalanced condition in the chromosome number in these microspores, their fate is already doomed. Unfortunately, in the material fixed for study, we could find stages only up to microspore but no further. Thus, the determination of the percentage of viable pollen is left undone.

Summary

A haploid plant was obtained from the F_3 progeny of a varietal cross in *T. vulgare*, "Quality" and 18-3874.

The appearance of this plant was described as compared with the normal diploid plant.

The microsporogenesis of this plant was reported in detail.

During prophase, the chromosomes are single. When paired, it is an end-to-end conjugation.

The highest number of bivalents found in this haploid is one, 6% of the cells studied. It is postulated that the chromosomes in the parents might differ structurally so that a mixture

of them in the haploid plant might hinder their pairing either inter-or intra-genomically.

There are diploid as well as polyploid cells present, beside the regular haploid cells (about 10% of the cells studied). Their chromosomes remain unpaired as in the regular haploid cell, except one. These polyploid cells are supposedly the result of fusion of the neighboring cells just prior to meiotic division.

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Explanation of the figures

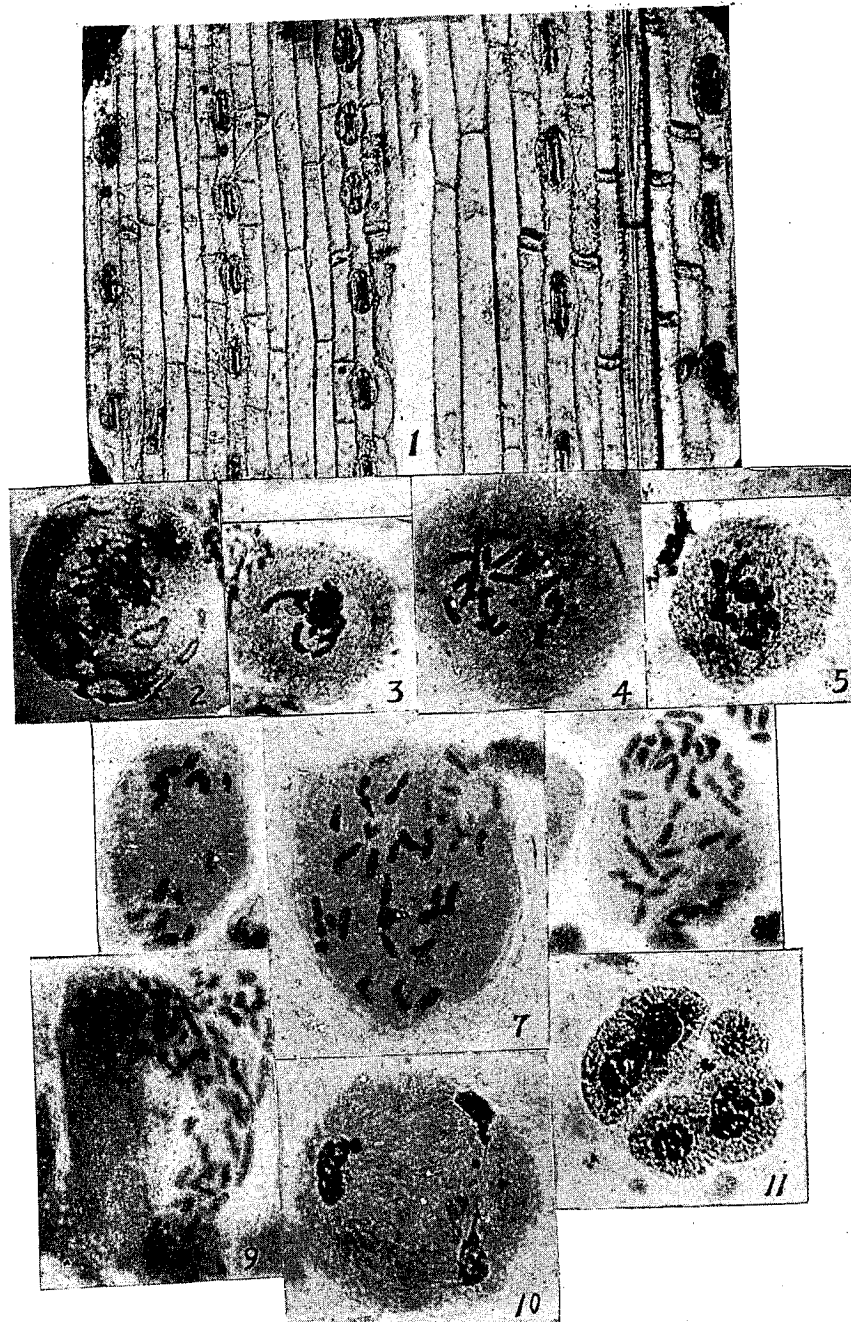
(Magnified 1330 times).

1. Diakinesis with two bivalents and 17 univalents.
2. Metaphase with one bivalent.
3. Curved spindle with split univalents.
4. Second metaphase more or less normal.
5. Second anaphase. The cell at the left has more chromosomes than that of the right.
6. Curved spindle with unsplit univalents.
7. Metaphase with an extra nucleus in a so-called dyad in second division.
8. A diploid cell with 42 univalents.
9. A triploid cell with 63 univalents.
10. A triploid cell with one tri-valent, 17 bivalents and 26 univalents.
11. Bivalents drawn separately to show the structure difference, and the satellite chromosome that is attached to the nucleolus.
12. The univalents in a cell drawn separately.

Explanation of the photomicrographs

(1. magnified 130 times, 2-10 inclusive 660 times.)

1. Stomata of the haploid plant at the left and that of the diploid plant at the right.
2. Leptotene.
3. Diplotene. Notice the end-to-end conjugation of the two chromosomes at the left.
4. Diakinesis.
5. Metaphase with the univalents lined up more or less on the equational plate.
6. Anaphase.
7. Same as Fig. 8.
8. Same as Fig. 9.
9. Polyploid cell with more than 100 chromosomes.
10. Telophase of a tripolar cell.
11. Quartet with poly- and micro-nuclei.



SOIL AND MAN IN WEST CHINA

H. L. RICHARDSON

The relationship between soil and man is a double-edged one: soil influences man, but man also influences soil—too often, alas, destructively. It might be difficult to particularise the extent to which the soil directly conditions or controls the men who live on it, but all are caught in the net of the same environment: the geography and climate, the geology and the vegetation, all influence the soil directly, and influence the men directly; and soil and man certainly interact on each other. In this paper an attempt will be made to trace out some of these relationships and interactions, as they may be observed in western China. It is not so much a research paper, as a "background" paper, and it is hoped that the information it contains may be of interest, and also of value, to other workers in those fascinating regions which are the subject of the Society's activities.

What follows is based in the first place on the writer's own observations, made during his journeys—amounting to many thousands of kilometres, by every kind of transport—for the National Agricultural Research Bureau, during the years 1937 to 1940. These observations have been supplemented by the collection of precise data whenever possible, and a study of the available literature. The provinces visited include Kansu, Shensi, Szechwan, Hupeh, Hunan, Yunnan, Kweichow and Kwangsi, as well as Tonkin in Indo-China; latitudes travelled range from tropical to temperate, and altitudes from sea level to about 4,000 metres (13,000 feet). Several years of often hasty travel cannot replace a lifetime's detailed study; and a generalised account is bound to suffer from exceptions; but the main outlines of the account that follows should be reliable, even if inaccuracies may be found in details.

Geography and Climate

Because of the dominating influence of topography on climate, and of both on soils and human activity, something must first be said about geographical factors in West China. Essentially the region consists of a series of plateaux, stepping down from west to east. But the land surface has been so deeply dissected by great rivers, and so ridged by ranges of mountains and hills, that the plateaux do not look much like those of the geography books when one travels across them. None the less, in spite of minor undulations, large areas are found to be at much the same level, only interrupted occasionally by deep valleys or high ranges. Using round figures, one may say that the plateau of Tibet and Sikang, in the far west,

averages 3,000 to 5,000 metres in altitude; then come the plateaux of Yunnan and of Kansu, around 2,000 m.; then Shensi and Kweichow, mostly around 1,000 m.; between these last lies the Red Basin of Szechwan, near to 500 m.; then to the east lie Honan, Hupeh, Hunan, and Kwangsi, each descending from high land in the west to near sea level in the alluvial plains of the big rivers. At the boundary or transition between any two of these natural regions, ranges of high mountains are often found.

Much of West China has not been accurately surveyed, and the altitudes which are shown, even on standard maps or in works of reference of recent date, are sometimes quite inaccurate and misleading. The altitude of Kweiyang, capital of Kweichow, for example, is sometimes given as 1500 or 2000 m., but it is actually only about 1100 m. During his journeys the writer has been to some pains to obtain the latest and most accurate information about the altitudes of places visited, and this information is incorporated in what follows.

Taking the relief in a little more detail, it may simplify things to follow the west-to-east succession along three parallels of latitude. In the north, latitude 36° N is a convenient one: beginning in Tsinghai, first comes the Tibetan plateau at around 4,000 m.; then follows the much dissected plateau of Kansu, with altitudes varying from 1500 to 2500 m. (Lanchow is 1550 m.) and towards the east of Kansu the Liupanshan or Lungshan range is crossed, this range being 2500 to 3000 m. high. The Shensi (loess) plateau which follows is a rather level plain of 1500 to 1000 m., cut by deep, narrow river valleys: and finally comes the Yellow River valley, here about 500 m. Beyond, the loess plateau is found again in Shansi, at about 1000 m., and this is bounded to the east by the Luliangshan range, rising to 2500 m.; beyond lies the low alluvial plain of the lower Yellow River basin.

For the centre of China, 31° N latitude is a convenient line to follow, 5° south of the last. Again we begin with the Tibetan plateau in Sikang, around 4,000 m., cut by deep, southward-flowing river valleys (those of the Salween, Mekong, Yangtze, Yalung, and their tributaries), with floors at about 2500 m. Then, on both sides of the Tung River, enormous mountain ranges rise to 5000 and 6000 m.; they have peaks capped with perpetual snow, giving rise to glaciers; a little to the south of our line they reach a climax in Minya Konka, 7,600 m. These ranges have been called the Szechwan Alps, although they mostly lie within the borders of present-day Sikang. The ranges intercept the moist, rain-bearing, air coming from the east, so that the rainfall is much lower to the west of them than to the east: for this reason, they have been called the "rainscreen mountains." Lower ranges, still with peaks of considerable height (Panlungshan, 4,000 m.; Chiu-

fengshan, 4000 to 6000 m.) lie to the east of the "snow mountains," and then quite suddenly comes the drop down to the Chengtu Plain and the Red Basin. Chengtu itself is about 450 m.; beyond the Plain the Lungchuan hills rise to about 1000 m.; and on latitude 31° the main floor of the Red Basin is close to 500 m., with a general tilt towards the south, and river valleys at a lower level. Chungking (low water river level) is 175 m. Towards the east, the Basin is crumpled into many parallel anticlinal ridges, with a NE-SW trend, having altitudes up to about 1000 m.; and then comes the eastern rim of the Red Basin, as extension of the Tapashan range, extremely rugged country with peaks from 1500 to 2500 m. This is deeply cleft by the Yangtze Gorges, close to our line of latitude; and beyond is the drop to the level, wide alluvial plain of the Lower Yangtze, in Hupeh Province, near to sea level.

For South China, one may go a further 5° southward and take 26° N Latitude. The Burma border lies along the divide between the Irrawaddy and the Salween rivers, a mountain range rising to 4,000 m. Further high ranges follow, with the tremendous valleys of the Salween and the Mekong, flowing southwards, between them; a part of the Upper Yangtze valley is also cut across by this latitude. The valley floors are low, 500 to 1000 m., while the ranges rise to 3000 and 4000 m., and even 6000 m. further north, near Likiang. The last of the high ranges (4000 m.) is that just west of Tali: then follows the Yunnan Plateau. This extends eastwards and southwards, a dissected and gently folded peneplain, with the tops around 2,000 to 2,500 m. on this latitude, and the valley and basin floors 100 to 500 m. lower. The whole system loses altitude towards the south, Kunming being 1893 m., and Kaiyuan (Amichow), 1059 m. Characteristic of the Yunnan plateau are the numerous small basins, usually several kilometres or tens of kilometres in length, consisting either of lake floors, more or less dried up, or of widened and flattened river valleys. Then come mountain ranges on the Yunnan-Kweichow border, rising to over 2500 m., which seem to be important as a climatic boundary. Kweichow is another dissected peneplain, cut by deep river valleys as well as minor erosion; it is tilted towards the east, the hill tops, representing the old peneplain, descending fairly regularly from about 2,000 m. in the west to 750 m. in the east, and the local, minor valleys lying 50 to 100 m. below the tops of the hills. The cultivated land of much of the centre of the Province is between 900 and 1200 m. altitude. The big river valleys which cut across the plateau lie several hundred metres below the peneplain level, their floors varying from about 300 to 1000 m. altitude in different localities. To the east come Hunan and northern Kwangsi, with, on this parallel of latitude, a rather irregular

topography of large hills and valleys, and an average altitude around 500 m.

Certain prominent features have been omitted in these latitudinal sections, notably the Tsinlingshan, the famous mountain range that runs almost exactly east and west, dividing North from Central and South China. This range marks many natural boundaries: between dry and moist climates, cold and mild winters, short and long growing seasons; between wheat and rice as main crops; and between frequent and infrequent droughts and famines. The range rises in the Tibetan plateau, and extends eastwards along latitude 34° N; it is mostly over 2,500 m., with peaks up to 4,000 m.; east of Shensi it gradually subsides into disconnected ranges of hills. North of the Tsinlingshan is the valley of the Wei river, a wide trough, with its floor at about 500 m.; south of the range is the similar, but narrower, valley of the Han river, with its floor at about the same altitude. Then comes the Tapashan range, 1500 to 3000 m., running ESE and forming the northern boundary of the Red Basin, as well as of Szechwan Province. The southern boundary of the Basin and the Province is a less clear-cut mountain range, or rather a tangle of high hills, 1500 to 2000 m. high, to the north of the Kweichow plateau. South of the Kweichow plateau lie hills and valleys of Kwangsi, notably the valleys of the Hungshui kiang and Yu kiang, branches of Canton's West River. Much of Kwangsi consists of undulating plains, altitude probably about 100 m., lying at the feet of remarkable, tooth-like limestone crags: the traditional mountains of Chinese paintings and gardens. There are also various higher ranges, of 1000 or 1500 metres.

This description will have driven home the outstanding feature of the topography of western China: its hilly and mountainous nature. In the whole of this region there is only one large, level, fertile alluvial plain comparable with the great fertile plains of the East: namely, the Chengtu Plain; and the area of this is a very small fraction of the area of the eastern plains.

The geological origins of these great natural features form a fascinating study, which is still, in spite of the fine work of the Chinese Geological Survey, only in its early stages. The positions of the mountain ranges have often been determined by enormous folding movements in the rocks of the earth's crust, or by intrusions of igneous rocks, or by both together; basins and river valleys have sometimes been formed by faulting and down-warping, at other times by the lines of the great fold mountains; some rivers have cut right across mountain ranges (like the Yangtze in its gorges); river capture has taken place—for example, it seems likely that the Upper Yangtze, which drains Tibet, once flowed southwards through Yunnan into the Red River of Indo-China, before it was

captured by the headwaters of a river flowing north-eastwards into the Red Basin. There is the problem of glaciation during the Quaternary Ice Age; it is most unlikely that there was ever a general ice-sheet over China, similar to those which covered northern Europe and the northern U.S.A. and Canada. But there may have been local centres of glaciation in the higher mountain masses; and some extension of the existing glaciers in Sikang. Geological factors are important in soil formation as well as in determining geographical features, but there is not space to go further into them here. A full account is available, for anyone who wants further information, in J. S. Lee's new book, "The Geology of China."

