

Chaquitacla, the native footplough and its persistence in central andean agriculture

by

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The most advanced agricultural tool known in the New World before the coming of the Europeans was the Andian footplough(1). Also known as the chaquitacla or simply *taccla*, it evolved from the digging stick and combined three advantages: metal point, curved handle, and footrest. No other indigenous tool utilized the pressure of the foot in digging up the sod which made it different from all farming implements known elsewhere in the Americas in pre-Columbian times (Donkin 1970, 514) (2). This relatively simple instrument has persisted long after more sophisticated technology was introduced into the Central Andes, and its enduring presence demonstrates that more advanced innovations do not necessarily displace primitive forms that under certain conditions may be more efficient (3).

Culture History

The *taccla* was only one of three technological inventions to have been made by the Inca civilization, and thus was a late achievement in the culture history of Western South America (Lanning 1967, 165). Similar tools also occurred in the Hebrides Island and in China, although no evidence yet exists to suggest other than independent invention in these three places (Kramer 1966, 37). Dated specimens are rare, and a precise understanding of the evolution of the *taccla* from the dibble will depend on future archaeological evidence. It is probable, nevertheless, that agricultural peoples living on the Peruvian coast long before the Incas contributed to the idea of the *taccla*. A copper-shod digging stick known by the Mochica culture (ca. 500 A.D.) may have been a forerunner of the *taccla* (Bushnell 1957, 83). A pottery representation of the *taccla* from the Chimu culture (1300 A.D) on the coast verifies its development by at least that time (Horkheimer 1960). However, the friable soils of the coastal desert were easily turned without the *taccla*, and the incentive to develop such a tool probably came from the adjacent Highlands. Historic distribution and the current diversity of forms point to the mountainous region of Southern Peru as its likely place of origin (fig. 1). With the expansion of the Inca Empire, the *taccla* was carried north to Ecuador and south to Bolivia where early colonial writings confirmed its presence (Jimenez de la Espada 1965, II, 227; Vázquez de Espinosa 1942, 660). It probably never occurred in Southern Chile, either before or after the conquest by the Spaniards (4).