Corresponding with the topographic features already outlined are various types of climate. Essentially, China has a "monsoon climate": there is a wet summer, due to the warming up of the interior relative to the sea, which causes winds off the ocean; and a dry winter, due to the greater cooling of the interior than the sea in winter, which gives outward-flowing, cold winds from the interior. The wet summer monsoon is less sharply defined than in India, except perhaps in Yunnan, because of the influence of barometric depressions which cross China from west to east, and bring some rain during spring and autumn. However, the winter monsoon is very definite, especially in North China. It depends on a large high pressure system (an anticyclone) developed over Siberia and the Gobi Desert; from this, cold, dry winds flow out over north and east China. These winds consist of rather surprisingly shallow masses of air; according to Dr. Coching Chu (private communication) they do not usually extend more than 1500 m. above the surface at Nanking and thus they are easily deflected by such high ranges as the Tsinlingshan. This, and the diversion of rain-bearing winds from the south-east in the summer, explain the profound differences already referred to between China to the north and to the south of this range. Szechwan, with the double barrier against the northern winds of first the Tsinlingshan and then the Tapashan, and further with the Tapashan extending around the east of the Province, is completely insulated from the cold winds that sweep down over Nanking and even so far as Hongkong. Incidentally, much of what has been written about the climate of China in the past applies more to the east and north of the country than to the west and southwest. With regard to the southwest, in particular, various misconceptions appear in standard works. For example, Kweichow and Yunnan are sometimes lumped together in one climatic type; but in many respects of great importance to soil formation and agriculture these two provinces are quite different. In particular, Yunnan has a warm, dry, sunny winter, whereas Kweichow has a cold, moist, cloudy one. Irrigation is necessary to grow winter crops in central Yunnan,

whereas in Kweichow the moisture supply is sufficient but the cold causes slow ripening and late harvests.

The chief types of climate in western China, important for soil formation or their influence on human activity, are, briefly, as follows. In the far west, on the Tibetan plateau, the winters are long, extremely cold, and dry. (As Edgar pointed out, "Tibetan snows" are largely an effort of the imagination). The summers have some, but not much, rain, and the growing season is very short. The mean annual precipitation over much of the plateau is probably about 500 mm. (Batang, or Paan, has 560 mm.); rising towards the south and east with the increasing proximity to the sea (Tachienlu, or Kangting, has 960 mm.). In Kansu, winters are shorter and the growing season rather longer than in Tibet and Sikang, but otherwise conditions are rather similar; going north, there is progressively less precipitation until the Gobi Desert is reached. Lanchow has about 300 mm. annual precipitation, and farmers conserve water by spreading a "mulch" of pebbles on the fields. In Shensi, north of the Tsinlingshan, the climate resembles that of North China generally: cold, dry winters and summers of moderate to low rainfall (at Sian the mean annual precipitation is 500 mm.); there is a long growing season, and winter wheat, which cannot be grown on the Tibetan or Kansu plateau, is general in Shensi. In the Tsinlingshan themselves, and southwards through south Shensi, Szechwan, Hupeh, Hunan, Kweichow and Kwangsi, the climate is of another type. It is rather moist throughout the year, although certainly with a higher rainfall in summer than in winter; and winters are less cold, except on the mountain ranges. The total rainfall generally increases towards the south and east. Thus the mean annual precipitation in Hanchung (South Shensi) is 740 mm.; at Chengtu, Szechwan, 830 mm.; at Chungking, Szechwan, 1100 mm.; at Ichang, Hupeh, 1100 mm.; at Hankow, Hupeh, 1260 mm.; at Changsha, Hunan, 1400 mm.; at Kweiyang, Kweichow, 1200 mm.; at Kweilin, Kwangsi, 1900 mm.; and at Nanning, Kwangsi, 1300 mm. (These values are rounded off, because they usually refer to the means of only short periods of years, and the last figures are thus uncertain. Some are taken from Provincial records made available to the writer, and some from Buck's "Land Utilisation in China.") In this belt, temperatures vary with latitude and altitude in the normal fashion, so that Kweichow, being high, is cooler than either Szechwan (which, although to the north, is lower), or than Kwangsi, which is both lower and further south. Kwangsi, in fact, verges on the tropical in the south, and most of it outside the mountains might be called subtropical; Szechwan, on the other hand, like Hupeh and Hunan, may be described as having a warm-temperate climate; and Kweichow a temperate one. The chief crops

are winter wheat (except in southern Kwangsi) and summer rice.

Szechwan is rather remarkable, in view of its location in the middle of a continent, for avoiding continental extremes of climate. The summers are warm, but not so hot as, for example, those of Hankow; while winters are cool, but not so cold as Hankow or Nanking, or even Shanghai, on the sea coast. Frosts are rare and snow almost unknown within the Basin. This is due both to the protection afforded to the Basin by its encircling ranges, which fortunately are not high enough to cut off the rain-bearing winds; and to the roof of cloud which lies across the Basin for most of the year, protecting it like the roof of a glasshouse from excessive radiation.

Yunnan is quite separate from the rest of China in its climate; Central Yunnan has been said to have "Spring all the year"; and also to have "All the seasons in one day." This is a result of the relatively high altitude, which counteracts the effect of the rather low latitude, combined with the generally clear weather. It is sunny enough to be warm in the winter (at least during the day: nights are cold, with frosts at Kunming); and it is high enough to be mild in the summer. The annual temperature range is only about 12° C. at Kunming. The distribution of the rainfall seems to be more closely related to the monsoon of India and Burma than to the monsoon-plus-depressions of the rest of China; and doubtless much of the rain is derived from the Gulf of Burma rather than from the China Sea. As already said, the winters are very dry; so are the springs; and most of the rainfall falls in summer and autumn. At Kunming, the mean annual precipitation is 1100 mm., of which only 16% falls during winter and spring (December to May), and most of this falls in May and is rapidly evaporated because of the sunny weather and the low atmospheric pressure. Thus, although the precipitation is similar in amount to that of Szechwan, the climate, vegetation and soils are very different. Western and Southern Yunnan differ again from the centre of the Province, in lying at lower altitudes (apart from the mountain ranges), and having higher temperatures and heavier rainfalls. At Laokay, on the border between Yunnan and Tonkin, the mean annual precipitation is 1800 mm.; and on the Burma border probably a similar figure would be found. These regions are in every respect, as to vegetation, crops and diseases, tropical or subtropical. In the great valleys of western Yunnan, the vertical zonation of climate is especially marked, and there is a corresponding zonation of vegetation, cropping, soils, and even the races of man.

Soils of West China

The classification of soils, on any basis other than such simple properties as texture, offers difficulties greater than the classification of almost any other natural object. This is because of the indefinite nature of soil properties, and the absence of sharp distinctions either between one soil and another, or between top soil, subsoil, and parent material. In recent years a new science has grown up, concentrating on "the study of the soil as a natural object"; making a study of the classification, surveying, and chemical and physical properties of soils as such, with only indirect reference to the function of soils as the medium in which crops grow. This science, pedology, is the study of the surface materials of the earth's crust, just as geology is the study of the underlying rocks. (The name is not to be confused with "paedology", a word sometimes used for the study of children.) The results achieved by pedology, in making possible a rational classification of soils from all parts of the world, as well as in leading to an understanding of the processes of soil formation, have been such as to leave no doubt concerning the validity of the new science. Because the results, and the exact terminology, of pedology, may be unfamiliar to some readers, the genetic classification of soils, which is adopted in that science, will be outlined below. It is, in the first place, a morphological classification—that is to say, it is based on the appearance of the soil as studied in the field, the unit of study being the "soil profile," the whole depth of soil and subsoil down to the limit of changes due to geologically recent weathering. From a study of the profile and the environment of the soil, with assistance from chemical and physical analyses, the history and mode of formation of the soil are inferred. It is then possible to classify it in one of various groups which have a genetic basis, that is, each of which has been formed under rather similar conditions of climate, drainage, vegetation, and so on. This rather involved method has proved to be the best, and indeed the only satisfactory method, for comparing and showing the relationships of soils from different parts of the world, although simpler bases of classification are often used to distinguish the soils in a local survey. Even here, however, the whole profile and not the surface soil alone is taken for study.

The most important single factor of the soil environment, in the genetic classification, is the climate. This is easily seen when one considers how widely the soils of the wet tropics differ from those of cool temperate regions, or the soils of grassy steppes differ from those of desert conditions. Such differences over-ride the effects of the rock or parent material from which the soils were formed, not to mention the texture (sandiness, clayeyness, or "lightness" and "heaviness") of the

soil itself. Parent material and texture are also very important, especially in local surveys, but in the second degree. Vegetation is also considered a fundamental factor in soil formation (as one may see by comparing, for example, forest, steppe, and long-cultivated soils), but vegetation is so much influenced by climate that it is difficult to separate them. Topography likewise plays a great part, not only because of its influence on climate, but directly, in controlling such factors as the rate of erosion from a slope, the rate of drainage, or the presence of waterlogging. Animal activity also has to be considered, especially the activity of burrowing animals such as earthworms and steppe rodents; man is likewise a soil-forming animal as well as a soil-destroying one, notably in the production of rice-paddy soils.

On this basis, it has proved possible to subdivide soils into great classes—"world groups", or "great soil groups"—many of which, called "zonal," correspond approximately with the chief climatic zones: others, "azonal," and "intrazonal," are dominated by local conditions of topography, drainage, or parent material, and may occur in various climatic zones. The great advantage of this classification is that the soils of different countries, of remote parts of the world, may be included in one system; its disadvantage is that long experience is sometimes necessary before workers can be sure about the allocation of certain soils to their correct groups. This is because of the lack of sharp distinctions between different but adjoining groups, and the overlapping that occurs in the actual distribution of the groups. Further, since the soils of the world are still imperfectly known, the present classification is only provisional, and subject to revision with further study.

None the less, the soils of most of the continents have now been classified and mapped on the genetic system; and in China, for example, an American pedologist, Thorp, with his Chinese colleagues, was able to classify the soils into broad groups, most of which had originally been identified and named in quite other parts of the world by pedologists of many nationalities; while an English soil worker, coming later, could verify and confirm Thorp's classification in all but minor details. This indicates the broad scope and general reliability of the system. The description of the soils of West China which is given in the present paper is based in the first place on the pioneer work of Thorp and the Chinese Soil Survey; only somewhat modified by the present writer where he visited localities that Thorp did not reach, or where he was possibly more familiar with some particular type of soil.

It is not possible here to go into detail about the processes by which different soil groups are formed, or the properties

by which they are identified, although these things have a considerable bearing on the value and utilisation of the soils. Anyone interested should consult Thorp's "Geography of the Soils of China," or such standard works on soil science as those of E. J. Russell ("Soil Conditions and Plant Growth") or G. W. Robinson. There are two major divisions: (a) *pedocals*, soils formed under relatively dry climatic conditions, in which calcium and sometimes other soluble salts tend to accumulate in the soil profile, because of the evaporation and upward movement of the ground water; (b) *pedalfers*, soils formed under moist climatic conditions, in which leaching and the downward movement of the soil water are dominant, and calcium and all soluble salts, are washed out of the profile. Aluminium and iron often tend to accumulate in some part of the pedalfers profile, because of the more rapid removal of other components. Within these divisions, subdivisions related to the natural drainage of the soil (whether or not the soil is constantly or frequently waterlogged), and then to other properties such as the colour and completeness of development of the profile, the amount and distribution of humus, iron, etc., or the nature of the parent material, are made use of, to give the great soil groups. In general, the amount of humus decreases, and the colour of the soil becomes brighter, as climatic conditions become warmer. It may be noted here that the names of great soil groups are frequently given in terms of colour; it has then to be understood that the colour term is used in a special sense; it generally, but not always, agrees with the popular name of the soil. Thus, most red soils are also Red Earths to the pedologist; but the special group of red soils found over limestone around the Mediterranean differs from other Red Earths, and is known as Terra Rossa (the local popular name); while the purplish-red soils of Szechwan and parts of Yunnan owe their colour to the parent rock, not to the weathering process, and they are entirely different in their properties from the true Red Earths: they are known as Purple-brown Soils. The red soils of Devon, in England, similarly owe their colour to the parent rock (Old and Young Red Sandstones), and they are not Red Earths. Again, Yellow Earths are a special group formed under rather warm, moist, climatic conditions similar to those of Szechwan; the yellow soils of North China (*huang tu*), often called "yellow earth" by popular writers, are entirely different pedologically, being closely related to the Chestnut Earths of South Russia.

The chief of the world soil groups found in West China are shown in the table below, the zonal soils (free drainage) being arranged in descending order according to the increasing mean annual temperature under which they are formed, within the two main divisions.

Great Soil Groups of West China.

(a) PEDOCALS.

FREE DRAINAGE:

Chernozem (Black Earth): sooty black in colour.

Chestnut Earth: the colour of the Spanish chestnut, not horse-chestnut.

Light (and Very Light) *Chestnut Earth*: greyish yellow; the *huang tu* or "loess soil" of North China.

Grey (and Yellow-grey) *Desert Soil*.

IMPEDED DRAINAGE:

Solonchak (White alkali): salty or saline soil.

Solonetz (Black alkali).

Shachiang Soil: with abundant calcareous concretions.

(b) PEDALFERS.

FREE DRAINAGE:

Podzol and *Podzolised Soil*: ashy grey at or just below the surface.

Brown Earth (Gray-brown Podzolic Soil);

Shantung Brownsoil
Purple-brown Soil.

Yellow Earth.

Red Earth: more or less podzolised Old and Young Red Earths.

Lateritic Soil: very rich in iron and aluminium, red-mottled.

IMPEDED DRAINAGE:

Peat Soil.

Mountain Meadow Soil.

Groundwater Podzol: old rice-paddy soils.

(c) UNDEVELOPED OR SPECIAL GROUPS.

Alluvial Soil (non-calcareous)

Calcareous Alluvial Soil.

Recalcified Paddy Soil (heavily limed).

Rendzina (black soil over, or mixed with limestone).

Rocky, or *Skeletal*, *Mountain Soil*.

(Note: the soil groups shown under (c) might be placed in either (a) or (b), according to whether or not the profile happened to be fairly rich in lime; on the whole it seemed better to group them separately.)

When it comes to mapping the distribution of the great soil groups in China, one meets difficulties because of the complex occurrence of various groups in a single region, and because of the existence of transitional regions where many of the soils are intermediate in properties between two of the

groups. Thus in Kweichow and other parts of West China one finds orange-coloured soils which are apparently transitional between yellow and red earths. Some groups, such as alluvial soils alongside rivers, and the *rendzinas* which occur in small patches over certain types of limestone, are found in individual areas too small to show on a small-scale map, although they may be of considerable local importance. Further, much of West China has not yet been accurately surveyed, even for topography or geology, let alone for soils. Detailed surveys of certain areas, and reconnaissance surveys of others, are steadily being pushed on by the Chinese Soil Survey; but at present the data are lacking for an accurate map, and only generalised mapping can be attempted for West China as a whole. The writer has prepared such a map for the soils of West China, based on Thorp's map with some modifications; but when reduced to a small scale it would show little difference from Thorp's map, which has already been published both in his "Geography of the Soils of China" and in Buck's "Land Utilisation in China" (Atlas volume). Consequently, it does not seem necessary to reproduce the writer's map here; instead, some comments will be made on the general distribution of the great soil groups.

The dividing line between pedocals and pedalferers in West China falls along the Tsinlingshan range, whose importance as an east-west climatic boundary has already been noted. Under the lower rainfall to the north, the soils are calcareous, sometimes even salty, and more or less alkaline in reaction. With the higher rainfall to the south, soils lack lime unless they are derived from calcareous parent materials, and they are neutral or acid in reaction except when they have been heavily limed by the farmers. Along with the heavier leaching of the pedalferers goes a greater tendency to be deficient in plant foods: soils of the south are, with certain exceptions, intrinsically less fertile than those of the north, and need manuring more. To the north, water supply is the chief limiting factor for crop production; to the south, plant food supply is the chief limiting factor. Possibly some of the soils of the Tibetan plateau, to the west of the rain-screen mountains, also belong to the pedalfer divisions: especially the soils of the rolling grasslands. Here, temperature would be the chief limiting factor for growth.

Taking the individual soil groups in turn, as they are listed in the Table: the largest areas of Chernozems, more or less completely developed, are found in far North, in Manchuria and Mongolia, and when one comes further south, into China's "Northwest", they only occur at high elevations (as on the Liupanshan), where the climate is cold and the precipitation is moderately high, allowing humus both to form and to accumulate in the soil. In similar localities at slightly lower

altitudes or where the precipitation is lower, chestnut earths are found. Both types of soil probably occur under the grasslands in the far north-west of Szechwan Province, beyond Sungpan, and very likely they are widely distributed in Sikang and Tibet. The next group, light and very light chestnut earths (often with rather undeveloped profiles, because of either erosion or loess deposition, depending on the topography), is the chief one in the drier or warmer loess regions of the North-west (Kansu and Shensi, as well as parts of Shansi). Towards the north and further north-west it grades into the grey, and yellow-grey, desert soil, found on both mountain and plateau where the precipitation is very low.

In valley bottoms close to the river level, and in low lands in the deserts, salty soils (solonchaks) are fairly common throughout the north-west, becoming more noticeable as the precipitation decreases. Throughout the dry winter, these soils are conspicuous because of their salt incrustations; during the growing season, their low fertility and the failure of many crops makes them evident. The ground-water throughout this region is salty, and wherever it comes close to the surface the salts are likely to be concentrated in the soil by evaporation. There is some danger of the trouble spreading with irrigation, unless deep drains are put in to keep down the level of the ground water. Black alkali soils (solonetz), which are much more difficult to reclaim than the solonchak, are fortunately rather rare, although they occur in the Salachi irrigation project. The shachiang ("sand ginger") soils, which contain such an abundance of calcareous concretions as to be gravelly in nature, are found chiefly to the east of the area being considered, i.e. in the lower Yellow River plain, where the rainfall is great enough to prevent the concentration of soluble salts, but calcium carbonate is deposited from the ground water where it comes near the surface.

Turning to the division of pedalfer soils, true podzols and podzolised soils of the "northern" type, such as are found in northern Europe and America, are rare in west China. In the north the rainfall is too low for their formation; they might, perhaps, be expected at high altitudes in the mountain ranges of the Tsinlingshan and further south, but in the writer's experience soils of the brown earth and the mountain meadow type, without clear profile development, are here more common. (Podzolised soils are characterised by a layer, or "horizon", of dark, humus-rich material at the surface, and below this comes a distinctive ashy-grey, leached, horizon; humus, iron, and other compounds have been washed out of this horizon and they are usually found deposited immediately below, often as concretions or hard-pan. This leaching process is so typical of podzolisation that other leached soils, such as the brown earths, are sometimes called podzolic although they do not show the ashy-grey horizon.) Quite another kind

of podzolised soils, those formed over red earths, is common in south China: these will be further considered along with the red earths.

The brown earths are a large and comprehensive group of soils, including such narrower groups as the brown forest soils of Europe, the gray-brown podzolic soils of America, and the Shantung brownsoils of China. They are typically formed under moderately heavy rainfall and moderately cool climates, and they are widespread in west China, in the mountainous regions. The soils of the Tsinlingshan, the Tapashan, and the western ranges of Szechwan, largely belong to this group, as well as local occurrences on the highest of the mountains further south. The Shantung brownsoils, a special sub-group formed under rather lower precipitation, occur to a limited extent in our region, along the eastern borders of Shansi and western Honan. The purplish red, grey, or brown soils of the "Red Basin" of Szechwan form a related group, that of purple-brown (forest) soils, in Thorp's nomenclature. The softness, ready weathering, and high base content, of the parent rocks (clay-shales and sandstones) has here prevented the development of the leached yellow earth profile which would otherwise be expected. Similar but not identical purple-brown soils are found scattered through Yunnan, Sikang (Sichang area), Kweichow, Hunan and Hupeh.

Where the climate is moist for most or all of the year, but the temperature is rather higher than that at which brown earths are formed, humus is decomposed too rapidly to darken the profile below the top soil, and then yellow earths are formed. These soils are found in and around the Szechwan Basin, wherever the temperature is high enough (below the brown earths in the mountain ranges), and the parent materials are suitable, as in the anticlinal ranges and on the Pleistocene river terrace and low plateau deposits. The Chengtu Clay, a weathered loess deposit found east and north of Chengtu, west of Mienyang, and in other localities, and fully discussed by Thorp and Dye, gives rise to soils of the yellow earth type. (After it was first laid down, however, the original loess was very likely to have been covered by a chestnut earth.) Yellow earths are also general in Kweichow, and in the mountainous parts of Kwangsi, although frequently the soils show an orange tint suggesting the transition to the red earths.

Red earths are produced where the mean temperature is rather higher than that which gives yellow earths, especially where, in spite of a fairly high annual rainfall, there is a pronounced dry season. Under these conditions reddish dehydrated iron compounds are formed instead of the yellowish hydrated compounds that give their colour to the yellow earths; and humus is so rapidly destroyed that it does not darken the profile, at least below the top soil. Red earths are common

throughout south and south-west China, usually at lower altitudes although they are also found at quite high altitudes in Yunnan, where the sunny climate and the long, dry season seem to aid their formation. Their detailed classification is complicated by the fact that during one of the inter-glacial periods of the Pleistocene age, central and south China was subjected to a climate probably warmer and moister than at present, and red earths were then widely formed, even so far north as in northern Szechwan. Other climates and soil-forming processes followed, and finally at the present day has come a partial return to the formation of red earths again. Erosion has removed varying amounts of both the old and the new red earths, and has caused a varying degree of intermingling of the two profiles. Further, under some but not all conditions in south China, most of the iron in the upper layers of the soil has been washed down into the subsoil, giving a podzolised red earth, with a bleached, creamy-white upper horizon overlying a red, usually mottled, lower horizon. Parent material is also an important factor, the reddest and deepest of the red earths being usually found over limestone, where the topography is such as to have permitted long-continued weathering. These differences are important in any detailed survey, but for present purposes all these soils may be taken together, simply as red earths. When the process by which red earths are formed has gone on for very long periods, or under more tropical conditions than those of south China, material known as laterite is formed: this is richer in iron and aluminium oxides than in silica, and has the property of hardening into a brick-like mass when exposed to air. There is little, if any, true laterite in China, but some of the red earths have properties, chemical and physical, approaching laterite, and these have been included in the table above as "lateritic soils." They are found scattered among the other red earths.

With regard to the soils of impeded drainage, true peat is rarely, if at all, found in China at ordinary altitudes. The climate is probably too warm to allow such large amounts of organic matter to accumulate. The writer has seen an old peat, buried under more recent lake deposits, at Weining, Kweichow, and he has been informed that swampy or marshy localities occur on the Tibetan plateau where peat is probably to be found. He has seen beds of sphagnum moss, and shallow peaty soils, at high altitudes in the mountains of western Szechwan. More common in these last localities are mountain meadow soils, with a dark, humus-rich upper horizon containing some mineral soil, and thus not a true peat. The other group of groundwater soils are formed under very different conditions, as a result of wet conditions artificially maintained: namely, the paddy soils. There is some discussion about the exact classification of these soils, especially since they vary so much according to parent material, stage of

development, and the influence of cultural treatments, particularly liming. Possibly the paddy soils should form an entirely separate group, but they are closely related, when fully developed, to the groundwater podzols. Under the constantly wet conditions, both reduction and leaching of iron take place, leaving a pale coloured surface or sub-surface horizon. They are found, of course, wherever rice is cultivated, in valleys and on terraced hillsides south of the Tsinlingshan.

Among the other groups listed, the alluvial soils are the most important; they are found chiefly in eastern China, and only locally in the west. North of the Tsinlingshan, the alluvium, derived chiefly from the loess, is calcareous; while to the south it is mostly either acid or neutral. The alluvium of the Chengtu Plain, the largest single area, is slightly alkaline when freshly deposited, but tends to turn acid under rice cultivation. The local belts of alluvium that occur alongside the rivers of the south and west and in the Yunnan basins vary greatly in composition, and in fertility, according to the river, and the materials from which they have been derived. Those of the Red Basin are probably the most fertile; those of the rivers north of the Tsinlingshan are also very fertile unless they become salty.

The recalcified paddy soils might formally be grouped with the pedocals, since they have lime in the profile; but they are, of course, formed under entirely different conditions from the true pedocals, by the farmers liming the rice fields so heavily that lime actually accumulates and gives the profile an alkaline reaction. They are found in some localities, particularly in Kwangsi, where it is the local custom to use such large amounts of lime. Possibly the lime, which is dusted on the growing rice, has some extra value in helping to control the attack of rice borer or other pests. Rendzinas are a special group of soils, found in many parts of the world, in which a top soil rich in both humus and lime occurs over limestone or chalk. Their production in China seems to require either a rather soft form of limestone, or a very fragmentary one; they are usually found on the sides of hills, where presumably gravity and soil creep assist in keeping a certain amount of calcareous material mixed up with the top soil. They are widely spread among the limestone hills of Kwangsi and Kweichow, and the writer has also seen them over the Sinian limestone on the slopes of Mount Omei; but their actual occurrence is always very local, among brown, yellow, or red earths. In the last locality mentioned, they, perhaps, grade into the group of "rocky mountain soils;" soils in which erosion, and soil creep, have proceeded so vigorously, that no true profile of fully weathered material has a chance to develop. Such soils are also known as "skeletal," from the amount of rocky, or skeletal, material which is present. They may be

found on steep, and especially on cultivated, mountainsides throughout west China, and probably the rocky or shaly soils mentioned by travellers in Sikang and Tibet belong to this class.

Implicit in the foregoing description, but worth mentioning separately, is the vertical zonation of soils which is very clearly developed in west China. As one climbs a mountain, and the climate grows progressively colder, one passes through a succession of soils similar to that which would be met with on going northward through a succession of climatic zones. Beginning in a red earth zone, and either going northwards or climbing to greater altitudes, one meets first yellow earths, then brown earths; and, on a high mountain, there follow podzolised or mountain meadow soils corresponding with the podzolic and meadow soils of high latitudes. (This assumes that the rainfall also increases, or undergoes no great decrease.)

A similar vertical zonation of vegetation also occurs, the soil group and the vegetation going together in this, as in other ways. This is so important in relation to the utilisation and productivity of the land that it is worth showing in detail; one may take the zonation in west China at about latitude 30°N, the vegetation zones being substantially those of Wilson ("A Naturalist in West China"):

Altitude (metres)	Climate	Soil	Typical Crops and Natural Vegetation.
200-750	Warm temperate	Yellow earth, alluvial and purple-brown.	Rice, maize, sweet potatoes, soybeans, sugar cane, cotton, winter cereals; tall bamboos, palms, cypress, alder, pine; citrus, mulberry.
750-1500	Temperate	Yellow earth, purple-brown.	Maize, rice, soybeans, winter cereals, Irish potatoes; pomaceous fruits, tea; "Evergreen rain forest", <i>Cunninghamia</i> , ferns, pine.
1500-3000	Cool temperate	Brown earth	No rice, some maize up to 2500m; wheat, oats, Irish potato; less cultivation than forest and scrub; deciduous trees resembling N. America and Europe; <i>Abies</i> , scrub bamboo, rhodendrons.
3000-3500	Sub-alpine	Brown earth, mountain meadow.	Wheat, barley, Irish potatoes; transitional, moorland, meadow, scrub; dwarf bamboo, flowering shrubs (esp. rhodendrons) and herbs, grasses, mosses; some spruce, fir and larch forests.

3500-4800	Alpine	Mountain meadow, peat; black and chestnut earth.	Wheat and barley (limit about 3600m.); tree limit about the same; flowering herbs and grasses dominant; moss in wet localities.
4800-5200	High alpine	Skeletal and desert.	Glaciers, moraines, alpine deserts; herbs and cushion plants up to about 5000m.; mosses and lichens.
Over 5200	Perpetual snow.	—	—

(Note: it seems better to use the name "alpine" than "tundra" for the highest zones, because the tundra of the arctic is a zone of perpetually frozen subsoil, with entirely different soil and vegetation conditions from those of the high mountains.)

It may be mentioned here that the writer's observations in China suggest that, very roughly, the following simple relationship exists between altitude and latitude, with regard to their effects on climate, soils, vegetation, and crops: namely, one metre of altitude is equivalent to one kilometre of latitude. Or, for larger units, one degree of latitude equals 100 metres of altitude. It is not pretended that these relationships are at all exact, but in any case so many extraneous factors besides temperature, such as rainfall, cloudiness, wind, and aspect, may influence the climatic relationship between latitude and altitude, that more exact values would be difficult to obtain and probably only of local application. The relationship given is easily remembered, and gives at least a guide to what may be expected. Thus, for illustration, if a zonal soil is found, or a fruit thrives, or a crop is at a certain stage of maturity on a certain date, in one locality, then 500 km. to the southwards similar conditions might be looked for at 500 m. greater altitude.

So much for soils in general. In relation to mankind, the most important aspect of soils is their fertility, or productivity. (The two words are sometimes taken as being equivalent; sometimes fertility is defined as the inherent plant food supply of a soil, which might be limited in practice by other factors such as water supply; while productivity is taken to refer to the actual ability of a soil to produce crops in the locality where it occurs. What we are interested in here is the productivity, in the latter sense, but the word fertility is so generally used to mean the same thing that it will be employed in what follows, as being a less cumbersome word.)

Fairly clear relationships exist between the various great soils groups and the fertility of the soil—a result which emphasises the practical value of the genetic classification. Of

fully developed soil types, the inherent fertility is higher in the pedocals than in the pedalfers, because much of the original content of available plant foods, as well as the lime, has been washed out of the latter soils by the leaching process. But the fertility of the pedocals may be limited by a deficiency of water, whereas water shortage (except during rare dry seasons) is not so likely to affect the pedalfers. Put in another way, water supply is the chief limiting factor for crop growth in pedocal soils; plant food supply is the chief limiting factor in pedalfers. (Occasional exceptions occur: an extreme deficiency of phosphorus in the parent rock gives soils limited by phosphate supply, in some dry regions of the world; and in moist regions with a very seasonal rainfall, crop growth may be limited by water supply during the dry seasons, as in central Yunnan). As a corollary, fertilisers and manures (especially the mineral fertilisers, namely phosphate and potash) are likely to be more effective with pedalfers than with pedocals, and only the pedalfers are likely to need liming. The irrigation of dryland crops may be the best means of increasing production with pedocals.