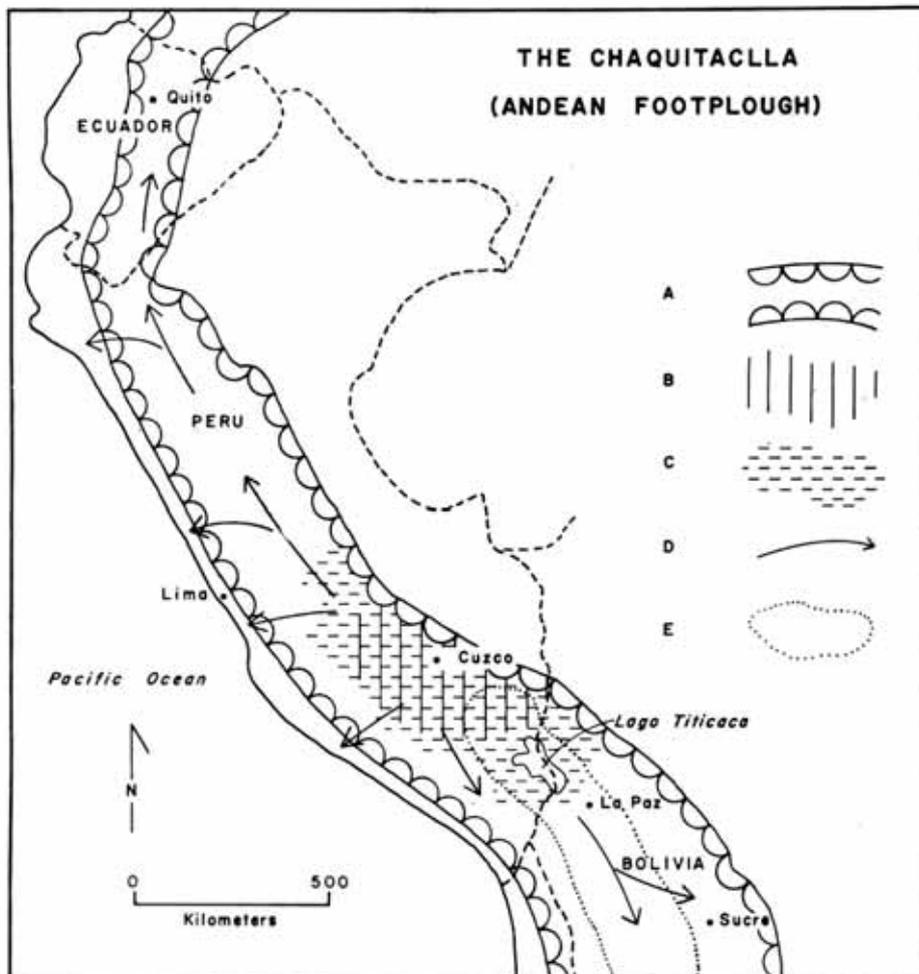


Fig. 1. Geography of the Andean footplough in South America: A. Andean Highlands; B. probable zone of origin; C. region of the greatest present importance; D. direction of diffusion in pre-Spanish times; E. high plateau above 3.800 m ("Altiplano"). Map by D. W. Gade.

Geographie des Fusspflugs der Anden in Südamerika: A. Die Anden; B. das vermutliche Entstehungsgebiet; C. Gebiet der heutigen grössten Bedeutung; D. Richtung der Verbreitung in vor-spanischer Zeit; E. Hochplateau über 3800 m ("Altiplano").

Land fallow is the key to understanding the past and present use of the *taclla*. In areas where plots were fertilized, irrigated, and farmed continuously, a small mattock, *raucana* or *Luciana*, was the important digging tool (fig. 2). However, where land was periodically rested, the *taclla* was indispensable for breaking up the compacted earth. While the *taclla* has had a close identification with the potato, aboriginal distribution of potato cultivation at the time of the Conquest extended well beyond the range of the footplough. The high plateau, as well as slopes above irrigated Andean valleys and basins, may have been cultivated for the time when the *taclla* appeared, thus increasing food production in the Inca Empire. On the Peruvian-Bolivian Altiplano, a grassy plateau over 3,800 m elevation, more than 800 square km of ridged fields were constructed, either for reclamation and/or irrigation, near Lake Titicaca by an as yet unknown ancient people (Smith, Denevan, Hamilton 1966, 355). The *taclla*, the only native implement suitable to dig up the tough sod of this region, probably was instrumental in his notable modification of nature.

Introduction of the traction plough

Soon after the Spanish Conquest, the "scratch" plough, *arado dental*, was introduced to the Andes, along with the oxen to pull it.



Fig. 2. Harvesting potatoes with *raucana* near Colquepata, Peru. This native mattock of the Andes was the chief competitor of the *chaquitaclla* before the introduction of the traction plough. Photo D. W. Gade 1968.

Kartoffelernte mit der *raucana* in der Nähe von Colquepata, Peru. Diese in den Anden einheimische Hacke war der schärfste Konkurrent des *chaquitaclla* vor der Einführung des Gespannpflugs.

Made of wood and light in weight, it was the only traction plough known in Spain in the sixteenth century that was brought to Peru (Foster 1960, 52-54). At first, it was used to prepare lands farmed by and for the spaniards, but there was a lag before the Indians accepted it. Zárate, a reliable Spanish chronicler of the time, mentioned that wheat was planted in land prepared with the *taclla* and was sown in holes, rather than broadcast (1947, 469). In the early seventeenth century, the indigenous peoples were using both oxen-pulled ploughs and the *taclla* (Cobo 1956, I, 382). The natives' acceptance of the Old World plough may be partly accelerated as a result of an edict by Viceroy Toledo (1580) decreeing that each Indian community purchase a plough with oxen for all its members to use where land could be so worked (Levillier, VIII, 333). The metal shovel and pickaxe were also introduced and gradually accepted by the Indians.