Among the pedalfers, certain, usually relatively undeveloped, soil types are more fertile than the average: these include the alluvial soils (rich in plant foods brought down by the floods, and often washed away from other surface soils higher up the river); the purple-brown soils of Szechwan (derived from parent material well supplied with readily available nutrients); and the rendzinas, in which leaching has been checked by the presence of lime in the profile, and the abundant humus is also a source of plant foods. Among the pedocals, alluvial soils are also usually especially productive, because of their good water supply; they may, however, suffer from salt accumulations or alkali formation, which can render them completely infertile.

Topography also shows a relation to productivity: steep hillsides—mountains and the sides of great valleys—tend to be of low fertility because of the rapid removal of the fertile top soil by erosion; contrariwise, valleys, plains and basins tend to be of high productivity, because they collect some of the fertile soils washed off the hills. The high fertility of paddy land is partly due to this cause, as well as to the abundant water supply and often to heavy manuring.

In south China, as in rice-growing regions generally, a complication arises from the fact that paddy rice gives higher yields of food per unit of land than any of the dryland crops as usually grown. As a consequence, popular and official usage may describe one region as having more fertile soils than another, when actually it has similar soils but a higher proportion of paddy land. It is usually found that if a region is spoken of as being an especially fertile one, it will prove to

be a region which has a particularly high proportion of rice land, usually as the result of favourable topographic conditions or abundant water supply, and not necessarily a region in which the (dryland) soils are of unusually high fertility.

This illustrates how productivity depends on the crops grown, as well as on other factors already mentioned. Over such a wide range of conditions as those of west China, one has also to take into account the length of the growing season, and whether the climate is such that one, two, or more successive crops can be grown in the year. Thus the chernozems, found at high altitudes where winter cropping is not possible, may be less productive than, say, a Szechwan yellow earth, although inherently, with their high humus and plant food content, and good structure, chernozems are among the most fertile soils in the world; and the leached, acid, yellow earths are naturally infertile.

It would be interesting to take the great soil groups in turn, and indicate their relative fertility or productivity. But to do this with any precision requires more data than are yet available; and the complications indicated in the preceding paragraphs make *a priori* generalisation difficult. It is hoped that the Soil Fertility Investigation being carried out by the National Agricultural Research Bureau, according to the writer's proposals, will give information that can be used for this purpose. Another important aspect of soil fertility, which is particularly evident in west China, is fertility migration. On the largest scale, one has the erosion of the top soils from the hilly country of west China, and the river transport and deposition of the material on the great alluvial plains of the east. Thus the high productivity of east China has been obtained at the expense of the west. On a small scale, similar fertility migration goes on, as already mentioned, on every hill and valley. Another type of the migration is that which enriches the soils near towns at the expense of the land further away. Food is incessantly being brought in from the country to the town, as it has been for millenia in China. The residues of this food, rich in plant nutrients, are then (in China) collected and returned to the soil: but they are not taken away from the town to so great a distance as that from which much of the food was derived. Thus the soils around a town grow steadily richer, but beyond this ring of high fertility the soils tend to become more and more exhausted, unless they are enriched by alluvial deposits or special measures are taken in the way of manuring.

Population.

The relations existing between soil and man in west China can well be approached by way of the population and its distribution. First, one may compare the mean population density

of Provinces in west China with some of those in the east, taking the data from C.G. Fuson's "New Geography of China" (1933). Population per square mile, west China: Ninghsia, 12; Tsinghai 3.6; Kansu 49; Shensi 154; Shansi 207; Sikang 18; Szechwan 476; Hupeh 477; Yunnan 88; Kweichow 164; Hunan 333; Kwangsi 167. East China: Hopei 651; Shantung 553; Honan 456; Anhwei 400; Kiangsu 845; Kiangsi 343; Fukien 362; Kwangtung 320. Shansi, Hupeh and Hunan should, perhaps, be reckoned in central China rather than west China; apart from them, Szechwan is the only Province in west China with a population density over 200 per square mile; whereas all the eastern Provinces, even the mountainous ones like Fukien, are well over this figure. The great contrast, in general, between the high population densities of the east and centre, and the low densities of the west, is evident. Since, everywhere in China, the population presses heavily on the limit set by the means of subsistence, the general inference as to the greater productivity of the soils of the east and centre, over those of the west, is clear, Szechwan being the only exception. Food imports along the coast do occur, but not enough to modify seriously the general relationship.

This comparison by Provinces is, however, a very crude one: for example, in Szechwan, most of the population is located within the Red Basin, where the density is probably twice the figure given above, and the density in the mountains surrounding the Basin is correspondingly low. On the Chengtu Plain, on the other hand, the population density (Cressey) is over 2150 per square mile.

A more detailed picture of the occurrence of population in west China is given by Cressey's population map ("China's Geographic Foundations"), which is reproduced also in Thorp's "Geography of the Soils of China," so it need not be shown here. In this map it can be seen how the population tends to be concentrated in the great valleys and alluvial plains, and, apart from these, in the Red Basin of Szechwan. The writer prepared a copy of this map on tracing paper and superimposed it on his map of the soils of western China: there was a clear correspondence of heavy population with the great soil groups of alluvial and purple-brown (Szechwan) soils. The other groups, light chestnut earths, yellow earths, and red earths, had much lower populations; and chernozems, chestnut earths, and brown earths had the lowest population densities of all, except, of course, desert soils.

In west China even more than in the east, there is practically no long-distance transportation of food, and the population density almost exactly coincides with the fertility, or more strictly the productivity of the soils. If detailed figures were available, one might take population density as an index to the fertility of the great soil groups! This depends, of course,

on the absence both of transport and of farm mechanisation. The result is a very different picture from that in, say, the U.S.A., where some of the most productive soils have among the lowest populations, because large areas are farmed mechanically by a few people, and the food produced is transhipped to industrial regions elsewhere, where the population may be high although the soils are infertile.

The distribution of different races, as well as that of population as a whole, shows some relation to soil type. The Chinese (*Han jen*) have most of the good, productive, soils, and of course, have spread also onto the less productive soil groups; the Mongols, Tibetans, and tribes-people have been left with the poor soils of the mountains and the high plateaux. The Chinese people are fundamentally cultivators: they prefer, and can make the most of, good, level soils and those, like the Szechwan purple-brown soil, which do not suffer too much from continual slope cultivation. Here they can squeeze out other races. But on steep hillsides, or in regions of forest and grassland, the Chinese farmers are less successful, and the native inhabitants are able to compete with them successfully in such localities. In parts of Kweichow, for example, the Miao tribespeople have retreated to the highest, steepest, hillsides, and here they carry on cultivation with the greatest diligence, constructing small terraces for dryland crops, almost like steps, all the way up the mountain sides. Chinese cultivators in similar situations are often less careful and thorough about making and maintaining the terraces; as a consequence, they set up severe erosion, and then have to abandon the land. In Sikang and Tibet, the Tibetans, Nosu and other tribespeople have flocks of animals and graze the local grasslands; this is also done by Mongols and Moslems in the north-west; where the climatic conditions are severe, it seems unlikely that Chinese settlers will make much headway in these regions unless they, too, pay more attention to animal husbandry and pasturing, less to crop cultivation. In western Yunnan, a vertical zonation of races is reported, corresponding with the vertical zonation of climate and soils: at low levels, below about 1200 m., the Shan people predominate, malaria being too severe for the Chinese; Chinese are found chiefly at moderate altitudes; and near the tops of the mountains are various, isolated, tribes. These zones would correspond roughly with the tropical red earths, yellow earths (and red earths over limestone), and brown earths respectively.

It is noteworthy that, outside the valley, plain, and basin areas, less than 10% of the land of west China is cultivated; the remainder is under coarse grass, scrub, or forest. To those accustomed to the intense and close cultivation of eastern China, it may seem almost unimaginable that out in the west 90% of the land is uncultivated, outside certain favoured

localities. The problems of agriculture, and their solution, have to be envisaged in entirely new terms in western China. Many of the things which are not done, or are said to be impossible, in agriculture in the east, are already being done, and are capable of great extension, in the west. Dairy farming is an example. (It may be mentioned that in spite of the dislike which most Chinese people profess for cheese, more than one kind of cheese is made, and eaten, by the farmers in certain localities in Yunnan).

But great caution is also necessary. The existence of these immense areas of uncultivated land has suggested to many that there must be a fine field in the west for resettlement and the disposal of some of the surplus population of the east. Actually this is not so, at least with present methods of land utilisation and the traditional Chinese pattern of cultivation. China has already reached the stage where almost all the land which should be cultivated is being cultivated, and much is already being cultivated which should not. The chief exceptions known to the writer are some relatively small valleys and basins in the north-west and south-west, notably those in Yunnan, where irrigation would extend the cultivable area of level ground. Also, it is possible that some localities in the far west and southwest of Yunnan could carry heavier populations if malaria and the mosquitoes which carry the disease could be brought under control. But on the whole, if the agricultural population of western China is to be increased, it will have to be done gradually, through improved agricultural methods such as the use of fertilisers and the terracing of sloping land, for both rice and dryland crops. If large numbers of settlers are brought in and put down haphazard wherever there happens to be unoccupied land, without especial training along improved lines, it is only too likely that accelerated erosion, famine, and failure will be the result. Where land is unoccupied or only lightly populated in west China (as in the rest of the country), there is usually a good reason for it. After all, the population of the whole of Szechwan was reduced to probably under a million during the wars at the end of the Ming dynasty (seventeenth century), but the Province was repopulated rapidly enough wherever the soils were fertile. It is because of infertile soils or unfavourable topography or climate that much of west China is still lightly populated, and these natural obstacles are not lightly to be overcome.

As it is, when one travels in western China one often sees abandoned hillsides, showing the marks of previous cultivation, sometimes crude terracing, generally sheet or gully erosion—now growing grass or scrub. These are places where the population was once higher than it is now, but the land could not sustain the greater numbers. Sometimes the abandon-

ment may have been due to banditry (itself often the result of an inability to get enough from the land); but more often it was the result of a famine, nature's way of dealing with overpopulation, or simply of the soil having become so impoverished by erosion accelerated by cultivation that it was no longer worth farming.

Soil Erosion.

Accelerated erosion (not the normal, slow erosion of geology) is the greatest problem of west China. From the point of view of an observer on Mars, the Earth must look something like a big, green-and-blue, pumelo attacked by plant lice: some pest creeps over it, destroying the green coating of vegetation and eating away the soil underneath. For soil erosion is the inevitable penalty man pays for cultivating the soil—it acts everywhere except on the alluvial plains, and these may suffer from floods or droughts consequent on erosion elsewhere. The acceleration of erosion is less severe in some regions than in others: it is not so bad in continuously moist regions, where rain falls in frequent light showers throughout the year, and the natural vegetation rapidly colonises any exposed soil (as in Britain); it may be devastating where the rainfall is seasonal, especially if there are long, dry periods which check vegetative growth, and where the rain is liable to fall in torrential storms. Thus the tropics and all monsoon regions, and semi-arid localities, suffer badly. There is not space here to discuss soil erosion at length: wind erosion (dust and sand storms) as well as water erosion can occur; the effects may take the form of sheet (surface) or gully erosion; along with the accelerated runoff, and decreased percolation of the rainwater, which accompany erosion, goes a lowering of the groundwater level in dry regions: this leads to the drying up of wells and springs, a shrinking of rivers, and a greater tendency to drought. Thus, it is often suggested that the failure of the ancient civilisations of Asia Minor, as well as other parts of the world, was largely due desiccation and accelerated erosion, following the cutting down of forests, overgrazing of grasslands, and careless continuous cultivation. Nor is China immune to this devastating disease.

The most striking examples of damage from erosion are seen in the loess country of the North-west, and they are known to all the world. Here, in the basin of the Yellow River and its tributaries, great chasms and pits have been cut into the hillsides and plateaux, by erosion, while there are severe floods and constantly changing river courses on the plains. There is much severe gullying, too, in Yunnan, where considerable areas have been so ruined by erosion that they can neither be cultivated nor grazed: although the rainfall is higher here than in the north-west, evaporation is also

greater, and the long, dry season checks the growth of vegetation that might otherwise help to protect or reclaim eroded land. Elsewhere in west China gully erosion is less strikingly developed, although it may often be seen; but soil erosion is only one degree less active even if its effects are less obvious. To what is the muddy water of the Yangtze River during the summer attributable, but to the erosion of fertile soil? And the colour of the water shows that most of the mud has come from the Red Basin. This is chiefly due to sheet erosion, in which the top layer of soil is washed away, without the formation of deep gullies (although small rills or "shoestring" gullies may be formed in the cultivated layer). The effect of sheet erosion on the soil is less evident to the eye than that of gully erosion, and thus it is more insidious, and perhaps on the whole even more dangerous. All that the farmer notices is that the top soil is getting thinner; he ploughs up more and more of the subsoil each year, until finally he may be cultivating nothing but subsoil, all of the original fertile soil having been lost. (This, by the way, is why in rocky regions it is often said that the rock "grows" or stones "work to the surface." It is really the surface that has worked down to the rocks!). And it is the most fertile part of the soil, the clay and the organic matter, richest in plant foods, which are washed away most quickly.

The rate of sheet erosion varies with the steepness of the slope and the intensity and frequency of heavy showers, and it is so great that on steep mountain slopes in a climate like that of west China, the whole top soil may be lost in a few years. The writer has seen, in Kweichow, half the top soil washed away by sheet and rill erosion, after a single heavy storm. Even under better conditions and on gentler slopes, it will only be a few tens of years before the whole of the original top soil has been lost. Thus, wherever sloping land has been cultivated continuously in west China, without level bench terracing, the top soil has, in fact, largely disappeared: what is now being cultivated is a mixture of scanty remains of the top soil, with the subsoil, including plentiful rock fragments if the rock comes near the surface. Hence the low fertility, and the abandonment, of many of the hillside soils and farms. It is only in the Red Basin, where the underlying rock is chiefly a soft, readily weathered, clay-shale rich in mineral plant foods, that erosion has not destroyed the fertility of the soil on sloping land. Erosion goes on in the Red Basin as elsewhere, but its effects have been less calamitous. None the less, there must be a great loss each year of the residual values of manures which have been added to the soil: even in the Red Basin, soil conservation is desirable, to reduce waste and improve production.

The best remedies and preventives for erosion are by now well known: since cultivation causes it, stopping cultivation will stop it, if the land is properly covered by close-growing vegetation; and systems of land management which include grassland and forestry are the best way of minimising its effects. Simply abandoning the land and going somewhere else, once the soil has become too badly eroded to be worth cultivating, is one way of meeting the problem—the one which has been most popular in the Southwest. But it is terribly wasteful. Rather similar is the system of shifting cultivation of hilly land which is found in Kwangsi and Kweichow: here, scrub or grassland is ploughed up, cultivated for a few years, until the fertility of the soil has been exhausted (chiefly through erosion, rather than through the crops themselves), and then allowed to return to its previous condition, under which it remains for another cycle of years.

It would be better to zone the land according to slope and liability to erosion; steep and moderate slopes should not be cultivated at all, unless after bench terracing, but they should be planted, the steep slopes to trees and the moderate slopes to grassland. (Both forest and grassland can be very productive if well managed). Only the gentler slopes should be cultivated, and even these require care, with either terracing, or strip cropping, contour ridging for row crops, and suitable rotations.