In certain areas of the Highlands, the *taclla* ceased to be used because of the introduction of superior technology. Close association of the *taclla* with Indian customs and mores may have caused *mestizos* to abandon it. Geographically, the *taclla* contracted from the entire desert coastal region of Peru and the flat floors of most valleys and basins in the Highlands. Yet in some parts of the Central Andes the oxen-pulled plough, suited as it was to the light soils of the Mediterranean Basin but not sturdy enough to turn compacted, turf-covered soil, never displaced the *taclla*. The *taclla* remains strongly imbedded in the livelihood of peasants in Southern Peru and Northern Bolivia in precisely those zones where it has always been most

necessary: on agricultural lands above 3,600 m above sea level or on steep slopes farmed below this elevation.

Form of the Taclla

The *chaquitacla* has probably changed little since the Inca period. Cobo's 350-year old description of it suggests a very similar tool to that found today (5). Naively charming sketches by the Indian Guaman Poma de Ayala, from a manuscript discovered in 1908 in the Royal Danish Library in Copenhagen, show the *taclla* as a long tool with a curiously curved handle (figs. 3 and 4), probably a stylized representation.



Fig. 3. Sowing the potato with the *chaquitacla*. From a sixteenth century manuscript by Guaman Poma de Ayala discovered in 1908 in the Royal Danish library in Copenhagen.

Kartoffelsäen mit dem *chaquitacla*. Aus einer Handschrift von Guaman Poma de Ayala aus dem 16. Jahrhundert, entdeckt 1908 in der Königlichen Bibliothek in Kopenhagen.



Fig. 4. Harvesting the potato with both the *chaquitaclla* and the *raucana*, from Guaman Poma de Ayala. In spite of some stylistic liberties, these drawings are the best pictorial representations of Inca life at the time of the Spanish Conquest that are available.

Kartoffelernte mit sowohl dem *chaquitaclla* als auch der *raucana*, von Guaman poma de Ayala. Trotz einiger stilistischer Freiheiten sind diese Zeichnungen die besten bildlichen Darstellungen des Lebens der Inkas zur Zeit der spanischen Eroberung.

The *taclla* varies in materials and form depending on location, yet the basic parts remain the same for all. The wooden shaft, *chanchaca*, 1 to 1.5 m high, has a handle, *kcumo*, attached to it or part of it, and a footrest, *taquilpo*, bound to it by leather thongs, *yauriga*. Today cattle leather has largely replaced llama leather for this purpose. The iron share, *chanka* or *reja*, about 7.5 cm wide and 23 cm long, has a life of 10 to 15 years. They are made in workshops in larger highland towns and purchased in a weekly market or annual fair. The share is the most expensive part of the whole tool, and fire-hardened wooden points have served when metal shares were unobtainable (fig. 5) (Troll 1943).

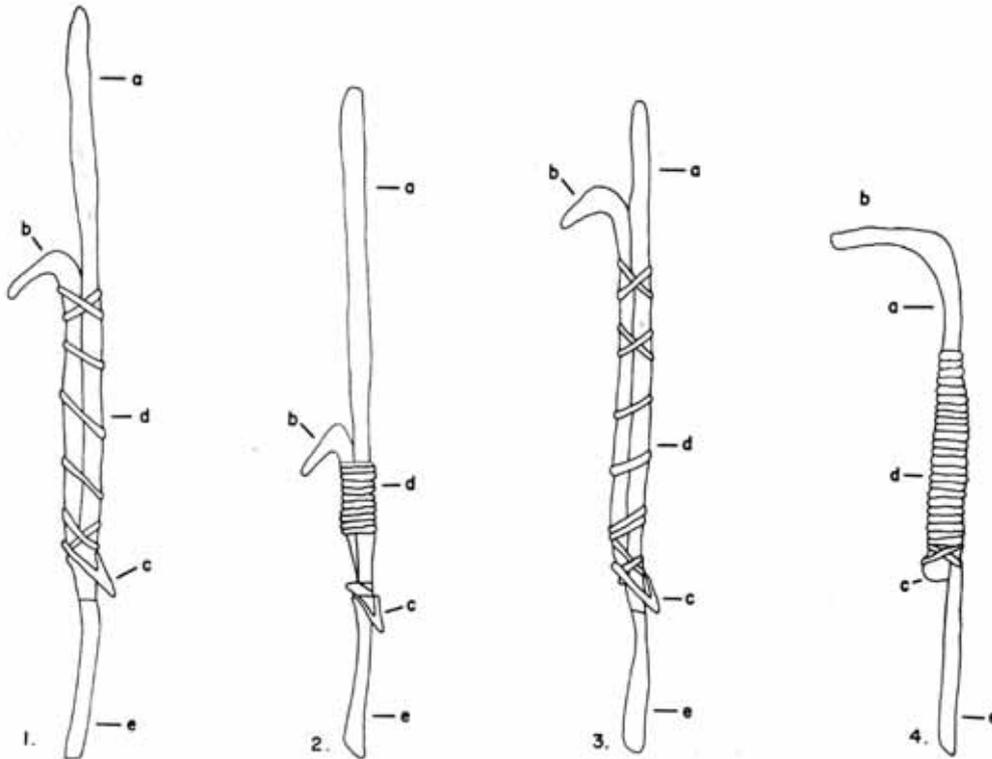


Fig. 5. Contemporary diversity in the *chaquitacla* within a 100 km radius of the city of Cuzco, Peru, ancient capital of the Inca Empire. 1, 2, and 3 are straight *chaquitacllas*; 4 is a *huiri*. In Quechua, the parts of the tool are (a) *chanchaca*; (b) *kcumo*; (c) *taquilpo*; (d) *yauriga*; and (e) *chanka*. Drawing by R. Rios.

Verschiedenheit gleichzeitiger *chaquitacllas* in einem Radius von 100 km der Stadt Cuzco in Peru, der alten Hauptstadt des Inkareichs. 1, 2 und 3 sind einfache *chaquitacllas*; 4 ist ein *huiri*. In Quechua heissen die Teile des Gerätes (a) *chancaca*; (b) *kcumo*; (c) *taquilpo*; (d) *yauriga*; (e) *chanca*.

Assembling the *taclla* is not a specialized artisan activity in most communities, and each peasant normally makes his own or inherits that which belonged to his father. The wooden shaft is made of a natural branch or crotch of a tree, rather than carved to a set pattern, and wide variation in the specific form results. One of several native tree species is selected for the shaft, depending on which is available or locally preferred. Among them are *quishar* (*Buddleia incana*), *colli* (*Buddleia corlacea*), *chachacomo* (*Escallonia resinosa*), and *huananhuay* (*Tecoma sambucifolia*). Where local wood sources are depleted or otherwise unsatisfactory, trade in wood takes place between communities. For example, *chonta* (*Bactris ciliata*), a tough palm wood, is brought to the treeless Bolivian Altiplano from the tropical *Yungas* to be used for making *taclla* shafts.



Fig. 6. A two-person footploughing team at Q'ero. Department of Cuzco, Peru, regarded as the most isolated and conservative Highland Indian community in the Central Andes. Photo S. S. Webster 1969.

Eine aus zwei Personen bestehende Fusspflügergruppe in Q'ero, Provinz Cuzco, Peru, das als das einsamste und konservativste indianische Gebirgsdorf in den Zentral-Anden gilt.

Local or regional custom and environmental differences account for more fundamental stylistic diversity in the *chaquitacla*. An essential distinction can be made between the straight *tacla* and the *hui* (fig. 5). The *hui* is a short version of the *tacla* and has a handle curved at a 70° to 90° angle that is part of the shaft itself. This form is preferred for digging up hard earth on relatively flat or moderately sloping land (fig. 7) (6). The straight *tacla*, on the other hand, is most often used to break ground on sloping land. The most extreme variation of the straight type is in the positioning of the hand grip. A form used on very steep declivities has the grip placed very low close to the footrest; the sharp bending of the body required to grasp it provides the needed balance for ploughing such steep slopes (figs. 6 and 9). Some peasants may have more than one kind of *tacla* to prepare different kinds of land or to use in different tasks more commonly, however, one *tacla* is used for all needs.