The cultivation of paddy rice, since it entails level bench-terracing, is almost ideal from the point of view of soil conservation. If the lower, or gentler, slopes of hillsides which previously grew dryland crops are terraced for rice cultivation, then the increased productivity of that land will make it possible to take the rest of the unterraced land out of cultivation, and put it under grass or trees. Even if rice is not grown (as in the North-west), the productivity of bench-terraced land is much greater than that of sloping land; the writer has noticed level terraces on rather steeply sloping land, where the growth of the crop on the terraces was several times as good as that of the same crop on the slope. In this way, by using bench-terracing for either rice or dryland crops, it is possible to take sloping land partly out of cultivation without prejudice to the food supply.

One finds, in fact, that most measures for soil conservation are already being carried out in west China—more or less, and rather less than more. Some farmers, especially among the tribespeople, have carried out extremely good hillside terracing, for both rice and dryland crops, covering whole mountainsides; but more often terracing for dryland crops is not done, or is done so poorly (with sloping terraces) as only to delay, not to prevent, erosion. Some mountain farmers realise that trees, under which the undergrowth and litter are allowed to remain, protect and regenerate the soil; and if they have to cultivate

steep hillsides, having none other to live on, they do so on a system of long rotation in which strips of land are alternately cultivated and wooded. But more often one sees that all the trees are exterminated, and even the steepest slopes are cultivated until the crop produced is no longer worth the trouble of growing it; then the land is allowed to go back to useless scrub.

Therefore, as a result of what he has seen in west China, the writer has been forced to the conclusion that the average Chinese farmer may be very good at cultivating good land (his worldwide fame as a cultivator has been established on the alluvial plains of the east): but he is very bad at cultivating or farming hilly land. Indeed, in many parts of the west the hillsides are practically robbed and pillaged to benefit the lowland farmer: the grasses are burned off every year (making forestry impossible) to provide ash which the rain washes down to the paddy fields (and also into the rivers); turf is stripped off the hillsides and burned in heaps, to make ash-manure; the soil itself, if fertile, like a rendzina, is carried away to manure poorer soil elsewhere; scrub is cut and the leafy twigs are used as green manure; work animals, notably buffalo, are allowed to graze the hillsides near towns and villages so heavily that severe gully erosion results. This last feature is a very striking one in many parts of the south-west: as one travels through rather sparsely settled country, every time a town or a fertile basin is approached, the neighbouring hillsides are seen to have lost their vegetation and to be practically destroyed by gully erosion.

Soil conservation is most easily carried out, and soil fertility best maintained in hilly country, under a well managed system of mixed farming: that is, both cultivating and pasturing the land: raising live stock for food, as well as crops, and using the animal manure to enrich the land. When this is suggested for China, the objection is often raised that the country can barely produce enough crops to feed its human population, as things are; and so there is nothing to spare for feeding live-stock. This might be true for the heavily populated parts of east China, although even here there is often some uncultivated, scrub or eroded land which might be reclaimed and used for grazing. But it is obviously less pertinent in the west, where—outside certain special areas—only ten per cent of the land is cultivated, and a good proportion of the remaining ninety per cent might very well be reclaimed, put down to good grasses, and used for pasture. Another, more serious, objection to the suggestion of developing the agriculture of west China along the lines of mixed farming is that the Chinese farmer is naturally a cultivator, not a pastoralist. Perhaps, instead of "naturally," one should say, "traditionally": because many farmers keep one or two work animals, or a goat or two (in addition to the universal pig)—

and the transition to animal husbandry on a slightly larger scale has in practice proved not too difficult where the financial reward is sufficient; witness the growth of dairying around Chengtu. In any event, there are various localities in west China, including Kansu and Yunnan as well as Sikang, where stock raising and grazing are already carried out on a large scale; and this not only by Moslems or Tibetans, but by Chinese themselves. The development of mixed farming as a general practice in west China might take time and perseverance, but there is no reason why it should be impossible. It would be, perhaps, the surest way of increasing the productivity of the west, and thus of allowing further population increase and permitting stable resettlement. But it would have to be developed along the right lines, using improved breeds of stock, improved or selected strains of grasses, and the best possible systems of management. Otherwise local over-grazing, and accelerated erosion, might merely be intensified.

Nutrition.

So far the relation between soil and man has been discussed in rather general terms. It is necessary to consider in more detail the question of nutrition, especially in relation to soil type. Here again, the primary division between pedocals and pedalfers is important. In China the pedocal soils grow wheat, millet, kaoliang and beans as the chief food crops; the pedalfers grow rice, maize, sweet potatoes and beans. (Under "beans" one may include all leguminous crops used for food, including soy and other summer beans, broad beans, peas, and peanuts). Crudely, it may be said that the dwellers on the pedocals are wheat eaters, whereas the people of the pedalfers are rice eaters. In China as in India it is readily observed that the wheat eaters of the north are on the whole a taller, larger built, and stronger people than the rice eaters of the south. Many factors, including supplementary foods, come into the explanation for this, but one thing seems very likely, and that is that crops grown on the relatively unleached pedocal soils will be richer in calcium, iron, and other mineral elements needed in human nutrition than will crops from the highly leached pedalfers. Because of both this, and the differences in composition between wheat and rice, Buck found in his survey that the people of the wheat region (pedocal soils) had more protein, calcium, phosphorus and iron in their diet, with a lower calcium phosphorus ratio, than did the people of the rice region (pedalfer soils). On the other hand, because yields of rice are on the whole heavier than those of wheat, and water is not a limiting factor in the south, the southerners were able to eat more abundantly than the northerners: the mean daily calorie intake was 3,400 in the rice region and 3,186 in the wheat region; or, if one takes only the western part of China, the respective values would be 3164 and 3040 calories. (The

difference between the latter and the former values reflects the fact that the west is less productive than the east, in proportion to its population; and the east also has some imported food.)

As far as West China is concerned, the amount of food available per head is thus not very different in the north and the south, but the diet is on the whole a healthier one in the north. The conditions in Szechwan are worth especial notice: in spite of the high fertility, and great productivity, of the soils of the Red Basin and the Chengtu Plain, the population has multiplied to such a degree that there is less food available per head in the Szechwan Rice Area than anywhere else in the Rice Region (2955 cal. head), and less indeed than any of the northern regions except the Winter wheat-millet Area (chiefly Shensi and Shansi). In other words, Szechwan is definitely overcrowded in relation to the food supply.

A problem which has not yet been fully explored is that of the nutrition of the mountain-dwelling people of west China, who live more on maize than on rice. Maize alone (or with bacon and molasses) has not proved a very healthful diet in the pellagra regions of the U.S.A., and yet the mountaineers of west China seem to thrive on it, being on the whole taller, stronger and healthier than the plainsmen. The mountain diet is supplemented by beans and garden and wild vegetables, and possibly this, along with a generally healthier environment, and racial differences, helps to give good growth.

Certain especial effects on health are definitely related to the composition of the soil and the groundwater. Thus goitre tends to occur in inland regions where the soil, vegetation, and water are deficient in iodine (this being brought in near the coast by sea-spray, fish, and other sea-food). In West China goitre is very bad in some of the remote mountain valleys the writer has seen it in the Tsinglingshan and in Yunnan, and Liljestrang and others have reported it from Sikang and elsewhere. It is found in pedocal as well as pedalfer regions, so the degree of leaching of the soil is not alone responsible; actually, the nature of the salt used seems to be of considerable importance. Most Szechwan salt apparently contains sufficient traces of iodine to protect against goitre, as, of course, does sea salt; whereas Yunnan salt and other local sources seem to be deficient. It is of interest to note here that seaweed is well known among the Chinese people to be a preventative or cure for goitre; and that, as Hosie recorded, in at least one part of west China a relationship with the source of the salt was inferred by the local people, although the implications were misunderstood. They thought that it was something toxic present in the salt used by certain localities which gave the inhabitants there goitre: instead of something beneficial absent from the salt.

Another chemical property of soil, or more especially of water, which directly influences human health is the action of traces of soluble fluorine compounds, taken over long periods of time, on teeth and bones: fluorosis. The usual symptom is mottled enamel of the teeth: Mullet reported mottled enamel in the Ningyuan (Sichang) region of Sikang, Morse noted its presence on the teeth of certain tribespeople in connection with his anthropometric measurements, and the writer is indebted to L. Kilborn for the information that fluorosis is common in the region where Yunnan, Kweichow, and Szechwan meet, the Chuan Miao people who live there being especially affected. Here there are extreme cases leading to severe bodily deformation, as well as the milder symptoms of mottled enamel. It seems likely that well water would have a higher concentration of fluorine than running water and rainwater, and it would be worth trying to avoid the worst effects of fluorosis by avoiding the wells in affected areas, and using streams or catching rainwater for drinking purposes. Of course, if the fluorine was also as common in the soil as to get into the food which was eaten, this measure would not prevent the trouble, but it might help.

Osteomalacia is another disease which may be related to nutrition and soil conditions: deficiency of exposure to sunlight, alone or along with dietary deficiencies and an unbalanced calcium phosphorus ratio, appears to cause it. Among animals, a deficiency of cobalt (only needed in traces) in the soil and in the crops grown on it may lead to poor growth and "pinning"; the same trouble in human beings has not so far been reported, but this may be because in most parts of the world the food consumed comes from a variety of sources: it is possible that in China, in localities where the people live entirely on locally-grown foods, cobalt deficiency in the soil might lead to stunted growth and sickness in humans. As far as the writer knows, no evidence for this happening has so far been brought forward, but it might be looked for if otherwise unexplainable cases of malnutrition appeared. With livestock, the trouble usually appears on leached soils over acid, igneous rocks.

Other relationships between soil properties and human welfare may take place through a "third party", as in schistosomiasis. The parasitic worm that causes this disease has to pass through one of its stages in a water snail; the water snail needs lime from the soil or water in order to form its shell; and so schistosomiasis is worst where the paddy soils are of a calcareous, or at least not strongly acid, nature, as on the alluvium of the lower Yangtze Valley. There has been said also to be some relationship between soil properties and hook-worm infestation, although more information is required on this subject.

The present relationship between soil and man in West China has now been outlined. We have seen how closely man depends on the soil in every way, in health and disease, in the amount and quality of his food, in the actual numbers of people which can live in a region before famine and epidemics come to have overruling influence on the population. And we have seen also how subject the soil is to man's activity, often in a destructive way. Where the environment controls human development so closely as in west China, it should be possible to make some forecast of the future. One safe forecast would seem to be, that as things are little further increase in population is possible without greatly increased danger from famine, and possibly internal strife. But, even in west China, man is gaining more control of his environment. A most important thing for the future will be the improvement of communications, especially the development of good roads and railways. As transport improves, the people will be less dependent on the amount and quality of the local foodstuffs for their nutrition: other grains than rice can be largely eaten in the rice regions; meat, butter, and other dairy products can be transhipped from places where there is a surplus to regions where they are needed, and it will be worth while producing them on a larger scale in west China, to improve the nutrition of the whole country. It will be possible to manufacture, import, and distribute artificial fertilisers: the experiments of the National Agricultural Research Bureau have already shown that on the hilly soils of west China the productivity can often be doubled or trebled by suitable fertilisers alone. Selected and improved varieties of crops will at the same time be introduced and widely distributed, and plant and animal diseases will be brought more under control. Human diseases will be reduced, not only by direct medical work, but by increasing the consumption of the protective foods, by introducing iodised salt in goiterous regions, and in every way by raising the quantity and quality of agricultural produce. Soil erosion can be brought under control, and soil conservation measures more widely practised, in order to increase the productivity, and prevent the further abandonment of hilly land.

And then what? Will the population bound up, uncontrolled, until it presses harder than ever on the limits of the soils' productivity—until the only alternatives for the future are once more war or famine? Or will the Chinese people learn, as the Western democracies have done, that quality is better than quantity, among human beings, and that a high standard of life for a moderate number of people is better than a bare subsistence for a horde? This might seem to imply a revolution in the background of Chinese thought and belief, but possibly no greater a revolution than the others that are taking place in Chinese customs at the present time. Even from the point of view of the continuation of a family line,

it may come to be realised that a few descendants with a high probability of survival may be as good or better than many descendants of whom most will die in childhood. The danger of overpopulation was realised long ago in China, as quotations given by Buck ("Chinese Farm Economy") from Mencius and Han Fei-tzu show clearly; as the latter writer said, "The wealth of a nation depends upon people having enough food, not upon the number of people." What is new is the understanding that population can be controlled by means short of famine and war.

But unless man in China learns the twin necessity of conserving the soil and of limiting reproduction, there is one sure prophecy for the future: as Thorp has put it, "He will tend to destroy his means of subsistence and lay the earth waste for his descendants."

CHINESE LONGICORN BEETLES OF THE TRIBE
TETRAOPINI (COLEOPTERA)*

J. LINSLEY GRESSITT

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This tribe of beetles, which stands almost at the end of the subfamily Lamiinae, is distributed in all the continents of the world except Australia and South America, but is particularly dominant in the Oriental Region, where eleven of the sixteen genera occur. In China, with the northward extension of this tropical region, five of the Oriental genera, besides the single Palearctic genus, are to be found. With the three additional new species described in this paper, the total number of species known from China now becomes twenty-one, or nearly one-tenth of the world's species. Most of these are found in the South, seven being known from Hainan Island and also seven from mainland Kwangtung and Hong Kong. Very few extend north of the Yangtze in eastern China, but four are now known from Szechuan, an additional one from Sikang, and still another from Mongolia.

The new species herein described are from the collections of the University of Nanking, West China Union University, and the Lingnan Natural History Museum, and the type specimens are to be deposited in the respective collections. I am indebted to Prof. Shen Tseng, Miss K. O. Victoria Lieu, Prof. B. A. Slocum, Mr. C. S. Tsi, Prof. Chang Min-chuen, Miss D. S. Pen Dr. Sicien Chen and Dr. Gaines Liu in connection with this study.

Tribe TETRAOPINI

This tribe is distinguished from others of the Lamiinae by the fact that its species have the eyes each divided into two distant lobes connected by a fine thread, and by the tarsal claws being divaricate and toothed basally. The species are mostly broad and oblong, flattened above and sometimes widened posteriorly. They are generally yellow and black or metallic bluish.

KEY TO THE CHINESE GENERA OF TETRAOPINI

1. Metasternum with a process projecting anteriorly between middle coxae 2
- Metasternum lacking a process projecting anteriorly between middle coxae 3

*Contribution from the Lingnan Natural History Survey and Museum, Lingnan University.

2. Intercostal process of metasternum extending forward and overlapping apex of mesosternal process, which is sub-vertical *Astathes*
- Intercostal process of metasternum meeting mesosternal process at about middle of coxae, and entering its angular emargination *Anastathes*
3. Metepisternum fairly broad 4
- Metepisternum very narrow; body small and slender, more or less cylindrical *Tetrops*
4. Antennae generally shorter than body in female; scape not reaching to middle of prothorax; sides of head without projecting fringes of hair 5
- Antennae longer than body in female; scape reaching beyond middle of prothorax; sides of head with projecting fringes of hair, particularly in male *Lasiophrus*
5. Elytra broadly expanded behind middle; antennae slender, with second segment about one-quarter as long as scape *Plaxomicrus*
- Elytra nearly parallel-sided; antennae moderately stout, with second segment generally one-third as long as scape, or longer *Chreonoma*

Genus *TETROPS* Stephens

Tetrops Stephens, 1831, Ill. Brit. Ent. Mand., 4: 228, 241; Lacordaire, 1872, Gen. Col., 9: 872, 880.