Functions of the *tacla*

Whatever the particular style, the *tacla* is used primarily where soils are alternated between cropping and fallowing. The length of time the land is rested before it is planted is determined by the quality of the soil, proximity to the village, and demographic pressures. An average of four years' rest permits the soil to regain some nutrients before the cropping cycle (two to three years) is reinitiated. The fibrous sod formed from the herbs and shrubs is broken for the first crop, which in Southern Peru and Northern Bolivia is invariably the potato. In the following year the

potato or some other hardy tuber or grain, such as barely or the chenopodia, is planted.



Fig. 7. Use of the *huiiri* among Westernized peasants near Copacabana, Bolivia. Instead of crouching down to turn the clod by hand, the woman is throwing the clod over with a stick as the men dig them up. Photo D. A. Preston, 1970.

Anwendung des *huiiri* bei verwestlichten Bauern in der Nähe von Copacabana in Bolivien. Anstatt sich niederzukauern, um den Erdklumpen mit der Hand zu wenden, stürzt ihn die Frau mit einem Stock um, sobald ihn die Männer ausgegraben haben.

In preparing potato land for the first time, sod is broken in strips down a slope, rather than along a contour, to allow for rapid drainage. With the left foot on the footrest, the left hand on the handle to gain leverage, and the right hand on the shaft, the clod is first cut with the ploughshare and then, crowbar fashion, pried from the ground with the full weight of the man. A physiological study of the work of cultivating a typical 500 square m potato plot near Nuñoa, Peru indicates that footploughing probably costs more kilocalories of energy than any other sustained agricultural activity. Further, physiological data show that woman, boys, and old men do not have the endurance to continue this arduous task for an entire work day (Thomas 1971). Thus the *taclla* has acquired a strong cachet as a man's tool.

The *taclla* also differs from most hand tools in that it is not designed for solitary use. A work team, *masa*, consisting of from two to five people, carries out this heavy task (*yapuy* in Quechua, *barbecho* in Peruvian Spanish) which takes place several months before planting. More than one team may work in different parts of the field at the same time. Most traditional, although no longer very common, is a work team of five, brought together to plough communal lands as part of reciprocal agreement, *ayni* or *minca*. Three men work side by side in a line: the ploughman in the centre, *chaupi*, sets the pace for both the man on the left, *kcawaya*, and the man on the right, *kcollana*. The clods of earth are turned aside by two women or children, *rapa*, who crouch on either side of the central furrow to turn the piece of sod, *champa*, aside. Unlike the spade, the *taclla* is not equipped to raise, cradle, and turn the sod away. Each excavated strip, about 30 cm wide, separated by a raised band about 46

cm wide, formed by the clods, but undug. Later a wooden mallet or a mattock is used to break up the clods enough for planting the potatoes on top of them.

More commonly today, strip ploughing to build potato ridges in Southern Peru and Northern Bolivia is done with a smaller work team of two ploughmen and one helper, or just one ploughman and one helper (fig.6). The latter arrangement reflects an emphasis on the nuclear family unit, and the concomitant decline of communally worked plots even though communal land ownership is maintained.

At lower elevations, the *taclla* is no longer common, in part because this tool is less efficient than the wooden traction plough on alluvial valley soils. In four hours, an average of 700 square m can be traction ploughed with a pair of oxen, whereas half this area can be prepared by a three person-team with the *taclla*. However, if a peasant has fields that are too tiny, fragmented or rocky to make the oxen-pulled plough a feasible arrangement, he may prepare land with the *taclla*. The *taclla* is also used to combat the unusually aggressive kikuyo grass, *Pennisetum clandestinum*, the most noxious weed now found in the Central Andes. The whole field is turned and each clod is placed over the pit of the proceeding one, a method (*thayay* in Quechua) which differs from strip ploughing and the construction of ridges.