Metasternum very narrow; form slender. Antennae slender, shorter than body in both sexes; head convex in front, hardly concave between antennal insertions; prothorax cylindrical, distinctly grooved basally; elytra parallel-sided, subtruncate posteriorly. The species are very small and are mostly black and pale yellow in color.

Genotype.—*Leptura praeusta* Linnaeus.

Range.—Holarctica.

1. *TETROPS HAUSERI* Reitter.

Tetrops hauseri Reitter, 1897, Deutsche Ent. Zeits.: 225 (Tian-shan).

I have seen no material of this species, which is not found in China proper.

Distribution.—Mongolia (Tian Shan)

Genus *LASIOPHRUS* Gahan

Lasiophrus Gahan, 1901, Trans. Ent. Soc. London: 71; Gressitt, 1940, Philippine Journ. Sci., 72: 226.

Head with lateral fringes of hairs, particularly in male antennae longer than body in both sexes; scape reaching beyond middle of prothorax; prothorax transverse, constricted near base; elytra parallel-sided, rounded apically; metasternum with a process extending anteriorly a short distance between middle coxae.

Genotype.—*Lasiophrys latifrons* Gahan.

Range.—Indo-Chinese Subregion.

2. *LASIOPHERYS TINHOSENSIS* Gressitt.

Lasiophrys tinhosensis Gressitt, 1940, Philippine Journ. Sci., 72: 226, pl. 6, fig. 13 (Tinhosa, near Hainan I.).

Orange ochraceous; antennae black; apical quarter of elytra brownish black; body surfaces with erect orange hairs and thin golden pubescence. Frons deeply but sparsely punctured; pronotum densely punctured on each side of disc; elytra with deep punctures, mostly in regular longitudinal rows. Length 10.2-10.8 mm.; breadth 3.4-4.

Distribution.—Tinhosa (Taai-chau I.), off Hainan Island.

Genus *PLAXOMICRUS* Thomson

Plaxomicrus Thomson, 1857, Archives Ent., 1: 57; Lacordaire, 1872, Gen. Col., 9: 672; Gahan, 1901, Trans. Ent. Soc. London: 69.

Head broader than prothorax; antennae relatively slender, shorter than body in female; prothorax strongly swollen at each side; elytra broadly expanded behind middle, rounded posteriorly.

Genotype.—*Plaxomicrus ellipticus* Thomson.

Range.—Indo-Chinese and Indo-Malayan Subregions.

KEY TO THE CHINESE SPECIES OF *PLAXOMICRUS*

1. Elytra not entirely metallic blue, violaceous or purplish, at least partly testaceous apically; elytra not very broadly expanded behind middle *guerryi*
Elytra entirely metallic violet blue with purplish reflections, broadly expanded behind middle *ellipticus*
3. *PLAXOMICRUS ELLIPTICUS* Thomson. Plate , fig. 4.
Plaxomicrus ellipticus Thomson, 1857, Archives Ent., 1: 58 (Shanghai).

Male.—Body largely testaceous yellow to pale orange ochraceous and elytra metallic purplish blue; head pale ochraceous; antennae with first two segments ochraceous, distal portions pitchy above, third testaceous with extreme apex blackish, fourth testaceous proximally and blackish distally, fifth and following segments black; prothorax and scutellum pale ochraceous; ventral surfaces testaceous, largely reddish or pitchy on sides of metasternum and abdomen; legs testaceous. Head and prothorax irregularly punctured, the latter more densely so; antennae barely longer than body; elytra very sparsely punctured, beset with suberect black hairs, densest on external margins. Length 10.8 mm.; breadth 5.2

Some specimens (University of Nanking Coll. of Agric. and Gressitt coll.) were collected at Chengtu (成都), Szechuan,

W. China in early July, 1938, by K. F. Chen. New to Szechuan Province.

Distribution.—Kiangsu (Shanghai); Szechuan (Chengtu).

4. *PLAXOMICRUS GUERRYI* (Pic).

Asthates Guerryi Pic, 1911, Matériaux Longicornes, 8 (1): 20 (Yunnan).

Asthates apicalis Pic, 1911, l.c. (Yunnan), new synonym.

Plaxomicrus Guerryi Pic, 1912, Matériaux Longicornes, 8 (2): 22; Aurivillius, 1923, Coleopt. Catal. 74: 578.

Plaxomicrus apicalis, Pic, 1912, Matériaux Longicornes, 8 (2): 22.

Plaxomicrus Guerryi ab. *apicalis*, Flavilstshikov, 1916, Rev. Russe d'Ent., 15: 80; Aurivillius, 1923, Coleopt. Catal., 74: 578.

Body testaceous, metallic violaceous blue on basal halves, or less, of elytra, partly, or largely, pitchy, or purplish black, on ventral surfaces; long pale or pitchy hairs on most of body surfaces; antennae testaceous with distal halves more or less brownish, or completely pitchy black, as long as body in male and slightly shorter in female. Elytra subparallel-sided, feebly punctured, with a few larger punctures basally. Length 12-14 mm.

Since Pic's *apicalis* was obviously founded merely on a slight color variation, and probably came from the same general locality as *guerryi*, I feel that the former has no valid systematic status, and must be considered a synonym of *guerryi*.

I have studied a specimen in the British Museum collected at Yei-chin, alt. 6,400 ft., Mekong River, Yunnan, June 20, 1922, by Prof. J. W. Gregory. This specimen has only the basal quarters of the elytra metallic, the antennae entirely pitchy black and the metathorax and first four abdominal segments purplish black.

Distribution.—Yunnan.

Genus *CHREONOMA* Pascoe

Chreonoma Pascoe, 1867, Trans. Ent. Soc. London, (3) 3: 348, 358; Lacordaire, 1872, Gen. Col. 9: 872, 876; Gahan, 1901, Trans. Ent. Soc. London: 63; Gressitt, 1940, Philippine Journ. Sci., 72: 223.

Body form moderately broad, suboblong; head as broad as, or broader than, prothorax, convex in front; inferior lobes of eyes a little broader than deep; antennae shorter, or very little longer, than body; prothorax transverse, swollen above and at sides; elytra broadly rounded apically; mesosternal intercoxal process narrow, gradually declivitous anteriorly.

Genotype.—*Chreonoma venusta* Pascoe.

Range.—Oriental and southeastern Palearctic Regions.

KEY TO THE CHINESE SPECIES OF CHREONOMA

1. Elytra entirely blue or violaceous 2
Elytra at least partly testaceous 5
2. Legs entirely testaceous 3
Tarsi and apices of tibiae black *atritarsis*
3. Antennae largely black 4
Antennae testaceous on at least first several segments; hairs on fore-body pale and short; elytra heavily punctured *hoffmanni*
4. Hairs on fore-body dark and very long; elytra heavily punctured *fortunei*
Hairs on fore-body mostly pale and not very long; elytra heavily and not very closely punctured *rigida*
5. Elytra entirely testaceous 6
Elytra not entirely testaceous 7
6. Fourth antennal segment three-fifths as long as third; antennae ochraceous *pallidicolor*
Fourth antennal segment four-fifths as long as third; antennae blackish *sikanga*
7. Only extreme bases of elytra pale 8
Elytra with either basal halves or apical halves, or equivalent, pale 9
8. Elytra testaceous basally for equivalent of one-half length of prothorax; head of male lacking frontal carina; abdomen densely hairy below *comata*
Elytra testaceous basally for equivalent of one-fourth length of prothorax; head of male with a frontal carina; abdomen sparsely hairy below *basalis*
9. Elytra with regular longitudinal rows of large punctures ... 10
Elytra with sparse irregular punctures, or small, close subregular ones 11
10. Only apical third of elytra metallic; remainder orange testaceous *cyaneoapicalis*
Nearly apical half of elytra metallic; remainder reddish ochraceous *cyaneoapicalis dimidiata*
11. Basal portions of elytra testaceous; elytral punctures small and close; body slender; less than 10 millimeters in length *dicica*
Basal portions of elytra bluish black; elytral punctures moderately large and sparse; body broad, more than 12 millimeters in length *nigronotata*

5. *CHREONOMA ATRITARSIS* Pic.

Chreonoma atritarsis Pic, 1912, *Materiaux Longicornes*, 8 (2): 21, (China?); Gressitt, 1935, *Philippine Journ. Sci.*, 57: 192 (Formosa); 1937, *Lingnan Sci. Journ.*, 16: 620 (Kiangsi and Kwangtung); 1939, 18: 111.

Orange testaceous; elytra metallic violet blue to greenish blue; antennae black with base of scape ochraceous and most of third and fourth, and bases of fifth to seventh, segments testaceous; tarsi and apices of tibiae black. Elytra deeply and irregularly punctured on basal two-thirds. Length 9-12.5 mm.

Several specimens were collected at Meitan (湄潭), N. Kweichow (貴州) Province, spring of 1940, by Dr. Liu Kanchih. New to Kweichow.

Distribution.—Kiangsi; Kweichow; Kwangtung; Formosa.

6. *CHREONOMA BASALIS* Gahan.

Chreonoma basalis Gahan, 1894, *Trans. Ent. Soc. London*: 487 (Hongkong); Gressitt, 1939, *Lingnan Sci. Journ.*, 18: 111, 112; 1940, *Philippine Journ. Sci.*, 72: 224.

Ochraceous; elytra violet or deep blue with a narrow ochraceous band at extreme base; last few antennal segments blackish; tarsi and tibiae completely ochraceous. Elytra with deep and moderately sparse punctures on basal two-thirds, partly arranged in longitudinal lines. Length 10-13 mm.

Distribution.—Hong Kong; Kwangtung; Hainan.

7. *CHREONOMA COMATA* Gahan.

Chreonoma comata Gahan, 1901, *Trans. Ent. Soc. London*: 67, pl. 4, fig. 8; Gressitt, 1939, *Lingnan Sci. Journ.*, 18: 112.

Body testaceous, more yellowish on head, pronotum and bases of antennae; elytra violet blue except for a basal yellowish band of about the width of half length of prothorax; antennae blackish brown on last six segments and apices of fourth and fifth; ventral surfaces of body, and legs, with tawny hairs, which are longest on sides of abdomen. Elytra closely punctured, the punctures smaller posteriorly; third to eighth or ninth antennal segments slightly angulate actoapically. Length 12 mm.

Distribution.—Hong Kong.

8. *CHREONOMA CYANEOAPICALIS* Gressitt.

Chreonoma cyaneoapicalis Gressitt, 1939, *Lingnan Sci. Journ.*, 18: 112, pl. 2, fig. 11 (Fong-tong-ping, N. Kwangtung).

Yellowish testaceous; apical two-sevenths of elytra steel blue with a greenish tinge; antennae pitchy black on apical halves; head reddish in front, Body broad; antennae fairly stout; pronotum strongly swollen and heavily punctured in center; elytra with moderately small punctures arranged in fairly regular longitudinal rows. Length 6-8.5 mm.

Distribution.—N. Kwangtung.

9. *CHREONOMA CYANEOAPICALIS DIMIDIATA* Gressitt.

Chreonoma cyaneoapicalis dimidiata Gressitt, 1940, *Philippine Journ. Sci.*, 72: 224 (Hainan).

Body ochraceous; elytra steely violet or purplish blue on apical four-ninths; antennae pitchy brown on distal segments and slightly pitchy on middle segments; legs testaceous. Pronotum moderately swollen and moderately punctured on center;

elytra with longitudinal rows of narrow punctures. Body more slender than in the typical form. Length 6.6 mm.

Distribution.—Hainan Island.

10. *CHREONOMA DIOICA* (Fairmaire), new combination. Plate , fig. 2.

Astathes dioica Fairmaire, 1878, Ann. Soc. Ent. France, (5) 8: 133 (Central China).

Pale testaceous, slightly ochraceous on head and pronotum; elytra with the discs purplish, the apical halves steel blue, or completely testaceous; prothorax with a slight pitchy spot on each side of disc and another below middle of each side; antennae largely pitchy black, except on undersides of basal segments; metathorax and first four abdominal segments shiny pitchy black; pro- and mesosterna and sides of femora pitchy. Front of head closely punctulate; pronotum strongly swollen along middle, heavily punctured; elytra finely and closely punctured in an irregular manner. Length 8.4-9 mm.

Several specimens were collected or reared from apple (*Malus*) at Cheng-tu (成都), Szechuan Prov., W. China in April and May, 1937, by Prof. Shen Tseng, and in the spring of 1940 by Prof. Tseng and Miss K. O. Victoria Lieu.

Host plant.—*Malus Communis* (Chengtu).

Distribution.—Szechuan; central China.

11. *CHREONOMA PORTUNEI* (Thomson).

Plaxomicrus fortunei Thomson, 1857, Archives Ent., 1: 53, pl. 8, fig. 2.

Chreonoma fortunei Gahan, 1901, Trans. Ent. Soc. London: 68; Ganglbauer, 1887, Horae Soc. Ent. Ross., 20: 132; Okamoto, 1927, Ins. Matsumurana, 2: 82; Savio, Notes d'Ent. Chinoise, 1 (4): 5-7, figs. 1-3 (biology); Matsushita, 1933, Journ. Fac. Agr. Hokkaido Imp. Univ., 34: 429.

Body yellowish testaceous; elytra entirely steel blue; proximal portions of first four antennal segments testaceous, sometimes darker; each side of metasternum with a black spot. Anterior portion of body with long erect black or yellowish hairs. Elytra heavily and somewhat closely punctured. Length 9-10 mm.

Host plants.—*Photinia serrulata* Lindley (Shanghai); *Prunus* (Japan).

Distribution.—Kiangsu; Anhwei; Chekiang; Korea; Japan.

12. *CHREONOMA HOFFMANNI* Gressitt.

Chreonoma hoffmanni Gressitt, 1939, Lingnan Sci. Journ., 18: 113, pl. 2, fig. 12 (Taam-yuen-tung, N. Kwangtung).

Body ochraceous; elytra steel blue; antennae slightly pitchy brown, with brownish hairs, on last four or five segments and apex of scape; legs ochraceous; front of head

reddish ochraceous. Anterior portion of body with meager erect golden buff hairs and golden pubescence. Pronotum swollen, with punctures on each side of swelling; elytra moderately punctured in subregular longitudinal rows. Length 11-11.5 mm.

Distribution. N. Kwangtung.

13. *CHREONOMA NIGRONOTATA* Pic.

Chreonoma nigronotata Pic. 1912, Matériaux Longicornes, 8: 21 ("Tsouglov", Asia); Gressitt, 1937, Lingnan Sci. Journ., 16: 621 (Kiangsi); 1939, 18: 114 (Kwangtung).

Body orange testaceous, paler on apical halves of elytra; basal halves of elytra black with violet or purplish tinges; antennae with apices of second to sixth segments, and most of last five segments, pitchy black. Pronotum with long erect ochraceous hairs, strongly swollen and somewhat finely rugulose-punctate; elytra impressed with relatively small scattered punctures. Length 14-15 mm.

Distribution.—Kiangsi; Kwangtung; "Tsouglov".

14. *CHREONOMA PALLIDICOLOR* Pic.

Chreonoma pallidicolor Pic. 1916, Mel. Exot. Ent., 17: 6, Saigon; Gressitt, 1940, Philippine Journ. Sci., 72: 225 (Hainan).

Body pale yellowish testaceous; head, pronotum and basal portions of antennae ochraceous; distal antennal segments pitchy brown. Dorsal surfaces of body with erect golden buff hairs. Pronotum feebly swollen, with moderately heavy sparse punctures; elytra with fairly large punctures in subregular longitudinal rows on basal three-fifths. Length 8.3-11 mm.

Distribution.—Cochin-China; Hainan Island.

15. *CHREONOMA RIGIDA* Gressitt, new species. Plate , fig. 1.

Female.—Oblong, nearly parallel-sided, robust. Body yellowish testaceous to reddish ochraceous, elytra rich steel blue with purplish reflections except for extreme bases (exclusive of humeri), which are ochraceous, antennae pitchy black with extreme bases of segments and inferior surface of scape reddish ochraceous; head orange ochraceous; eyes pitchy brown; mandibles blackish distally; prothorax orange ochraceous, paler beneath; scutellum ochraceous; ventral surfaces yellowish testaceous, very slightly darker towards apices of tibiae and tarsi. Body surfaces clothed with hairs in general corresponding in color to respective surfaces; head and prothorax with thin golden pubescence as well as erect golden yellow hairs, part of latter on frons pitchy brown.

Head barely broader than prothorax, strongly convex in front, feebly concave along middle of vertex between antennal

insertions, deeply but not very closely punctured; inferior eye-lobes rounded below, transverse above. Antennae not quite reaching to end of body; scape gradually widened distally, flattened and transversely corrugate-punctate above; second segment one-third as long as scape; third slightly longer than scape; fourth four-fifths as long as third; fourth to tenth gradually decreasing in length; last about as long as seventh, slightly constricted beyond middle, blunt distally. Prothorax one-third again as broad as long; posterior margin distinctly sinuate; disc strongly convex in center, coarsely punctured; middle of each side convex and projecting, not quite so coarsely punctured. Scutellum short, rounded-truncate posteriorly. Elytra broad, slightly wider near base and apex than in middle; apices conjointly rounded; surfaces somewhat heavily and irregularly punctured, the punctures becoming almost obsolete on apical quarter. Ventral surfaces micropunctulate. Legs moderately compressed, hardly punctured. Length 9.5 mm.; breadth 3.3 mm.

Holotype, female (University of Nanking Coll. of Agric.), Chengtu (成都), Szechuan Prov., W. China, May 24, 1938; paratopotypes (University of Nanking and Lingnan Nat. Hist. Museum), same data.

Differs from *C. fortunei* Thomson in being more robust, in having the elytra shorter and more heavily punctured, the hairs on the anterior portion of the body much shorter and paler, and the antennae a little paler and with shorter and more brownish hairs.

Distribution.—W. China (Szechuan).

16. *CHREONOMA SIKANG* Gressitt, species.

Female.—Broad, dorso-ventrally compressed, subparallel-sided. Body orange ochraceous, testaceous on elytra and parts of legs, almost pitchy on posterior portion of abdomen and sides of neck; eyes, mandibles and antennae black, scape of latter reddish brown beneath and at base, pitchy black on rest. Body surfaces almost entirely clothed with oblique reddish golden hairs of moderate length.

Head slightly broader than prothorax; frons strongly convex, feebly depressed along median line, rather heavily punctured; vertex barely concave, less closely punctured; occiput convex, similarly punctured; inferior eye-lobes slightly broader than deep. Antennae not quite as long as body, moderately thick; scape about as long as third segment; fourth three-fourths as long as third; fifth four-fifths as long as fourth; fifth to last slightly decreasing in length. Prothorax nearly twice as broad as long, constricted apex and base, swollen on middle of disc and on each side; surface irregularly punctured, heavily so on each side of middle of disc. Scutellum short, emarginate apically. Elytra broad, subparallel-sided; nar-

rowed and rounded at apices, surfaces with moderate-sized subseriate punctures. Ventral surfaces almost impunctate. Legs short; posterior femora reaching to base of fourth abdominal segment; first posterior tarsal segment not quite as long as following two united. Length 11 mm.; breadth 4.1 mm.

Holotype, female (W. China Union Univ., biol. dept.), Tienchuan (天全), Sikang (西康) Province, W. China, July 16, 1939, D. S. Pen, collector.

Differs from *C. pallidicolor* Pic in being larger, in having the antennae much darker, with the fourth segment longer, the frons more swollen, the pronotum in part more densely punctured, etc.

Distribution.—W. China (Sikang).

Genus *ANASTATHES* Gahan

Anastathes Gahan, 1901, Trans. Ent. Soc. London: 60; Gressitt, 1940, Philippine Journ. Sci., 72: 221.

Form stout, subrectangular; head broader than prothorax; antennae thick and short, third segment no longer than scape; prothorax strongly swollen above and at sides; elytra broad, parallel-sided; metasternum produced anteriorly to about middle coxae, entering angulate posterior emargination of mesosternal intercoxal process, which is almost vertical.

Genotype.—*Astathes nigricornis* Thomson.

Range.—Eastern part of Oriental Region.

KEY TO THE CHINESE SPECIES OF *ANASTATHES*

Body rather long and narrow; antennae relatively slender; pronotum with a moderate swelling at center and clothed with pubescence; elytra with a pair of feebly raised lines *parva hainana*

Body very broad; antennae stout; pronotum with a large swollen area reaching nearly to apex and base, almost lacking pubescence; elytra with two broad, distinctly raised longitudinal lines *robusta*

17. *ANASTATHES PARVA HAINANA* Gressitt, new subspecies. Plate , fig. 3.

Chreonoma atricornis, Gressitt, 1940, Philippine Journ. Sci., 72: 223 (not of Pic).

Female.—Moderately broad; dorso-ventrally compressed. Body testaceous, somewhat orange-yellow above, darker on head and pronotum, paler beneath, with translucent areas showing dark internal structures within; antennae black, somewhat shiny on first four segments, last segment paler, reddish at apex; eyes black; clypeus and labrum reddish; mandibles reddish basally and pitchy distally; tibiae pitchy black on basal portion of outer surfaces, posterior pair nearly to apices. Body clothed above with erect or suboblique golden hairs and

thin golden pubescence and below with whitish buff hairs and pubescence, more golden towards apices of abdomen; antennae with long suberect goldish hairs beneath and shorter and sparser ones above, as well as shorter pale buff hairs.

Head broader than prothorax; frons convex, heavily punctured, with minute punctures in interspaces; vertex slightly concave, medially grooved and less closely punctured; occiput convex, sparsely punctured; inferior lobes of eyes slightly broader than deep. Antennae not quite as long as body, relatively slender; scape subcylindrical beyond basal third, finely punctured; third segment about as long as scape; fourth fourfifths as long as third; fourth to tenth gradually shorter; last as long as sixth, attenuated and acuminate apically. Prothorax broader than long, constricted near apex and between middle and base, swollen on center of disc, and coarsely punctured. Scutellum short and broad, subtruncate posteriorly. Elytra fairly long, slightly broader near apices than at bases, each impressed with about twelve subregular longitudinal rows of moderate punctures. Ventral surfaces sparsely punctured at sides. Legs fairly slender. Length 10.7 mm.; breadth 3.6 mm.

Holotype, female (Lingnan Natural History Museum), Taipin-ts'uen (大邊村) alt. 400 meters, Lam-ka-heung, Lai-moling (Loi Mother Mt.), Kiung-shan Distr., central Hainan (海南島), May 14, 1935, F. K. To.

Differs from *A. parva* Gressitt (1935, Philippine Journ. Sci., 57: 193, Formosa) in being larger, with the frons and vertex more heavily punctured, the pronotum more swollen and much more strongly punctured, particularly on anterior portion, and the elytra a little less regularly punctured and a little less strongly so behind middle.

Distribution.—Hainan Island.

18. *ANASTATHES ROBUSTA* Gressitt.

Anastathes robusta Gressitt, 1940, Philippine Journ. Sci., 72: 222 (Hainan).

Body ochraceous, reddish on head and pronotum, slightly so on abdomen; elytra pale orange testaceous; antennae black. Dorsal surfaces with some erect goldish hairs, but almost lacking pubescence. Pronotum with a very large swelling, reaching almost to apex and base, heavily punctured; elytra with moderate punctures in subregular longitudinal rows on basal two-thirds. Length 9.5-11.5 mm.; breadth 3.6-4.6 mm.

Distribution.—Hainan Island.

Genus *ASTATHES* Newman

Astathes Newman, 1842, Entomologist, 1: 299; Thomson, 1860, Classif. Ceramb.: 42; 1864, Syst. Ceramb.: 399; Pascoe, 1867, Trans. Ent. Soc. London, (3) 3: 348; Lacordaire, 1872, Gen. Col., 9: 872, 873; Gahan, 1901, Trans. Ent. Soc. London: 38; Gressitt, 1940, Philippine Journ. Sci., 72: 220.

Tetraopthalmus Guerin, 1844, Icon. Regne Anim. Ins.: 244; Thomson, 1857, Archives Ent., 1: 48.

Tetraopthalme Blanchard, 1845, Nat. Ins., 2: 161.

Body broad, oblong; head as wide as prothorax; front of head convex; prothorax broader than long, swollen on center of disc and at middle of each side; elytra broadly rounded apically; intercoxal process of mesosternum nearly vertical anteriorly, over-lapped posteriorly by a long anterior process of metasternum, which reaches almost to anterior borders of middle coxae.

Genotype.—*Astathes perplexa* Newman.

Range.—Oriental Region; Wallacea.

KEY TO THE CHINESE SPECIES OF ASTATHES

1. Antennae largely black 2
Antennae yellow *flavicornis*
2. Elytra greenish or steely blue; third to fifth antennal segments largely ochraceous *cyanoptera*
Elytra purplish blue; third antennal segment black, fourth to sixth black distally *episcopalis*

19. *ASTATHES CYANOPTERA* Gahan.

Astathes cyanoptera Gahan, 1900, Ann. Mag. Nat. Hist., (7) 5: 353 (Hainan Island); 1901, Trans. Ent. Soc. London: 44; Matsushita, 1933, Journ. Fac. Agr. Hokkaido Imp. Univ., 34: 430; Gressitt, 1940, Philippine Journ. Sci., 72: 221, pl. 6, fig. 14.

Reddish ochraceous; elytra greenish or greenish blue; antennae pitchy black on scape and sixth to last segments; tarsi and apices of tibiae blackish. Pronotum strongly swollen, sparsely and finely punctured on swelling; elytra strongly and irregularly punctured. Length 11.5-13 mm.

Distribution.—Hainan Island; Formosa.

20. *ASTATHES EPISCOPALIS* Chevrolat.

Astathes episcopalis Chevrolat, 1852, Revue Zool., (2) 4: 418; Gahan, 1901, Trans. Ent. Soc. London: 44; Savio, 1929, Notes d'Ent. Chinoise, 1 (4): 3; Matsushita, 1933, Journ. Fac. Agr. Hokkaido Imp. Univ., 34: 430; Liu, 1934, Lingnan Sci. Journ., 13: 660; Pic, 1935, Arkiv f. Zool., 27 A 2: 12; Wu, 1937, Cat. Ins. Sin., 3: 775; Gressitt, 1939, Lingnan Sci. Journ., 18: 110; 1940, Notes d'Ent. Chinoise, 7: 197.

Tetraopthalmus episcopalis Thomson, 1857, Archives Ent., 1: 48.

Reddish ochraceous; elytra purplish blue; antennae black with most of fourth segment, and bases of fifth to seventh, pale ochraceous; tibiae and tarsi black. Pronotum moderately swollen in center, with coarse punctures on sides of swellings; elytra with fairly close and deep punctures, becoming smaller and sparser at apices. Length 10.5-16.3 mm.

One specimen was collected at Tau-chi-tsz (桃溪寺), near Tsengyih (遵義), alt. 250 meters, northern Kweichow Province (貴州), July 14, 1940, by the writer. New to Kweichow. Some specimens were taken at Ta-o-sze (大蛾寺), Omei Shan (峨眉山), Szechuan, in July 1940, by Dr. C. C. Liu; specimens in Univ. Nanking Coll. Agr. from Chengtu (成都) and Kuanhsien (灌縣). The Academia Sinica has specimens from Chekiang.

Distribution.—Shensi, Szechuan; Kweichow; Anhwei; Kiangsu; Chekiang; Kiangsi; Fukien; Kwangtung; Kwangsi; Hong Kong; Formosa.

21. *ASTATHES FLAVICORNIS* Pic.

Astathes flavicornis Pic, 1939, Echange, 55: 31 (China).

Distribution.—China.

EXPLANATION OF PLATE

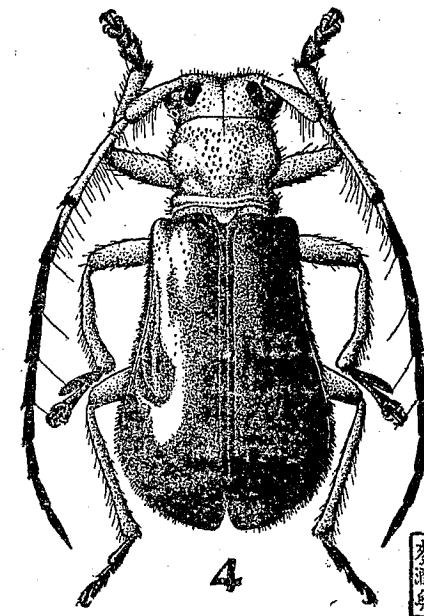
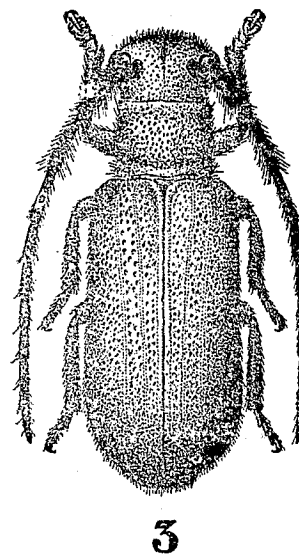
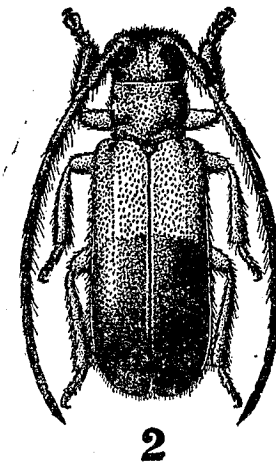
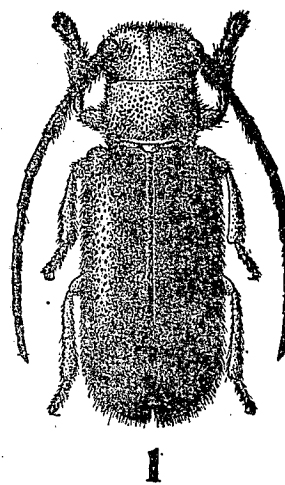
(Magnified 6.8 times) (allowing $\frac{1}{4}$ reduction).

Figure 1. *Chreonoma rigida* Gressitt, new species, holotype.

Figure 2. *Chreonoma dioica* (Fairmaire); Chengtu.

Figure 3. *Anastathes parva hainana* Gressitt, new subspecies, holotype.

Figure 4. *Plaxomicrus ellipticus* Thompson; Chengtu.