Although the *taclla* is specifically designed for breaking the sod, it also serves a number of other tasks. To sow Andean tubers (potato, *oca*, *añu*, and *ullucu*) or large seeds (maize, legumes) in previously ploughed ground, the metal share is used to perforate a hole into which the seed and fertilizer are deposited. As the plant grows, the soil may be banked around the roots with a *taclla*, especially if more suitable tools are lacking. A special rounded ploughshare, *kcorana*, rather than the straight share is suited for this purpose.

Tubers are also harvested with the *taclla* by lifting the whole plant out of the ground in one fell swoop, a more efficient - if also more difficult- operation than with other tools. The *taclla* can also cut and extract blocks of turf for the construction of sod fences; one man in a day can make from 200 to 300 blocks, enough for from 20 to 30 m of fence. Foundations and post holes and irrigation and drainage ditches are also dug with this tool. Shovels are recognized as more efficient implements for such work, but this European introduction is still not part of the tool inventory of all peasants at high elevations.



Fig. 8. Huirí from the Province of Canchis, Department of Cuzco, Peru. Photo H. H Iltis 1971.

Huirí aus der Provinz Canchis, Kreis Cuzco, Peru.



Fig. 9. Unusually long *chaquitacllas*, made of eucalyptus saplings, used in *corvée* at Hualgoy, Province of Huamílíes, Department of Huánuco, Peru. Photo M. A. Barash 1966.

Ungewöhnlich lange *chaquitacllas*, angefertigt aus jungen Eukalyptusbäumen, verwendet bei der Fronarbeit in Hualgoy, Provinz Hualmalíes, Kreis Huánuco, Peru.

Survival of the chaquitacla

Given the relative primitiveness of the *taclla*, one expects it to have disappeared by the twentieth century, yet it remains indispensable in certain highland districts of Peru and Bolivia. Agronomic, economic, and cultural reasons together account for its continued presence. The *taclla* is particularly appropriate for preparing fields for potatoes, the staple food at high elevations. Potato tubers are susceptible to water rot during the rainy season, and the construction of ridges ensures necessary drainage. Oxen-pulled wooden ploughs cannot cut deep enough, cannot make these ridges, nor can they manoeuvre the extraordinarily steep slopes that are cultivated.

The cycle of poverty in which Andean peasants are caught also explains the persistence of the *taclla*. Widespread use of fertilizers on these lands is costly, and with little cash, fallowing is the only feasible way to maintain productivity. But breaking the fibrous sod at the end of the fallow period requires implements stronger than the "scratch" plough, which cannot cut and turn the grassy turf. Other alternatives are too costly. Where peon labour is scarce on hacienda lands, metal ploughs pulled by oxen are used, but they are too expensive for the average peasant

farmer. Then too at high elevation the oxen are relatively small and lightweight and seem to be scarcely strong enough to draw the deep-cutting and heavy metal plough. Because most of the *taclla* is made of local materials obtained free or at very low cost, it is cheaper than other hand tools. A metal shovel costs about four times as much as the iron share of the *taclla*. While the traction plough, pickaxe, or shovel, are each more efficient for specific purposes, none can be used as well as the *taclla* to perform several different tasks.

Even where more efficient technological alternatives are available, Indians insist potato fields are best prepared with the *taclla*. Suggested here is the strength of a deeply-rooted tradition that involves fidelity to long established ways. The peasant's conversation towards different tools actually may be most closely related to an unwillingness to learn new movements and to adjust his muscles to new implements (Steenberg 1971, 76). An additional force against change is the strong association of the *taclla* with the male prerogative, and its implications for integrity of the social fabric of Andean villages.

Conclusion

The machine has not yet become the regulator of life at high elevations in the Andes, but it is uncertain how much longer the essential tasks of agriculture will be carried on with methods and devices passed down from a pre-industrial age. Given the current trends toward social and demographic reorganization in the Andean Highlands, the future retention of the *taclla* by the people who continue to live there is in doubt. Rural depopulation is decreasing the availability of hand labour, and the gradual adoption of metal ploughs and, in some cases on better soils, tractors, can be expected. Steep slopes, often badly eroded, are increasingly being put into tree plantations or otherwise decommissioned for cropping purposes. In the meantime, it is in living museums such as the Central Andes, where tools such as *chaquitacla* still persist, to which we must look not only to record old ways, but also comprehend what mankind has gained or lost in its quest for agricultural efficiency and material progress.

Zusammenfassung

Der einheimische Fusspflug, chaquitacla, und sein Fortleben im Ackerbau der Zentral-Anden.

Das modernste Ackerbaugerät, das in der Neuen Welt vor dem Kommen der Europäer bekannt war, war der Fusspflug der Zentral-Anden. Der *taclla* ist eine Erfindung, die der Inkakultur entstammt, obwohl ältere Völker als die Inkas an der peruanischen Küste für einen Teil seiner Entwicklung verantwortlich zeichneten. Er hatte vor dem Grabstock drei Vorteile voraus; eine Metallspitze, einen gekrümmten Stertz und eine Fusstütze. Dieses Gerät dürfte wahrscheinlich im südperuanischen Gebirge entstanden sein, von wo es sich nach Ecuador im Norden und nach Bolivien im Süden ausbreitete. Seine Hauptkonkurrenten waren die einheimische Hacke und der "Kratzpflug", der im 16. Jahrhundert aus Spanien eingeführt wurde. Auf Feldern in einer Höhe von mehr als 3600 m oder an tiefergelegenen Steilhängen ist der *taclla* nach wie vor unlösbar verknüpft mit dem Lebensunterhalt der indianischen Bauern in Südperu und Nordbolivien.

Material und Form des *taclla* variieren von Ort zu Ort. Ein Teil dieser Variationen ist darauf zurückzuführen, dass der Schaft eher aus dem naturgewachsenen, beziehungsweise gegabelten Ast eines Baumes gemacht als nach einem Standardmuster geschnitzt wird. Örtliche oder regionale Gebräuche und Unterschiede in den äusseren Lebensbedingungen sind die Ursachen weiterer stilistischer Verschiedenheiten des *taclla*. Die Brachlandwirtschaft ist der Schlüssel zum Verständnis der früheren und heutigen Anwendung dieses Geräts. Die faserige Grasnarbe, die sich nach einer durchschnittlichen Rast von vier Jahren gebildet hat, wird für die erste Saat (unabänderlich: Kartoffeln) mit dem *taclla* aufgebrochen. Der *taclla* ist klarerweise ein Gerät für Menschen, aber nicht dafür berechnet, von einem einzelnen gehandhabt zu werden. Arbeitsgruppen von 2 bis 5 Mann bearbeiten den Boden, oft in Streifen; die Erdklumpen müssen von einem Helfer gewendet werden. Der *taclla* wird auch zum Säen, Haufeln, Ernten und zum Anlegen von Fundamenten, Gruben und Dämmen verwendet.

Das Überleben des *chaquitaclla* ist auf eine Reihe von Umständen zurückzuführen; unter anderem auf die eigentümliche Art des Kartoffelanbaus auf Balken, die Unmöglichkeit, Geld für moderne Geräte aufzubringen, die die kompakte Scholle wenden können, seine Verwendbarkeit für eine Reihe von Arbeiten, und die Rolle des *taclla* im sozialen Leben der bäuerlichen Gesellschaft. In Anbetracht des gegenwärtigen Trends zu einer sozialen und demographischen Reorganisation im Hochland der Zentral-Anden erscheint es jedoch zweifelhaft, ob sich der *taclla* auch in Zukunft halten können.