A BUTTERFLY MIGRATION IN WESTERN SZECHWAN

K. J. FISHER (Mrs. Richardson),

Assistant Professor, University of Nanking.

On October 12th 1940, the writer walked west up the Min River valley from Kwanhsien to the junction of the Lung Chi River, and then north up the valley of the latter to Nan Yo Miao. The distance is reckoned locally as about 40 *li* perhaps rather less than 20 km., as the mountain *li* hereabout represent time of journeying rather than actual distance, and so are shorter in hilly country.

During the walk the sun was shining, and many autumn butterflies were to be seen, especially Pieridae. *Pieris napi* or *P. melete* L. and *P. deota* or *P. canidia* Nicev. were particularly common, and gave the impression of being in uni-directional movement, down the river toward Kwanhsien. Being accompanied by carriers, who were anxious to arrive as soon as possible, the writer could not make counts at the time, but determined to do so, should the appearance of migration continue.

After arrival at Nan Yo Miao the weather turned cold and rainy and few butterflies were seen for the next two days. The fifteenth, however, was fine in the morning, so a suitable position was taken up, from which the count illustrated in Fig. 1 was made.

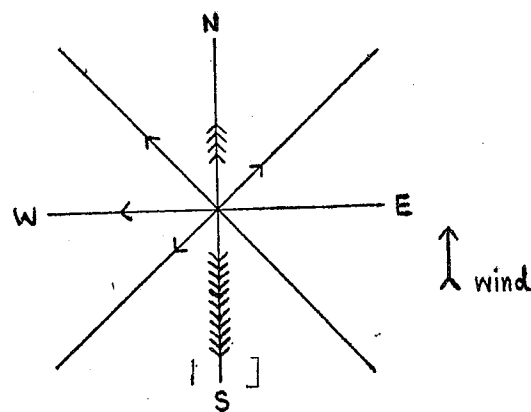


Fig. 1.

The starfish-like arrangement of lines represents compass-directions; each arrow on the lines stands for a single butterfly, either *P. napi* or *P. deota*. It will easily be seen, therefore,

that if flight direction was at random, an approximately equal number of arrows should appear on each arm of the "starfish". This is not the case. Out of 19 butterflies seen, 11, or more than one-half, were flying S, and one SW. The remaining seven were scattered between W and N. Examined statistically, this difference, although impressive, is not significant when measured by the Chi square test, but their behaviour was similar to that which I have seen in other migrations of *Pieris* species. The south wind, though very light, (about force 1-2 on the Beaufort scale) was cold, and the butterflies tended to linger in a sheltered sunny hollow just below the observation point. They would appear over the north side of the hollow, flying fairly briskly (5 or 6 m.p.h.) into the wind, about two or three feet from the ground. Following the contours, they would find themselves in a warm sheltered spot, and slow down, perhaps stopping to feed on wild flowers. But their urge to migrate would not let them rest for long, and they would gradually move across the hollow, then boldly take the plunge into the cold wind on the other side.

The next two days were colder, and although some solitary butterflies were seen, there was nothing that could be called migratory flight. An hour's waiting would only produce one or two *Pieris* and it is not possible for one person alone to make use of observations on solitary insects.

On October 18th the return trip to Kwanhsien was made, and again there was some impression of a drift of *Pieris* downstream along the main Min valley, though it was not so strong as on the 12th. On the 19th, we returned to Chengtu by rickshaw, south-east across the Chengtu plain. The day was fairly warm, sometimes sunny, sometimes overcast. The wind was very light, E by S. A good many butterflies of different species were seen by the road, including the ubiquitous *Pieridae*. Another "starfish" diagram was therefore made, with the direction of every individual *Pieris* noted. It will be seen from the accompanying diagram that these were few (in a seven hours' journey) but there is an overwhelming preponderance of movement in a south easterly direction, across the plain and away from the mountains. 17 butterflies were seen moving S, SE, or E, and only four going SW, W, NW, or NE. The flight was somewhat similar to that at Nan Yo Miao, the butterflies keeping close to the ground, flying fairly fast, sometimes a little faster, sometimes a little slower, than our trotting rickshaws, and showing a tendency to linger over flowers in sunny coners. The above figures are highly significant, judged by the Chi square test.

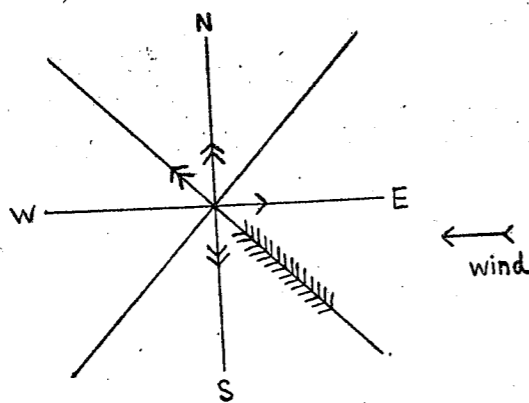


Fig. 2.

After returning to Chengtu, watch was continued on the butterflies. It was possible to make a good count on October 21st, when a thin migration continued across the West China Union University Campus, on the south side of Chengtu city. The accompanying diagram, Fig. 3, shows the distribution of flights. It will be seen that the flight has swung round still more to the East, but this may not be due to the movements of the butterflies on this occasion so much as to the fact that on the earlier observations I had no compass and was obliged to work out an approximate direction with watch and sun.

From Fig. 3, it will be seen that fourteen butterflies had an easterly component in their flight, while five were flying in other directions. These figures are again significant by the Chi square test. Again the butterflies kept close to the ground, rising to pass over trees and houses in preference to flying round them. . . . this is a very common phenomenon in migrating insects.

After October 21st, no more migratory movements were seen, and the butterflies decreased in number, disappearing early in November.

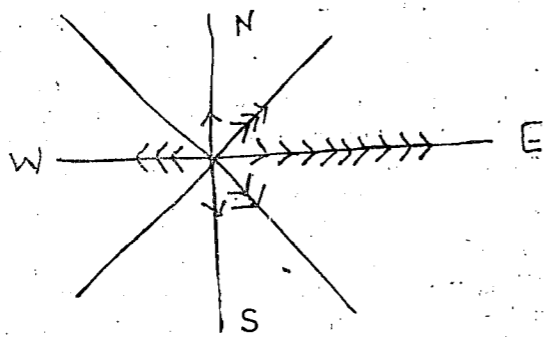


Fig. 3.

Note on nomenclature.

At the present time, owing to war conditions and the difficulty of transport, it is extremely difficult to settle systematic points in West China. The books at my disposal are Schweiz's "Macrolepidoptera of the World," Palearctic section, and Leech's "Butterflies of China," from which the relevant plates are missing.

Coming from Europe, it was natural that I should identify the first of the butterflies mentioned in the fore-going paper as *Pieris napi*, L., thinking it to be a rather dark local race. This fits in very well with the description in Schweiz, but according to Leech, *P. napi* does not occur in China, and specimens are to be referred to the spring form of *P. melete*. I can only say that this species is more or less common in Chengtu at all times of the year, but most common in autumn, not spring. I have not observed any seasonal variation.

As to *Pieris deota* or *canidia*, it is impossible to distinguish between them from the descriptions given in Schweiz. Leech described *canidia* only, not mentioning *deota*. Franck, *Jl. W. China Boarder Res. Soc.*, Vol 2, 1924, mentions *deota* but not *canidia*, while Ho and Pen, *Ibid*, Vol 6, 1933, mention both species, recording *deota* from Chengtu and Kwanhsien and *canidia* from Mount Omei.

In consequence of all this, I fear we shall have to postpone the proper naming of these species until the wars are over and we can get in touch with good museum collections again; in the meanwhile, I can only warn the reader that my paper deals with two species, one of which certainly resembles the *P. napi* which we already know as a migrant in Europe, and the other is probably either *P. deota* or *P. canidia*.

NOTES and OBSERVATIONS

Flight of Sea-gulls.

On November 8th, 1939, sailing from Shanghai to Honkong, I watched for a considerable time a flock of sea-gulls which had followed our ship from Shanghai. These scavengers of the deep apparently work in squadrons to a fixed operational order. First one would come soaring alongside and only a few feet above my head, so close that I could have followed Captain Bligh's example. Then, flying in the teeth of a high wind, the bird would reconnoitre the whole length of the ship from stern to bow, his eyes unwaveringly fixed along the bubbling water-line, watchful for any dross which might belch forth from a porthole or any fish which might be turned up in the wash. Having reached what the cabin-boy calls the "sharp end" of the ship without reward, he would give a squawk of disgust, wheel over and allow the gale to carry him back to the stern, to rejoin the main squadron. I calculated his speed on this return flight to be some fifty miles an hour; the graceful streak of silver and black outlined against the grey sky was a very pretty sight. His place would be taken by the second bird of the squadron who would carry out the same tactics, legs tucked close under his tail, beady eyes constantly on the watch, his wings hardly in motion but keeping him on a steady forward path. This process continued for two whole days. Occasionally a bird would fall out of the formation and nestle down on the rough water to rest for a few minutes (if bobbing up and down like a cork can be called "resting") but aroused by the squeals of his comrades he would soon come winging his way back to his allotted place in the hungry line. The continuous reconnaissance lasted from dawn to dusk.

One peculiar fact that I noticed, although it is probably well-known to ornithologists, was that if a bird had a chip out of one wing, or a few feathers missing, the other wing was equally affected. It seemed to me as though a bird after an accident involving one of its "planes" knew instinctively that its stability in flight was going to be affected and purposely trimmed the unaffected wing to preserve symmetry. I tried to find one with odd-shaped wings but failed to do so; even where it was obvious that a bird had lost through violence a considerable number of feathers from one member, I found that its other wing was modified to present an equal pattern.

At noon we were off Foochow although we were too far out to see the coast, and at 7 p.m. we passed Turnabout Light-house, a magnificent white swathe in the darkness to starboard. Here our winged escorts left us.

R. A. Walker.

Food of Local Birds.

A specimen of the Chinese Bulbul, *Pycnonotus sinensis sinensis*, was obtained from Jenchow and its gizzard (the crop having been lost) examined. The gizzard was nearly full of seeds of *Coriaria sinica* and another kind of seed, unidentified. There were also, however, a few insect remains, notably the wings of a large fly, badly damaged, some scraps of what looked like the elytra of Telephorid beetles, and some fragments of insect legs. This bird appears to be a somewhat harmful and mischievous species, for it has been seen pecking at fruit and cabbage leaves, and Miss Hu tells us that it will destroy young wheat seedlings. A favourite food is, of course, the berries of the creeper (*Vitis* sp.?) that grows on the walls of so many of the campus houses.

From Jenchow came also a Dayal, *Copsychus saularis prosthoptellus*, and this again lacked the crop. The gizzard, however, was full of very finely comminuted bits of chitin, most of which appeared to be parts of beetles. No seeds or any other material was found, and it seems that this bird is purely an insect feeder, at least at this time of year (May.)

W. & R. Hibbard.

Butterfly Migration.

On June 1st., 1941, while approaching the river to the south of the City (Chengtu) at 9 a.m., a mass of cabbage white butterflies was seen moving from west to east across a market garden of kohlrabi. The butterflies were flying slowly just above the plants, and were alighting on them and on the path, where they were crushed by the feet of passers-by. But the westerly movement was very distinct, in spite of its sluggishness, and two and a half hours later, returning by the same path, very few butterflies were seen where previously there had been hundreds. The day was bright and sunny and there was little wind.

W. Small.

Pieris rapae, L., almost certainly the species referred to above, has been unusually numerous in May and early June this year. A great deal of damage has been done to cabbage and particularly to kohlrabi in the market gardens around the town, whole fields being completely skeletonised by the larvae, which can be seen in dozens on every plant. Ed.

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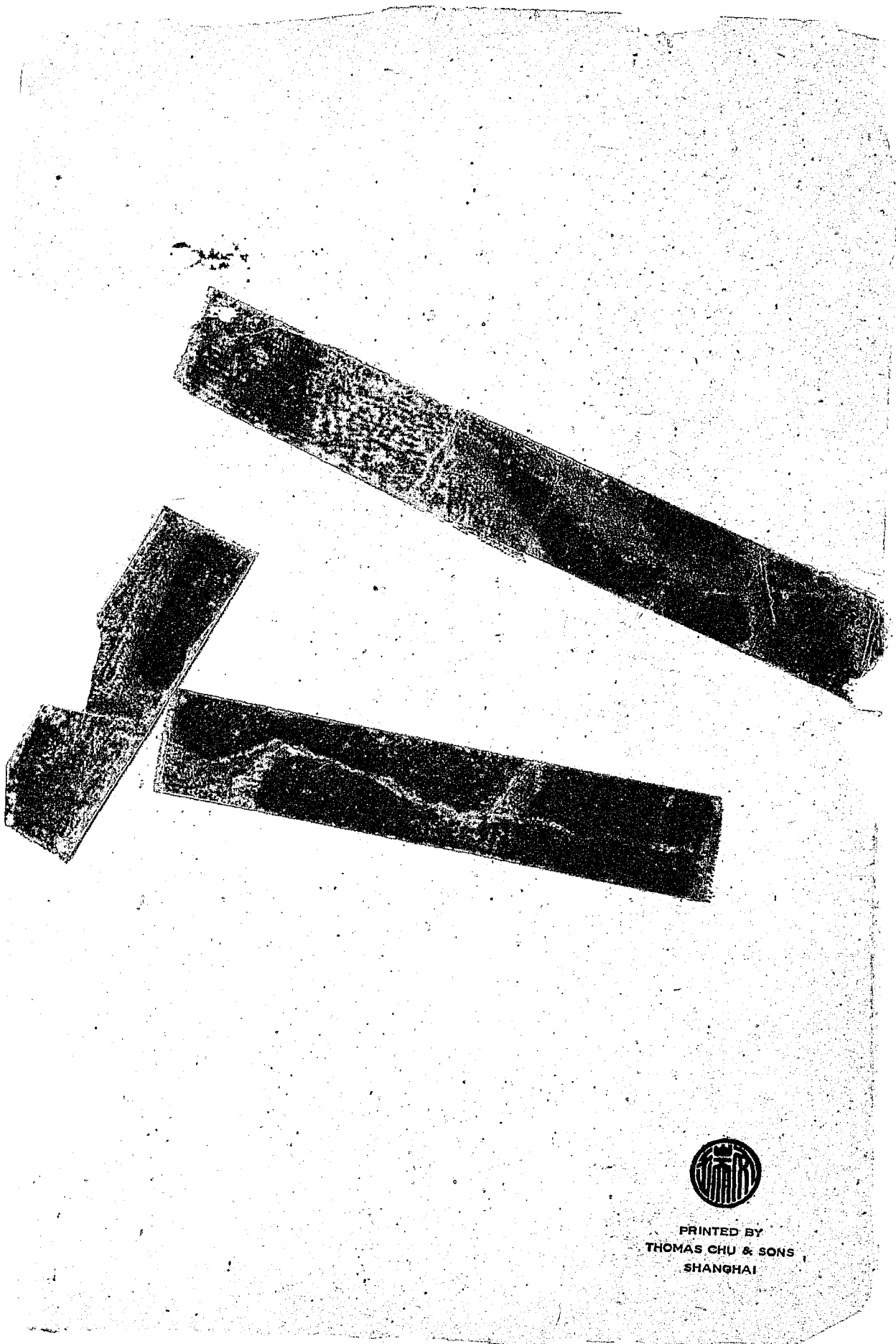
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