Notes

1. The term *footplough*, while open to ambiguities of meaning, is the closest term in English to describe this tool. In Spanish the term *tirapié* has been used. The native Quechua word, *chaquitaclla* (*chaqui* = foot; *taclla* = plough) or simply *taclla* is commonly used in the Central Andes. An equivalent term in the Aymara language is *huisu*, infrequently used except in Northern Bolivia.
2. Prescott's (1857, I, 136) comment about the existence of a traction plough pulled by men in the Inca period is based on a misreading of the chronicler Garcilaso de la Vega (1960, 183).
3. The earliest published description of the *taclla* and associated agriculture by a trained scientist was by Orator Fuller Cook (1920).
4. In my opinion Salaman (1949, 72) misinterprets Tschudi's (1849, 14) description of sod breaking on Chiloé Island in South Chile as having been done with the *taclla*.
5. It is worth quoting the original: "El arado o azada era un instrumento llamado *taclla*, de un palo tan grueso como la muñeca y largo poco más de dos codos, a manera de zanco. Por donde lo asían estaba torcido como cayado, y en la punta ataban otro palo de cuatro dedos, de ancho y uno de canto de otra madera más recia; y como un palmo antes del remate della tenían asido un gancho del largor de un jeme, donde hacían fuerza con el pie izquierdo" (Cobo, 1965, II, 252).

6. Published descriptions of the *huiri* are mostly from the Altiplano (Galdo Pagaza 1962, 201; Salaman 1949, 46; Tschopik 1946, 516).

Literature

Bushnell, G. H. S.: Peru. New York 1957.

Cobo, Bernabe: Historia del Nuevo Mundo. Madrid 1956.

Cook, O. F.: Foot-Plow Agriculture in Peru. Annual Report of the Smithsonian Institution for 1918. Washington 1920 pp. 487-492.

Donkin, R. A.: Pre-Columbian Field Implements and their Distribution in the Highlands of Middle and South America, *Anthropos*, Vol. 65, 1970, pp. 505-529.

Foster, G. N.: Culture and Conquest: America's Spanish Heritage. Chicago 1960.

Galdo Pagaza, Raúl: Economía de las colectividades indígenas colindantes con el Lago Titicaca (serie monográfica No. 3) Lima 1962.

Garcilaso de la Vega, El Inca: Comentarios Reales de los Incas. Cuzco 1960.

Guaman Poma de Ayala, Felipe: La Nueva Crónica y Buen Gobierno (L. Bustios Galvez, ed.). Lima 1956.

Horkheimer, Hans: Nahrung und Nahrungsgewinnung im vorspanischen Peru. Berlin 1960.

Jimenez de la Espada, Marcos (ed): Relaciones Geográficas de las Indias. Madrid 1965.

Kramer, Fritz L.: Breaking Ground: Notes on the Distribution of Some Simple Tillage Tools (Sacramento Anthro. Society, Paper 5) Sacramento 1966.

Lanning, E. P.: Peru Before the Incas. Englewood Cliffs 1967.

Levillier, Roberto (ed.): Gobernantes del Perú: Cartas y Papeles. Madrid 1925.

Prescott, W. H.: History of the Conquest of Peru. Boston 1857.

Salaman, R. N.: The History and Social Influence of the Potato. Cambridge 1949.

Smith, C. T., Denevan, W. M. and Hamilton, P.: Ancient Ridged Fields in the Region of Lake Titicaca. *The Geographical Journal*, vol. 134, 1968, pp. 353-367.

Steenberg, Axel: Tools and Man *in* Man and His Habitat: Essays presented to Emyr Estyn Evans (Buchanan, Jones and McCourt, eds.) London 1971, pp. 62-78.

Thomas, R. Brooke, Ph. D. dissertation, Department of Anthropology, Pennsylvania State University, 1971.

Troll, Carl: Die Stellung der Indianer-Hochkulturen im Landschaftsbau der tropischen Anden. *Erdkunde*, Vol. 3, 1943, pp. 93-128.

Tschopik, Harry: The Aymara in Handbook of South American Indians (J. Steward, ed.) Washington 1946, pp. 501-574.

Tschudi, Johann von: Travels in Peru During the Years 1838-1842. New York 1849.

Vásquez de Espinosa, Antonio: Compendium and Description of the West Indies (Smithsonian Miscell. Collections, vol. 102) Washington 1942.

Zárate, A. de: in *Historiadores Primitivos de Indias* (E. de Vedia, ed.) Madrid 1947, vol. 2.